

NATIONAL EDUCATION POLICY-2020

Bachelor in Computer Application (BCA)



PROPOSED STRUCTURE FOR Bachelor in Computer Application (BCA) 2025

(as per AICTE Draft Model Curriculum)

Sridev Suman Uttarakhand University
Badshahi Thaul (Tehri Garhwal) Uttarakhand -249199
(State University of Uttarakhand)

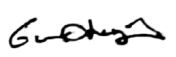
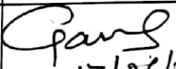

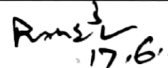
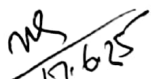
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Rawat *rs* *ms* *gang*

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**GENERAL COURSE
STRUCTURE
&
CREDIT DISTRIBUTION**

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

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

B. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
CC	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

Course Name: Bachelor in Computer Application, Bachelor in Computer Application (Honours) and Bachelor in Computer Application (Honours with Research)

Course Level/Duration/System:

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

- a. **One year:** Under Graduate Certificate in Computer Application
- b. **Two years:** Under Graduate Diploma in Computer Application
- c. **Three years:** Bachelor in Computer Application (BCA)
- d. **Four years:** Bachelor in Computer Application with Honors- BCA (Honors)
or
Bachelor in Computer Application Honors with Research- BCA (Honors with Research)

Minimum Eligibility Criteria:

- 1 Admission to BCA 1st semester will be made as per the rules prescribed by the Academic Council of University,
2. Eligibility for Admissions:
As per University Ordinance.
3. Duration of the BCA Programme, Provision of Multiple Exit and Awarding:
Certificate, Diploma, Degree, Degree with Honors / Degree with Honors with Research
As per the regulations and recommendations of the statutory bodies governing the BCA Programme as prescribed by the University, the maximum duration of Programme will be 7 years.

SEMESTER WISE CREDIT DISTRIBUTION:

SEMESTER WISE CREDIT DISTRIBUTION OF PROPOSED BCA [BCA (HONOURS) AND BCA (HONOURS WITH RESEARCH)] PROGRAM:

Sem	Core Courses	Ability Enhancement Courses	Multi-Disciplinary Elective Courses	Value Added Courses	Skill Enhancement courses	Discipline Specific Elective	Total
I	8	2	2	2	5	–	19
II	12	–	–	2	7	–	21
III	11	0	0	2	4	3	20
IV	15	0	0	0	2	3	20
V	0	0	0	0	6	15	21
VI	4	1	0	0	4	10	19
BCA (Honors)							
VII	5	0	3	0	4	8	20
VIII	–	–	–	–	8	12	20
BCA (Honors with Research)							
VII	12	–	–	–	–	8	20
VIII	20	–	–	–	–	–	20

Category-wise distribution*

Description	Core Courses	Ability Enhancement Courses	Multi-Disciplinary Elective course	Value added Courses	Skill Enhancement courses	Discipline Specific Elective	Total
BCA	50	3	2	6	28	31	120
BCA (Honours)	55	3	5	6	40	51	160
BCA (Honours with Research)	82	3	2	6	28	39	160

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

Note: Students can take extra credit courses from their own department or from other departments as per the University norms.

INDUCTION PROGRAM

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	<ul style="list-style-type: none">● Physical activity● Creative Arts● Universal Human Values● Literary● Proficiency Modules● Lectures by Eminent People● Visits to local Areas● Familiarization to Department/Branch & Innovations

Mandatory Visits/ Workshop/Expert Lectures:

1. It is mandatory to arrange one industrial visit every semester for the students of each branch.
2. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

For Summer Internship / Projects / Seminar etc.

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

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

Semester wise Structure and Curriculum for UG Course in BCA

SEMESTER I

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC101	Introduction to Artificial Intelligence & Computer Fundamentals with Lab	3	0	4	5
2	SEC101	Problem Solving Using C with Lab	3	0	4	5
3	CC102	Mathematics Foundations to Computer Science	3	0	0	3
4	AEC101	Communicative English	1	1	0	2
5	MDE101	Indian Knowledge System	2	0	0	2
6	VAC101	Environmental Science and sustainability	2	0	0	2
TOTAL						19

SEMESTER II

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC103	Fundamentals of Digital Electronics	3	0	0	3
2	CC104	Data Structures with Lab	3	0	4	5
3	CC105	Operating System	2	0	0	2
4	SEC102	Java Programming with lab	3	0	4	5
5	SEC103	Web Technologies - II	3	0	2	4
6	VAC102	Indian Constitution	2	0	0	2
TOTAL						21

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

An UNDER-GRADUATE CERTIFICATE IN COMPUTER APPLICATION will be awarded, if a student wishes to exit at the end of First year.

[Exit Criteria after First Year of BCA Programme](#)

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

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

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

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

[Re-entry Criteria in to Second Year \(Third Semester\)](#)

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

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

SEMESTER III

S.No.	Course Code	Course Title	L	T	P	Credit
1	CC201	Cyber Security	3	0	2	4
2	CC202	Database Management System	3	0	4	5
3	SEC201	Python Programming	3	0	2	4
4	CC203	Software Engineering	3	0	0	3
5	DSE201*	Professional Elective – I	2	0	2	3
6	VAC201	Yoga/Sports/NCC/NSS/Disaster Management	0	0	4	2
TOTAL						21

* To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science / Artificial Intelligence/ Cyber Security proposed by department as indicated at the appendix - A

SEMESTER IV

S.No.	Course Code	Course Title	L	T	P	Credit
1	CC204	Object Oriented Programming using C++ with Lab	3	0	2	4
2	CC205	Computer Networks	3	0	0	3
3	CC206	Design and Analysis of Algorithm	3	0	0	3
4	CC207	Artificial Intelligence	3	0	2	4
5	DSE202*	Professional Elective – II	2	0	2	3
6	SEC202	Design Thinking and Innovation	1	1	0	2
TOTAL						19

Note:

1. 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.
2. **An UNDERGRADUATE DIPLOMA IN COMPUTER APPLICATION** will be awarded, if a student wishes to exit at the end of Second year.

Exit Criteria after Second Year of BCA Programme

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

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

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

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

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

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

SEMESTER V

S.No.	Course Code	Course Title	L	T	P	Credit
1	DSE301*	Professional Elective – III	3	0	2	4
2	DSE302*	Professional Elective – IV	3	0	2	4
3	DSE303*	Professional Elective – V	3	0	2	4
4	SEC301	Data analysis with excel & AI tools	3	0	4	5
5	SEC302	Internship/Capstone Project	0	0	8	4
6	SEC303	Major Project [evaluation in sixth semester]	-	-	-	0
TOTAL						21

*L-T-P for Discipline Electives depends on the subject that the University offers

SEMESTER VI

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC301	Generative AI	2	0	4	4
2	DSE304*	Professional Elective – VI	3	0	4	5
3	DSE305*	Professional Elective – VII	3	0	4	5
4	AEC301	Soft Skills	0	1	0	1
5	SEC304	Major Project [Initiated in 5th Semester]	0	0	8	4
TOTAL						19

*L-T-P for Discipline Electives depends on the subject that the University offers

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

Exit Criteria after Third Year of BCA Programme

The students shall have an option to exit after 3rd year of Computer Application Program and will be awarded with a Bachelor's in Computer Application.

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

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

Model curriculum for UG Degree in BCA

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

SEMESTER VII - BCA (Honours)

Specialization – AI & ML

S.No.	Course Code	Course Title	L	T	P	Credit
1	MDE401	Social Network Analysis	-	-	-	3
2	CC401	Optimization of ML	3	-	4	5
3	DSE401*	Professional Elective – VIII	3	-	4	5
4	DSE402*	Professional Elective – IX	-	-	-	3
5	SEC401	Dissertation work [Evaluation in eight semester]	-	-	-	-
6	SEC402	Summer Internship II	0	0	8	4
TOTAL						20

*L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University

SEMESTER VII - BCA (Honours)

Specialization – Data Science

S.No.	Course Code	Course Title	L	T	P	Credit
1	MDE401	Advanced Statistical methods for Data Science	-	-	-	3
2	CC401	Python for Data Science	3	-	4	5
3	DSE401*	Professional Elective – VIII	3	-	4	5
4	DSE402*	Professional Elective – IX	-	-	-	3
5	SEC401	Dissertation work [Evaluation in eight semester]	-	-	-	-
6	SEC402	Summer Internship II	0	0	8	4
TOTAL						20

*L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University

SEMESTER VIII - BCA (Honors)

S.No.	Course Code	Course Title	L	T	P	Credit
1	DSE403*	Professional Elective – X	3	-	4	5
2	DSE404*	Professional Elective – XI	3	-	4	5
3	DSE405*	Professional Elective – XII	2	-	-	2
4	SEC403	Dissertation work [Started in seventh semester]	0	0	16	8
TOTAL						20

*L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University

SEMESTER VII - BCA – (Honours with Research)

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC401	Advanced Data Analysis Tools	2	0	4	4
2	CC402	Research Methodology	2	2	0	4
3	CC403	Research Internship Report and Viva –Voce	0	0	8	4
4	DSEX	Professional Elective – IX	-	-	-	4
5	DSEX	Professional Elective – X	-	-	-	4
TOTAL						20

L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University

SEMESTER VIII- BCA (Honours with Research)

S.No.	Course Code	Course Title	L	T	P	Credit
1	SEC401	Dissertation (For Research Track) *	-	-	-	20
TOTAL						20

*The Dissertation work will start from the beginning of fourth year of BCA (Honors with Research) Program.

For Research Track, students of Fourth Year shall be assessed for Project Work and Research Internship Report & Viva –Voce and Dissertation.

Proposed Streams with Discipline-Specific Electives (DSE)

Note: The following is indicative. Universities/Institutes may add streams / electives as per their specific requirements.

1. Data Science

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Basics of Data Analytics using Spreadsheet
2	IV	DSE*202	Data Visualization
3	V	DSE301	Introduction to Data Science
4	V	DSE302	Basics of network Security
5	V	DSE303	Machine Learning
6	VI	DSE304	Big Data Analytics
7	VI	DSE305	Exploratory Data Analysis
8	VII	DSE401	Business Intelligence & Analytics
9	VII	DSE402	Data Mining
10	VIII	DSE403	Advanced Data Visualization
11	VIII	DSE404	Security in Cloud Computing
12	VIII	DSE405	Data Security & Privacy

2. Artificial Intelligence and Machine Learning

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Feature Engineering
2	IV	DSE*202	Advanced ML
3	V	DSE301	Neural Network
4	V	DSE302	Digital Image Processing
5	V	DSE303	Natural Language Processing
6	VI	DSE304	Deep Learning
7	VI	DSE305	Predictive Analysis
8	VII	DSE401	Prompt Engineering
9	VII	DSE402	Advanced Artificial Intelligence
10	VIII	DSE403	Speech Recognition
11	VIII	DSE404	Data Security & Privacy
12	VIII	DSE405	Augmented Reality & Virtual Reality

3. Full Stack Development

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Web Programming -I
2	IV	DSE*202	Web Programming -II

SEMESTER – I

Model curriculum for UG Degree in BCA

CC101	Introduction to Artificial Intelligence and Fundamental of Computer	3L:0T:4P	5 Credits
<p>Course Objective: The objective of this course is to introduce students to the essential concepts and principles of computer science. The course aims to provide a comprehensive understanding of the foundational knowledge and skills necessary for students to explore more advanced topics in computer science and related fields. The course also seeks to cultivate problem-solving abilities and analytical thinking, fostering a strong foundation for future studies and careers in the computing industry.</p>			
<p>Course Outcome:</p>			
<p>Unit 1: Introduction to Artificial Intelligence Overview of artificial intelligence and its applications, History and foundations of AI, Ethical considerations in AI development and deployment</p> <p>Unit 2: Introduction to Computer Systems and Types Computer system: characteristics and capabilities. Computer Hardware and Software: Block Diagram of a Computer, Different Data Processing: Data, Data Processing System, Storing Data, Processing Data. Types of Computers: Analogue, Digital, Hybrid, General and Special Purpose Computers. Generation of Computers. Computer Systems: Micros, Minis & Main-frames. Limitations of Micro Computer.</p> <p>Unit 3: Number Systems and Logic Gates Number systems: Decimal Number system, Binary number system, Octal & Hexadecimal number system, 1's & 2's complement Codes: ASCH, EBCDI Codes, Gray code & BCD. Logic Gates: AND, OR, NOT GATES and their Truth tables, NOR, NAND & XOR gates</p> <p>Unit 4: Input Devices and Computer Output Introduction to Input Devices: Categorizing Input Hardware, Keyboard, Direct Entry — Card Readers, Scanning Devices — O.M.R., Character Readers, Thumb Scanner, MICR, Smart Cards, Voice Input Devices, Pointing Devices — Mouse, Light Pen, Touch Screen. Computer Output: Output Fundamentals, Hardcopy Output Devices, Impact Printers, Non-Impact Printers, Plotters, Computer output Microfilm/Microfiche (COM) systems, Softcopy Output Devices, Cathode Ray Tube, Flat Screen, Technologies, Projectors, Speakers.</p> <p>Unit 5: Central Processing Unit (CPU) Central Processing Unit: The Microprocessor, control unit, A.L.U., Registers, Buses, Main Memory, Main Memory(RAM) for microcomputers, Read Only Memory (ROM).</p> <p>Unit 6: Storage Devices and Data Storage Methods Storage Devices: Storage Fundamentals, Primary and Secondary Storage, Data Storage and Retrieval Methods — Sequential, Direct & Indexed Sequential, Tape Storage and Retrieval Methods Tape storage Devices, characteristics and limitations, Direct access Storage and Microcomputers – Hard Disks, Disk Cartridges, Direct Access Storage Devices for large Computer systems, Mass storage systems and Optical Disks, CD ROM.</p> <p>Recommended Books:</p> <ol style="list-style-type: none"> 1. "Computer Science: An Overview" by J. Glenn Brookshear 2. Computer Fundamentals, P. K. Sinha, BPB Publications, Sixth Edition. 3. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig. 			

Model curriculum for UG Degree in BCA

SEC101	Problem Solving using C with lab	3L:0T:4P	5 Credits
Course Objectives: <ol style="list-style-type: none">CO1: Understand basic terminology of computers, problem solving, programming Languages and their evolution.CO2: Create specification from problem requirements by asking questions to disambiguate the requirement statement.CO3: Design the solution from specification of a problem and write pseudo code of the algorithm using building blocks or structured programming constructs (Sequence, Selection and Repetition statement).CO4: Translate an algorithm into a C computer program.CO5: Testing and analyzing programs using debugging tools. (Analyze)			
UNIT I: <p>Evolution of C, Programming languages, Structure of a C program, Compiling a C program, Character set In C, Keywords in C, Hierarchy of operators, Basic data types, Qualifiers used with basic data types, Variables in C, Type declaration, Output function, Input function and format specifiers, arithmetic operators, Unary operators, Relational and logical operators.</p>			
UNIT II: <p>if statement, if else statement, for statement, while loop, do while statements, break statements continue statements, switch statement, goto statement, ternary operators.</p>			
UNIT III: <p>Advantages of arrays, types of arrays, array declaration, array initialization, accessing data from array, array inside the memory, multidimensional arrays. Character arrays, Array overflow, String Variables, Reading & writing strings, string handling functions.</p>			
UNIT IV: <p>Advantages of functions, declaring a function, calling a function, variables, passing arguments to a function, nested functions, passing array to functions, recursion in functions, Call by value and Call by reference. Pointers and function, Array of pointers, Pointer and Strings, Pointer to structure, Pointers within structure, Introduction of Static and Dynamic memory allocation, Dynamic memory allocation, DMA functions, malloc () function, Size of () operator, Function free (), Function realloc ().</p>			
UNIT V: <p>Introduction, File structure, File handling function, File types, Streams, Text, Binary, File system basics, The file pointer, Opening a file, Closing a file, Writing a character, Reading a character, Using fopen (), getc (), putc (), and fclose (), Using feof ()</p>			
Text Books <p>Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company, 2024. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company, 2024. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015 R G Dromey, How to Solve It by Computer.</p>			

Model curriculum for UG Degree in BCA

CC102	Mathematics Foundation to Computer Science	3L:0T:0P	3 Credits
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Course Objectives

1. CO1: Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics.
2. CO2: This course enables the students to use mathematical models and techniques to analyze and understand problems in computer science.
3. CO3: This course demonstrates how the mathematical principles give succinct abstraction of computer science problems and help them to efficiently analyze.

Course Content:

UNIT 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. Some useful functions for Computer Science: Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.

UNIT II: Counting and Recurrence Relation:

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.

UNIT III: Elementary Graph Theory:

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.

UNIT IV: Matrix Algebra:

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.

Text Books

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

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

<https://nptel.ac.in/courses/106103205>

<https://nptel.ac.in/courses/111101115>

Model curriculum for UG Degree in BCA

AEC 101	Communicative English	1L:1T:0P	2 Credits
<p>Course Objective:</p> <ol style="list-style-type: none">1. To provide learning environment to practice listening, speaking, reading and writing skills.2. To assist the students to carry on the tasks and activities through guided instructions and materials.3. To effectively integrate English language learning with employability skills and training.4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.			
<p>Course Content:</p> <p>Unit- I: Vocabulary Building</p> <p>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.</p> <p>Unit-II: Basic Writing Skills</p> <p>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</p> <p>Unit- III: Identifying Common Errors in Writing</p> <p>Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies</p> <p>Unit- IV: Nature and Style of sensible Writing</p> <p>Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Module V: Writing Practices, Comprehension, Précis Writing, Essay Writing</p> <p>Unit-V: Oral Communication (This Module involves interactive practice sessions in Language Lab)</p> <p>Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations</p> <p>Unit- VI: Oral Communication (This Module involves interactive practice sessions in Language Lab)</p> <p>Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.</p>			

Model curriculum for UG Degree in BCA

Text/Reference Books:

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.

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

MDE 101	Indian Knowledge System	2L:0T:0P	2 Credits
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*For Detailed Course Refer APPENDIX – II

Model curriculum for UG Degree in BCA

VAC 101	Environmental Science and Sustainability	2L:0T:0P	2 Credits
Course description: <p>This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers.</p>			
Course Objective(s): <ol style="list-style-type: none">1. This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forthcoming sustainability challenges.2. This course will equip students to make decisions that consider environmental consequences.3. This course will enable future business graduates to become environmentally sensitive and responsible managers.			
Course Content:			
Unit 1: Understanding Environment, Natural Resources, and Sustainability <p>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.</p>			
Unit 2: Ecosystems, Biodiversity, and Sustainable Practices <p>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.</p>			
Unit 3: 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.			
Unit 4: Social Issues, Legislation, and Practical Applications <p>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.</p>			

Readings: Text Books (Latest Editions):

- Poonia, M.P. *Environmental Studies* (3rd ed.), Khanna Book Publishing Co.
- Bharucha, E. *Textbook of Environmental Studies* (3rd ed.) Orient Blackswan Private Ltd.
- Dave, D., & Katewa, S. S. *Text Book of Environmental Studies*. Cengage Learning India Pvt Ltd.
- Rajagopalan, R. *Environmental studies: from crisis to cure* (4th ed.). Oxford University Press.
- Miller, G.T. & Spoolman S. *Living in the Environment*. (20th ed.). Cengage.
- Basu, M., & Xavier Savarimuthu, S. J. *Fundamentals of environmental studies*. Cambridge University Press.
- Roy, M. G. *Sustainable Development: Environment, Energy and Water Resources*. Ane Books.
- Pritwani, K. *Sustainability of business in the context of environmental management*. CRC Press.
- Wright, R.T. & Boorse, D.F. *Environmental Science: Toward A Sustainable Future* (13th ed.). Pearson.

SEMESTER –II

Model curriculum for UG Degree in BCA

CC103	Fundamentals of Digital Electronics	3L:0T:0P	3 Credits
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Course Objectives:

The student can acquire the basic knowledge of measurement principles and their application in electrical engineering. The students will be able to effectively employ electrical and electronics instruments for measurements of various electrical quantities.

Course Content:

UNIT 1: DIGITAL LOGIC AND ARITHMETIC CIRCUITS

Introduction to number systems – Binary to decimal conversion – Decimal to binary conversion – Octal numbers – Hexadecimal numbers – Excess-3 code – Gray code.

Logic gates – NOT, OR, AND – Universal NAND and NOR gates – EX-OR and EX-NOR gates – De- Morgan's Theorems – Universal building blocks (NOT, OR, AND) Binary addition and subtraction – 1's complement – 2's complement – Adders (half & full) – Subtractor (half & full).

UNIT 2: COMBINATIONAL AND DATA PROCESSING CIRCUITS

Boolean algebra – Sum of products method – Product of methods – Truth table of Karnaugh map – Pairs, Quads and Octet – Karnaugh map simplification – Digital Logic families and their parameters.

Multiplexer and demultiplexers – 4X1 Multiplexer – 8X1 Multiplexer – 16X1 Multiplexer – 1X4 De- multiplexer – 1X8 De-multiplexer – Decoder – BCD-to-decimal decoder – Encoder – Parity Checkers.

UNIT 3: FLIP-FLOPS AND MEMORIES

Flip-flops – Types of flip-flop – RS (NAND and NOR) flip-flop – Edge triggered D flip-flop – Edge triggered T flip-flop – Edge triggered JK flip-flop – Master-Slave flip-flop – Triggering, propagation delay time, setup time, hold time.

Memories – ROM, RAM, EPROM, EEPROM – Volatile and non-volatile – Static and dynamic RAM.

UNIT 4: REGISTERS AND DIGITAL COUNTERS

Registers – Introduction- Modes of operation of register (SISO, SIPO, PISO and PIPO). Counters – Asynchronous counter- Synchronous counter – Ripple counters – MOD-7 ripple counter – Decade counter – 4 bit down counter – Up/down counter.

UNIT 5: ANALOGUE AND DIGITAL INTERFACE 17 HOURS

Analogue to digital converters – Parallel Comparator A/D converter – Dual slope converter – Successive approximation method – Counter type converter.

Digital to analogue converters – Binary weighted D/A converter – R/2R ladder network converter – Bus standards – Introduction to microprocessor – 8-bit and 16 bit processor.

Main Reading:

- Digital Principles and Applications, Donald P Leach, Malvino, McGraw Hill
- Digital Electronics, Prof. C. Kumar and Selvakumar, N.V Publications

Supplementary Books

- Modern Digital Electronics, Satish Jain, Tata McGraw Hill
- Fundamentals of Digital Electronics and its Application, V.M. RAO and R.K. SRIVASTAVA

Model curriculum for UG Degree in BCA

CC104	Data Structures with Lab	3L:0T:4P	5 Credits
<p>Course Objectives</p> <ul style="list-style-type: none"> ● CO1: Understand the fundamental concepts of Data Structures and their applications. CO2: Develop problem-solving skills using Data Structures. ● CO3: Implement Data Structures using C programming language. 			
<p>Prerequisite:</p> <ol style="list-style-type: none"> 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. 			
<p>Course Content:</p>			
<p>UNIT I:</p> <p>Introduction and Overview: Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Tradeoff.</p> <p>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.</p> <p>UNIT II:</p> <p>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.</p> <p>Hashing and Collision: Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.</p> <p>UNIT III:</p> <p>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.</p> <p>Recursion: Definition, Recursive Notation, Runtime Stack, Applications of Recursion: Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi.</p> <p>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.</p> <p>UNIT IV:</p> <p>Graphs: Definition, Terminology, Representation, Traversal.</p> <p>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.</p>			
<p>Text Books</p> <ul style="list-style-type: none"> ● R.B. Patel, “Expert Data Structures with C”, Khanna Book Publishing Company, 2023 (AICTE Recommended Textbook) ● Seymour Lipschutz, “Data Structures with C”, Schaum’s Outlines, Tata McGraw-Hill, 2011. ● Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications, 2022. 			
<p>Reference Books</p> <ol style="list-style-type: none"> 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. 			

Model curriculum for UG Degree in BCA

CC105	Operating Systems	2L:0T:0P	2Credits
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Course Content:
<p>UNIT I:</p> <p>Operating Systems Overview: Definition, Evaluation of O.S, Components & Services of OS, Structure, Architecture, types of Operating Systems, Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems.</p> <p>Operating Systems Structures: Operating system services and systems calls, system programs, operating system structure, operating systems generations.</p> <p>UNIT II:</p> <p>Process Management: Process Definition, Process states, Process State transitions, Process Scheduling, Process Control Block, Threads, Concept of multithreads, Benefits of threads, Types of threads.</p> <p>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</p> <p>UNIT III:</p> <p>Process Synchronization: Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors.</p> <p>Deadlocks: System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.</p> <p>UNIT IV:</p> <p>Memory Management: Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, Segmentation.</p> <p>Virtual Memory: Demand paging, Page Replacement algorithms, Allocation of frames, thrashing.</p> <p>I/O Management: Principles of I/O Hardware: Disk structure, Disk scheduling algorithms.</p>
Text Books:
<ol style="list-style-type: none"> 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. 3. Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.
Reference Books:
Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.

SEC102	Java Programming with Lab	3L:0T:4P	5 Credits
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Course Objectives

1. To introduce the object oriented programming system concepts CO2: To introduce syntax and semantics of Java programming language CO3: To develop modular programs using Java
2. To setup JDK environment to create, debug and run Java programs

Course Content:

UNIT 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.

Overview of Java Language: Introduction to Simple Java Program, Use of Comments and Math function, Application of two classes, Java Program Structure, Java Tokens and statements, Implementing Java program And JVM, Command Line Arguments.

UNIT II:

Constants, Variables and Data Types: Constants, Variables, 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, Looping statements, Jump in loops, Labelled loops.

UNIT III:

Classes, Objects and Methods: Defining Class, Methods Declaration, Constructors, Methods Overloading, Overriding Methods, Inheritance

Arrays, Strings and Vectors: 1D arrays, Creating an Array, 2D arrays, Strings, Vectors, Wrapper Classes, Enumerated Types

Inheritance: Defining, extending classes, and Implementing Interfaces. Multiple Inheritance and polymorphism.

UNIT 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

Text Books

1. Balaguruswamy E. (2023). Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education
2. Schildt, H. (2022). Java: The Complete Reference. 12th edition. McGraw-Hill Education.

Reference Books

1. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited, 2012.
2. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited, 2015.
3. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson, 2008.
4. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press, 2014.

Model curriculum for UG Degree in BCA

SEC103	Web Technologies-II	3L:0T:2P	4 Credits
Course Objectives			
<ul style="list-style-type: none"> ● To understand the concepts and architecture of the World Wide Web, Markup languages along with Cascading Style Sheets. ● To understand the concepts of event handling and data validation mechanisms. ● To understand the concepts of embedded dynamic scripting on client and server side Internet Programming and basic full stack web development. ● To develop modern interactive web applications 			
Prerequisite:			
<ul style="list-style-type: none"> ● 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. ● Familiarity with object-oriented programming (OOP) principles, including classes, objects, inheritance, and polymorphism. 			
Course Content:			
Unit I:			
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, 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. 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.			
Unit II:			
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			
Text Books			
<ol style="list-style-type: none"> 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			
<ol style="list-style-type: none"> 1. Silvio Moreto, Bootstrap 4 By Example, ebook, 2016. 2. Tanweer Alam, Web Technologies, Khanna Book Publishing, 2011. 			

Model curriculum for UG Degree in BCA

VAC102	Indian Constitution	2L:0T:0P	2 Credits
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Course Content:

<p>Unit 1: The Constitution - Introduction</p> <ul style="list-style-type: none"> • 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 <p>Unit 2: Union Government</p> <ul style="list-style-type: none"> • Structure of the Indian Union • President – Role and Power • Prime Minister and Council of Ministers • Lok Sabha and Rajya Sabha <p>Unit 3: State Government</p> <ul style="list-style-type: none"> • Governor – Role and Power • Chief Minister and Council of Ministers • State Secretariat <p>Unit 4: Local Administration</p> <ul style="list-style-type: none"> • District Administration • Municipal Corporation • Zila Panchayat <p>Unit 5: Election Commission</p> <ol style="list-style-type: none"> a. Role and Functioning b. Chief Election Commissioner c. State Election Commission

Suggested Learning Resources:

<ol style="list-style-type: none"> 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
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Suggested Software/Learning Websites:

<ol style="list-style-type: none"> a. https://www.constitution.org/cons/india/const.html b. http://www.legislative.gov.in/constitution-of-india c. https://www.sci.gov.in/constitution d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/
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Cases

<ul style="list-style-type: none"> • Rustom Cavasjee Cooper v. Union of India, (1970) 1 SCC 248 • State of Rajasthan v. Mohan Lal Vyas, AIR 1971 SC 2068 (confirmation of a private monopoly, not a violation of fundamental right) • Mithilesh Garg v. Union of India, (1992) 1 SCC 168 : AIR 1992 SC 221 (Right to carry on business, not breached when it is liberalised) • Chintamanrao v. The State of Madhya Pradesh, AIR 1951 SC 118 (scope of reasonable restrictions in relation to trade and occupation) • Cooverjee B. Bharucha v. Excise Commissioner, Ajmer, AIR 1954 SC 220 (the reasonableness of the restriction imposed may depend upon the nature of the business and prevailing conditions including public health and morality) • T. B. Ibrahim v. Regional Transport Authority. Tanjore, AIR 1953 SC 79
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- Harman Singh v. RTA, Calcutta, AIR 1954 SC 190
- Dwarka Prasad Laxmi Narain v. State of U.P., AIR 1954 SC 224
- State of Bombay v. R.M.D. Chamarbaugwala, AIR 1957 SC 699
- Parbhani Transport Coop. Society Ltd. v. Regional Transport Authority, Aurangabad, AIR 1960 SC 801
- State of Bombay v. R. M. D. Chamarbaugwala, (1957) S.C.R. 874,
- G.K.Krishnan vs State of Tamil Nadu, 1975 SCC (1) 375

Automobile Transport (Rajasthan) Ltd. Vs State of Rajasthan, AIR 1962 SC 1406

Course Outcome(s):

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

1. Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure.
2. Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha).
3. State Government Mechanisms: Examine the powers of the Governor, Chief Minister, and the State Secretariat.
4. Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats.
5. Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections.
6. Application of Knowledge: Apply constitutional principles to contemporary political issues and evaluate governance effectiveness.

SEMESTER –III

Model curriculum for UG Degree in BCA

CC201	Cyber security	3L:0T:2P	4 Credits
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<p>Course objectives:</p> <ul style="list-style-type: none"> • To understand various types of cyber-attacks and cyber-crimes • To learn threats and risks within context of the cyber security • To have an overview of the cyber laws & concepts of cyber forensics • To study the defensive techniques against these attacks
<p>UNIT -I Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.</p> <p>UNIT - II Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics</p> <p>UNIT - III Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.</p> <p>UNIT- IV Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.</p> <p>UNIT - V Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc</p> <p>Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.</p>
<p>TEXT BOOKS:</p> <ol style="list-style-type: none"> 1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives,Wiley 2. B.B.Gupta,D.P.Agrawal,HaoxiangWang,ComputerandCyberSecurity:Principle s, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.
<p>REFERENCES:</p> <ol style="list-style-type: none"> 1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRCPress. 2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&FGroup.
<p>Course Outcomes:</p> <p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Analyze cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks. 2. Interpret and forensically investigate security incidents 3. Apply policies and procedures to manage Privacy issues 4. Design and develop secure software modules

Model curriculum for UG Degree in BCA

CC202	Database Management Systems	3L:0T:4P	5 Credits
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Course Objectives
CO1: Understanding Core Concepts of DBMS CO2: Proficiency in Database Design and SQL CO3: Application of Advanced Database Techniques Prerequisite: Basic knowledge of Set Theory.
Course Content:
<p>UNIT I:</p> <p>Introduction to Databases: Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators</p> <p>Data Models: Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS</p> <p>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</p> <p>UNIT II:</p> <p>Relational Algebra and Calculus: Introduction to Relational Algebra,Operations: Selection, Projection, Set Operations, Join Operations, Division,Tuple and Domain Relational Calculus</p> <p>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</p> <p>Advanced SQL: Analytical queries, Hierarchical queries, Recursive queries, Views, Cursors, Stored Procedures and Functions, Packages, Triggers, Dynamic SQL</p> <p>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.</p> <p>UNIT III:</p> <p>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</p> <p>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, Basic Examples of Index Selection</p> <p>UNIT IV:</p> <p>NoSQL Databases and Big Data: Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra.</p> <p>Database Security and Advanced Topics: Introduction to Database Security, Access Control, Discretionary Access</p>

Model curriculum for UG Degree in BCA

Control, Introduction to Data Warehousing, OLAP, Data Mining
Text Books
1.Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, third edition, McGraw – Hill, 2018 2. Benjamin Rosenzweig, Elena Rakhimov, “Oracle PL/SQL by Example”, fifth edition, Prentice Hall, 2015 3. Brad Dayley, “NoSQL with MongoDB in 24 Hours”, 1st edition, Sams Publishing, 2024
Reference Books
1. Korth, Silbertz, Sudarshan,” Database System Concepts”, Seventh Edition, McGraw - Hill.(2019)

Model curriculum for UG Degree in BCA

SEC201	Python Programming	3L:0T:4P	5 Credits
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Course Objectives:

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 Content:

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

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

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

Text Books:

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:

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.

Model curriculum for UG Degree in BCA

CC203	Software Engineering	3L:0T:0P	3 Credits
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Course Objectives

CO1: To Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.
 CO2: To Develop proficiency in project management methodologies and strategic decision- making for successful software project execution.
 CO3: To Master the art of software design, development, and testing to produce robust and efficient software solutions.

Prerequisites: Basic understanding of Software, Applications, Programming fundamentals.

Course Content:

UNIT I:
 The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.
Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.

UNIT 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.

UNIT 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.
Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.
Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

UNIT IV:
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.

Text Books

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook)
2. Software Engineering, Ian Sommerville, 9th edition, Pearson education.
3. Software Engineering A practitioner’s Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

Reference Books

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007
2. Software Engineering: Principles and Practice Hans van Vliet

Model curriculum for UG Degree in BCA

Professional Elective -I

DSE201	Professional Elective -I (Data Science/ AIML/ Full Stack Development)	2L:0T:2P	3 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science / Artificial Intelligence and Machine Learning/ Full Stack Development**

Model curriculum for UG Degree in BCA

VAC201	Disaster Management	0L:0T:4P	2 Credits
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Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

DISASTER MANAGEMENT

In our rapidly evolving 21st-century world, challenges emerge in diverse forms, transcending borders and intertwining economic, societal, and environmental realms. These challenges profoundly affect vulnerable communities, magnifying their susceptibility to climate-related shocks and disasters. As we navigate through these complexities, it becomes increasingly evident that aligning strategies with global Sustainable Development Goals (SDGs) across various geographical scales is paramount. This alignment incorporates perspectives of environmental sustainability, climate adaptation, and disaster resilience. In light of these considerations, this course aims to equip students with the knowledge and skills necessary to address and mitigate the impacts of disasters in a holistic manner.

Course Objective(s):

- to provide understanding of the concepts related to disaster
- to highlight the importance and role of disaster management
- to enhance awareness of institutional processes and management strategies to mitigate the impacts of disasters

Course Content:

Unit 1: 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)

Unit 2: 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

Unit 3: Initiatives at national and international level

Disaster Risk Management in India and at international level: Related policies, plans, programmes and legislation; International strategy for disaster reduction and other initiatives

Unit 4: Emergency Management

Explosion and accidents (Industrial, Nuclear, Transport and Mining) - Spill (Oil and Hazardous 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.

Readings

Model curriculum for UG Degree in BCA

1. Sharma, S.C. (2022), Disaster Management, Khanna Book Publishing.
2. Clements, B. W., (2009): Disasters and Public Health: Planning and Response, Elsevier Inc.
3. Dunkan, K., and Brebbia, C. A., (Eds.) (2009): Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK.
4. Singh, R. B. (ed.), (2006) Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.
5. Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Modh, S. (2010) Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.
7. Carter, N. (1991) Disaster Management: A Disaster Management Handbook. Asian Development Bank, Manila.
8. Govt. of India (2008) Vulnerability Atlas of India. BMTPC, New Delhi.
9. Govt. of India (2011) Disaster Management in India. Ministry of Home Affairs, New Delhi.
10. Matthews , J.A., (2002) Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.

E-Resources <http://www.ndma.gov.in/en/> <http://nidm.gov.in/> <https://www.unisdr.org/> <http://www.emdat.be>
<https://www.weather.gov/safety/>

<https://www.preventionweb.net/risk/vulnerability>

Course Outcomes:

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

- i. Articulate the critical role of disaster management in reducing risks and enhancing resilience
- ii. Identify and describe key institutional frameworks and processes in disaster management.
- iii. Conduct risk assessments and develop disaster management plans for specific scenarios

SEMESTER –IV

Model curriculum for UG Degree in BCA

CC204	Object Oriented Programming using C++ with Lab	3L:0T:2P	4 Credits
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Course Objective:

The objective of this course is to introduce students to the principles and concepts of object-oriented programming using the C++ programming language. The course aims to develop students' skills in designing and implementing object-oriented solutions to real-world problems.

Course Outcome:

By the end of this course, students should be able to:

1. Understand the fundamental concepts of object-oriented programming.
2. Design and implement C++ programs using classes, objects, and inheritance.
3. Apply polymorphism and templates to develop reusable code.
4. Utilize advanced features of C++ to develop efficient and modular programs.

Course Content:**Unit-1: Introduction to Object-Oriented Programming (OOP)**

OOP concepts: Abstraction, Encapsulation, Inheritance, Polymorphism, Procedural Vs. Object- Oriented Programming, Principles of OOP and their benefits.

Unit-2: C++ Programming Basics

Program structure and basic syntax in C++, Namespaces, Identifiers, Variables, Constants, Enums, Operators and typecasting in C++.

Unit-3: Classes and Objects

Classes and Objects in C++, Access specifiers: Public, Private, Protected, Constructors and Destructors in classes.

Unit-4: Inheritance and Polymorphism

Concept of Inheritance and its types, Polymorphism and function overloading, Virtual functions and abstract classes.

Unit-5: Exception Handling and File I/O

Introduction to exception handling, try-catch blocks, Exception propagation, File input and output operations in C++.

Recommended Books:

1. "C++ Primer" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo.
2. "Effective C++: 55 Specific Ways to Improve Your Programs and Designs" by Scott Meyers.

Model curriculum for UG Degree in BCA

CC205	Computer Networks	3L:0T:0P	3 Credits
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Course Objectives:
<ul style="list-style-type: none"> ● Understand the fundamental concepts of Computer Networks and their applications. ● Develop problem-solving skills related to network design, implementation, and troubleshooting. ● Implement network protocols and configure network devices.
Prerequisites:
<ul style="list-style-type: none"> ● Basic Networking Knowledge: Familiarity with basic networking concepts such as IP addressing and network topologies. ● Programming Skills: Ability to write basic network programs and scripts in languages such as Python or C. ● Operating Systems: Understanding of OS concepts related to networking, such as process management and memory allocation
Course Content:
<p>UNIT I: Introduction to Computer Networks</p> <p>Overview of Computer Networks: Definition and Objectives, Applications and Examples Network Components and Architecture</p> <p>Network Models: OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models</p> <p>Network Topologies: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology</p> <p>Data Transmission: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency</p> <p>Networking Devices: Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.</p> <p>UNIT II: Data Link Layer and Networking Protocols</p> <p>Data Link Layer Fundamentals: Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms.</p> <p>Ethernet: Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods</p> <p>Network Protocols: Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation</p> <p>Address Resolution Protocol (ARP): ARP Operation and Table, ARP Spoofing and Security Considerations</p> <p>Virtual LANs (VLANs): Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases</p> <p>UNIT III: Network Layer and Transport Layer</p> <p>Network Layer: IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT)</p> <p>Transport Layer: TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP</p> <p>Congestion Control Algorithms: Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas.</p> <p>Quality of Service (QoS): QoS Principles and Mechanisms, Differentiated Services (DiffServ) and Integrated Services (IntServ)</p> <p>Network Security Fundamentals: Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption</p> <p>UNIT IV: Application Layer and Emerging Technologies</p> <p>Application Layer Protocols: HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution</p> <p>Network Applications: Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming.</p> <p>Emerging Technologies: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking</p>

Model curriculum for UG Degree in BCA

<p>Network Management: SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques.</p> <p>Future Trends in Networking: 5G and Beyond, Network Automation and Artificial Intelligence in Networking.</p>
<p>Text Books:</p> <ul style="list-style-type: none">• Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.• James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021
<p>Reference Books:</p> <ul style="list-style-type: none">• Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.• Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.• Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023.• Mastering PC Hardware & Networking, Khanna Publishing House, 2024.

Model curriculum for UG Degree in BCA

CC206	Design and Analysis of Algorithms	3L:0T:0P	3 Credits
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Course Objectives

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

Course Content:

UNIT 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.

UNIT II:

The Divide & Conquer Design Technique:

The general concept. Binary search, finding the maximum and minimum, merge 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.

UNIT III:

The Dynamic Programming Design Technique:

The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem.

Algorithms on Graphs:

Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.

UNIT IV:

Limitations of Algorithmic Power:

Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem. Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.

Text Books:

- Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
- Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.
- Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012.
- Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson, 2012

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Reference Books

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

Web Resources

- <https://nptel.ac.in/courses/106101060>
- <https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf>

Model curriculum for UG Degree in BCA

CC207	Artificial Intelligence	3L:0T:2P	4 Credits
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Prerequisites:

Basic understanding of computer science concepts, including data structures and algorithms. Proficiency in minimum one programming language, such as Python.

Course Content:

UNIT 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.

UNIT 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, Applications of evolutionary search in AI.

UNIT 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.

UNIT 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.

Text Books:

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

Professional Elective -II

DSE202	Professional Elective -I (Data Science/ AIML/ Full Stack Development)	2L:0T:2P	3 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning/ Full Stack Development.**

SEC 202	Design Thinking and Innovation	1L:1T:0P	2 Credits
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Course Objectives:

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

The primary focus of DTI is to help learners develop creative thinking skills and apply design based approaches/tools for identifying and implementing innovation opportunities into implementable projects.

Following a learning-by-doing approach, the objectives of the course are –

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

Course Content:

Model curriculum for UG Degree in BCA

Unit 1: Basics of Design Thinking

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

Unit 2: Learning to Empathize and Define the Problem

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

Unit 3 : Ideate, Prototype and Implement

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

Unit 4 : Feedback, Re-Design & Re-Create

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

Text Books (Latest Edition):

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

Reference Book

1. Design Thinking by Nigel Cross, Bloomsbury

Course Outcome(s):

By the end of the course, students will be able to –

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

SEMESTER-V

Professional Elective -III

DSE301	Professional Elective -III (Data Science/ AIML)	3L:0T:2P	4 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

Professional Elective -IV

DSE302	Professional Elective -IV (Data Science/ AIML)	3L:0T:2P	4 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning/**

Professional Elective -V

DSE303	Professional Elective -V (Data Science/ AIML)	3L:0T:2P	4 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning/**

Model curriculum for UG Degree in BCA

SEC301	Data Analysis with excel and AI Tools	3L:0T:4P	5 Credits
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Course Objectives : The course enables students to format and edit data, perform basic and advanced calculations, manage data import/export, and apply analytical and visualization tools to support effective decision-making.

Unit I: Introduction to Spreadsheets

This unit introduces spreadsheets, their history, and popular platforms like Excel, Calc, and Google Sheets. Students will learn about the user interface, including the Ribbon and Quick Access Toolbar, and basic spreadsheet operations such as opening/saving files, entering data, navigating cells, and using multiple sheets. It also covers formatting cells, editing content, using autofill, and basic page layout and print settings.

Unit II: Spreadsheet Operations

Learners will deepen their skills in managing rows, columns, and cells, including inserting, deleting, and formatting data. Advanced selection methods and number formatting (currency, percentage, date) will be covered. The unit also emphasizes sheet management, keyboard navigation, and page setup tools like margins, orientation, and watermark settings.

Unit III: Functions and Formulas

This unit explores common functions used for data analysis. Students will use mathematical (SUM, COUNT), text (CONCATENATE, SUBSTITUTE), date/time (TODAY, DATEDIF), lookup (VLOOKUP, XLOOKUP), financial (PMT, NPV), and statistical (AVERAGE, STDEV, RANK) functions to calculate, organize, and manipulate data efficiently.

Unit IV: Data Analysis and Visualization

Students will apply data analysis tools like Sort, Filter, Remove Duplicates, and Subtotals. Pivot Tables and Charts will be used for data summarization and visualization. The unit also includes What-If Analysis (Goal Seek, Data Tables) and tools from the Analysis ToolPak, such as regression, correlation, and descriptive statistics.

Book titles and References

- **Microsoft Excel Data Analysis and Business Modeling** – Wayne Winston
- **Excel 2021 Bible** – Michael Alexander, Richard Kusleika, John Walkenbach
- **Data Analysis Using Microsoft Excel** – Michael R. Middleton

SEMESTER-VI

Model curriculum for UG Degree in BCA

CC301	Generative AI	2L:0T:4P	4 Credits
Course Objectives:			
This course aims at enabling students, <ol style="list-style-type: none">1. To learn the fundamentals of Neural Networks and their various types.2. To explore Generative AI models like GANs, VAEs, and Transformers.3. To analyze the limitations of traditional RNNs and LSTMs.4. To discuss current trends and future directions in Generative AI research.			
Unit-I Foundations of AI and Neural Networks: History and evolution of AI/ML, Deep learning revolution, transfer learning, History of Neural Natural Language Processing, Structure of Artificial Neural Networks, Steps in Training an Artificial Neural Network, Parameters and Hyper parameters, Backpropagation. Unit- II Advanced Neural Network Architectures: Introduction to advanced architectures, Introduction to Generative AI Models: Generative Adversarial Networks (GANs), Variational Auto encoders (VAEs), Transformers, Attention Mechanism in detail Long Short-Term Memory Networks (LSTMs). Unit -III Data Preprocessing: Probability and Statistics, Data Preprocessing Techniques, Model Training Techniques Unit -IV Generative AI Applications: Applications in Various Fields: Art and Creativity, Image and Video Generation, Text Generation, Music Composition, Healthcare Finance. Real-world use cases and challenges in deploying generative AI models			
Text Books:			
<ol style="list-style-type: none">1. "Introduction to Generative AI", Numa Dhamani, Kindle Edition, 2024.2. "Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology". Altaf Rehmani3. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal.			

Professional Elective –VI

DSE304	Professional Elective -VI (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

Professional Elective –VII

DSE305	Professional Elective -VII (Data Science/ AIML))	3L:0T:4P	5 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning/**

SEMESTER-VII

Specialization – AI & ML

MDE401	SOCIAL NETWORK ANALYSIS	-L:-T:-P	3 Credits
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Unit-I: INTRODUCTION

Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.

Unit-II: MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

Unit-III: EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS

communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.

Unit-IV: PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES

Understanding and predicting human behavior for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.

Unit-V: VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

REFERENCES:

- Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
- Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
- Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet

COURSE OBJECTIVES

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behavior in social web and related communities.
- To learn visualization of social networks.

Model curriculum for UG Degree in BCA

CC401	Optimization of ML	3L:0T:4P	5 Credits
Course Objectives:			
<p>Most problems arising in modern Machine Learning and Data Science are formulated as optimization programs. The most efficiently tractable subclass of these problems is the family of convex programs. The course will consist of two parts:</p> <p>1) Convex Optimization (CO), 2) Application of the CO machinery in Data Science.</p>			
Unit I			
Convex Optimization. The first part of the course focuses on defining, analyzing, and solving convex optimization problems that arise in applications. We will cover Convex sets, functions, and programs and their properties, Basics of convex analysis, cones, Linear, quadratic, and semi definite programming.			
Unit II			
Optimality conditions, introduction to duality theory, theorems of alternatives, Algorithms: Unconstrained minimization, Descent methods, Newton's method, Interior-point methods.			
Unit III			
Applications. Applications of the CO machinery to Statistics, Machine learning, and Data Science problems. Maximum likelihood and elements of Robust Statistics, Regularization: ridge regression, LASSO, and their analysis.			
Unit IV			
Elements of Bayesian Statistics, SVD, Matrix Norms, Robust Principal Component Analysis, Matrix completion, Examples from big data , engineering, and machine learning.			
Unit V			
Unconstrained Optimization, Optimality conditions. Convexity. Descent directions. Line search. Acceptability of step sizes. General minimization algorithm. Gradient method. Rate of convergence. Newton's method. Factorizations to ensure convergence. Weighted least squares. Introduction to AMPL. The Neso solver site.			
Text Books:			
<ul style="list-style-type: none"> ● Optimization in Operations Research, second edition, Ronald L. Rardin, ISBN- 13: 978-0-13-438455-9 ● An Introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, ISBN-13: 978-1461471370 (also available for free online) ● Scientific Computing, second edition, Michael T. Heat, ISBN-13: 978-1259002281 			
Reference Books:			
<ul style="list-style-type: none"> ● Nesterov. Introductory Lectures on Convex Optimization: A Basic Course. Kluwer-Academic. 2003 ● Boyd & Vandenberghe. Convex Optimization. Cambridge University Press. 2003 ● Sra, Nowozin, Wright (eds). Optimization for Machine Learning. MIT Press. 2011 ● Bubeck. Convex Optimization: Algorithms and Complexity. In Foundations and Trends in 			

Professional Elective –VIII

DSE401	Professional Elective - VIII (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

Professional Elective –IX

DSE402	Professional Elective - IX (Data Science/ AIML)	0L:0T:0P	3 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

SEMESTER VII

Specialization – Data Science

MDE401	Advanced Statistical methods for Data Science	-L:-T:-P	3 Credits
Course Content:			
<p>Unit I: Linear Regression Linear Regression – the theory: What is simple linear regression and its uses – Types of variables – Assumptions of simple linear regression – Perform a simple linear regression involving test & training data sets – Interpreting the results – Presenting the results.</p> <p>Unit II: : Linear Regression using Python Carry out Simple Linear regression analysis in Python and interpreting the results using pandas, numpy, matplotlib, seaborn, sklearn.</p> <p>Unit III: Multi Linear Regression Multi Linear Regression – the theory: What is Multi linear regression and its uses – Types of variables – Assumptions of Multi linear regression – Perform a Multi linear regression – Interpreting the results – Presenting the results</p> <p>Unit IV: : Multi Linear Regression using Python Carry out Multi-Linear regression analysis in Python and interpreting the results using pandas, numpy, matplotlib, seaborn, sklearn</p> <p>Unit IV Logistic Regression Logistic Regression – the theory: What is Logistic regression and its uses – Linear regression vs logistic regression – Types of variables – Assumptions of Logistic regression – Types of Logistic regression models – Perform a Logistic regression – Interpreting the results – Presenting the results</p> <p>Unit VI: : Logistic Regression using Python Carry out Binary Logistic regression analysis in Python and interpreting the results using pandas, numpy, matplotlib, seaborn, sklearn</p>			
BOOKS FOR REFERENCE:			
<ol style="list-style-type: none"> 1. Statistical Methods by SP GUPTA 48TH EDITION 2022, Sultan Chand & Sons. 2. Advanced Statistical Methods in Data Science, Xuewen Lu, Ding-Geng Chen, Jiahua Chen, Hao Yu , Grace Y. Yi, Springer 3. Advanced Statistical Methods for the Analysis of Large Data-Sets, Agostino DiCiaccio, Mauro Coli, Jose Miguel Angulo Ibanez, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG 			

CC401	Python for Data Science	3L:0T:4P	5 Credits
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Course Content:

UNIT I: Explore Data using Python

Understanding Characteristics of the dataset – Size, Shape, value counts – Data Types and change data types

UNIT II: Measures of Central Tendency

Arithmetic Mean, Median, Mode – Relationship between mean, median and mode –Computation of the measures for grouped and ungrouped data

UNIT III: Measures of dispersion

Range, mean deviation and standard deviation – coefficient of variation and its use – Quartiles and Inter quartile range – Quintiles, Deciles and Percentiles — Skewness and Kurtosis and their uses

UNIT IV: Understanding Correlation

Understanding correlation – calculating correlation using Pandas – Interpreting a correlation Matrix

UNIT V: Statistical Quality Control

Nature of Control Limits – Purpose of Control Charts – Control Charts for Variables – Control Charts for Attributes

UNIT VI: Conducting EDA using Python

Data Analysis using Python – Handling missing data – Computing metrics – Analysis & Interpretation of the data and connected visualization

BOOKS FOR REFERENCE:

1. Hands-On Data Science and Python Machine Learning, Kane Frank, Packt Publishing Limited
2. Data Science and Machine Learning Interview Questions Using Python a Complete
3. Question Bank to Crack Your Interview, Vishwanathan Narayanan, BPB

Publications.

1. Python for data science, Tony F Charles.
2. Data Structures using Python, Shriram K. Vasudevan, OUP India.
1. 5. Python Data Science Handbook, Jake Vanderplas, O'Reilly Media.

Professional Elective – VIII

DSE401	Professional Elective - VIII (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

Professional Elective – IX

DSE402	Professional Elective - IX (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

SEMESTER VIII

(Honours)

Professional Elective - X

DSE403	Professional Elective - X (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

Professional Elective - XI

DSE404	Professional Elective - XI (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

Professional Elective - XII

DSE405	Professional Elective - VIII (Data Science/ AIML)	3L:0T:4P	5 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning**

SEMESTER VII

(Honours with Research)

CC401	Advanced Data Analysis Tools	2L:0T:4P	4Credits
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Course Objectives:

- Equip students with foundational data analysis concepts and hands-on skills.
- Enable effective data cleaning, exploration, analysis, and visualization.
- Introduce principles of data-driven decision-making.

Course Contents:

Session 1: Data Analytics Fundamentals

Definition, importance, and applications in engineering.
Data types, sources, and ethical considerations.
Introduction to data analysis tools and workflows.

Session 2: Data Handling with Excel

Data organization, cleaning, and manipulation using Excel.
Pivot tables, filtering, sorting, and conditional formatting. Creating basic charts and visualizations in Excel.

Session 3 & 4: Exploratory Data Analysis (EDA)

Descriptive statistics, measures of central tendency, dispersion, and distribution.
Visualizing data distributions and relationships using Excel and basic statistical software.
Identifying patterns, trends, and outliers through EDA.

Session 5: Probability and Statistics Foundations

Basic probability concepts, random variables, distributions, and central tendency. Introduction to hypothesis testing and statistical inference.

Session 6: Data Visualization with Tableau or Power BI

Effective visualization principles and techniques.
Creating compelling charts, graphs, and dashboards using Tableau or Power BI.

Session 7: Data Cleaning and Preparation

Handling missing values, outliers, and inconsistencies using Excel or statistical software.
Data wrangling techniques for transformation, merging, and aggregation.

Session 8: Data Analysis for Decision-Making

Applying data analysis techniques to inform decision-making in engineering contexts.
Case studies and examples of data-driven problem-solving.

Session 9 & 10: Mini-Project

Hands-on application of data analysis tools and techniques to solve engineering problems.
Students work on individual or group projects with presentations.

Session 11: Ethical Considerations in Data Analysis

Data privacy, bias, and social responsibility.
Best practices for ethical data collection, analysis, and interpretation. Session

12: Course Review and Future Directions

Recap of key concepts and skills learned.
Exploring advanced data analysis tools and techniques.
Discussing the role of data analytics in future engineering advancements.

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Software Tools:
Data visualization tools (Tableau, Power BI, Excel)
Additional Resources:
Online tutorials and courses on data analysis. Open-source datasets for practicing data analysis skills.
Text Book:
Naked Statistics: Stripping the Dread from the Data by Charles Wheelan: Storytelling with Data: A Guide for Presenting Visual and Statistical Analyses by Cole Nussbaumer Knaflic

Model curriculum for UG Degree in BCA

CC402	Research Methodology	2L:2T:0P	4credits
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Course Objective: To familiarize the students to the principles of scientific methodology in business enquiry, to develop analytical skills of business research, and to develop the skills for scientific communications

Course Content:

Unit – I Introduction

Meaning, objectives and motivations in research, Characteristics and limitations of research – Components of research work - Criteria of good research, Research process – Types of Research, Fundamental, Pure or Theoretical Research –Applied Research –Descriptive Research – Evaluation Research –Experimental Research Survey Research – Qualitative Research – Quantitative Research – Historical Research.

Unit – II Research Design

Research Design – definition – essentials and types of research design – errors and types of errors in research design. Research problem: Selecting and analyzing the research problem – problem statement formulation – formulation of hypothesis. Literature review: purpose, sources, and importance - literature review procedure. Objectives: Learning Objectives; Definitions; Formulation of the research objectives.

Unit – III Measurement. Scaling and Sampling Variables in Research –

Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument. Data Collection methods – primary and secondary data – Construction of questionnaire and instrument – validation of instruments. Sample size determination - Sample design and sampling techniques.

Unit – IV Data Analysis and Tools Processing of Data:

Editing of Data – Coding of Data – Classification of Data Statistical Series. Qualitative vs Quantitative data analyses – Univariate, Bivariate and Multivariate statistical techniques
Measures of Central Tendency, Dispersion, correlation and Regression, Chi-square test: Applications, Steps, characteristics, limitations, Analysis of Variance and Covariance, Factor analysis – Discriminant analysis – cluster analysis – multiple regression and correlation – multidimensional scaling – Conjoint Analysis - Application of statistical software for data analysis.

Unit – V Research Report Writing Research report

Different types – Contents of report –executive summary – chapterization – contents of chapter – report writing – the role of audience – readability – comprehension – tone – final proof – report format – title of the report – Ethical issues in research: Code of Ethics in Research – Ethics and Research Process – Importance of Ethics in Research.
Cooper, D.R., Schindler, P.S. and Sun, J., 2006. Business research methods (Vol. 9). New York: McGraw-Hill Irwin.
Creswell, J.W. and Creswell, J.D., 2017. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

APPENDIX

Appendix – I

Proposed Streams with Discipline-Specific Electives (DSE)

Proposed *Note: The following is indicative. Universities/Institutes may add streams / electives as per their specific requirements.*

Data Science

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Basics of Data Analytics using Spreadsheet
2	IV	DSE*202	Data Visualization
3	V	DSE301	Introduction to Data Science
4	V	DSE302	Basics of network Security
5	V	DSE303	Machine Learning
6	VI	DSE304	Big Data Analytics
7	VI	DSE305	Exploratory Data Analysis
8	VII	DSE401	Business Intelligence & Analytics
9	VII	DSE402	Data Mining
10	VIII	DSE403	Advanced Data Visualization
11	VIII	DSE404	Security in Cloud Computing
12	VIII	DSE405	Data Security & Privacy

2. Artificial Intelligence and Machine Learning

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Feature Engineering
2	IV	DSE*202	Advanced ML
3	V	DSE301	Neural Network
4	V	DSE302	Digital Image Processing
5	V	DSE303	Natural Language Processing
6	VI	DSE304	Deep Learning
7	VI	DSE305	Predictive Analysis
8	VII	DSE401	Prompt Engineering
9	VII	DSE402	Advanced Artificial Intelligence
10	VIII	DSE403	Speech Recognition
11	VIII	DSE404	Data Security & Privacy
12	VIII	DSE405	Augmented Reality & Virtual Realit

3. Full Stack Development

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Web Programming -I
2	IV	DSE*202	Web Programming -II

Data Science

DSE201	Basics of Data Analytics using Spreadsheet	1L:0T:4P	3credits
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Course Objectives
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 Content:
UNIT I: Introduction to Data Analytics Understanding data and its types (structured, unstructured, semi-structured)-What is Data Analytics- Types of data Analytics-Importance of Data Analytics- Applications of Data Analytics.
UNIT II: Data, Ethics, and Industry: Case Studies Data Collection Methods - Different Data Sources & format - Data Cleaning and Transformation - Handling Missing Data and Outliers. - Ethical considerations in data analytics. - Real-world Applications of Data Analytics- Industry-specific applications (finance, marketing, operations) - Case Study <i>Note:</i> Case study is for discussion not to be considered for evaluation.
Text Books
1. "Beginner's Guide for Data Analysis using R Programming" by Jeeva Jose, Khanna Publishing House, 2024. 2. "Data Analytics" by V.K. Jain, Khanna Book Publishing Company, 2024. 3. "Excel Data Analysis For Dummies" by Stephen L. Nelson and E. C. Nelson, John Wiley & Sons; 3rd edition, 2016 4. "Data Analysis Using Microsoft Excel" by Michael R. Middleton, Thomson, Brooks/Cole, 3rd edition , 2004
Reference Books
1. "Excel 2019 Bible" by Michael Alexander, Richard Kusleika, and John Walkenbach, John Wiley & Sons, 25 Sept 2018 2. "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics" by Cliff T Ragsdale, Cengage learning asia pet. 2015 3. "Mastering Excel" by WebTech Solutions, Khanna Publishing House, 2024.

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DSE202	Basics of AI	1L:0T:4P	3credits
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<p>Course Content:</p> <p>UNIT I: Introduction to AI</p> <p>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.</p> <p>UNIT II: Advanced Search Techniques</p> <p>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, Applications of evolutionary search in AI.</p> <p>UNIT III: Logical Reasoning and Uncertainty</p> <p>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.</p> <p>UNIT IV: Domains and Applications of AI</p> <p>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.</p> <p>UNIT V: Introduction to Machine Learning</p> <p>Introduction: Definition, History and Application of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled 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.</p> <p>UNIT VI: Supervised Learning and Unsupervised Learning</p> <p>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.</p> <p>Text Books:</p> <ol style="list-style-type: none"> 1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House. 2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House. 3. M.C. Trivedi, <i>A Classical Approach to Artificial Intelligence</i>, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook). 4. Nilsson Nils J, <i>Artificial Intelligence: A new Synthesis</i>, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.

Model curriculum for UG Degree in BCA

Course Outcomes

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

CO2: Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, Logistic Regression).

CO3: Apply unsupervised learning methods (e.g., K-Means, Hierarchical Clustering, Association Rules).

CO4: Develop and evaluate simple machine learning models (e.g., Perceptron, single-layer neural networks).

CO5: Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.

CO6: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents.

CO7: Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications.

DSE301	Introduction to Data Science	3L:0T:4P	5credits
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<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. Understand the foundational concepts and processes in data science. 2. Learn to work with data collection, preprocessing, exploration, and visualization techniques. 3. Gain exposure to supervised and unsupervised learning algorithms. 4. Develop hands-on skills using Python, pandas, NumPy, matplotlib, and scikit-learn. 5. Practice applying data science techniques to solve real-world problems.
<p>Course Content:</p> <p>Module 1: Introduction to Data Science</p> <p>What is Data Science? Importance and applications. Data Science Life Cycle (OSEM: Obtain, Scrub, Explore, Model). Roles: Data Scientist vs Analyst vs Engineer.</p> <p>Module 2: Data Wrangling & Preprocessing</p> <p>Types of data: Structured, unstructured, semi-structured. Data collection and input sources. Missing values, noise, outliers. Data normalization and transformation techniques.</p> <p>Module 3: Exploratory Data Analysis (EDA)</p> <p>Descriptive statistics (mean, median, std, etc.). Data visualization: histograms, box plots, scatter plots. Correlation, covariance, pair plots.</p> <p>Module 4: Introduction to Machine Learning</p> <p>Overview of ML: Supervised vs Unsupervised Learning. Simple Linear Regression, K-Nearest Neighbors. Clustering: K-Means. Model evaluation metrics (Accuracy, Precision, Recall, F1 Score).</p> <p>Module 5: Data Science Tools and Technologies</p> <p>Introduction to Python for Data Science. Libraries: NumPy, pandas, matplotlib, seaborn, scikit-learn. Jupyter Notebook, Google Colab.</p> <p>Module 6: Applications & Case Studies</p> <p>Real-world case studies: health, finance, e-commerce, etc. Ethical issues in Data Science. Mini Project Planning.</p>
<p>Lab Experiments (Python-based):</p> <ol style="list-style-type: none"> 1. Install and set up Jupyter Notebook / Google Colab 2. Basic Python exercises – variables, data types, loops, functions 3. NumPy operations – arrays, indexing, reshaping 4. pandas for data handling – reading CSV, filtering, grouping 5. Visualization with matplotlib and seaborn 6. Missing value handling and outlier detection 7. Implementing Linear Regression using scikit-learn 8. Classification using KNN 9. K-Means clustering and visualization 10. Mini-project: Choose a dataset and complete EDA + ML model
<p>Textbooks and References:</p>

Model curriculum for UG Degree in BCA

- **Textbooks:**
 - Joel Grus, 'Data Science from Scratch', O'Reilly Media, 2nd Edition, 2019
 - V.K. Jain, 'Fundamentals of Data Science', Khanna Publishing, 2020
- **Reference Books:**
 - Cathy O'Neil and Rachel Schutt, 'Doing Data Science', O'Reilly, 2013
 - Aurélien Géron, 'Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow', 2nd Ed., O'Reilly, 2019
 - Jake VanderPlas, 'Python Data Science Handbook', O'Reilly, 2016

DSE302	Basics of network Security	3L:0T:4P	5credits
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Course Content:

Unit-I - Introduction -

Attacks, Services, and Mechanisms – Security Attacks: Passive Attacks –Active Attacks – Security Services – Model for Internetwork Security – Internet Standards and RFCs: Internet Society – RFC Publication – Standardization Process – Non- Standardization Track Documents – Conventional Encryption and Message Confidentiality: Conventional Encryption Principles: Cryptography – Cryptanalysis – Feistel Cipher Structure – Conventional Encryption Algorithms – Cipher Blocks Models of Operation: Cipher Block Chaining Mode – Cipher Feedback Model – Location of Encryption Devices – Key distribution.

Unit-II - Public Key Cryptography and Message Authentication - Approaches to Message

Authentication: Authentication using Conventional Encryption – Message Authentication without Message Encryption – Message Authentication Code – One Way Hash Function – Secure Hash Function and HMAC: Hash Function Requirements – Simple Hash Functions the SHA-1 Secure Hash Function – Other Secure Hash Functions – HMAC Design Objectives – HMAC Algorithm – Public Key Cryptography Principles: Public Key Encryption Structure Application for Public Key Cryptosystems – Requirements for Public Key Cryptography – Public Key Cryptography Algorithms: RSA Public Key Encryption Algorithms – Diffie-Hellman Key Exchange – Other Public Key Cryptography Algorithms – Digital Signature – Key Management.

Unit-III - Electronic Mail Security - Pretty Good Privacy (PGP): Notation – Operational Description –

Cryptography Keys and Key Rings – Public Key Management – S/MIME: RFC 822 – Multipurpose Internet Mail Extensions – S/MIME Functionality – S/MIME Messages – S/MIME Certificate Processing – Enhanced Security Services – IP Security: IP Security Overview: Application of IPsec – Benefits of IPsec – Routing Applications – IP Security Architecture: IPsec Documents – IPsec Services – Security Associations – Transport and Tunnel Modes – Authentication Header – Encapsulating Security Payload –Combining Security Associations – Key Management: Oakley Key Determination Protocol – ISAKMP

Unit-IV - Web security - Web security Requirements: Web security Threats – Web Traffic Security

Approaches – Secure Socket Layer (SSL) and Transport Layer Security (TLS): SSL Architecture – SSL Record Protocol – Change Cipher Spec Protocol – Alert Protocol - Handshake Protocol – Cryptographic Computations – Transport Layer Security – Secure Electronics Transaction (SET): SET Overview – Dual Signature – Payment Processing – Network Management Security: Basic Concepts of SNMP: Network Management Architecture – Network Management Protocol Architecture – Proxies – snmpv2 – snmpv1 Community Facility – snmpv3: SNMP Architecture – Message Processing and the User Security Model – View Based Access Control.

Unit-V - System Security - Intruders and Viruses: Intruders: Intrusion Techniques – Password Protection –

Password Selection Strategies – Intrusions Detection – Viruses and Related Threats: Malicious Programs – The Nature of Viruses – Types of Viruses – Macro Viruses – Antiviruses Approaches – Advanced Antiviruses Techniques – Firewalls: Firewall Design Principles: Firewall Characteristics – Types of Firewalls – Firewall Configuration – Trusted Systems: Data Access Control – The Concept of Trusted Systems – Trojan Horse Defense.

Text book:

1. William Stallings, Network Security Essentials, Prentice Hall, Third Edition, 2006.

Reference Books:

1. Manish Tiwari, Handbook of Network Security and Anti Terrorism Laws, Neha Publishers and Distributors, 2012.
2. Adesh K. Pandey, Network Security and Administration, S.K. Kataria and Sons, 2010.

Model curriculum for UG Degree in BCA

DSE303	Machine Learning	3L:0T:4P	5credits
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Course Content:

UNIT 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 Unlabelled 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.

UNIT 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.

Text Books:

1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.
3. Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.
4. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780

Reference Books:

1. Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012.
2. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
3. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.

Machine Learning Lab

Prerequisites: Understanding of machine learning algorithms and concepts (e.g., classification, clustering, regression). Proficiency in Python programming, with experience using libraries such as NumPy, pandas, Scikit-Learn, NLTK, Matplotlib, and Seaborn.

LAB Experiments

The lab experiments may be implemented in Python using relevant ML libraries, and datasets from Kaggle, public repositories, or generated datasets.

Suggested list of Experiments (not limited to):

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1. Implement linear regression on a dataset and visualize the regression line.
2. Implement logistic regression on a binary classification dataset 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 Naive 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. Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.
7. Implement hierarchical clustering on a dataset and plot the dendrogram.
8. Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.
9. Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.
10. 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.
11. Demonstrate the concept of boosting using the AdaBoost algorithm.

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DSE304	Big Data Analytics	3L:0T:4P	5credits
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Course Content:

Unit -I: Introduction to Big Data, Characteristics of Data, and Big Data Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Data Warehouse environment, Traditional Business Intelligence versus Big Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Examples of big Data Analytics.

Big Data Analytics, Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics Life Cycle

Unit - II: Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models.

Unit - III: Analytical Theory and Methods: Classification, Decision Trees, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods, Time Series Analysis, Box Jenkins methodology, ARIMA Model, Additional methods. Text Analysis, Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments.

Unit- IV: Data Product, Building Data Products at Scale with Hadoop, Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, working with Distributed file system, Working with Distributed Computation, Framework for Python and HadoopStreaming, Hadoop Streaming, MapReduce with Python, Advanced MapReduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications,

Unit-V: Distributed Analysis and Patterns, Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data Ingestion, Importing Relational data with Sqoop, Injesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher level APIs.

Books and References

Big Data and Analytics Author/s Subhashini Chellappan Seema Acharya Wiley

Data Analytics with Hadoop An Introduction for Data Scientists Benjamin Bengfort anJenny Kim O'Reilly

DSE305	Exploratory Data Analysis	3L:0T:4P	5credits
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COURSE OUTCOMES:

At the end of the Course, the Student will be able to:

CO1: Introduction on R- Creation of environment, packages and some simple functions etc.(L2)

CO2: Understand and use Date types and control structures and loops. (L2)

CO3: Understand and use vectors and matrices. (L2)

CO4: Understand and use data frames, lists, arrays and time series. (L3)

CO5: Analysis of Data by using Statistical functions and Basic Visual representations. (L3)

Unit 1.

Introduction to Statistical Methods

Statistics & Managerial Decisions, Statistical Data, Operation Research Techniques

Unit 2. Data Collection And Analysis

Collection and presentation of data in terms of tables, graphs, raw data, frequency distributions, histogram etc. Cumulative frequency curve, Measures of central tendency and location, Partition values, Comparison of various measures of central tendencies, Measures of dispersion, skewness & kurtosis, comparison of various measures of dispersion

Unit 3. Probability Distribution & Statistics

Introduction of Probability, sample, space & events, Basic rules of probability, permutation & combinations, conditional probability, Bayes' theorem, distributions: Binomial, Poisson, Exponential and Normal distribution with their properties and application. Random variables –discrete and continuous probability distribution functions

Unit 4. Correlation And Regression Analysis

Curve fitting, correlation and regression analysis, Autocorrelation, Multiple regression, statistical Inference & estimation applied to Industrial problems

Unit 5. Understanding Data for Exploratory Analysis

Exploratory data analysis and data visualization, Perception, Continuous variables, Discrete variables, Dependency relationships, Multivariate categorical variables, Temporal data, Spatial data Data Science Pipeline: Collect, Import, Clean, Transform, Visualize, Model, Communicate

Unit 6. Statistical Tests and Testing of Hypothesis

Elementary theory and practice of sampling, standard error or means and variance, tests of significance, T test, F test, Z test and chi-square test along with their applications, Goodness of fit, testing of hypotheses and decision making, analysis of variance (ANOVA)

LIST OF EXPERIMENTS:

1. Download and install R-Programming environment and install basic packages using install. Packages()

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command in R.

2. Learn all the basics of R-Programming (Data types, Variables, Operators, simple Mathematical functions etc.,)
3. Write a program to find list of even numbers from 1 to n using R-Loops.
4. Create a function to print squares of numbers in sequence.
5. Write an R-program to create a matrix, assign some dim names to the matrix and combines two matrices and do some basic operations on matrix.
6. Implement different String Manipulation functions in R.
7. Implement different data structures in R (Vectors, Lists, Data Frames and Time Series)
8. Write a program to read a csv file and analyze the data by applying statistical operations on it.
9. Create Basic exploratory graphs in R.
10. Write an R-programming to exploring a new data set and summarizing the numerical data and also detect anomalies in numerical data.

Text Book

- Norman Matloff, The Art of R Programming, UC Davis 2009.
- Ronald K. Pearson, Explorative Data Analysis using R.

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DSE401	Business Intelligence & Analytics	3L:0T:4P	5credits
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Course Learning objectives:

- Explain the Business Intelligence, Analytics and Decision Support system
- List the technologies for Decision making, Automated decision systems
- Explain sentiment analysis techniques
- Illustrate Multi-criteria Decision making systems, predictive modelling techniques

Course Content:

Module-1: An Overview of Business Intelligence, Analytics, and Decision Support Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics,

Module-2: Decision Making Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.

Module-3: Neural Networks and Sentiment Analysis Basic Concepts of Neural Networks, Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbor Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process,, Sentiment Analysis, Speech Analytics.

Module-4 : Model-Based Decision Making Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons.

Module-5: Automated Decision Systems and Expert Systems Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.

Text Books:

1. Robert J, Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, Reprint 2014. Reference books: 1. Earl Gose, Richard John son baugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Ltd., New Delhi – 110 001, 1999.
2. Duda R.O. and Hart P.E., "Pattern Classification and Scene Analysis", Wiley, New York, 1973.

Model curriculum for UG Degree in BCA

DSE402	Data Mining	3L:0T:4P	5credits
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Course Content:

Unit – I

Data Mining: Data, Information and Knowledge, Attribute Types, Introduction to Data Preprocessing, Data Cleaning, Data integration, data reduction, transformation and Data Discretization. Measuring the Central Tendency: Basics of Mean, Median, and Mode, Measuring the Dispersion of Data, Variance and Standard Deviation. Measuring Data Similarity and Dissimilarity, Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes and Binary Attributes, Dissimilarity of Numeric Data, Correlation among attributes. Case Study ; Practice on Excel/ R/Weka/Python.

Unit – II

Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules Mining Frequent Patterns, Associations, and Correlations Frequent pattern mining: , associative classification, Association rule mining- Apriori Algorithm, Improving the efficiency of Apriori, Various measures support, Confidence, Lift, Evaluation of candidates rules.

Case Study ; Practice on Excel/ R/Weka/Python

Unit – III

Classification: Rule-Based Classification -Decision Tree Induction, Attribute Selection Measures, Tree Pruning, Decision Tree Induction, Bayes Classification Methods, Baye’s Theorem, Naive Bayesian Classification, Ensemble Methods, Bagging, Boosting and Ada Boost, Random Forests, Improving Classification Accuracy of Class-Imbalanced Data.

Case Study ; Practice on Excel/ R/Weka/Python.

Model curriculum for UG Degree in BCA

DSE403	Advanced Data Visualization	3L:0T:4P	5credits
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UNIT I: Advanced Concepts in Data Visualization, Visualization for big data and streaming data, Real-time dashboards and monitoring, Visualizing multivariate and high-dimensional data, Techniques for visualizing uncertainty and incomplete data, Case studies in business, healthcare, and public policy,

UNIT II: Visual Analytics & Cognitive Science, Visual analytics framework and pipeline, Cognitive load theory in dashboard design, Gestalt principles and pre-attentive attributes, Perceptual and cognitive biases in visualization, Accessibility and inclusive design considerations

UNIT III: Ethical & Cross-Cultural Visualization, Ethical issues in data visualization (e.g., misleading visuals, manipulation), Designing visuals for diverse cultural audiences, Visual misinformation and data ethics, Legal and privacy considerations in publishing visuals

UNIT IV: Advanced Power BI & Integrations, Data modeling and Power Query best practices, Advanced DAX expressions and dynamic calculations, Bookmarks, drill-throughs, tooltips, and animations, Real-time data integration and API connections, Custom visuals using R and Python in Power BI

UNIT V: Capstone Project & Visualization Strategy, End-to-end project: data wrangling to dashboard delivery, Defining KPIs and stakeholder goals, Storyboarding and narrative flow in visual design, Dashboard presentation, peer review, and critique

Text Books:

- "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018.
- "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.
- "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.

Model curriculum for UG Degree in BCA

DSE404	Security in Cloud Computing	3L:0T:4P	5credits
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Course Objectives:

CO1: Understand the fundamental concepts and architecture of cloud computing with a focus on security.
 CO2: Identify and analyze cloud-specific security threats and vulnerabilities.
 CO3: Explore cryptographic techniques and identity management for secure cloud environments.

Course Content / Syllabus:

UNIT I: Introduction to Cloud Security

Overview of cloud computing architecture – Cloud deployment and service models – Cloud security fundamentals – Shared security responsibility model – Security issues in IaaS, PaaS, and SaaS – Threats: data breaches, insecure APIs, malicious insiders, data loss, and denial of service.

UNIT II: Data Security and Encryption in Cloud

Data confidentiality and integrity – Encryption techniques for data at rest, in transit, and in use – Homomorphic encryption – Key management in cloud – Secure data deletion – Tokenization and masking techniques

UNIT III: Identity and Access Management (IAM)

Authentication and authorization in the cloud – Identity federation and single sign-on (SSO) – OAuth 2.0, SAML, OpenID Connect – Role-Based and Attribute-Based Access Control – Identity as a Service (IDaaS) – Multi-factor authentication

UNIT IV: Cloud Security Architecture and Compliance

Security architecture design for cloud – Cloud security standards and frameworks (ISO/IEC 27017, NIST SP 800-144, CSA CCM) – Legal and compliance issues: HIPAA, GDPR, PCI-DSS – Risk assessment and audit mechanisms – Security Service Level Agreements (SLAs)

UNIT V: Security Tools, Best Practices & Case Studies

Security tools and solutions: CASB, cloud firewalls, SIEM, IDS/IPS in cloud – Best practices for secure cloud deployment – Cloud security automation – Incident response in cloud – Case studies of cloud security breaches and mitigations

Text Books:

"Cloud Security and Privacy" by Tim Mather, Subra Kumaraswamy, and Shahed Latif – O'Reilly Media
 "Cloud Computing Security: Foundations and Challenges" by John R. Vacca – CRC Press
 "Architecting the Cloud: Design Decisions for Cloud Computing Service Models" by Michael J. Kavis – Wiley

Reference Books:

"Security, Privacy and Trust in Cloud Systems" by Surya Nepal & Marios D. Dikaiakos – Springer
 "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl – Prentice Hall
 "NIST SP 800-144: Guidelines on Security and Privacy in Public Cloud Computing" – National Institute of Standards and Technology

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DSE405	Data Security and Privacy	3L:0T:4P	5credits
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Course Objectives (CO):

CO1: Understand foundational concepts of data security and privacy.
 CO2: Identify types of data threats, breaches, and risk analysis techniques.
 CO3: Learn cryptographic methods and access control models for data protection.

Course Content / Syllabus

UNIT I: Introduction to Data Security and Privacy

Fundamentals of data security – CIA triad – Types of threats: internal, external, passive, active – Security attacks: eavesdropping, spoofing, tampering, repudiation – Introduction to privacy: types (informational, bodily, territorial, communicational) – Privacy vs Security

UNIT II: Cryptography for Data Protection

Symmetric and asymmetric encryption – Public Key Infrastructure (PKI) – Digital signatures – Hash functions and message authentication codes (MACs) – Data integrity and authentication – Key distribution and management – Encryption of data at rest and in transit

UNIT III: Access Control and Data Governance

Access control models: Discretionary, Mandatory, Role-Based (RBAC), Attribute-Based (ABAC) – Data classification and labeling – Audit trails and logging – Secure identity management – Secure storage and secure deletion – Database security and inference attacks

UNIT IV: Privacy Models and Regulatory Compliance

Privacy models: k-anonymity, l-diversity, t-closeness – Differential privacy – Legal frameworks: GDPR, HIPAA, CCPA, IT Act (India) – Consent management and privacy policies – Privacy Impact Assessment (PIA) – Ethics in data sharing and surveillance

UNIT V: Applied Data Security and Privacy Solutions

Data masking and tokenization – Secure multiparty computation – Blockchain and privacy – Secure cloud storage – Case studies: healthcare data breaches, social media privacy violations, data protection in e-governance – Tools: Snort, Wireshark, VeraCrypt, Metasploit (for demo)

Text Books:

- “Principles of Information Security” by Michael E. Whitman and Herbert J. Mattord – Cengage Learning
- “Cryptography and Network Security” by William Stallings – Pearson Education
- “Privacy, Big Data, and the Public Good: Frameworks for Engagement” by Julia Lane et al. – Cambridge University Press

Reference Books:

1. “Data and Goliath” by Bruce Schneier – W.W. Norton & Company
2. “Security Engineering” by Ross Anderson – Wiley
3. “Understanding Privacy” by Daniel J. Solove – Harvard University Press
4. NIST Guidelines on Data Security & Privacy – NIST SP 800 series

Artificial Intelligence and Machine Learning

DSE201	Feature Engineering	2L:0T:4P	3credits
Course Objective:			
Understand the importance of features in machine learning and differentiate between various types of data and features (structured vs. unstructured, categorical, numerical, text, and date-time). Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization. Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation.			
Course Content:			
UNIT 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.			
UNIT 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.			
Text Books			
<ul style="list-style-type: none"> ● M.C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024. ● Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning: Principles and techniques for data scientists. O'Reilly Media, Inc. ● Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN-13: 9780323917780. 			
Reference Books:			
<ul style="list-style-type: none"> ● Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167. ● N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024. ● M.C. Trivedi, Deep Learning and Neural Network MC Trivedi, Khanna Publishing House, 2024. ● Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500. ● Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791. ● Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047. 			

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DSE202	Advanced Machine Learning	2L:0T:2P	3credits
<p>Course Objective: Define and explain machine learning concepts, types, and basic metrics. Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, Logistic Regression). Apply unsupervised learning methods (e.g., K-Means, Hierarchical Clustering, Association Rules). Develop and evaluate simple machine learning models (e.g., Perceptron, single-layer neural networks). Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data</p>			
<p>Course Content:</p>			
<p>UNIT I: Introduction to Machine Learning</p> <p><i>Introduction:</i> Definition, History and Application of Machine Learning, <i>Types of Machine Learning:</i> Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. <i>Supervised Learning Tasks:</i> Regression vs. Classification, <i>Learning Framework:</i> Training, Validation and Testing of ML models. <i>Performance Evaluation Parameters:</i> Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.</p> <p>UNIT II: Supervised Learning and Unsupervised Learning</p> <p><i>Regression:</i> Linear and non-linear Regression, Logistic Regression. <i>Classification:</i> Naïve Bayes, K-Nearest Neighbors, Decision Trees. <i>Linear model:</i> Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron, Introduction to Support Vector Machine for linearly separable data. <i>Clustering:</i> K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. <i>ML Applications:</i> Ethical Considerations in Machine Learning, Case study and Real-world Applications.</p>			
<p>Text Books:</p>			
<ol style="list-style-type: none"> 1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House. 2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House. 3. Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill. 4. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780 			
<p>Reference Books:</p>			
<ol style="list-style-type: none"> 1. Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012. 2. Duda, R. O., Hart, P. E., <u>Stork, D</u> (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167. 3. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning. 4. Chollet, F. (2018). Deep Learning with Python. Manning Publications. 5. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer. 6. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. 7. Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media. 			

Model curriculum for UG Degree in BCA

DSE301	Neural Network	3L:0T:4P	3credits
<p>Course Content:</p> <p>UNIT I: Basics of Artificial Neural Networks: Characteristics of Neural Networks, Historical Development of Neural Network Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws.</p> <p>UNIT II: Activation and Synaptic Dynamics: Introduction, Activation Dynamics Models, Synaptic Dynamics Models, Learning Methods.</p> <p>UNIT III: Feedforward Neural Network: Introduction, Analysis of Pattern Association Networks, Analysis of Pattern Classification Networks,</p> <p>UNIT IV: Feedback Neural Networks: Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks.</p> <p>UNIT V: Applications of ANN: Introduction, Direct Applications</p> <p>Reference Books:</p> <ol style="list-style-type: none">1. B. Yegnanarayana - Artificial neural network PHI Publication.20052. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms			

Model curriculum for UG Degree in BCA

DSE302	Digital Image Processing	3L:0T:4P	5credits
Course Objectives:			
<ol style="list-style-type: none"> 1. To introduce students to the Basic concepts and analytical methods of analysis of digital images. 2. To Study fundamental concepts of Digital Image Processing and basic relations among pixels. 3. To Study different Spatial and Frequency domain concepts. 4. To understand Restoration process of degraded image and Multi resolution processing. 5. To understand image compression and Segmentation Techniques. 			
UNIT I			
<p>Introduction: Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels.</p>			
UNIT 2			
<p>Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters.</p> <p>Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing frequency-domain Filters, Sharpening Frequency-domain Filters, Homomorphic Filtering, Implementation.</p>			
UNIT 3			
<p>Image Restoration: A Model of the Image Degradation/Restoration Process, Linear, Position-Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. Wavelets and Multi resolution Processing: Multi resolution Expansions, Wavelet Transforms in one Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions.</p>			
UNIT 4			
<p>Image Compression: Image Compression Models, Error-free Compression, Lossy Compression, Image Compression Standards. Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.</p>			
UNIT 5			
<p>Representation and Description: Various schemes for representation, boundary descriptors, and regional descriptors.</p>			
Text Books			
<ol style="list-style-type: none"> 1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. Prentice Hall India/Pearson Education. 			
References			
<ol style="list-style-type: none"> 1. A.K.Jain, Fundamentals of Digital Image Processing. Prentice Hall India. 2. Madhuri.A.Joshi, Digital Image Processing, PHI. 3. Sonka, Image Processing, Analysis and Machine Vision. Cengage Publications. 4. Fundamentals of Digital Image Processing, Anna durai, Shanmuga lakshmi. 			

Model curriculum for UG Degree in BCA

DSE303	Natural Language Processing	3L:0T:4P	5credits
Course Objectives:			
<ol style="list-style-type: none"> 1. Understand the fundamentals of Natural Language Processing and its applications. 2. Explore the techniques used for text processing, syntactic analysis, and semantic analysis. 3. Learn various models and algorithms used in NLP tasks. 4. Implement and evaluate NLP models using Python and NLP libraries. 5. Develop real-world NLP applications like chatbots, translators, and summarizers. 			
Theory Syllabus:			
<p>Module 1: Introduction to NLP What is NLP? Applications of NLP, Natural Language Understanding vs. Generation, NLP pipeline, Text encoding: ASCII, UTF-8.</p> <p>Module 2: Text Processing and Linguistic Preprocessing Tokenization, Stemming, Lemmatization, POS tagging, Stop-word removal, Regular expressions, Syntax trees.</p> <p>Module 3: Language Modeling and Text Classification N-grams, Bag of Words, TF-IDF, Naive Bayes Classifier, Logistic Regression, Word Embeddings (Word2Vec, GloVe).</p> <p>Module 4: Syntax and Parsing Context-Free Grammar, Dependency Parsing, Constituency Parsing, Syntax Trees.</p> <p>Module 5: Semantics and Pragmatics Named Entity Recognition (NER), Coreference Resolution, Semantic Role Labeling, Word Sense Disambiguation.</p> <p>Module 6: Advanced Topics Introduction to Transformers, BERT, GPT models, Transfer Learning in NLP, Question Answering, Summarization.</p>			
Lab Experiments (Python-based):			
<ol style="list-style-type: none"> 1. Text preprocessing using NLTK and spaCy 2. Building a Bag-of-Words and TF-IDF model 3. Training a text classification model using Naive Bayes 4. Named Entity Recognition using spaCy 5. Sentiment Analysis using pre-trained models 6. Building a simple chatbot using rule-based and ML approaches 7. Working with HuggingFace Transformers (BERT/GPT) 8. Text summarization using NLP techniques 9. Language translation using transformer models 10. Mini-project: End-to-end NLP application (e.g., chatbot, Q&A, summarizer) 			
Textbooks and References:			
<p>Textbooks: Daniel Jurafsky and James H. Martin, 'Speech and Language Processing', 3rd Edition Draft, 2023 Steven Bird, Ewan Klein, and Edward Loper, 'Natural Language Processing with Python', O'Reilly Media, 2009</p> <p>Reference Books: Yoav Goldberg, 'Neural Network Methods in NLP', Morgan & Claypool Publishers, 2017 Delip Rao and Brian McMahan, 'Natural Language Processing with PyTorch', O'Reilly Media, 2019 Thomas Wolf et al., 'Transformers: State-of-the-Art Natural Language Processing', HuggingFace, 2020</p>			

Model curriculum for UG Degree in BCA

DSE304	Deep Learning	3L:0T:4P	5credits
Course Objective:			
<ul style="list-style-type: none"> ● The objective of this course is to provide students with an in-depth understanding of deep learning principles, algorithms, and applications. ● The course aims to develop students' skills in designing and implementing deep neural networks for solving complex machine learning tasks. 			
Course Content:			
<p>Unit 1: Introduction to Deep Learning Overview of deep learning concepts and its significance, Basics of neural networks and gradient- based optimization, Activation functions and loss functions in deep learning</p> <p>Unit 2: Deep Neural Network Architectures Feedforward neural networks and backpropagation algorithm, Convolutional neural networks (CNNs) for image processing, Recurrent neural networks (RNNs) for sequential data analysis</p> <p>Unit 3: Deep Learning Frameworks and Libraries Introduction to popular deep learning frameworks (e.g., TensorFlow, PyTorch), Building and training deep neural networks using frameworks, Transfer learning and pre-trained models</p> <p>Unit 4: Advanced Deep Learning Techniques Generative adversarial networks (GANs) for data generation, Autoencoders and variational autoencoders (VAEs), Reinforcement learning with deep neural networks</p> <p>Unit 5: Applications of Deep Learning Deep learning for image classification and object detection, Natural language processing and sentiment analysis with deep learning, Deep learning in recommendation systems and autonomous vehicle</p>			
Recommended Books:			
<ul style="list-style-type: none"> ● "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville. ● "Deep Learning with Python" by Francois Chollet. 			

Model curriculum for UG Degree in BCA

DSE305	Predictive Analysis	3L:0T:4P	5credits
<p>Course Objective: To know various predictive data analysis models and use analytical tools to solve real-life business problems. To understand basic forecasting techniques to predict future values</p>			
<p>Course Content:</p>			
<p>UNIT-I: Simple Regression Analysis: Concept Fundamentals of Regression Analysis - Requirements in Regression Model Building - Model Diagnostics - Interpretation of Regression results for Management Decision. Multiple Regression Analysis: Concept - Significance of Multiple Regression Analysis - Structure of Model Estimation - Testing Rule of Multiple Regression Analysis</p>			
<p>Unit-II: Nonlinear Regression and Regression Modeling UNITIII: Non-Linear Regression Analysis: Concept - Types of Non-linear Regression Models - Model Transformation - Difference between Linear and Non-linear Regression Models. Diagnostics of Regression Modelling: Model Diagnostics - Multicollinearity - Autocorrelation</p>			
<p>Unit-III: Dummy modelling and Panel Data Model Dummy modeling: Dummy independent modelling-linear probability Model-Logit model-Probit model Panel Data Model: Concept - Panel Data Models - Fixed Effects Model - Random Effects Model - Forms of Panel Data Models - Applications to use Panel Data Models.</p>			
<p>Unit-IV: Forecasting and Machine Learning: Time Series Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend Analysis - Time Series Models - Auto Regressive Model - Applications of Time Series Models. Machine Learning: Concept - Predictive Analysis under Machine Learning - Model of Artificial Neural Networks (ANN) - Model of Random Forest - Model of Support Vector Machine - Assumptions under Machine Learning.</p>			
<p>Unit-V: Data Mining and Simulation: Data Mining: Concept - Data Interpretation - Data Reduction - Classification and Clustering Techniques - Association Rule Mining - Cause and Effect Model. Simulation: Concept - Monte Carlo Simulation - Discriminant Event Simulation - Application Using Simulation.</p>			

Model curriculum for UG Degree in BCA

DSE401	Prompt Engineering	0L:0T:0P	3credits
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Course Content:

Unit I: Introduction to Prompt Engineering

Large Language Model , Working of LLM, Prompt Engineering, importance of Prompt Engineering, Types of prompts: security threats, system failures, performance bottlenecks, Benefits and limitations of Prompt Engineering, Benefits and limitations of Prompt Engineering, Case studies highlighting the impact of prompts on computing systems Real-world applications across various domains

Unit II: Foundations of NLP and Generative Models

Overview of NLP tasks and applications, Preprocessing techniques for text data, Basic NLP tools and libraries (NLTK, SpaCy), Text Representation and Feature Engineering - Bag-of-Words model, Word embeddings (Word2Vec, GloVe), Deep learning-based text representations (BERT, Transformer). Generative Models - Overview of generative modeling, Probabilistic generative models, Autoencoders and variational inference.

Unit III: Prompt Types and Techniques

Zero-shot vs. Few-shot learning with prompts, Task-specific prompt design strategies, Advanced techniques like Chain-of-Thought prompting, Introduction to prompt engineering tools and resources, Prompt Detection Techniques- Anomaly detection methods, Threshold-based approaches, Machine learning techniques for prompt detection

Unit IV: Prompt Development and Evaluation

Exercises - case studies in crafting prompts for various tasks (e.g., text generation, question answering), Techniques for evaluating prompt effectiveness and factual accuracy, Refining and iterating on prompts based on results, bias detection and mitigation in prompts

Unit V: Current trends and case studies of Prompt Engineering

Emerging trends and advancements in prompt engineering Ethical considerations and potential societal impacts Discussion on the future of human-AI collaboration through prompts, Case Studies: Analysis of real-world prompt events, Design and implementation of prompt-resistant solutions, Evaluation of prompt engineering techniques in practice,

Model curriculum for UG Degree in BCA

DSE402	Advanced Artificial Intelligence	2L:0T:2P	3credits
<p>Course Objective: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents. Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications. Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning. Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets. Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI</p>			
<p>Course Content :</p>			
<p>UNIT 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.</p>			
<p>UNIT 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, Applications of evolutionary search in AI.</p>			
<p>UNIT 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.</p>			
<p>UNIT 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.</p>			
<p>Text Books:</p> <ul style="list-style-type: none"> ● M.C. Trivedi, <i>A Classical Approach to Artificial Intelligence</i>, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook). ● Nilsson Nils J, <i>Artificial Intelligence: A new Synthesis</i>, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4. ● Dan W Patterson, <i>Introduction to Artificial Intelligence & Expert Systems</i>, PHI Learning 2010. ● Rajiv Chopra, <i>Data Science with Artificial Intelligence, Machine Learning and Deep Learning</i>, Khanna Book Publishing Company, 2024. 			
<p>Reference Books:</p> <ul style="list-style-type: none"> ● M.C. Trivedi, <i>Introduction to AI and Machine Learning</i>, Khanna Book Publishing Company, 2024. ● Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall ● Van Hirtum, A. & Kolski, C. (2020). <i>Constraint Satisfaction Problems: Algorithms and Applications</i>. Springer ● Rajiv Chopra, <i>Machine Learning and Machine Intelligence</i>, Khanna Book Publishing Company, 2024. 			

Model curriculum for UG Degree in BCA

DSE403	Speech Recognition	3L:0T:4P	5credits
Course Objectives:			
<p>Understand the fundamentals of speech production, acoustic features, and signal processing techniques. Learn statistical and machine learning methods for speech modeling and recognition. Explore algorithms for speech-to-text, speaker recognition, and real-time applications. Implement feature extraction and model training using modern tools and toolkits. Analyze challenges in speech recognition, including noise, accents, and low-resource languages.</p>			
Course Content			
<p>UNIT I: Introduction to Speech Processing</p> <p>Basics of speech production and hearing – Anatomy of the vocal tract – Types of speech signals – Overview of speech applications – Speech signal properties: pitch, formants, energy, duration – Challenges in automatic speech recognition (ASR)</p> <p>UNIT II: Signal Processing & Feature Extraction</p> <p>Digitization of speech – Preprocessing: pre-emphasis, framing, windowing – Feature extraction: Mel-Frequency Cepstral Coefficients (MFCC), Linear Predictive Coding (LPC), PLP – Delta and acceleration coefficients – Spectrograms and filter banks</p> <p>UNIT III: Speech Modeling Techniques</p> <p>Acoustic modeling with Hidden Markov Models (HMMs) – Gaussian Mixture Models (GMMs) – Viterbi algorithm – Language models: n-gram models, smoothing techniques – Statistical ASR pipeline – Training and decoding processes</p> <p>UNIT IV: Deep Learning for Speech Recognition</p> <p>DNNs and CNNs in speech – Recurrent Neural Networks (RNNs), LSTM and GRU architectures – End-to-end models: CTC, Attention, and Transformers – Transfer learning (e.g., Wav2Vec, Whisper) – Model evaluation metrics: WER, CER, PER</p>			
Text Books:			
<ul style="list-style-type: none"> ● “Fundamentals of Speech Recognition” by Lawrence Rabiner and Biing-Hwang Juang – Pearson ● “Spoken Language Processing” by Xuedong Huang, Alex Acero, and Hsiao-Wuen Hon – Prentice Hall ● “Automatic Speech Recognition: A Deep Learning Approach” by Dong Yu and Li Deng – Springer 			
Reference Books:			
<ul style="list-style-type: none"> ● “Speech and Language Processing” by Daniel Jurafsky and James H. Martin – Pearson ● “Deep Learning for Speech and Language” by Uday Kamath et al. – Springer ● Research papers from IEEE, ACL, and Interspeech conferences 			

Model curriculum for UG Degree in BCA

DSE404	Data Security and Privacy	3L:2T:0P	5credits
Course Objectives			
<p>By the end of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand fundamental concepts of data security and privacy. 2. Recognize various types of threats, vulnerabilities, and risks in digital systems. 3. Learn about cryptographic principles and their applications in security. 4. Analyze security measures in networks, web, and cloud computing. 5. Apply techniques to ensure data privacy and compliance with regulations. 			
Course Content:			
<p>Unit 1: Definition and importance of data security and privacy, Basic terminologies: Confidentiality, Integrity, Availability (CIA Triad), Types of threats: malware, phishing, social engineering. Security goals and principles, Data breaches and case studies.</p> <p>Unit 2: Cryptography Fundamentals - Symmetric vs. Asymmetric Encryption, Block ciphers (AES, DES) and stream ciphers, Public Key Infrastructure (PKI), RSA, Diffie-Hellman, Hash functions (MD5, SHA family), Digital signatures and certificates.</p> <p>Unit 3: Network Security & Access Control - Firewalls, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS), Virtual Private Network (VPN), Secure Socket Layer (SSL)/Transport Layer Security (TLS), Authentication, Authorization, Accounting (AAA), Access control models (MAC, DAC, RBAC)</p> <p>Unit 4: Data privacy and Legal Framework-Data privacy principles, Personally Identifiable Information (PII), GDPR, HIPAA, and Indian IT Act, Privacy by design, Data anonymization and pseudonymization</p> <p>Unit 5: Security in cloud & web Applications -Cloud security challenges and solutions, Web application vulnerabilities (OWASP Top 10), Secure coding practices, Multi-factor authentication (MFA), Security audit and compliance tools</p>			
Reference Books:			
<ol style="list-style-type: none"> 1. "Cryptography and Network Security" by William Stallings – Pearson Education 2. "Principles of Information Security" by Michael E. Whitman, Herbert J. Mattord – Cengage Learning 3. "Data Privacy and Security" by David Salomon – Springer 4. "Cybersecurity for Beginners" by Raef Meeuwisse 5. OWASP Foundation Resources (for Unit 5 on Web Security) – https://owasp.org 			

Model curriculum for UG Degree in BCA

DSE405	Augmented Reality & Virtual Reality	3L:2T:0P	5credits
Course Objective:			
CO1: Describe the concept of virtual reality and Communication Media. CO2: Understand current virtual reality hardware and software CO3: Understand various modeling approaches CO4: Illustrate the concepts of Human Factors and Applications of VR. CO5: Build a Virtual Reality Application.			
Course Content:			
UNIT- I: INTRODUCTION TO VIRTUAL REALITY (VR): Defining Virtual Reality, Key elements of virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace. Bird's-Eye View: Hardware, Software, Human Physiology and Perception.			
UNIT-II Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. Output Devices: Graphics displays, sound displays & haptic feedback.			
UNIT-III Modeling: Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.			
UNIT-IV Augmented Reality (AR): Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems AR software development: AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.			
UNIT-V Interaction & Audio: Interaction- Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio-The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering. Interaction- Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio-The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.			
TEXTBOOKS:			
1. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc, 2017. 2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.			

Indian Knowledge Systems(IKS)

IKS-I: Indian Knowledge Systems and Traditions

Course Objectives
<ul style="list-style-type: none">● To sensitize the students about context in which they are embedded i.e. Indian culture and civilisation including its Knowledge System and Tradition.● To help students to understand the knowledge, art and creative practices, skills and values in the ancient Indian system.● To help to study the enriched scientific Indian heritage.● To introduce the contribution from Ancient Indian system & tradition to modern science & Technology
Detailed contents:
Unit I: Introduction to Indian Knowledge System (IKS), Definition, Concept and Scope of IKS <ul style="list-style-type: none">● Definition, Concept and Scope of IKS● IKS based approaches on Knowledge Paradigms● IKS in ancient India and in modern India Unit II: IKS and Indian Scholars, Indian Literature <ul style="list-style-type: none">● Philosophy and Literature (Maharishi Vyas, Manu, Kanad, Pingala, Parasar, Banabhatta, Nagarjuna and Panini)● Mathematics and Astronomy (Aryabhatta, Mahaviracharya, Bodhayan, Bhashkaracharya, Varahamihira and Brahmgupta)● Medicine and Yoga (Charak, Susruta, Maharishi Patanjali and Dhanwantri)● Sahitya (Vedas, Upvedas, Upavedas (Ayurveda, Dhanurveda, Gandharvaveda)● Puran and Upanishad) and shad darshan (Vedanta, Nyaya, Vaisheshik, Sankhya, Mimamsa, Yoga, Adhyatma and Meditation)● Shastra (Nyaya, vyakarana, Krishi, Shilp, Vastu, Natya and Sangeet) Unit III: Indian Traditional/tribal/ethnic communities, their livelihood and local wisdom <ul style="list-style-type: none">● Geophysical aspects, Resources and Vulnerability● Resource availability, utilization pattern and limitations● Socio-Cultural linkages with Traditional Knowledge System● Tangible and intangible cultural heritage. Unit IV: Unique Traditional Practices and Applied Traditional Knowledge <ul style="list-style-type: none">● Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives● Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices● Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes 4.4 Vaidya (traditional health care system), Tantra-Mantra, Amchi Medicine System 4.5 Knowledge Dyeing, chemistry of dyes, pigment and chemicals Unit V: Protection, preservation, conservation and Management of Indian Knowledge System <ul style="list-style-type: none">● Documentation and Preservation of IKS● Approaches for conservation and Management of nature and bio-resources● Approaches and strategies to protection and conservation of IKS