

**Faculty of Commerce and Management,
Dr. Rammanohar Lohia Avadh University,
Ayodhya-224001, Uttar Pradesh, India**



**Syllabus for the
Programme**

3-Years Bachelor of Computer Application

Or

4-Years Bachelor of Computer Application

(Honours/Honours with Research)

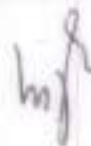
As per

NEP-2020

Effective from the Session: 2025-2026

(Subject to the modifications that will be made from time to time)


24-5-25







**Ordinance for the Programme 3-Years Bachelor of Computer Application Or 4-Years
Bachelor of Computer Application (Honours/Honours with Research) As per NEP-2020
(Effective from the Session: 2025-2026)**

1. General Information:

- 1.1 The degree of BCA 3-Years/BCA Honours/Honours with Research 4 -Years of Dr. Rammanohar Lohia Avadh University, Ayodhya shall be conferred on the candidates who have pursued the prescribed course of study and have passed the examinations as prescribed in the ordinances. The course will be conducted on full time basis.
- 1.2 Total number of students to the BCA programmes shall be restricted to numbers decided by the University from time to time all the departments.

2. Eligibility for Admission Entry) and Exit as Per NEP-2020:

- 2.1 BCA 3-Years/BCA Honours/Honours with Research 4-Years of first year in first semester (from 2025-2026) and onwards will be made through University entrance examination or merit based or as decided by Executive Council of the University.
 - 2.2 The minimum academic qualification for appearing in the Entrance Examination will be a pass in the final examination of 10+2 system or its equivalent with Mathematics/Computer Science/Computer Application/Information Technology/Information Practice/Computer Technology and Maintenance as one of the subjects or as notified. *10+2 merit based.*
 - 2.3 Application with full time one-year certificate in Computer Application/Computer Science are eligible for admission directly (within a stipulated time)* in third semester (Second Year). (Maximum up to 10% of approval intake).
 - 2.4 Application with full time minimum two-year Diploma in Computer Application/Computer Science are eligible for admission directly (within a stipulated time)* in the fifth semester (Third Year). (Maximum up to 10% of the approval intake).
- * The stipulated time period depends on the maximum duration allowed for the completion of degree that is 6 academic sessions for BCA (3-Years) and 8 academic sessions for BCA Honours with Research (4-Years) from the date of admission in the first semester.
- 2.5 Up to 5% of the seats may be filled by Son/Daughter/Spouse of RMLAU (including self-finance course) and RMLAU affiliated Government/Aided Colleges Teachers/Employees by direct admission. These shall be supernumerary seats. They shall be admitted as per University norms.

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2.6 In the cases, the admission of an applicant to the BCA 3-Years/BCA Honours/Honours with Research 4-Years program required that the applicant has:

1. The minimum academic qualification as notified.
2. Fulfilled the prescribed admission procedure and paid the prescribed fees.

2.7 Students can exit with certificate in Computer Application after the successful completion of first year of BCA.

2.8 Students can exit with Diploma in Computer Application after the successful completion of second year of BCA.

2.9 Students shall be awarded with BCA degree after the completion of third year of BCA.

2.10 Students shall be awarded with BCA Honours with Research (4-Years) after the completion of fourth year of BCA.

3 Attendance:

3.1 Students are required to attend 100% classes. Any relaxations in attendance are subject to the satisfaction of concerned HOD/Dean. Normally student shall not be allowed to appear in a semester examination unless he/she has an overall average 75% attendance and 60% attendance in each of the theory/practical subjects in that semester. Attendance for dissertation work shall be verified by the supervisor/guide. However, an additional shortage by an amount not exceeding 15% of the total number of lectures delivered or practical work done in each subject may be condoned for special reasons as given below.

1. A shortage up to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the head of the Department.
2. A further shortage up to 10% may be condoned by the Dean of faculty on the specific recommendation of the concerned head of Department.

3.2 No students will be allowed to appear in the end semester examination if he/she does not satisfy the overall average attendance requirements of clause no. 3.1 and such candidates(s) shall be treated as having failed and will be further governed by clause no. 4.2 & 4.3.

3.3 The attendance shall be counted from the date of admission in the faculty or start of academic session whichever is later.

(Note: For the purpose of the attendance not more than three periods including lecture and tutorial in the same subject shall be counted shall be counted on any one day).

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4 Duration of Courses:

- 4.1 Total duration of the BCA 3-Years/BCA Honours/Honours with Research 4-Years course shall be 3 or 4 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by UGC/University norms from time to time.
- 4.2 A candidate, who has failed twice in first year due to any reason, including due to his/her non-appearance or he/she being not permitted to appear in semester examinations, shall not be allowed to continue his/her studies further.
Provided further that if a student wishes to continue third time in first year, he/she may be allowed on the recommendation of a committee constituted by the dean. However, the maximum time allowed for completing the course shall remain the same as in clause 4.3.
- 4.3 The maximum time allowed for a candidate admitted in first semester for completing BCA 3-Years/BCA Honours/Honours with Research 4-Years course shall be 06 (Six) years and 08 (Eight) years respectively,
- 4.4 The minimum credit requirement for BCA 3-Years/BCA Honours/Honours with Research 4-Years degree in 120/160.

5 Curriculum:

- 5.1 The 3- or 4-years curriculum has been divided into 6/8 semesters and shall includes lectures, tutorials, particulars, seminars, projects, project dissertations, research dissertations, industrial training, educational tour etc. as defined in the scheme and executive instructions issued from time to time.
- 5.2 The curriculum shall also include such other curricular, co-curricular and extracurricular activities as may be prescribed by the faculty from time to time.
- 5.3 Total duration of the BCA 3-Years/BCA Honours/Honours with Research 4-Years course shall be 3 or 4 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by UGC/University norms from time to time.

6 Examination Pattern

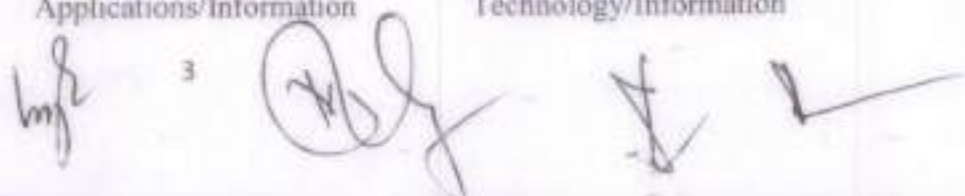
The examination pattern of Minor/major subjects will be subjective.

Multiple Entry and Exit Rules for BCA Programme

Entry:

1. In first year, students with Intermediate/12th or equivalent with Mathematics/Computer Science/Computer Applications/Information Technology/Information

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Practices/Computer Technology and maintenance as one of the subjects or as notified are eligible for admission.

2. Applicant with full time minimum two years Diploma in Computer Application/Computer Application or full time one-year certificate in Computer Application/Computer Science Course are eligible for admission directly in third semester (Second Year). (maximum up to 10% of the approval intake).
3. Applicant with full time minimum two years Diploma in Computer Application course are eligible for admission directly in the fifth semester (Third Year). (maximum up to 10% of the approval intake).

Exit:

1. Students can exit with Certificate in Computer Application after the completion of first year of BCA.
2. Students can exit with Diploma in Computer Application after the completion of second year of BCA.
3. Students can exit with the degree of Bachelor of Computer Application after the completion of third year of BCA.



BCA 1st Year

BCA 3-Years or BCA Honours/Honours with Research 4 - Years(2025-26) Syllabus semester wise with Marks and Credit Break-up										
Sem	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credit
I	Major 01	BCA101 T	Programming Principles Using C & Python	75	25	100	4			3
	Major 02	BCA102 T	Computer System Architecture	75	25	100	4			3
	Major 03	BCA103 T	Foundation of Mathematics for Computer Applications	75	25	100	3	1		4
	Minor 1	BCA108 T	History of Science and Technology in Ancient India	75	25	100	4			3
	Vocational 1	1150101T	Information Communication Technology (ICT)			100				3
	AECC 1		Food, Nutrition and Hygiene	75	25	100	3	1		0
		BCA101 P	Practical Lab for Programming Principles Using C & Python			50			4	2
		BCA102 P	Practical Lab for Computer System Architecture			50			4	2
	Total					700				20
II	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credits
	Major 04	BCA201 T	Object Oriented Programming Using C++	75	25	100	4			3
	Major 05	BCA202 T	Concepts of Data Structure	75	25	100	4			3
	Major 06	BCA203 T	Discrete Mathematics	75	25	100	3	1		4
	Major 07	BCA208 T	Professional Communication	75	25	100	4			3
	Vocational 2	1190101T	Desk Top Publishing (DTP)			100				3
	AECC 2		First Aid and Health	75	25	100	3	1		0
		BCA201 P	Practical Lab for Object Oriented Programming Using C++			50			4	2
		BCA202 P	Practical Lab for Data Structure			50			4	2
	Total					700				20

(40 Credits)
Certificate in
Computer
Application

(Cumulative
Minimum
Credits)
Required for
Awards of
Certificate
/Diploma/Degree

BCA 2nd Year

BCA (2024-25) Syllabus semester wise with Marks Break-up

BCA (2024-25) Syllabus semester wise with Marks Break-up											
Sem	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credit	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
III	Major 08	BCA301 T	JAVA Programming and Dynamic Web Design	75	25	100	4			3	
	Major 09	BCA302 T	Operating System	75	25	100	4			3	
	Major 10	BCA303 T	Numerical Methods	75	25	100	3	1		4	
	Minor 2	BCA308 T	Elements of Statistics	75	25	100	4			3	
	Vocational 3	1180101 T	Web Designing			100				3	
	AEC3	BCA305	Human Values and Environmental Studies	75	25	100	3	1		0	
		BCA301 P	Practical Lab for Java Programming			50			4	2	
		BCA302 P	Practical Lab for Operating System			50			4	2	
Total						700				20	
IV	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credits	(80 Credits) Diploma in Computer Application
	Major 11	BCA401 T	Introduction to DBMS	75	25	100	4			3	
	Major 12	BCA402 T	Design and Analysis of Algorithm	75	25	100	4			3	
	Major 13	BCA403 T	Software Engineering	75	25	100	3	1		4	
	Major 14	BCA408 T	Computer Network	75	25	100	4			3	
	Vocational 4	1650101 T	Cyber Security			100				3	
		AEC4	Physical Education and Yoga	75	25	100	3	1		0	
		BCA401 P	Practical Lab for DBMS			50			4	2	
	BCA402 P	Practical Lab for DAA			50			4	2		
Total						700				20	

(80 Credits)
Diploma in
Computer
Application

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BCA 3rd Year

BCA (2024-25) Syllabus semester wise with Marks Break-up

Sem	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credit	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
V	Major 14	BCA501 T	Computer Graphics & Animation	75	25	100	4			4	
	Major 15	BCA502 T	Web & Internet Technologies	75	25	100	4			4	
	Minor-03	BCA511 T	Artificial Intelligence	75	25	100	3	1		4	
	AECC 5		Analytic Ability and Digital Awareness	75	25	100	3	1		0	
		BCA505	Minor Project			50		1	2	3	
V		BCA506	Viva-Voce on Minor Project	75	25	50			2	1	
		BCA501 P	Practical Lab for Computer Graphics & Animation			50			4	2	
		BCA502 P	Practical Lab for Web & Internet Technologies			50			4	2	
	Total					600				20	
VI	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credits	(120 Credits) Bachelor of Computer Application
	Major-16	BCA601 T	Information Security	75	25	100	4			4	
	Major 17	BCA602 T	Theory of Computation	75	25	100	3	1		4	
	Major-18	BCA612 T	Machine Learning	75	25	100	3	1		4	
	AECC 6		Communication Skill and Personality Development	75	25	100				0	
VI		BCA603	Major Project			150		3	6	6	
		BCA604	Presentation/Seminar based on Major Project			50				2	
	Total					600				20	

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BCA 4th Year

BCA (2024-25) Syllabus semester wise with Marks Break-up

Sem	Subject	Paper Code	Paper Name	External Marks	Internal Marks	Total Marks	L	T	P	Credits	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
VII	Major-19	BCA701 T	Research Methodology	75	25	100	4			3	
	Major-20	BCA711 T	Soft Computing	75	25	100	3	1		3	
	Major-21	BCA712 T	Cloud Computing	75	25	100	3	1		3	
	Major-22	BCA713 T	Advanced Software Engineering	75	25	100	3	1		3	
	Minor-4	BCA708 T	Advanced Computer Network	75	25	100	4			3	
	Research Project	BCA702	Research Project (Conceptual)			200		3	6	5	
Total											20
VIII	Major-23	BCA801 T	Business Intelligence	75	25	100	4			3	(160 Credits) Bachelor of Computer Application (Honors)
	Major-24	BCA811 T	Digital Image Processing	75	25	100	3	1		3	
	Major-25	BCA812 T	Advanced DBMS	75	25	100	3	1		3	
	Major-26	BCA813 T	Data Mining	75	25	100	3	1		3	
	Major-27	BCA808 T	Data Centre Management	75	25	100	4			3	
	Research Project	BCA802	Research Project			200		3	6	5	
Total											20

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BCA (2024-25) NEP Syllabus Draft

1st Year

Sem	Subject	Paper Code	Paper Name	L	T	P	Credits	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
I	Major 01	BCA101 T	Programming Principles Using C & Python	4			3	(40 Credits) Certificate in Computer Application
	Major 02	BCA102 T	Computer System Architecture	4			3	
	Major 03	BCA103 T	Foundation of Mathematics for Computer Applications	3	1		4	
	Minor 1	BCA108	History of Science and Technology in Ancient India	4			3	
	Vocational 1	1150101T	Information Communication Technology (ICT)				3	
	AECC 1		Food, Nutrition and Hygiene	3	1		0	
		BCA101 P	Practical Lab for Programming Principles Using C & Python			4	2	
		BCA102 P	Practical Lab for Computer System Architecture			4	2	
							20	
Sem	Subject	Paper Code	Paper Name	L	T	P	Credits	
II	Major 04	BCA201 T	Object Oriented Programming Using C++	4			3	
	Major 05	BCA202 T	Concepts of Data Structure	4			3	
	Major 06	BCA203	Discrete Mathematics	3	1		4	
	Major 07	BCA208	Professional Communication	4			3	
	Vocational 2	1190101T	Desk Top Publishing (DTP)				3	
		AECC 2	First Aid and Health	3	1		0	
		BCA201 P	Practical Lab for Object Oriented Programming Using C++			4	2	
		BCA202 P	Practical Lab for Data Structure			4	2	
							20	






Course Code	Course Name	L	T	P	Credit
BCA101 T	Programming Principles Using C & Python	4			3

Unit-I

Computer Fundamentals and Problem Solving: Basic Computer Organization: CPU, memory, I/O Units.

Introduction to Programming: How to develop a program, Algorithms, Flow-charts, Types of Programming Languages, Compiler and Linker, Testing and Debugging a program, Documentation.

C-Programming: Constants, Variables & Data Types, Operators & Expressions, Managing Input & output operations, Decision Making – Branching & Looping, Functions, Storage Classes, Structures and Unions, Pointers.

Unit-II

Introduction to Python Programming: Python interpreter/Python shell, indentation; identifiers and keywords; literals, numbers and strings; operators (Arithmetic, Relational, Boolean, Assignment, Ternary and Bitwise) and expressions.

Creating Python Programs: Input and output statements, control statements (conditional statements, loop control statements, break, continue and pass, exit), defining functions, default arguments, errors and handling exceptions.

Unit-III

Strings and Lists: String class, built-in functions for string, string traversal, string operators and operations; Lists creation, traversal, slicing and splitting operations, passing list to a function.

Unit-IV

Object Oriented Programming: Introduction to Object, Class and Method, Standard Libraries, File handling through libraries.

Unit V

Built-in data structures: Tuples, Sets, Dictionary, Stacks, and Queues; Sorting and Searching.

Text Books:

1. Downey, A.B., (2015), Think Python-How to think like a Computer Scientist, 3rd edition. O' Reilly Media.
2. Guttag, J.V. (2016), Introduction to computation and programming using Python. MIT Press.
3. Liang, Y.D. (2013), Introduction to programming using Python. Pearson Education.
4. Brown, M. C. (2001). The Complete Reference: Python, McGraw Hill Education.

BCA I Semester

Course Code	Course Name	L	T	P	Credit
BCA102 T	Computer System Architecture	4			3

Unit-I

Data Representation and Basic Computer Arithmetic: Number systems, complements, fixed and floating-point representation, addition, subtraction, magnitude comparison, multiplication and division algorithms for integers, Logic gates, Boolean algebra, combinational circuits, circuit simplification, flip-flops and sequential circuits, decoders, multiplexers, registers, counters.

Unit-II

Basic Computer Organization and Design: Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt, Interconnection Structures, Bus Interconnection design of basic computer.

Unit-III

Central Processing Unit: Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming, RISC, CISC architectures, pipelining and parallel architecture.

Unit-IV

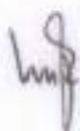
Memory Organization: Cache memory, Associative memory, mapping.

Unit V

Input-Output Organization: Input / Output- External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access, I/O Channels.

Text Books:

1. M. Mano, Computer System Architecture, Pearson Education 1992.
2. Digital Design, M.M. Mano, Pearson Education Asia, 2015.
3. W. Stallings, Computer Organization and Architecture Designing for Performance, 8th Edition, Prentice Hall of India, 2009.



BCA I Semester

Course Code	Course Name	L	T	P	Credit
BCA103	Foundation of Mathematics for Computer Applications	3	1		4

Unit-I

Basic concepts of set theory, Operations on sets: power set, Venn diagram Cartesian product, relations, functions, types of functions, composition of functions.

Unit-II

Mathematical logic-introduction, statements, connectives, negation, conjunction, disjunction, statement formulas and truth tables, conditional and bi-conditional statements, tautology, contradiction, equivalence of formulas, duality law-Predicates and Quantifiers, Arguments.

Unit-III Matrix algebra: Types of matrices, matrix operations, transpose of a matrix, determinant of matrix, inverse of a matrix, Cramer's rule, Matrix: Rank of a matrix, normal form, echelon form, Cayley-Hamilton theorem, Eigen values, Eigen Vectors.

Unit-IV

Differential calculus: Functions and limits, Simple Differentiation of Algebraic Functions, Evaluation of First and Second Order Derivatives, Maxima and Minima,

Unit V

Integral Calculus: Integral as Limit of Sum, Fundamental Theorem of Calculus (without proof), Indefinite Integrals, Methods of Integration Substitution, By Parts, Partial Fractions, Reduction Formulae for Trigonometric Functions, Gamma and Beta Functions (definition).

Text Books:

1. B.S. Grewal, —Elementary Engineering MathematicsI, 34th Ed., 1998.
2. Shanti Narayan, —Integral CalculusI, S. Chand & Company, 1999
3. H.K. Dass, —Advanced Engineering MathematicsI, S. Chand & Company, 9th Revised Edition, 2001.
4. Shanti Narayan, —Differential CalculusI, S. Chand & Company, 1998.



Course Code	Course Name	L	T	P	Credit
BCA108	History of Science and Technology in Ancient India	4			3

Unit-I

Indus Civilization: Metallurgy, Mathematics and Astronomy, Town Planning, Flora and Fauna.

Unit-II

A brief History of Astronomy in Ancient India: Vedic Period, Vedic Age, Classical Age.

Unit-III

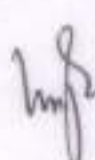
A brief history of Chemistry in Ancient India upto NBPW Period: Metallurgy: Copper in Chalcolithic to pre-NBPW Period, Iron Technology from earliest time to NBPW Period, Glass: Technology from earliest time to NBPW Period

Unit-IV

An Outline of the development of Mathematics in Ancient India up to Gupta Period: Bakhshali Mathematics, Geometry, Algebra, Arithmetic.

Recommended Readings

1. Hegde, K.T.M., An Introduction to Ancient Indian Metallurgy, Bangalore, 1991.
2. Hodges, H., Technology in the Ancient world, London, Pelican, 1970.
3. Kutumbia, P., Ancient Indian Medicine, New Delhi, 1962.
4. Prasad, G., Bharatiya Jyotisa Ka Itihasa, Lucknow, 1974.
5. Randhawa, M.S., A History of Agriculture in India, New Delhi, 1980.
6. Rose, D.M. et al., Concise History of Science of India, New Delhi, 1971.
7. Satya Prakash, Prachina Bharata mein Rasayan Ka Vikasa (Hindi), Varanasi, 1960.





BCA I Semester

Course Code/Course Name	Course Name	L	T	P	Credit
II50101T	Information Communication Technology (ICT)				3

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BCA I Semester

Course Code/Course Name	Course Name	L	T	P	Credit
AECC 1	Food, Nutrition and Hygiene	3	1		0

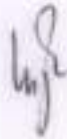





BCA I Semester

Course Code/Course Name	Course Name	L	T	P	Credit
BCA101 P	Practical Lab for Programming Principles Using Python			4	2

On the recommendation of Board of Studies Internal/External Examiner allotment by the University. Practical will be based on the Theory Paper of Programming Principles Using Python on whole Syllabus.

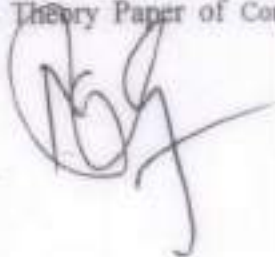





BCA I Semester

Course Code/Course Name	Course Name	L	T	P	Credit
BCA102 P	Practical Lab for Computer System Architecture			4	2

On the recommendation of Board of Studies Internal/External Examiner allotment by the University. Practical will be based on the Theory Paper of Computer System Architecture on whole Syllabus.



Course Code/Course Name	Course Name	L	T	P	Credit
BCA201 T	Object Oriented Programming Using C++	4			3

UNIT-I

Introduction: Introducing Object – Oriented Approach, Relating to other paradigms {Functional, Data decomposition}.

Basic terms and ideas: Abstraction, Encapsulation, Inheritance, Polymorphism, Review of C, Difference between C and C++ - cin, cout, new, delete, operators.

UNIT-II

Classes and Objects: Encapsulation, information hiding, abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behaviour of an object, Constructors and destructors, instantiation of objects, Default parameter value, object types, C++ garbage collection, dynamic memory allocation, Metaclass / abstract classes.

UNIT-III

Inheritance and Polymorphism: Inheritance, Class hierarchy, derivation – public, private & protected, Aggregation, composition vs classification hierarchies, Polymorphism, Categorization of polymorphism techniques, Method polymorphism, Polymorphism by parameter, Operator overloading, Parameteric Polymorphism.

UNIT-IV

Generic function: Template function, function name overloading, Overriding inheritance methods, Run time polymorphism, Multiple Inheritance.

UNIT-V

Files and Exception Handling: Streams and files, Namespaces, Exception handling, Generic Classes.

Referential Books:

1. A. R. Venugopal, Rajkumar, T. Ravishanker —Mastering C++, TMH, 1997.
2. S. B. Lippman & J. Lajoie, — C++ PrimerI, 3rd Edition, Addison Wesley, 2000.
3. R. Lafore, —Object Oriented Programming using C++I, Galgotia Publications, 2004
4. D. Parsons, —Object Oriented Programming using C++I, BPB Publication.

Course Code/Course Name	Course Name	L	T	P	Credit
BCA202 T	Concepts of Data Structure	4			3

UNIT-I

Introduction to Data Structure and its Characteristics Array: Representation of single and multidimensional arrays; Sparse arrays – lower and upper triangular matrices and Tridiagonal matrices with Vector Representation also.

UNIT-II

Stacks and Queues: Introduction and primitive operations on stack; Stack application; Infix, postfix, prefix expressions; Evaluation of postfix expression; Conversion between prefix, infix and postfix, introduction and primitive operation on queues, D- queues and priority queues.

UNIT-III

Lists Introduction to linked lists; Sequential and linked lists, operations such as traversal, insertion, deletion searching, two way lists and Use of headers.

UNIT-IV:

Trees: Introduction and terminology; Traversal of binary trees; Recursive algorithms for tree operations such as traversal, insertion, deletion; Binary Search Tree.

UNIT-V

B-Trees: Introduction, the invention of B-Tree; Statement of the problem; Indexing with binary search trees; a better approach to tree indexes; B-Trees; working up from the bottom; Example for creating a B-Tree, Sorting Techniques- Insertion sort, selection sort, merge sort, heap sort, searching Techniques: linear search, binary search and hashing.

Referential Books:

1. E. Horowitz and S. Sahani, — Fundamentals of Data structures, Galgotia Book source Pvt. Ltd., 2003.
2. R.S. Salaria, — Data Structures & Algorithms I, Khanna Book Publishing Co. (P) Ltd., 2002.
3. Y. Langsam et. Al., — Data Structures using C and C++, PHI, 1999.

Course Code/Course Name	Course Name	L	T	P	Credit
BCA203	Discrete Mathematics	3	1		4

Unit – I

Set Relation and Function: Sets & subsets, set operation, power set, Cartesian product of two sets composition of relation, type of relation, mapping, mathematical function, exponential & logarithmic functions.

Group & fields: Group, sub group, Finite & infinite group, cyclic group, permutation group, homomorphism, isomorphism, automorphism, endomorphism, coset, Field, sub field & Ring.

Unit – II

Mathematical Logic: Statement & Notations, connectives, Normal forms, Theory of inference for the statement calculus, Predicate calculus.

Unit – III

Basic concept of Graph: Basics of Graph, Pseudograph, Multigraph, Simple graph, Bipartite graph and Complete Bipartite graph, Hand Shaking Lemma, Sub graphs, Operations on graph, Walk, Path and Circuits and their properties. Shortest Path Problem.

Unit - IV

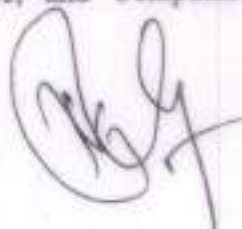
Eulerian and Hamiltonian Graph: Unicursal and Eulerian graph, Randomly Eulerian graph, Fleury's Algorithm, Chinese Postman Problem, Hamiltonian Graph, Necessary and Sufficient conditions, Traveling Salesman Problem.

Unit – V

Trees and Spanning Trees: Tree, Properties of tree, Distance, Radius, Diameter of a tree, Spanning tree, Fundamental Circuit, Cayley's Formula for number of spanning tree, Minimal spanning tree: Kruskal's and Prim's Algorithm, Connectivity and Separability.

Text Books:

1. C.L. Liu & Mahapatra, Elements of Discrete mathematics, 2nd Sub Edition 1985, Tata McGraw Hill
2. Rosen, Discrete Mathematics and Its Applications, Sixth Edition 2006
3. J. L. Hein, Discrete Structures, Logic, and Computability, Jones and Bartlett Publishers, 3rd Edition, 2009



Course Code/Course Name	Course Name	L	T	P	Credit
BCA208	Professional Communication	4			3

UNIT-I

Means of Communication: Meaning and Definition – Process – Functions – Objectives – Importance – Essentials of good communication – Communication barriers, 7C's of Communication.

UNIT-II

Types of Communication: Oral Communication: Meaning, nature and scope – Principle of effective oral communication – Techniques of effective speech – Media of oral communication (Face-to-face conversation – Teleconferences – Press Conference – Demonstration – Radio Recording – Dictaphone – Meetings – Rumour – Demonstration and dramatization – Public address system – Grapevine – Group Discussion – Oral report – Closed circuit TV). The art of listening – Principles of good listening.

UNIT-III

Written Communication Purpose of writing, Clarity in Writing, Principle of Effective writing, Writing Techniques, Electronic Writing Process.

UNIT-IV

Business Letters & Reports: Need and functions of business letters – Planning & layout of business letter – Kinds of business letters – Essentials of effective correspondence, Purpose, Kind and Objective of Reports, Writing Reports.

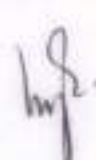
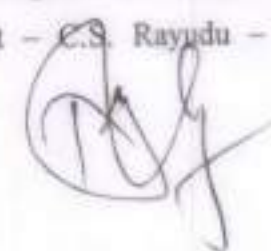
Drafting of business letters: Enquiries and replies – Placing and fulfilling orders – Complaints and follow-up Sales letters – Circular letters Application for employment and resume.

UNIT-V

Information Technology for Communication: Word Processor – Telex – Facsimile (Fax) – E-mail – Voice mail – Internet – Multimedia – Teleconferencing – Mobile Phone Conversation – Video Conferencing – SMS – Telephone Answering Machine – Advantages and limitations of these types. Topics Prescribed for workshop/skill lab Group Discussion, Mock Interview, Decision Making in a Group.

Referential Books:

1. Business Communication – K.K. Sinha – Galgotia Publishing Company, New Delhi.
2. Media and Communication Management – C.S. Rayudu – Hikalaya Publishing House, Bombay.


3. Essentials of Business Communication – Rajendra Pal and J.S. Korihalli- Sultan Chand & Sons, New Delhi.
4. Business Communication (Principles, Methods and Techniques) Nirmal Singh -Deep & Deep Publications, New Delhi.
5. Business Communication – Dr. S.V. Kadvkar, Rawal and Kothavade- Diamond Publications, Pune.
6. Business Correspondence and Report Writing – R.C. Sharma, Krishna Mohan – TMH, New Delhi.
7. Modern Business Correspondence – L. Gartside – The English Language Book Society and Macdonald and Evans Ltd.
8. Business Communication – M. Balasubrahmanyam – Vani Education Books.

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BCA II Semester

Course Code/Course Name	Course Name	L	T	P	Credit
1190101T	Desk Top Publishing (DTP)				3

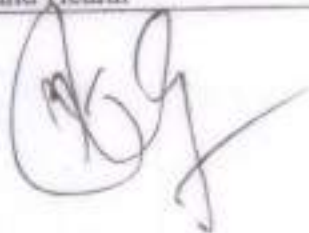
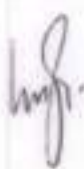
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BCA II Semester

Course Code/Course Name	Course Name	L	T	P	Credit
AECC 2	First Aid and Health	3	1		2



BCA II Semester

Course Code/Course Name	Course Name	L	T	P	Credit
BCA201 P	Practical Lab for Object Oriented Programming Using C++			4	2

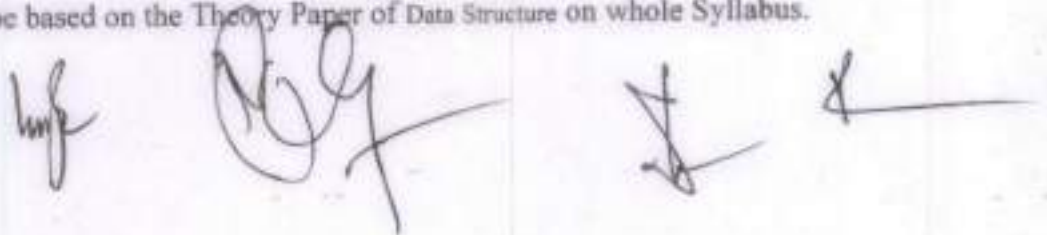
On the recommendation of Board of Studies Internal/External Examiner allotment by the University. Practical will be based on the Theory Paper of Object-Oriented Programming Using C++ on whole Syllabus.

BCA II Semester

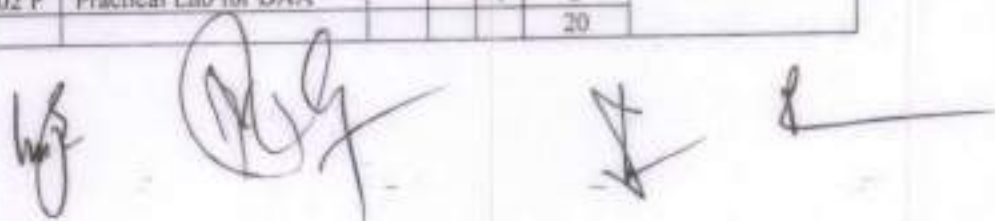
Course Code/Course Name	Course Name	L	T	P	Credit
BCA202 P	Practical Lab for Data Structure			4	2

On the recommendation of Board of Studies Internal/External Examiner allotment by the University, Practical will be based on the Theory Paper of Data Structure on whole Syllabus.



2nd Year

Sem.	Subject	Paper Code	Paper Name	L	T	P	Credits	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
III	Major 08	BCA301 T	JAVA Programming and Dynamic Web Design	4			3	(80 Credits) Diploma in Computer Application
	Major 09	BCA302 T	Operating System	4			3	
	Major 10	BCA303 T	Numerical Methods	3	1		4	
	Minor 2	BCA308 T	Elements of Statistics	4			3	
	Vocational 3	1180101T	Web Designing				3	
	AECC 3	BCA305	Human Values and Environmental Studies	3	1		0	
		BCA301 P	Practical Lab for Java Programming			4	2	
		BCA302 P	Practical Lab for Operating System			4	2	
							20	
Sem.	Subject	Paper Code	Paper Name	L	T	P	Credits	
IV	Major 11	BCA401 T	Introduction to DBMS	4			3	(80 Credits) Diploma in Computer Application
	Major 12	BCA402 T	Design and Analysis of Algorithm	4			3	
	Major 13	BCA403	Software Engineering	3	1		4	
	Major-14	BCA408 T	Computer Network	4			3	
	Vocational 4	1650101T	Cyber Security				3	
		AECC 4	Physical Education and Yoga	3	1		0	
		BCA401 P	Practical Lab for DBMS			4	2	
		BCA402 P	Practical Lab for DAA			4	2	
							20	



Course Code	Course Name	L	T	P	Credit
BCA301 T	JAVA Programming and Dynamic Web Design	4			3

UNIT-I

Java Programming: Data types, control structured, arrays, strings, and vector.

UNIT-II

Classes, Inheritance, Abstract Class, Interface, Package, Exception Handling, Multithreaded Programming.

UNIT-III

Networking (datagram socket and TCP/IP based server socket) event handling, JDBC: Introduction, Drivers, Establishing Connection, Connection Pooling.

UNIT-IV

HTML: use of commenting, headers, text styling, images, formatting text with , special characters, horizontal rules, line breaks, table, forms, image maps, <META> tags, <FRAMESET> tags, file formats including image formats.

Java Servlets: Introduction, HTTP Servlet Basics, The Servlet Lifecycle, Retrieving Information, Sending HTML Information, Session Tracking, Database Connectivity.

UNIT-V

Java Server Pages: Introducing Java Server Pages, JSP Overview, Setting Up the JSP Environment, Generating Dynamic Content, Using Custom Tag Libraries and the JSP Standard Tag Library, Processing Input and Output.

Referential Books:

1. Patrick Naughton and Herbertz Schildt —Java-2 The Complete Reference 1999, TMH.
2. Shelley Powers—Dynamic Web Publishing 2nd Ed. Techmedia, 1998.
3. Ivor Horton —Beginning Java-2, SPD Publication.
4. Jason Hunter, —Java Servlet Programming, O' Reilly
5. Shelley Powers, —Dynamic Web Publishing, 2nd Ed. Techmedia, 1998
6. Hans Bergsten, —Java Server Pages, 3rd Ed. O' Reilly

Course Code	Course Name	L	T	P	Credit
BCA302 T	Operating System	4			3

UNIT-I

Introduction, what is an operating system, Simple Batch Systems, Multi-programmed Batch systems, Time- Sharing Systems, Personal – Computer Systems, Parallel systems, Distributed systems, Real- Time Systems.

Memory Management: Background, Logical versus physical Address space, swapping, Contiguous allocation, Paging, Segmentation.

Virtual Memory: Demand Paging, Page Replacement, Page- replacement Algorithms, Performance of Demand Paging, Allocation of Frames, Thrashing, Other Considerations.

UNIT-II

Processes: Process Concept, Process Scheduling, Operation on Processes.

CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple – Processor Scheduling.

Process Synchronization: Background, The Critical – Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization.

UNIT-III

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT-IV

Device Management: Techniques for Device Management, Dedicated Devices, Shared Devices, Virtual Devices; Input or Output Devices, Storage Devices, Buffering, Secondary Storage Structure: Disk Structure, Disk Scheduling, Disk Management, Swap- Space Management, Disk Reliability.

UNIT-V

Information Management: Introduction, A Simple File system, General Model of a File System, Symbolic File System, Basic File System, Access Control Verification, Logical File System, Physical File system File – System Interface; File Concept, Access Methods, Directory Structure, Protection, Consistency Semantics File – System Implementation: File – System Structure, Allocation Methods, Free- Space Management.

Referential Books:

1. Silberschatz and Galvin — Operating System Concepts, Person, 5th Ed. 2001.
2. Madnick E., Donovan J. — Operating Systems, Tata McGraw Hill, 2001.
3. Tannenbaum, — Operating Systems, PHI, 4th Edition, 2000.



Course Code	Course Name	L	T	P	Credit
BCA303	Numerical Methods	3	1		4

UNIT-I

Roots of Equations: Bisections Method, False Position Method, Newton's Raphson Method, Rate of convergence of Newton's method.

UNIT-II

Interpolation and Extrapolation: Finite Differences, The operator E, Newton's Forward and Backward Differences, Newton's dividend differences formulae, Lagrange's Interpolation formula for unequal intervals, Gauss's Interpolation formula, Stirling formula, Bessel's formula, Laplace- Everett formula.

UNIT-III

Numerical Differentiation Numerical Integration: Introduction, direct methods, maxima and minima of a tabulated function, General Quadratic formula, Trapezoidal rule, Simpson's One third rule, Simpson's three- eight rule.

UNIT-IV

Solution of Linear Equation: Gauss's Elimination method and Gauss's Siedel iterative method.

UNIT-V

Solution of Differential Equations: Euler's method, Picard's method, Fourth-order Runge-Kutta method.

Referential Books:

1. Scarbourogh, —Numerical Analysis.
2. Gupta & Bose S.C. —Introduction to Numerical Analysis, —Academic Press, Kolkata.
3. S.S. Shashtri, — Numerical Analysis, PHI.

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Course Code	Course Name	L	T	P	Credit
BCA308	Elements of Statistics	4			3

UNIT-I

Population, Sample and Data Condensation: Definition and scope of statistics, concept of population and sample with Illustration, Raw data, attributes and variables, classification, frequency distribution, Cumulative frequency distribution.

UNIT-II

Measures of Central Tendency: Concept of central Tendency, requirements of a good measures of central tendency, Arithmetic mean, Median, Mode, Harmonic Mean, Geometric mean for grouped and ungrouped data.

UNIT-III Measures of Dispersion: Concept of dispersion, Absolute and relative measure of dispersion, range variance, Standard deviation, Coefficient of variation.

UNIT-IV

Permutations and Combinations: Permutations of 'n' dissimilar objects taken 'r' at a time (with or without repetitions). $nPr = n!/(n-r)!$ (without proof). Combinations of 'r' objects taken from 'n' objects. $nCr = n!/(r!(n-r)!)$ (without proof). Simple examples, Applications.

UNIT-V

Probability Theory: Experiments and random experiments, Ideas of deterministic and non-deterministic experiments; Definition of sample space, discrete sample space, events; Types of events, Union and intersections of two or more events, mutually exclusive events, Complementary event, Exhaustive event; Simple examples. Classical definition of probability, Addition theorem of probability without Proof (up to three events are expected). conditional probability, independence of two events.

Statistical Quality Control Introduction, control limits, specification limits, tolerance limits, process and product control

Referential Books:

1. S.C. Gupta - Fundamentals of statistics - Sultan Chand & sons, Delhi.
2. D.N. Elhance - Fundamentals of statistics - Kitab Mahal, Allahabad.
3. Montgomery D.C. - Statistical Quality Control - John Welly and Sons
4. Goon, Gupta And Dasgupta - Fundamentals of statistics - The world press private ltd., Kolkata.
5. Hogg R.V. and Craig R.G. - Introduction to mathematical statistics Ed 4 {1989} - Macmillan Pub. Co. Newyork.
6. Gupta S.P. - Statistical Methods, Pub - Sultan Chand and sons New Delhi.

BCA III Semester

Course Code	Course Name	L	T	P	Credit
1180101T	Web Designing				3

BCA III Semester

Course Code	Course Name	L	T	P	Credit
BCA305	Human Values and Environmental Studies	3	1		0

Unit-I

Human Values- Introduction- Values, Characteristics, Types, Developing Value system in Indian Organisation, Values in Business Management, value based Organisation, Trans – cultural Human values in Management. Swami Vivekananda's philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam view on role of parents and Teachers. Human Values and Present Practices – Issues: Corruption and Bribe, Privacy Policy in Web and Social Media, Cyber threats, Online Shopping etc.

Unit-III

Remedies UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy. Principles of Ethics Secular and Spiritual Values in Management- Introduction- Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values, Corporate Social Responsibility- Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji and Bill Gates.

Unit-III

Holistic Approach in Decision making- Decision making, the decision-making process, The Bhagavad Gita: Techniques In Management, Dharma and Holistic Management.

Discussion through Dilemmas – Dilemmas in Marketing and Pharma Organisations, moving from Public to Private – monopoly context, Dilemma of privatisation, Dilemma on liberalization, Dilemma on social media and cyber security, Dilemma on Organic food, Dilemma on standardization, Dilemma on Quality standards.

Unit-IV

Ecosystem: Concept, structure & functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids Conservation of Biodiversity- In-situ & Ex- situ conservation of biodiversity, Role of individual in Pollution control, Human Population & Environment, Sustainable Development India and UN Sustainable Development, Goals Concept of circular economy and entrepreneurship.

Unit-V

Environmental Laws?, International Advancements in Environmental, Conservation Role of National Green Tribunal, Air Quality Index, Importance of Indian Traditional knowledge on environment, Bio assessment of Environmental, Quality Environmental Management System, Environmental Impact. Assessment and Environmental Audit.

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Suggested Readings:

1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangal et.al
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
3. Human Values by A. N. Tripathi New Age International.
4. Environmental Management by N.K. Uberoi.
5. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
6. <https://www.india.gov.in/my-government/schemes>
7. <https://www.legislation.gov.uk/ukpga/2010/23/contents>
8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921.



BCA III Semester

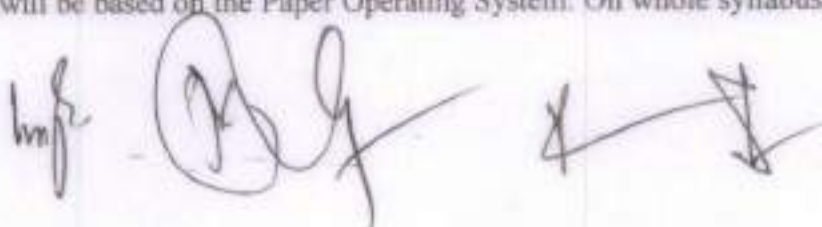
Course Code	Course Name	L	T	P	Credit
BCA301 P	Practical Lab for Java Programming			4	2

On the recommendation of Board of Studies, Internal / External Examiner appointed by the University. Practical will be based on Paper Java Programming & Web Design: on Whole Syllabus

BCA III Semester

Course Code	Course Name	L	T	P	Credit
BCA302 P	Practical Lab for Operating System			4	2

On the recommendation of Board of Studies, Internal / External Examiner appointed by the University. Practical will be based on the Paper Operating System: On whole syllabus.



Course Code	Course Name	L	T	P	Credit
BCA401 T	Introduction to DBMS	4			3

UNIT-I

Introduction: Characteristics of database approach, data models, DBMS architecture and data independence.

E-R Modeling: Entity types, Entity set, attribute and key, relationships, relation types, roles and structural constraints, weak entities, enhanced E-R and object modeling, Sub classes; Super classes, inheritance, specialization and generalization.

UNIT-II

File Organization: Indexed sequential access files; implementation using B & B++ trees, hashing, hashing functions, collision resolution, extendible hashing, dynamic hashing approach implementation and performance.

UNIT-III

Relational Data Model: Relational model concepts, relational constraints, relational algebra
SQL: SQL queries, programming using SQL.

UNIT-IV

EER and ER to relational mapping: Data base design using EER to relational language.

UNIT-V

Data Normalization: Functional Dependencies, Normal form up to 3rd normal form.
Concurrency Control: Transaction processing, locking techniques and associated, database recovery, security and authorization. Recovery Techniques, Database Security.

Referential Books:

1. Abraham Silberschatz, Henry Korth, S. Sudarshan, —Database Systems Concepts, 4th Edition, McGraw Hill, 1997.
2. Jim Melton, Alan Simon, —Understanding the new SQL: A complete Guide, Morgan Kaufmann Publishers, 1993.
3. A.K. Majumdar, P. Bhattacharya, —Database Management Systems, TMH, 1996.
4. Bipin Desai, —An Introduction to database systems, Galgotia Publications, 1991.






Course Code	Course Name	L	T	P	Credit
BCA402 T	Design and Analysis of Algorithm	4			3

Unit – I

Introduction: Algorithm, Analysis of algorithm, Designing Algorithm, Mathematical Foundations, Growth of functions, Summation, Recurrence relation, Sets, Counting & Probability.

Unit – II

Divide & Conquer: Searching: Binary search, Sorting: Counting Sort, Radix Sort, Bucket Sort, Selection Sort, Heap Sort, Merge sort, Quick sort, Greedy Methods – Minimum spanning tree, Dijkstra's Algorithm for shortest paths from a single source, Fractional Knapsack problem, Optimal storage on tapes.

Unit – III

Dynamic Programming: Application to various problems (for reference; Weighted Interval Scheduling, Sequence Alignment, Knapsack), their correctness and analysis. Greedy Algorithms: Application to various problems, their correctness and analysis.

Unit – IV Back Tracking:

8 Queen Problem, Chromatic number, Graph coloring, Coloring of tree.

Unit – V

Branch & Bound: Traveling salesman problem.

Advanced Analysis Technique: Amortized analysis.

Books:

1. Kleinberg, J., & Tardos, E. (2013). Algorithm Design. 1st edition. Pearson Education India.
2. Cormen, T.H., Leiserson, C.E. Rivest, R.L., & Stein, C. (2015). Introduction to Algorithms. 3rd edition. PHI.
3. Sarabasse & Gledler A. V. (1999). Computer Algorithm – Introduction to Design and Analysis. 3rd edition. Pearson Education
4. Horowitz & Sahani, (2008) Fundamental of Computer Algorithms: (Second Edition).



Course Code	Course Name	L	T	P	Credit
BCA403	Software Engineering	3	1		4

UNIT-I

Software Engineering: Definition and paradigms, A generic view of software engineering.

Requirements Analysis: Statement of system scope, isolation of top-level processes and entities and their allocation to physical elements, refinement and review. Analyzing a problem, creating a software specification document, review for correctness, consistency, and completeness.

UNIT-II

Designing Software Solutions: Refining the software Specification; Application of fundamental design concept for data, architectural and procedural designs using software blue print methodology and object-oriented design paradigm; Creating design document: Review of conformance to software requirements and quality.

UNIT-III

Software Implementation: Relationship between design and implementation, Implementation issues and programming support environment, Coding the procedural design, Good coding style and review of correctness and readability.

UNIT-IV

Software Maintenance: Maintenance as part of software evaluation, reasons for maintenance, types of maintenance (Perceptive, adoptive, corrective), designing for maintainability, techniques for maintenance.

UNIT-V

Comprehensive examples using available software platforms/case tools, Configuration Management.

Referential Books:

1. K.K. Aggarwal & Yogesh Singh —Software engineeringI, 2nd Ed., New Age International 2005.
2. I. Sommerville, —Software EngineeringI, Addison Wesley, 2002.
3. James Peter, W. Pedrycz, —Software Engineering: An Engineering ApproachI John Wiley & Sons.

BCA IV Semester

Course Code	Course Name	L	T	P	Credit
BCA408	Computer Network	4			3

UNIT-I

Basic Concepts: Components of data communication, distributed processing, standards and organizations. Line configuration, topology, Transmission mode, and categories of networks.

OSI and TCP/IP Models: Layers and their functions, comparison of models. Digital Transmission: Interfaces and Modems: DTE-DCE Interface, Modems, Cable modems.

UNIT-II

Transmission Media: Guided and unguided, Attenuation, distortion, noise, throughput, propagation speed and time, wavelength, Shannon capacity, comparison of media.

UNIT-III

Telephony: Multiplexing, error detection and correction: Many to one, one to many, WDM, TDM, FDM, Circuit switching, packet switching and message switching. Data link control protocols: Line discipline, flow control, error control, synchronous and asynchronous protocols, character and bit-oriented protocols, Link access procedures.

Point to point controls: Transmission states, PPP layers, LCP, Authentication, NCP. **ISDN:** Services, Historical outline, subscriber's access, ISDN Layers and broadcast ISDN.

UNIT-IV

Devices: Repeaters, bridges, gateways, routers, The Network Layer; Design issues, Routing algorithms, Congestion control Algorithms, Quality of service, Internetworking, Network-Layer in the internet.

UNIT-V

Transport and upper layers in OSI Model: Transport layer functions, connection management, functions of session layers, presentation layer and application layer.

Referential Books:

1. A.S. Tanenbaum —Computer Networks; Pearson Education Asia, 4th Ed. 2003.
2. Behrouz A. Forouzan —Data Communication and Networking, 3rd Ed. Tata McGraw Hill, 2004.
3. William Stallings —Data and computer communications, Pearson education Asia, 7th Ed., 2002.



BCA IV Semester

Course Code	Course Name	L	T	P	Credit
I650101T	Cyber Security				3

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Course Code	Course Name	L	T	P	Credit
AECC 4	Physical Education and Yoga	3	1		0

Unit-I

Physical Education: Meaning, Definition, Aim and Objective, Misconception About Physical Education, Need, Importance and Scope of Physical Education in the Modern Society, Physical Education Relationship with General Education, Physical Education in India before Independence, Physical Education in India after Independence.

Unit-II

Concept of Fitness and Wellness: Meaning, Definition and Importance of Fitness and Wellness, Components of Fitness, Factor Affecting Fitness and Wellness.

Weight Management: Meaning and Definition of Obesity, Causes of Obesity, Management of Obesity, Health problems due to Obesity.

Lifestyle: Meaning, Definition, Importance of Lifestyle, Factor affecting Lifestyle, Role of Physical activity in the maintains of Healthy Lifestyle.

Unit-III

Yoga and Meditation: Historical aspect of yoga, Definition, types scopes & importance of yoga, Yoga relation with mental health and value education, Yoga relation with Physical Education and sports, Definition of Asana, differences between asana and physical exercise, Definition and classification of pranayama, Difference between pranayama and deep breathing.

Practical: Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasan, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam: Anulom, Vilom.

Unit-IV

Traditional Games of India: Meaning, Types of Traditional Games-Gilli, Danda, Kanche, Stapu, Gutte, etc. Importance/ Benefits of Traditional Games. How to Design Traditional Games.

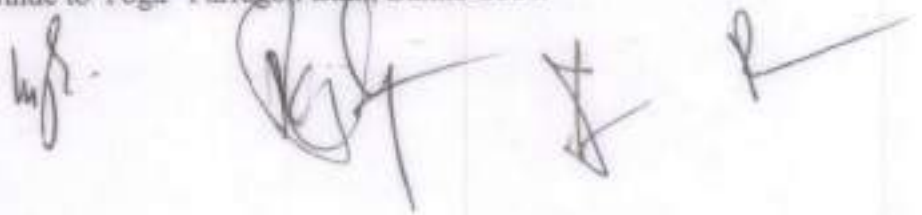
Unit-V

Recreation in Physical Education: Meaning, Definition of Recreation, Scope and Importance of Recreation, General Principles of Recreation, Types of Recreational Activities, Aerobics and Zumba, (Fir India Movement).

Suggested Readings:

1. Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006
2. Patel, Shri krishna, Physical Education, "Agrawal Publishers", Agra, 2014-15
3. Panday, Preeti, Sharirik Shiksha Sankalan, "Khel Sanskriti Prakashan, Kanpur

4. Kamlesh M.L., "Physical Education, Facts and foundations", Faridabad P.B. Publications.
5. B.K.S. Yengar, "Light and Yog. Yoga Deepika", George Allen of Unwin Ltd., London, 1981.
6. Braj Bilari Nigam, Yoga Power "TheKpath of Personal achievement" Domen and Publishers, New Delhi, 2001.
7. Indira Devi, "Yoga for You", Gibbs, Smith Publishers, Salt Lake City, 2002 Domenand Publishers, New Delhi - 2001.
8. Jack Peter, "Yoga Master the Yogic Powers", Abhishek Publications, Chandigarh, 2004.
9. Janice Jerusalem, "A Guide to Yoga" Parragon Bath, Baiihe-2004.



BCA IV Semester

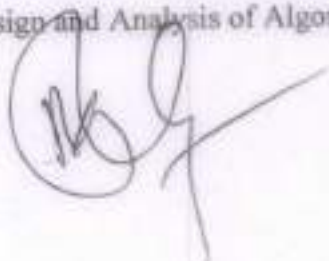
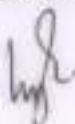
Course Code	Course Name	L	T	P	Credit
BCA401 P	Practical Lab for DBMS			4	2

On the recommendation of Board of Studies Internal / External Examiner allotment by the University. Practical will be based on the Paper Introduction to DBMS: On whole Syllabus.

BCA IV Semester

Course Code	Course Name	L	T	P	Credit
BCA402 P	Practical Lab for DAA			4	2

On the recommendation of Board of Studies Internal / External Examiner allotment by the University. Practical will be based on the Paper Design and Analysis of Algorithm: On whole Syllabus.



3rd Year

Sem.	Subject	Paper Code	Paper Name	L	T	P	Credits	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
V	Major 14	BCA501 T	Computer Graphics & Animation	4			4	(120 Credits) Bachelor of Computer Application
	Major 15	BCA502 T	Web & Internet Technologies	4			4	
	Minor-03	BCA511 T	Artificial Intelligence	3	1		4	
	AECC 5		Analytic Ability and Digital Awareness	3	1		0	
		BCA505	Minor Project		1	2	3	
		BCA506	Viva-Voce on Minor Project			2	1	
		BCA501 P	Practical Lab for Computer Graphics & Animation			4	2	
		BCA502 P	Practical Lab for Web & Internet Technologies			4	2	
							20	
Sem.	Subject	Paper Code	Paper Name	L	T	P	Credits	
VI	Major 16	BCA601	Information Security	4			4	
	Major 17	BCA602	Theory of Computation	3	1		4	
	Major 18	BCA612	Machine Learning	3	1		4	
	AECC 6		Communication Skill and Personality Development				0	
		BCA603	Major Project		3	6	6	
		BCA604	Presentation/Seminar based on Major Project				2	
							20	

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Course Code	Course Name	L	T	P	Credit
BCA501 T	Computer Graphics & Animation	4			4

UNIT-I

Introduction: Advantage of Computer Graphics and Areas of Applications, Hardware and Software for Computer Graphics. (Hard Copy, Display Technologies), Random Scan Display System, Video Controller, Random Scan Display Processor, Raster Graphics, Scan Conversion Algorithms (Line, Circle, Ellipse), Area Filling (Rectangle, Ellipse), Clipping (Lines, Circle, Ellipse), Clipping Polygons.

UNIT-II

Two dimensional transformations: 2-Dimensional transformation, 2-D Translation, Rotation, Scaling, Homogeneous Coordinates, Reflection, Shear transform,

UNIT-III

Three dimensional transformations: 3-dimensional transformation, 3-D Translation, Rotation Scaling, Reflection, Shear.

UNIT-IV

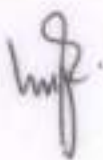
Clipping: Window to view port transformation, Clipping, line clipping, Cohen —Sutherland line clipping, Polygon clipping, Sutherland and Gary Hodgman polygon clipping algorithm.

UNIT-V

Animation and virtual reality: Basic Principles of Animation and Types of Animation, Introduction to the flash-interface, setting stage dimensions, working with panels, panel layouts, Layers & Views, Shaping Objects – Overview of shapes, Drawing & Modifying Shapes, Bitmap Images & Sounds, Animation -Principles, Frame by frame animation, tweening, masks, Introduction to virtual reality.

Text Books:

1. Foley, Van Dam, Feiner, Hughes, Computer Graphics Principles & practice, 2000.
2. D. Haran & Baker. Computer Graphics Prentice Hall of India, 1986.
3. D.J. Gibbs & D.C. Tsichritz: Multimedia programming Object Environment & Frame work, 2000.






Course Code	Course Name	L	T	P	Credit
BCA502 T	Web & Internet Technologies	4			4

Unit-I

Introduction: Network address translation, Subnet Masking, Difference between Intranet and Internet, Working of Internet, Dynamic and Static Routing, Domain Name Server, networking tools - ipconfig, ping, netstat, traceroute.

Unit-II

Introduction to Internet Protocols: HTTP, HTTPS, FTP, SMTP, IMAP, POP3, VoIP.

Unit-III

Web Servers: Introduction, Working, Configuring, Hosting and Managing a Web server, Proxy Servers: Introduction, Working, Type of Proxies, setting up and managing a proxy server Client-side Technologies, Server-side Technologies and hybrid technologies.

Unit-IV

Javascript, jQuery, JSON, NODE.js, BOOTSTRAP, Introduction to forums, blogging, portfolio, developing a responsive website, Combining Web Applications and Mobile Applications.

Unit-V

Search Engines - components, working, optimization, Crawling, BOTS. Introduction to cookies and sessions, Introduction to e-commerce websites and e-carts.

Text Books:

1. DComer. (2018). The Internet Book: Everything You need to know about Computer networking and how the internet works. 5th edition. CRC Press.
2. Patel, B & Barik, L.B, Internet & Web Technology, Acme Learning Publisher
3. Bayross, I. (2013). Web enabled commercial application development using HTML, JavaScript, DHTML and PHP. 4th edition. BPB Publication.
4. Godbole, A. S.& Kahate A (2008). Web Technologies. Tata McGraw-Hill.

Course Code	Course Name	L	T	P	Credit
BCA511	Artificial Intelligence	3	1		4

Unit-I

Introduction: Introduction to artificial intelligence, background and applications, Turing test, rational agents, intelligent agents, structure, behavior and environment of intelligent agents, Ethics in AI.

Unit-II

Knowledge Representation: Propositional logic, first order predicate logic, resolution principle, unification, semantic nets, conceptual dependencies, frames, scripts, production rules, conceptual graphs.

Unit-III

Reasoning with Uncertain Knowledge: Uncertainty, non-monotonic reasoning, truth maintenance systems, default reasoning and closed world assumption, Introduction to probabilistic reasoning, Bayesian probabilistic inference, introduction to fuzzy sets and fuzzy logic, reasoning using fuzzy logic.

Unit-IV

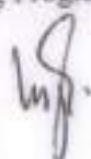
Problem Solving and Searching Techniques: Problem characteristics, production systems, control strategies, breadth first search, depth first search, hill climbing and its variations, heuristics search techniques: best first search, A* algorithm, constraint satisfaction problem, means-end analysis.

Unit-V

Game Playing: introduction to game playing, min-max and alpha-beta pruning algorithms. Prolog Programming: Introduction to Programming in Logic (PROLOG), Lists, Operators, basic Input and Output.

Text Books:

1. Russell, S.J. & Norvig, P. (2015) Artificial Intelligence - A Modern Approach. 3rd edition. Pearson Education
2. Rich, E. & Knight, K. (2012). Artificial Intelligence. 3rd edition. Tata McGraw Hill.
3. Patterson, D.W. (2015). Introduction to Artificial Intelligence and Expert Systems. 1st edition. Pearson Education.
4. Bratko, I. (2011). Prolog Programming for Artificial Intelligence. 4th edition. Pearson Education






BCA V Semester

Course Code	Course Name	L	T	P	Credit
AECC 5	Analytic Ability and Digital Awareness	3	1		0

Unit-I

Alphabet test, Analogy, Arithmetic Reasoning, Blood relations, Coding and Decoding, Inequalities, Logical Venn diagram, Seating Arrangements, Puzzles and Missing numbers.

Unit-II

Syllogism, Pattern completion and figure series, Embedded Figure and counting of figures, Cube & Dice, Paper cutting and folding, Data sufficiency, Course of Action, Critical Reasoning, Analytical and decision making.

Unit-III

Computer Basics: Block diagram of Digital Computer, Classification of Computers, Memory System, Primary storage, Auxiliary memory, Cache memory, Computer Software (System/Application Software).

MS Word Basics: The word screen, getting to word documents, typing and Revising text, Finding and Replacing, Editing and Proofing tools, Formatting text characters, Formatting Paragraph, Document templates., Page set up, tables, Mail Merge, Macros, protecting documents, printing a document.

Unit-IV

MS-Excel: Introduction, Worksheet basics, Creating worksheet, Heading information, Data & Text, Date & Time, Alphanumeric values, Saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Excel shortcut and function keys, Working with single and multiple workbook, -Working with formulae & cell referencing, Auto sum, coping formulae, Absolute & relative addressing, Worksheet with ranges, Formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and using macros, Multiple worksheets- concepts Introduction of Open Source Applications: LibreOffice, OpenOffice and Google Docs etc.

Unit-V

Web Surfing: An Overview: working of Internet, Browsing the Internet, E-Mail, Components of E-Mail, Address Book, Troubleshooting in E-Mail, Browsers: Netscape Navigator, Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Tor, Search Engines lik Google, DuckDuckGo etc., visiting web sites: Downloading. Cyber Security: Introduction to Information System, Type of information system, CIA model of Information Characteristics, Introduction to Information Security, Need of Information Security, Cyber

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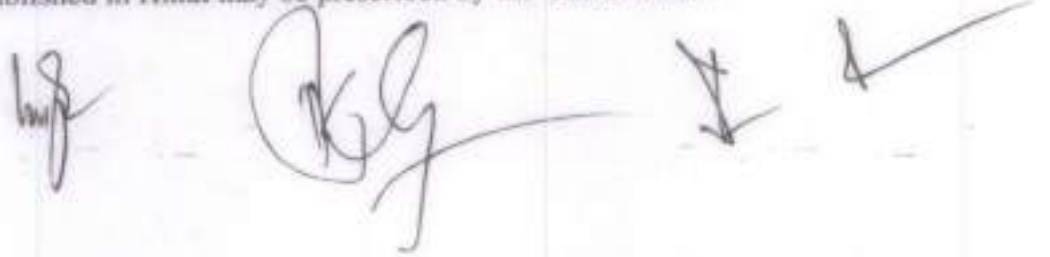
1

Security, phishing, spamming, fake news, general issues related to cyber security, Business need, Ethical and Professional issues of security.

Books

1. Sharma, A., "How to prepare for Data Interpretation and Logical Reasoning for the CAT" McGraw Hill Education Pvt. Ltd., New Delhi, India, 2011, Ed. 5, ISBN 978 2007 070 481.
2. Aggarwal, R.S., "A Modern Approach to Verbal and Non-verbal Reasoning" S. Chand Publishers New Delhi, India, 2010, ISBN 10: 8121905516.
3. Madan, Sushila, Introduction to Essential tools, Jain Book Agency, New Delhi/India, 2009, 5th ed. 4. Goel, Anita, Computer Fundamentals, Pearson Education, India, 2012.
4. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security," Sixth Edition, Cengage Learning, 2017.

Note: Course Books published in Hindi may be prescribed by the Universities.



BCA V Semester

Course Code	Course Name	L	T	P	Credit
BCA505	Minor Project		1	2	3

Minor Project / summer training of four weeks after the end of fourth Semester and will be evaluated by the Internal /External Examiner appointed by the university on the recommendation of Board of Studies.

BCA V Semester

Course Code	Course Name	L	T	P	Credit
BCA506	Viva-Voce on Minor Project			2	1

The viva will be conducted based on Minor Project/summer training of four weeks after the end of fourth Semester and will be evaluated by the Internal /External Examiner appointed by the university on the recommendation of Board of Studies.

BCA V Semester

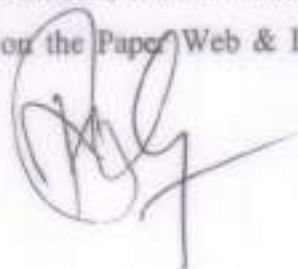
Course Code	Course Name	L	T	P	Credit
BCA501 P	Practical Lab for Computer Graphics & Animation			4	2

On the recommendation of Board of Studies, Internal / External Examiner appointed by the University. Practical will be based on the Paper Computer Graphics & Animation. On whole Syllabus.

BCA V Semester

Course Code	Course Name	L	T	P	Credit
BCA502 P	Practical Lab for Web- & Internet Technologies			4	2

On the recommendation of Board of Studies, Internal / External Examiner appointed by the University. Practical will be based on the Paper Web & Internet Technologies. On whole Syllabus.



Course Code	Course Name	L	T	P	Credit
BCA601	Information Security	4			4

Unit-I

Introduction: Security Concepts, Challenges, Security architecture, Security attacks, security services, security mechanisms.

Unit-II

Error detecting/correction: Block Codes, Generator Matrix, Parity Check Matrix, Minimum distance of a Code, Error detection and correction, Standard Array and syndrome decoding, Hamming Codes.

Unit-III

Cryptography: Encryption, Decryption, Substitution and Transposition, Confusion and diffusion, Symmetric and Asymmetric encryption, Stream and Block ciphers, DES, cryptanalysis. Public-key cryptography, Diffie-Hellman key exchange, man-in-the-middle attack Digital signature, Steganography, Watermarking.

Unit-IV

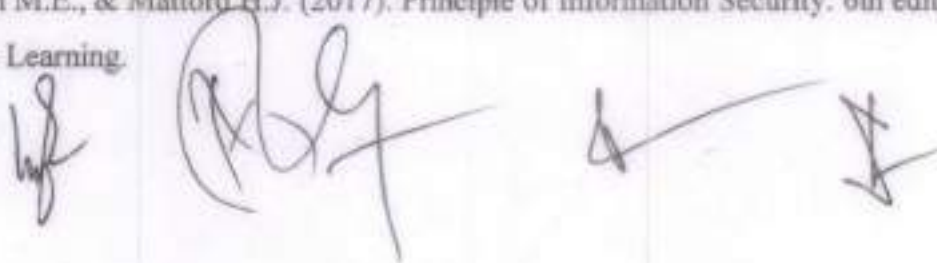
Malicious software's: Types of malwares (viruses, worms, trojan horse, rootkits, bots), Memory exploits - Buffer overflow, Integer overflow.

Unit-V

Security in Internet-of-Things: Security implications, Mobile device security - threats and strategies.

Text Books:

1. Stallings, W. (2018). Cryptography and network security. 7th edition. Pearson Education.
2. Pfleeger, C.P., Pfleeger, S.L., & Margulies, J. (2015). Security in Computing. 5th edition. Prentice Hall
3. Whitman M.E., & Mattord H.J. (2017). Principle of Information Security. 6th edition. Cengage Learning.



BCA VI Semester

Course Code	Course Name	L	T	P	Credit
BCA602	Theory of Computation	3	1		4

Unit-I

Languages: Alphabets, string, language, basic operations on language, concatenation, union, Kleene star.

Unit-II

Regular Expressions and Finite Automata: Regular expressions, Deterministic finite automata (DFA).

Unit-III

Regular Languages: Non-deterministic Finite Automata (NFA), relationship between NFA and DFA, Transition Graphs (TG), properties of regular languages, the relationship between regular languages and finite automata, Kleene's Theorem.

Unit-IV

Non-Regular Languages and Context Free Grammars: Pumping lemma for regular grammars, Context-Free Grammars (CFG),

Unit-V

Context-Free Languages (CFL) and PDA: Deterministic and non-deterministic Pushdown Automata (PDA), parse trees, leftmost derivation, pumping lemma for CFL, properties of CFL.

Unit-VI

Turing Machines and Models of Computations: Turing machine as a model of computation, configuration of simple Turing machine, Church Turing Thesis, Universal Turing Machine, decidability, halting problem.

Text Books:

1. Cohen, D. I. A. (2011). Introduction to Computer Theory. 2nd edition. Wiley India.
2. Linz, P. (2016). An Introduction to Formal Languages and Automata. 6th edition. Jones and Bartlett Learning.
3. Lewis & Papadimitriou (1997), Elements of the theory of computation – 2nd Edition PHI.

BCA VI Semester

Course Code	Course Name	L	T	P	Credit
BCA612	Machine Learning	3	1		4

Unit-I

Introduction to Machine Learning: What is human learning? Human learning versus machine learning, Types of machine learning, Applications of machine learning, Tools for machine learning, Preparing to Model.

Feature Engineering: Machine Learning activities, Basic Types of data in Machine Learning, Structures of data, Data Quality and Remediation, Data Pre-Processing, Introduction to Feature Engineering, Feature Transformation, Feature Subset Selection

Unit-II

Introduction: Basic definitions, Hypothesis space and inductive bias, Bayes optimal classifier and Bayes error, Occam's razor, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

Unit-III

Regression: Linear regression with one variable, linear regression with multiple variables, gradient descent, logistic regression, over-fitting, regularization, performance evaluation metrics, validation methods.

Unit-IV

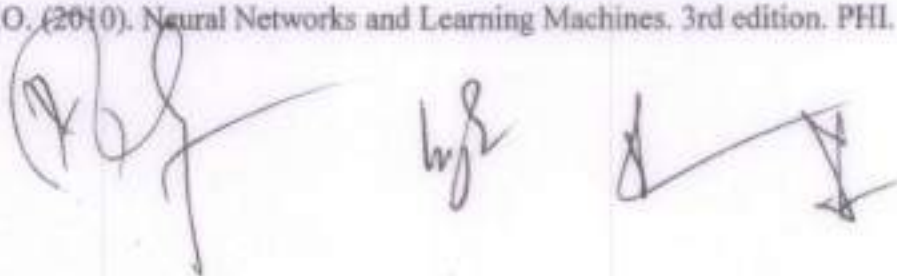
Classification: Decision trees, Naive Bayes classifier, k-nearest neighbor classifier, perceptron, multilayer perceptron, neural networks, back-propagation algorithm, Support Vector Machine (SVM), Kernel functions.

Unit-V

Clustering: Approaches for clustering, distance metrics, K-means clustering, expectation maximization, hierarchical clustering, performance evaluation metrics, validation methods.

Text Books:

1. Mitchell, T.M. (2017). Machine Learning. McGraw Hill Education.
2. Flach, P. (2015). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press.
3. Haykins, S.O. (2010). Neural Networks and Learning Machines. 3rd edition. PHI.



BCA VI Semester

Course Code	Course Name	L	T	P	Credit
BCA612	Machine Learning	3	1		4

Unit-I

Introduction to Machine Learning: What is human learning? Human learning versus machine learning, Types of machine learning, Applications of machine learning, Tools for machine learning, Preparing to Model.

Feature Engineering: Machine Learning activities, Basic Types of data in Machine Learning, Structures of data, Data Quality and Remediation, Data Pre-Processing, Introduction to Feature Engineering, Feature Transformation, Feature Subset Selection

Unit-II

Introduction: Basic definitions, Hypothesis space and inductive bias, Bayes optimal classifier and Bayes error, Occam's razor, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

Unit-III

Regression: Linear regression with one variable, linear regression with multiple variables, gradient descent, logistic regression, over-fitting, regularization, performance evaluation metrics, validation methods.

Unit-IV

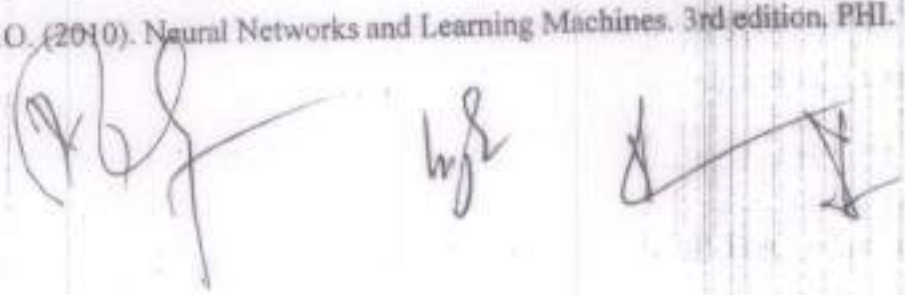
Classification: Decision trees, Naive Bayes classifier, k-nearest neighbor classifier, perceptron, multilayer perceptron, neural networks, back-propagation algorithm, Support Vector Machine (SVM), Kernel functions.

Unit-V

Clustering: Approaches for clustering, distance metrics, K-means clustering, expectation maximization, hierarchical clustering, performance evaluation metrics, validation methods.

Text Books:

1. Mitchell, T.M. (2017). Machine Learning. McGraw Hill Education.
2. Flach, P. (2015). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press.
3. Haykins, S.O. (2010). Neural Networks and Learning Machines. 3rd edition, PHI.



BCA VI Semester

Course Code	Course Name	L	T	P	Credit
AECC 6	Communication Skill and Personality Development				2

Unit-I

Introduction to communication, process of communication, Importance of communication, 7c's of Communication, Essentials of effective communication.

Unit-II

Different forms of communication: Verbal communication, Non-verbal communication, Intrapersonal communication, Interpersonal communication, group communication, mass communication, new media communication.

Unit-III

Developing skills: Listening, Speaking, Reading and Writing skill.

Essential Soft skills: group discussion, Presentation skills, Decision-making, Team work, Innovation, Creative thinking, Time-management.

Unit-IV

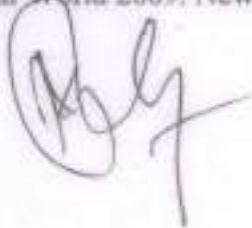
Personality Development: concept of personality, dimensions of personality and dimensions of personality.

Unit-V

Attitude and Motivation: concept of motivation, positive attitude, negative attitude, ways to develop a positive attitude, concept of motivation and importance of self-motivation.

Books

1. Raman and Sharma, Technical Communications, OUP, New Delhi, 2017.
2. Lata and Kumar, Communication Skills, OUP, New Delhi, 2018.
3. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014.
4. Sherfield, Montgomery and Moody, Cornerstone: Developing Soft Skills, UP, 2009.
4. Lesikar R V, Flatley M E, Rentz K and Pandey Business Communication: Making Connections in a Digital World 2009: New Delhi, Tata McGraw Hill.



BCA VI Semester

Course Code	Course Name	L	T	P	Credit
BCA603	Major Project		3	6	5

Evaluation of Major Project by Internal /External Examiner appointed by the university on the recommendation of Board of Studies.

BCA VI Semester

Course Code	Course Name	L	T	P	Credit
BCA604	Presentation/Seminar based on Major Project				1

The viva will be conducted based on Presentation/Seminar based on Major Project and will be evaluated by the Internal /External Examiner appointed by the university on the recommendation of Board of Studies.



4th Year

Sem.	Subject	Paper Code	Paper Name	L	T	P	Credits	(Cumulative Minimum Credits) Required for Awards of Certificate /Diploma/Degree
VII	Major 19	BCA701 T	Research Mythologies	4			3	(160 Credits) Bachelor of Computer Application (Research)
	Major 20	BCA711 T	Soft Computing	3	1		3	
	Major 21	BCA712 T	Cloud Computing	3	1		3	
	Major 22	BCA713 T	Advanced Software Engineering	3	1		3	
	Minor 04	BCA708 T	Advanced Computer Network	4			3	
	Research Project	BCA702	Research Project (Conceptual)		3	6	5	
							20	
Sem.	Subject	Paper Code	Paper Name	L	T	P	Credits	
VIII	Major 23	BCA801 T	Business Intelligence	4			3	
	Major 24	BCA811 T	Digital Image Processing	3	1		3	
	Major 25	BCA812 T	Advanced DBMS	3	1		3	
	Major 26	BCA813 T	Data Mining	3	1		3	
	Major 27	BCA808 T	Data Centre Management	4			3	
	Research Project	BCA802	Research Project		3	6	5	
							20	

BCA VII Semester

Course Code	Course Name	L	T	P	Credit
BCA701	Research Methodology	4			3

Unit-I

Philosophical Underpinnings of Research:

Introduction to Research: Novelty, Originality, Organized Method of Investigation, and Communication of Problem, Data, Method, and Results for Peer Group Verification; Paradigm and paradigm shift.

Types of Research: Theoretical, Empirical, Experimental, and Design and Characterization of New Materials, Components, Processes, and Systems.

Broad Objectives of Research: Problem-oriented—Defining Problems and Problem Issues, Analyzing Data, Predicting, and Designing; Technique-oriented—Improving Performance and Expanding Scope.

Modes of Inquiry and Inquiring Systems: Hypothetical-deductive and Empirical-inductive modes; Scientific Method, and Inquiring Systems of Locke, Kant, Leibnitz, Hegel, and Singer, Continuum of Connections among Facts, Data, Laws, Hypotheses, Theory, Models, and Experiments; Criteria of a Theory, Research Topic, Problem, Questions, Objectives, and Scope, Methodology, Methods, Tools, and Techniques, Research Ethics, Plagiarism, and Their Prevention.

Unit-II

Measurement, Data, and Analytics, Structured and Unstructured Data, Scales of Measurement, Population and Sample, Descriptive Statistics, Data Visualization, Probability and Random Variables, Sampling and Estimation, Hypothesis Testing, ANOVA, Correlation, and Regression. Data Analytics: Elements of Association, Clustering, and Classification.

Unit-III

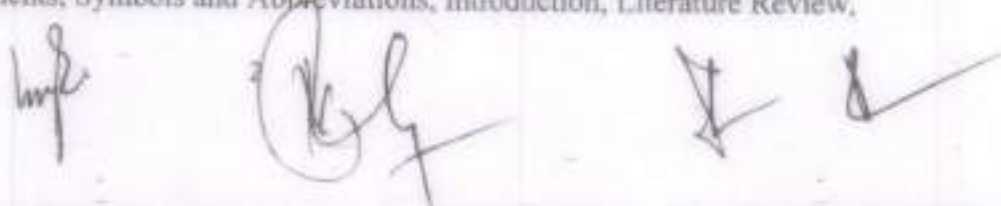
Elements of Theoretical Research, Model and Model Building: Classification of Models, Exogenous and Endogenous Variables, Variable Relationships, Model Boundary, and Predictive and Prescriptive Models.

Unit-IV

Research Methods for Computer Science, Formal Methods: Formal Specification, Algorithm, and Complexity, Building Artefacts: Proof of Performance, Proof of Concept, and Proof of Existence, Process Methodology: Methods for Software Engineering and Human-Computer Interaction, Cognitive Processes, Interactive Games, Social Networks, and Web Analytics.

Unit-V

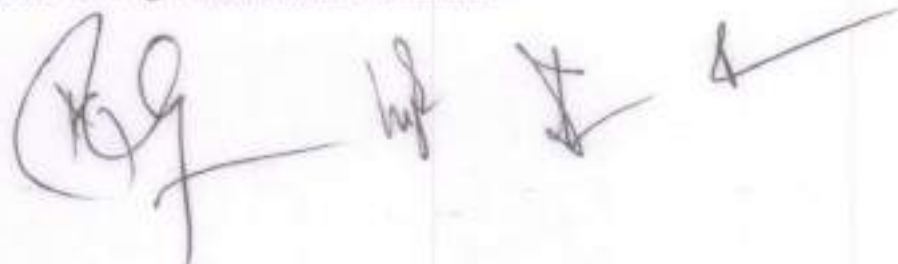
Research Documentation, Elements of Preparing a Paper and a Thesis: Title, Abstract, Keywords, Acknowledgements, Symbols and Abbreviations, Introduction, Literature Review,



Materials and Methods, SI Units, Mathematical Materials, Graphical and Tabular Presentation, Results and Discussion, Conclusion, Interpretation, Generalization, Scope for Future Work, Citations and List of References, and Appendixes, Elements of Good English Writing: Signposts, Paraphrasing—Unity, Coherence, and , and Topic Sentence, and Transitions.

Books

1. Kothari, C. R. and G. Garg (2019), Research Methodology: Methods and Techniques, Fourth MultiColour Edition, New Age International Publishers.

Handwritten signatures and marks. On the left, a large signature that appears to be 'K. G.' with a long horizontal stroke. To its right, a smaller signature 'h. g.' followed by a checkmark and another signature.

Course Code	Course Name	L	T	P	Credit
BCA711	Soft Computing	3	1		3

Unit-I

Introduction: Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Fuzzy Membership functions, interference in Fuzzy Logic, Fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzification & De-Fuzzification, Fuzzy Controller, Industrial applications.

Unit-II

Introduction & Architecture: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions.

Unit-III

Neural network architecture: Single layer and Multilayer feed forward networks, Recurrent networks, Learning techniques, Perception and Convergence rule, Auto-associative and hetero-associative memory.

Unit-IV

(Back propagation networks) Architecture: perceptron model, solution, single layer artificial neural network, Multilayer perceptron model; back propagation learning methods, effect of learning rule co-efficient; back-propagation algorithm, factors affecting back-propagation training, applications.

Unit-V

Genetic Algorithm (GA) Basic concepts, Working principle, Procedures of GA, Flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, Applications.

Text Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, —Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications| Prentice Hall of India.
2. N. P. Padhy, |Artificial Intelligence and Intelligent Systems| Oxford University Press.
3. Simon Haykin, |Neural Networks| Prentice Hall of India
4. Timothy J. Ross, —Fuzzy Logic with Engineering Applications| Wiley India.
5. Kumar Satish, —Neural Networks| Tata McGraw Hill.

BCA VII Semester

Course Code	Course Name	L	T	P	Credit
BCA712	Cloud Computing	3	1		3

UNIT-I

Client-Server Computing, Cluster Computing, Grid Basics, Distributed Computing, Introduction to Cloud Computing, Introduction to Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS).

UNIT- II

Understanding Google Cloud, Google Apps, Google Compute Engine (GCE), Google App.

UNIT-III

Engine, Amazon Services, Amazon Web Services, Amazon EC2.

UNIT-IV

IBM Cloud Computing with its PaaS, IBM as SaaS and IBM as IaaS, Red hat Cloud Computing with its PaaS.

UNIT-V

Microsoft Azure Cloud Computing Service- Windows azure platform Services, Windows Azure storage, Windows Azure fabrics, Salesforce Cloud Computing Services Pass, SaaS and IaaS, Heroku and Force.com as PaaS.

Books:

1. Mastering Cloud Computing, Buyya, R., Vecchiola, C., Selvi, S.T., McGraw Hill Education; First edition (2017)
2. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Kai Hwang, Jack Dongarra and Geoffrey Fox, Morgan Kaufmann, 2011.



Course Code	Course Name	L	T	P	Credit
BCA713	Advanced Software Engineering	3	1		3

Unit-I

Introduction: FAQs about Software Engineering; Professional and Ethical Responsibility; Software Process: Models; Process Iteration, Specification, Software Design and Implementation; Verification & Validation; Software Evolution; Automated Process Support.

Project Management: Management Activities, Project PI Software Project Management and Requirements Project Management: Management Activities, Project Planning, Project Scheduling, Risk Management; Software Requirements: Functional and Non-Functional Requirements, User Requirements, System Requirements, Requirements Document; Requirements Engineering Process: Feasibility Studies, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management.

Unit-II

Architectural Design: System Models, Software Prototyping and Specifications System models: Context, Behavioral, Data, and Object models, CASE Workbenches; Software Prototyping: Prototyping in the Software Process, Rapid Prototyping Techniques, User Interface Prototyping; Specifications: Formal Specification in the Software Process, Interface Specification, Behavioral Specification.

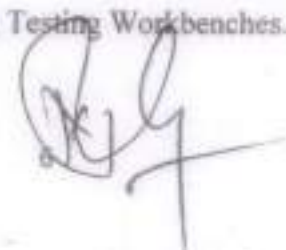
Advanced Design: Introduction: System Structuring; Control Models; Modular Decomposition; Domain-Specific Architectures; Distributed Systems Architectures; Multiprocessor Architectures; Client-Server Architectures, Distributed Object Architectures; CORBA (Common Object Request Broker Architecture).

Unit-III

Software Design: Object Oriented Design: Objects and Object Classes, Object-Oriented Design Process, Design Evolution; Real Time Software Design: Systems Design, Real-Time Executives, Monitoring and Control Systems, Data Acquisition Systems; Design with Reuse: Component-Based Development, Application Families, Design Patterns; User Interface Design: Principles, User Interaction, Information Presentation, User Support, Interface Evaluation.

Unit-IV

Verification, Validation and Testing: Verification and Validation (V & V): Static and Dynamic V & V, V & V Goals, V & V vs. Debugging, Software Inspections / Reviews, Clean-Room Software Development; Software Testing: Defect Testing, Integration Testing, Interface Testing, Object-Oriented Testing, Testing Workbenches.

Inf.   

Managing People: Introduction; Limits to Thinking; Memory Organization; Knowledge Modeling; Motivation; Group Working; Choosing and Keeping People; the People Capability Maturity Model.

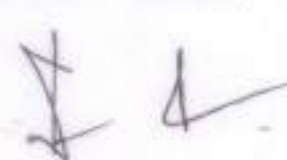
Unit-V

Software Cost Estimation and Quality Management: Software Cost Estimation: Productivity, Estimation Techniques, Algorithmic Cost Modelling, Project Duration and Staffing. Quality Management: Quality Assurance and Standards, Quality Planning, Quality Control, Software Measurement and Metrics; Process Improvement: Process and Product Quality, Process Analysis and Modelling, Process Measurement, the SEI Process Maturity Model, and Process Classification.

Evolution: Legacy Systems: Structures, Design, and Assessment; Software Change: Program Evolution Dynamics, Software Maintenance, Architectural Evolution; Software Re-Engineering: Source Code Translation, Reverse Engineering, Program Structure Improvement, Program Modularization, Data Re-Engineering; Configuration Management.

Books

1. Software Engineering: An Engineering Approach, by J.F. Peters and W. Pedrycz, Publisher: John Wiley and Sons.
2. Software Engineering: A Practitioner's Approach by Roger Pressman, Publisher: McGraw-Hill.
3. Fundamentals of Software Engineering by Ghezzi, Jayazeri, and Mandrioli, Publisher: Prentice-Hall.
4. Software Engineering Fundamentals by Ali Behforooz, and Frederick J. Hudson, Publisher: Oxford University Press.



Course Code	Course Name	L	T	P	Credit
BCA708 (Minor)	Advanced Computer Network	4			3

UNIT-I

Computer Networks and the Internet: Computer Networks and the Internet: History of Computer Networking and the Internet, Networking Devices, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones. Networking Models: 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal- Sized Packets Model: ATM.

UNIT-II

Network Routing and Its Concepts: Network Routing and its concepts: Structure of a Router, Basic Router Configuration, Building a Routing Table, Static Routing, Dynamic Routing Distance Vector Routing Protocol (RIPv1, RIPv2, EIGRP), Link State Routing Protocols (OSPF).

UNIT-III

Lan Switching: Switching And Its Concepts: LAN Switching: Switching and its concepts: Structure of a Switch, Basic Switch Configuration, Virtual LANs (VLANs), VLAN Trunking Protocol (VTP), Spanning Tree Protocol (STP), Inter-VLAN Routing.

UNIT-IV

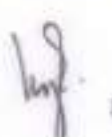
Wide Area Networks (WANS): Wide Area Networks (WANs): Introduction to WANs, Point-to-Point Protocol (PPP) concepts, Frame Relay concepts, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), IPv6.

UNIT-V

Network Programming Using JAVA: Network Programming using Java: TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI) - Basic RMI Process, Implementation details Client Server Application.

Books:**Text Books:**

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Fifth Edition, Pearson Education, 2012.
2. Network Fundamentals, Mark Dye, Pearson Education.
3. Computer Networks: A Systems approach, Larry L. Peterson & Bruce S. Davie, Fifth edition, Elsevier, 2012.






4. Computer Networks: A Top-Down Approach, Behrouz A. Forouzan, Firoz Mosharaf, Tata McGraw Hill, 2012.
5. Java Network Programming, 3rd edition, E.R. H

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BCA VII Semester

Course Code	Course Name	L	T	P	Credit
BCA702	Research Project (Conceptual)		3	6	5

Presentation/Seminar based on Research Project will be evaluated by internal/external examiner appointed by university on the recommendation of Board of Studies.



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BCA VIII Semester

Course Code	Course Name	L	T	P	Credit
BCA801	Business Intelligence	4			3

Unit-I

Business intelligence: Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence Decision support systems: Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system.

Unit-II

Mathematical models for decision making: Structure of mathematical models, Development of a model, Classes of models Data mining: Definition of data mining, Representation of input data, Data mining process, Analysis methodologies Data preparation: Data validation, Data transformation, Data reduction.

Unit-III

Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression, Neural networks, Support vector machines Clustering: Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models.

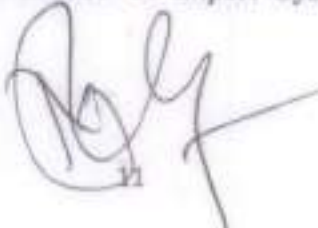
Unit-IV

Business intelligence applications: Marketing models: Relational marketing, Sales force management, Logistic and production models: Supply chain optimization, Optimization models for logistics planning, Revenue management systems. Data envelopment analysis: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices.

Unit-V

Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation, Roles of People in Knowledge Management Artificial Intelligence and Expert Systems: Concepts and Definitions of Artificial Intelligence, Artificial Intelligence Versus Natural Intelligence, Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.

Books

Wp.   

1. Carlo Vercellis-Business Intelligence: Data Mining and Optimization for Decision Making, Wiley, 1st Edition, 2009.
2. Efraim Turban, Ramesh Sharda, Dursun Delen-Decision support and Business Intelligence Systems, Pearson, 9th Edition, 2011.
3. Grossmann W, Rinderle-Ma-Fundamental of Business Intelligence, Springer, 1st Edition, 2015.



Course Code	Course Name	L	T	P	Credit
BCA811	Digital Image Processing	3	1		3

Unit-I

Introduction: Digital Image Fundamentals: Brightness, Adaptation and Discrimination, Light and Electromagnetic Spectrum, Image Sampling and Quantization, Some Basic Relationships between Pixels Types of images.

Unit-II

Spatial Domain Filtering: Some Basic Intensity Transformation Functions, Histogram Equalization, Spatial Correlation and Convolution, Smoothing Spatial Filters: Low pass filters, Order Statistics filters; Sharpening Spatial Filters: Laplacian filter.

Unit-III

Filtering in Frequency Domain: The Discrete Fourier Transformation (DFT), Frequency Domain Filtering: Ideal and Butterworth Low pass and High pass filters, DCT Transform (1D, 2D).

Unit-IV

Image Restoration: Image Degradation/Restoration Process, Noise models, Noise Restoration Filters Image Compression: Fundamentals of Image Compression, Huffman Coding, Run Length Coding, JPEG.

Unit-V

Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transformation, Basic Morphological Algorithms, Point, Line and Edge Detection, Thresholding, Region Based Segmentation.

Books:

1. Gonzalez, R. C., & Woods, R. E. (2017). Digital Image Processing. 4th edition. Pearson Education.
2. Jain, A. K. (1988). Fundamentals of Digital Image Processing. 1st edition Prentice Hall of India.
3. Castleman, K. R. (1995.). Digital Image Processing. 1st edition. Pearson Education
4. Gonzalez, R. C., Woods, R. E., & Eddins, S. (2004). Digital Image Processing using MATLAB. Pearson Education Inc.

BCA VIII Semester

Course Code	Course Name	L	T	P	Credit
BCA812	Advanced DBMS	3	1		4

UNIT - I

History of Data base Systems. Data base System Applications, data base System VS file System. data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML. Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying/altering Tables and Views. Introduction of Object Database Systems, Structured Data types, operations on structured data, Encapsulation and ADTS, Inheritance.

UNIT - II

Database design for ORDBMS, ORBMS implementation and challenges, OODBMS, comparison of RDBMS, OODBMS and ORDBMS. (chapter 23 from text book 1) Introduction to Parallel databases, architectures for parallel databases, Parallel Query Evaluation – data partitioning and parallelizing sequential operator evaluation code, Parallelizing individual operations, and parallel Query optimization.

UNIT - III

Introduction to distributed databases; features of distributed databases vs centralized databases, Why distributed databases, DDBMS, levels of transparency- reference architecture for DDB, types of data fragmentation, distribution transparency for read-only and update applications, distributed database access primitives, Integrity Constraints in Distributed databases.

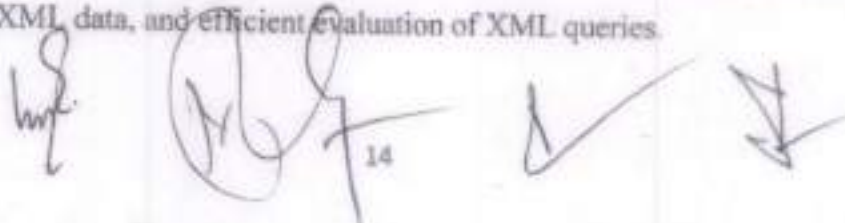
UNIT - IV

Distributed database design: framework for distributed database design, the design of database fragmentation, allocation of fragments; Distributed Query processing: Equivalence of transformations for queries, transforming global queries into fragment queries, distributed grouping and aggregation functions, parametric queries.

UNIT - V

A framework for query optimization, join queries and general queries. non-join queries in a distributed DBMS, joins in a distributed DBMS, cost-based query optimization. (chapter 5 and 6 from text book 2). DBMS Vs IR systems, Introduction to Information retrieval, indexing for text search, web search engine, managing text in a DBMS, a data model for XML, Querying XML data, and efficient evaluation of XML queries.

Books:



14

1. Raghuramakrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, TMH, 2006.
2. S. Ceri and G. Pelagatti, "Distributed databases principles and systems", 1st Edition, TMH, 2008.

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Course Code	Course Name	L	T	P	Credit
BCA813	Data Mining	3	1		3

Unit-I

Introduction to Data Mining: Applications of data mining, data mining tasks, motivation and challenges, types of data attributes and measurements, data quality. Data Pre-processing - aggregation, sampling, dimensionality reduction, Feature Subset Selection, Feature Creation, Discretization and Binarization, Variable Transformation.

Unit-II

Classification: Basic Concepts, Decision Tree Classifier: Decision tree algorithm, attribute selection measures, Nearest Neighbour Classifier, Bayes Theorem and Naive Bayes Classifier, Model Evaluation: Holdout Method, Random Sub Sampling, Cross-Validation, evaluation metrics, confusion matrix.

Unit-III

Association rule mining: Transaction data-set, Frequent Itemset, Support measure, Apriori Principle, Apriori Algorithm, Computational Complexity, Rule Generation, Confidence of association rule.

Unit-IV

Cluster Analysis: Basic Concepts, Different Types of Clustering Methods, Different Types of Clusters, K-means: The Basic K-means Algorithm, Strengths and Weaknesses of K-means algorithm.

Unit-V

Agglomerative Hierarchical Clustering: Basic Algorithm, Proximity between clusters, DBSCAN: The DBSCAN Algorithm, Strengths and Weaknesses.

Books:

1. Han, J., Kamber, M., & Jian, P. (2011). Data Mining: Concepts and Techniques. 3rd edition. Morgan Kaufmann
2. Tan, P.-N., Steinbach, M., & Kumar, V. (2005). Introduction to Data Mining. 1st Edition. Pearson Education.
3. Hand, D., & Mannila, H. & Smyth, P. (2006). Principles of Data Mining. Prentice-Hall of India.

Course Code	Course Name	L	T	P	Credit
BCA813	Data Mining	3	1		3

Unit-I

Introduction to Data Mining: Applications of data mining, data mining tasks, motivation and challenges, types of data attributes and measurements, data quality. Data Pre-processing - aggregation, sampling, dimensionality reduction, Feature Subset Selection, Feature Creation, Discretization and Binarization, Variable Transformation.

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Books:

1. Han, J., Kamber, M., & Jian, P. (2011). Data Mining: Concepts and Techniques. 3rd edition. Morgan Kaufmann
2. Tan, P.-N., Steinbach, M., & Kumar, V. (2005). Introduction to Data Mining. 1st Edition. Pearson Education.
3. Hand, D., & Mannila, H. & Smyth, P. (2006). Principles of Data Mining. Prentice-Hall of India.

BCA VIII Semester

Course Code	Course Name	L	T	P	Credit
BCA808	Data Centre Management	4			3

Unit-I

Data center Architecture, Data center Requirements, Data center prerequisites, Required Physical Area for Equipment and Unoccupied Space, required power to run all the devices, required cooling and HVAC Required weight, Required Network bandwidth, Budget Constraints, Selecting a Geographic Location Safety from Natural hazards, Safe from Manmade disaster.

Unit-II

Availability of local Technical talent, Abundant and Inexpensive Utilities, Selecting an Existing building, Data Center design, Characteristics of an Outstanding Design, Guidelines for Planning a Data Center, Data Center structures.

Unit-III

Raised Floor Design and Deployment, Design and Plan against Vandalism, Data center design case study, Modular Cabling Design, Points of Distribution, ISP Network Infrastructure, ISP WAN Links.

Unit-IV

Data Center Maintenance, Network Operations Center, Network Monitoring, Datacenter physical security, Data center Logical security, Data center Consolidation, Reasons for data center Consolidation, Consolidation opportunity, Server consolidation, Storage Consolidation, Network Consolidation, Service Consolidation, Process Consolidation, Staff Consolidation.

Unit-V

Data Consolidation phases, Data center servers, Server Capacity Planning, System Management Best Practices, Server Cluster Best Practices, Data Storage Best Practices, Network Management Best Practices, Documentation Best Practices, Security Guidelines Internet security, Source Security Issues, Best Practices for System Administration, System Administration Work Automation, Device Naming, Naming Practices, NIS, DNS, LDAP, Load balancing, Terminology, Advantages, Types of load balancing, Implementing a Network with Load-Balancing Switches.

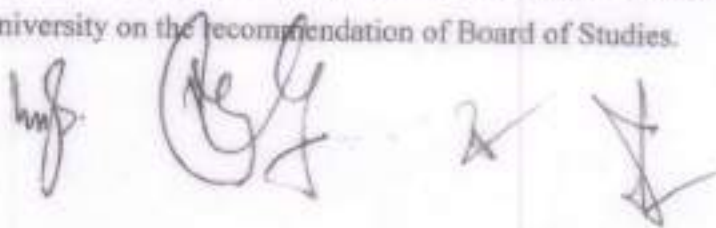
Books:

1. Administering Data Centers: Servers, Storage and Voice over IP, Kailash Jaisawal.
2. Data center fundamentals, Mauricio Arregoces, Maurizio Portol.

BCA VIII Semester

Course Code	Course Name	L	T	P	Credit
BCA802	Research Project		3	6	5

Presentation/Seminar based on Research Project will be evaluated by internal/external examiner appointed by university on the recommendation of Board of Studies.



**Department of Business Management & Entrepreneurship
Dr. Rammanohar Lohia Avadh University, Ayodhya**

List of internal and external Expert in Viva in BCA for Campus and Colleges

S.No	Internal Examiner	External Examiner / <i>Internal</i>
1	Dr. Ramjeet Singh Yadav	Prof. Himanshu Shekhar Singh
2	Dr. Anurag Tiwari	Prof. Shailendra Kumar Verma
3		Dr. Rana Rohit Singh
		Dr. Anurag Tiwari
		Dr. Ramjeet Singh Yadav
4		Dr. Vijendra Pratap Singh, Department of Computer Science and Applications, MGKVP, Varanasi-221001, UP, India
5		Dr. Pawan Chaurasiya, BBAU Lucknow
6		Dr. Saurabh Pal, VBSPU, Jaunpur
7		Dr. Rajshree, BBAU, Lucknow
8		Dr. Puneet Mishra Deptt. of Computer Science, University of Lucknow
9		Dr. Jyotirmay Patel, Associate Professor, Faculty of Computer Application, SRMS CET, Bareilly-243202, UP, India. Mobile No.: 8171531537, 9235858579 Email: jyotirmaypatel@gmail.com

