

PROGRAM/ COURSE STRUCTURE AND SYLLABUS

as per the Choice Based Credit System (CBCS) designed in accordance with Learning Outcomes-Based Curriculum Framework (LOCF) of National Education Policy (NEP) 2020

for

BACHELOR OF COMPUTER APPLICATIONS (BCA)

w.e.f.

Academic Year 2022-23 and onwards



PROGRAM STRUCTURE

er		egory			Teaching Hrs./ Week		Teaching Hrs./ Week		Week		Exa (Ma	aminat Scheme ax. Ma	ion e rks)
Semest	CourseTeCourseCode3Code3OD		Course Title	Lecture	Tutorial	Practical	Ins. Hrs. /	Credi	Term End Examination	Internal Assessment	Total		
	BCA-101	Major	Programming in C	3	1	-	4	4	60	40	100		
	BCA-102	Minor	Computer Organization & Architecture	3	1	-	4	4	60	40	100		
Ţ	BCA-103	GEC	Mathematics-I (Discrete Mathematics)	3	1	-	4	4	60	40	100		
	BCA-104	AEC	Communicative English Grammar	3	1	-	4	4	60	40	100		
	BCA- 101P	Major	Programming in C Lab	-	-	4	4	2	30	20	50		
	BCA- 102n	Minor	Lab	_	_	4	4	2	30	20	50		
	102p	Willor	Total				24	20	50	20	500		
	BCA-201	Major	Data Structure	3	1	-	4	4	60	40	100		
	BCA-202	Minor	DBMS	3	1	-	4	4	60	40	100		
п	BCA-203	GEC	Mathematics-II (Calculus)	3	1	-	4	4	60	40	100		
11	BCA-204	AEC	Communication Techniques	3	1	-	4	4	60	40	100		
	BCA-201P	Major	Data Structure Lab		-	4	4	2	30	20	50		
	BCA-202P	Minor	DBMS(Oracle)Lab	-	-	4	4	2	30	20	50		
			Total				24	20			500		
	BCA-301	Major	Introduction to Operating System	3	1	-	4	4	60	40	100		
	BCA-302	Minor	Programming in C++	3	1	_	4	4	60	40	100		
	0011002	Trinor	Mathematics-III		1		•		00	10	100		
III	BCA-303	GEC	(Numerical Methods)	3	1	-	4	4	60	40	100		
	BCA-304	SEC	Visual C#.Net	3	1	-	4	4	60	40	100		
	BCA- 301P	Major	Project I	-	-	4	4	2	30	20	50		
	BCA- 302P	Minor	C++ Lab		-	4	4	2	30	20	50		
-			Total				24	20			500		
-	BCA-401	Major	Programming in Java	3	1	-	4	4	60	40	100		
	BCA-402	Minor	Web Technologies	3	1	-	4	4	60	40	100		
IV	BCA-403	GEC	Mathematics-IV (Statistical Methods)	3	1	-	4	4	60	40	100		
	BCA-404	SEC	Python Programming	3	1	-	4	4	60	40	100		
	BCA-	Major	Programming in Java Lab	-	-	2	4	2	30	20	50		



	401P										
	BCA- 402P	Minor	Project II		-	4	4	2	30	20	50
			Total				24	20			500
J.		egory		Tea H W	Teaching Hrs./ Week				Examination Scheme (Max. Marks)		
Semeste	Course Code	Course Cat	Course Title Course Title		Tutorial	Practical	Ins. Hrs. / V	Credit	Term End Examination	Internal Assessment	Total
	BCA 501	Major	Programming in Advance	1		_	1	1	60	40	100
	BCA 502	DSE1	Softwara Engineering	4	-	-	4	4	60	40	100
v	DCA-502	SEC1	Artificial Intelligence	4	-	-	4	4	60	40	100
•	BCA-503	Intern	Internship	5	1		-	4	00	40	150
	BCA-	mem	Programming in Advance	-	_		0	0	-	-	150
	501P	Major	Java	_	_	2	4	2	30	20	50
	2011	inagoi	Total			_	22	20		20	500
	BCA-601	Major	Machine learning	3	1	_	 	 	60	40	100
	BCA-602	DSF2	Software Testing	3	1	_	4	4	60	40	100
	BCA-603	DSE 3	Computer Networks	3	1	_	4	4	60	40	100
VI	BCA-604	Project	Major Project	-	-	-	- 6	6	-	-	150
	BCA-	Tiojeet					0	0			100
	601P	Major	Machine learning	-	-	2	4	2	30	20	50
		5	Total				20	20			500
	BCA-701	Maior	Data Mining	3	1	-	4	4	60	40	100
	BCA-702	Minor	Research Methodology	3	1	-	4	4	60	40	100
	BCA-703	DSE4	Data science using Python	3	1	-	4	4	60	40	100
VII	BCA-	Maior	Data Mining		-	2	4	2	20	20	50
	701p	Draigor	Descerch project I	-	-	Ζ	4	6	30	20	150
	BCA-705	Project	Tetal	-	-	-	20	20	-	-	150 500
			Total Mobile Application				20	20			500
	BCA-801	Major	Development	3	1	-	4	4	60	40	100
	BCA-802	Minor	Cloud Computing	3	1	-	4	4	60	40	100
VIII	BCA- 801P	Maior	Mobile Application Development	-	_	2	4	2	30	20	50
	BCA-804	Project	Research project II	-	-	-	10	10		-	250
			Total	1			22	20			500
								-			



BCA – 101 Programming in C

Course Objectives: The course is designed to initiate the students into the discipline of Programming. It aims to start off the development of problem solving ability using computer programming. This course teaches not only the mechanics of programming, but also how to create programs that are easy to read, maintain, and debug. Students are introduced to the design principles for writing good programs. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Course Outcomes: At the end of the course, students will be able to

- CO-1: Understand the programming concepts.
- CO-2: Develop the logic of programs.
- CO-3: Use of Different Control Structure.
- CO-4: Understanding the Array, Structure and user-defined function.
- CO-5: Tracing the execution of program for better understanding.

Course Contents:

Unit-I

Programming fundamentals: program concept, algorithms, flow charts - symbols, rules for making flow chart, types of flowchart, advantage & disadvantage, techniques of problem solving: programming techniques – top down, bottom up, modular, structured - features, merits & demerits, programming logic- simple, branching, looping. Testing & debugging & their tools.

Unit-II

Programming in c including features of 'c', c tokens, variables, identifiers, keywords, data types, constants, operator and expression, operators: arithmetic, logical, relational, conditional and bit wise operators, precedence and associativity of operators, type conversion in expression, basic input/output and library functions single character input/output i.e. getch(), getchar(). Getche(), putchar(),formatted input output i.e. printf() and scanf().

Unit-III

Branching constructs: If statement, if.....else statement, nesting of if....else statement, else if ladder, the ?: operator, switch statement, compound statement, loop controls: for, while, do-while loops, break, continue, goto statement, arrays : what is array, declaring initializing 1d, 2d and 3d array. String: declaration, string functions – strcat, strcpy, strcmp, strlen, strstr.

Unit-IV

Functions: Categories of functions user defined and library function, recursion, function arguments, return values and nesting of function, calling of functions, scope and life of variables - local and global variable, storage classes - auto, extern, static, pointers: operations on pointers, operators for pointers, pointers and function, array of pointers, pointer and strings.

Unit-V

Preprocessor directives: #define, defining functions like macros, include, conditional compilation directives. Structures: the concept of structure, initializing a structure, the structure tag, dot operator, array of structure, structure and pointer, arrow operator and



nesting of structure. Unions: initialization and use of it in a program. Command line arguments

Suggested Text Books:

- 1. Kanitkar Y. Let us C. BPB Publicatiuon.
- 2. C Programming. Schaum's series.
- 3. Balgurusuamy. Programming in ANSI C. Tata McGraw Hill

BCA – 101P Programming in C Lab

- 1. WAP to print the sum and product of digits of an integer.
- 2. WAP to reverse a number.
- 3. WAP to compute the sum of the first n terms of the following series $S = \frac{1}{2+1} + \frac{1}{4} + \frac{1}{4}$
- 4. WAP to compute the sum of the first n terms of the following series S =1-2+3-4+5.....
- 5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
- 6. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100.
- 7. WAP to compute the factors of a given number.
- 8. Write a macro that swaps two numbers. WAP to use it.
- 9. WAP to print a triangle of stars as follows (take number of lines from user):

* *** ***** ****** *******

10. WAP to perform following actions on an array entered by the user:

i) Print the even-valued elements ii) Print the odd-valued elements iii) Calculate and print the sum and average of the elements of array iv) Print the maximum and minimum element of array v) Remove the duplicates from the array vi) Print the array in reverse order The program should present a menu to the user and ask for one of the options. The menu should also include options to re-enter array and to quit the program.

- 11. WAP that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.
- 12. Write a program that swaps two numbers using pointers.
- 13. Write a program in which a function is passed address of two variables and then alter its contents.
- 14. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
- 15. Write a program to find sum of n elements entered by the user. To write this program, allocate memory dynamically using malloc()/ calloc() functions .
- 16. Write a menu driven program to perform following operations on strings:

a) Show address of each character in string b) Concatenate two strings without using streat function. c) Concatenate two strings using streat function. d) Compare two



strings e) Calculate length of the string (use pointers) f) Convert all lowercase characters to uppercase g) Convert all uppercase characters to lowercase h) Calculate number of vowels i) Reverse the string

- 17. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
- 18. WAP to display Fibonacci series (i)using recursion, (ii) using iteration
- 19. WAP to calculate Factorial of a number (i)using recursion, (ii) using iteration
- 20. WAP to calculate GCD of two numbers (i) with recursion (ii) without recursion
- 21. Create Matrix class using templates. Write a menu-driven program to perform following Matrix operations (2-D array implementation): a) Sum b) Difference c) Product d) Transpose.
- 22. WAP to count frequency of each element of an array.
- 23. WAP to find encoded array from original array for any parameter.
- 24. WAP to perform following operation on string without using Library function:
 - a) Length of a string
 - b) Reverse of a String
 - c) Check it is palindrome or not
- 25. WAP to count sum of each digit of string if string have only digits.
- 26. WAP to calculate sum of n number using command line argument.
- 27. WAP to convert lower to upper case or vice-versa of each character of string..
- 28. WAP to count vowel's in a string.
- 29. WAP to create a structure of student (ID, Name, Age) perform Insert and display operation.
- 30. WAP to perform operation on file handling:
 - a) Write character into a file.
 - b) Read character from a file.
 - c) Create Copy a file.



BCA – 102 Computer Organization and Architecture

Course Objectives: The course focus on structure and function of the computer system. Analyze and understand the Logic Gates, Boolean algebra, Combinational and sequential circuits, instruction set. Addressing modes, Memory hierarchy, I/O systems DMA Technique.

Course Outcomes: At the end of the course, students will be able to

- CO-1: Identify various components of computer and their interconnection.
- CO-2: Understand the concepts of logic gates, Different Digital Circuit.
- CO-3: Use of the data representation technique.
- CO-4: Compare and select various Memory devices.
- CO-5: Understanding the various types of IO mapping techniques.

Course Contents:

Unit-I

Digital Logic Circuits: Logic gates Boolean algebra, map simplification, combinational circuits, and sequential circuits.

Unit-II

Data Representation: Representation signed and unsigned integer, fixed-point representation, floating – point representation, other binary codes.

Unit-III

Basic Computer Organization and Design: computer instruction, Instruction codes, timing and control, execution and instruction, input-output and interrupt, priority interrupt, design of computer.

Unit-IV

Central Processor Organization: Processor bus organization, arithmetic logic unit (ALU) instruction formats, addressing modes, data transfer and manipulation, program control, microprocessor organization.

Unit-V

Memory Organization: Auxiliary memory, microcomputer memory hierarchy, associative memory, virtual memory, cache memory. **Input-Output Organization:** Peripheral devices. Asynchronous and synchronous data transfer, direct memory access (DMA), input –output processor (IOP).

Suggested Text Books:

- 1. Williams S. Computer Organization and Architecture. PHI.
- 2. Mano, M.M. Computer Organization and Architecture, PHI.

Reference Book:

1. John P. Hayes, Computer Architecture and Organization, Tata McGrawHill.



BCA-103 Discrete Mathematics

Course Objective: To understand the role of **'Discrete Mathematical Structures' in scientific computing and logic development** through practical exercises aspiring to be successful in the world of Computer Science.

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

- CO-1. Understand the key concept of propositions, set, relation and function and its operations.
- CO-2. Construct truth table of any compound proposition and use logically equivalent statements.
- CO-3. Evaluate Boolean algebra expressions and functions; algebraic representations of the functioning of logic gates.
- CO-4. Simplify the Boolean expression representing circuits.
- CO-5. Demonstrate graph, path, cycles, complement of a graph, trees and its types
- CO-6. Knowledge about representing matrix, operations on matrix and to solve system of linear equations using rank.

Course Contents

UNIT-I

Introduction and Preliminaries: Logical connectives, Truth tables, Tautologies and Contradiction, Logical equivalence, Algebra of propositions. **Set Theory:** Set, Singleton set, Finite and Infinite sets, Subsets, Proper subsets, Equality of sets, Union, Intersection and Difference of sets, Universal set, De Morgan laws, Symmetric difference of sets, Generalized De Morgan laws, Cartesian product of sets.

UNIT-II

Relations: Relation between two sets, Binary relation on a set, Types of binary relations, Equivalence relation, Equivalence class, Partition of a set, Fundamental theorem of equivalence relation, Composition of relations. **Functions:** Function or mapping, One-one, Many-one, into and onto mappings, Identity mapping, Constant mapping, Equality of mappings, Inverse of a mapping, Composition of mappings.

UNIT-III

Boolean algebra: Definition and properties of Boolean algebra, a brief introduction to the application of Boolean algebra to switching theory, conversion of complicated switching circuits to simple one, Disjunctive and Conjunctive normal forms. **Graph Theory:** Introduction to graph theory, Paths and Circuits, Trees, Spanning trees.

UNIT-IV

Matrices: Introduction, Expression of complex numbers in the form of a matrix, De Moivre's theorem, Elementary transformations, Elementary matrices, Equivalent matrices, Properties of equivalent matrices, Sub-matrix of a matrix, Rank and Nullity of a matrix, Row equivalence and canonical form, Normal form of a matrix.



UNIT-V

Solution of Homogeneous and Non-homogeneous system of linear equations, Characteristic roots and Characteristic vectors of a matrix, Caley-Hamilton theorem, to find the inverse of a non-singular matrix using Caley-Hamilton theorem.

Suggested Readings

Main Text Books

- 1. Tremblay, J. P., & Manohar, R. (1975). *Discrete mathematical structures with applications to computer science*. McGraw-Hill, Inc.
- 2. Deo, N. (2017). *Graph theory with applications to engineering and computer science*. Courier Dover Publications.

Reference Books

- 1. Liu, C. L. (1987). *Elements of discrete mathematics*. Tata McGraw-Hill Education.
- 2. Johnsonbaugh, R. (2005). Discrete Mathematics. Pearson Education.
- 3. Bernard, K., Robert, B., & Sharon, R. (1996). *Discrete mathematical structures*. Prentice Hall of India.



BCA – 104 Communicative English Grammars

Course Objective: To enable students to learn General English Grammar and its use in daily life.

- Course Outcomes: On successful completion of this course students will be able to
- CO-1. Enhance the learner's communication skills by giving adequate exposure in listening, speaking, reading and writing skills and the related sub-skills.
- CO-2. Recognize and operate in various styles and registers in English.
- CO-3. Get rid of his present flaws and mistakes in pronunciation and grammar.
- CO-4. Identify and repair the voids in his present vocabulary and pronunciation targeting those specific array of words which create a barrier in his thought process.
- CO-5. Boost confidence in oral and interpersonal communication by reinforcing the basics of pronunciation specially focusing on interviews/ corporate meetings/ international business travels.
- CO-6. Achieve adequate linguistic skills to help him compete well in international certification tests of English such as IELTS and TOEFL.

Course Contents:

Unit-I

Sentence- its kinds, subject and predicate. Parts of Speech- Noun, Pronoun, Adjective, Verb and Adverb, Preposition, Conjunction, Interjection in detail.

Unit-II

The Structure of Sentences- Clauses (subordinate and coordinate) and Phrases, Simple, Complex and Compound Sentences.

Unit-III

Tenses- Present, Past and Future (Indefinite, Continuous, Perfect, Perfect Continuous) Conditional Sentences, Subject Verb Agreement (Concord), Active and Passive Voice, Direct and Indirect Narration.

Unit-IV

Infinitive and the Ing form, Participles and Gerund, Relative Clauses, Articles, Determiners, Punctuation.

Unit-V

Letters and Application, Writing, Newspaper Reports, Paragraph Writing, Precis Writing, Seminar Presentation, Writing a CV/ Resume.

Suggested Text Books:

- 1. Leech, G. N., Leech, G., & Svartvik, J. (2002). *A communicative grammar of English*. Pearson Education.
- 2. Thomson, A. J., & Martinet, A. V. (1980). *A practical English grammar*. Oxford University Press.
- 3. Wood, F. T. (1965). A remedial English grammar for foreign students. Macmillan.

Reference Books:

- 1. Lewis, N. (1991). Word power made easy. Simon and Schuster.
- 2. Swan, M. (2005). Practical english usage. Oxford Univ. Press.
- 3. Allen, W. S. (1954). *Living English structure: a practice book for foreign students and key.* Longmans, Green.



BCA – 102P Lab

Practical exercises based on MS Office tools using document preparation, presentation preparation and spreadsheet handling packages.

MS Word

1. Prepare a grocery list having four columns (Serial number, The name of the product, quantity and price) for the month of April, 06.

- Font specifications for Title (Grocery List): 14-point Arial font in bold and italics.
- The headings of the columns should be in 12-point and bold.
- The rest of the document should be in 10-point Times New Roman.
- Leave a gap of 12-points after the title.
- 2. Create a telephone directory.
 - The heading should be 16-point Arial Font in bold
 - The rest of the document should use 10-point font size
 - Other headings should use 10-point Courier New Font.
 - The footer should show the page number as well as the date last updated.
- 3. Design a time-table form for your college.

• The first line should mention the name of the college in 16-point Arial Font and should be bold.

• The second line should give the course name/teacher's name and the department in 14-point Arial.

- Leave a gap of 12-points.
- The rest of the document should use 10-point Times New Roman font.
- The footer should contain your specifications as the designer and date of creation.

4. BPB Publications plans to release a new book designed as per your syllabus. Design the first page of the book as per the given specifications.

• The title of the book should appear in bold using 20-point Arial font.

• The name of the author and his qualifications should be in the center of the page in 16-point Arial font.

• At the bottom of the document should be the name of the publisher and address in 16-point Times New Roman.

• The details of the offices of the publisher (only location) should appear in the footer.

5. Create the following one page documents.

a. Compose a note inviting friends to a get-together at your house, Including a list of things to bring with them.

- b. Design a certificate in landscape orientation with a border around the document.
- c. Design a Garage Sale sign.

d. Make a sign outlining your rules for your bedroom at home, using a numbered list.

6. Create the following documents:

(a) A newsletter with a headline and 2 columns in portrait orientation, including at least one image surrounded by text.

(b) Use a newsletter format to promote upcoming projects or events in your classroom or college.



7. Convert following text to a table, using comma as delimiter. Type the following as shown (do not bold).

Color, Style, Item Blue, A980, Van Red, X023, Car Green, YL724, Truck Name, Age, Sex Bob, 23, M Linda, 46, F Tom, 29, M

8. Enter the following data into a table given on the next page.

Salesperson	Dolls	Trucks	Puzzles
Kennedy, Sally	1327	1423	1193
White, Pete	1421	3863	2934
Pillar, James	5214	3247	5467
York, George	2190	1278	1928
Banks, Jennifer	1201	2528	1203
Atwater, Kelly	4098	3079	2067
Pillar, James	5214	3247	5467
York, George	2190	1278	1928
Banks, Jennifer	1201	2528	1203
Atwater, Kelly	4098	3079	2067

Add a column Region (values: S, N, N,S,S,S) between the Salesperson and Dolls columns to the given table Sort your table data by Region and within Region by Salesperson in ascending order:

Then you will add a new row to your table, place the word "Total" at the bottom of the Salesperson column, and sum the Dolls, Trucks, and Puzzles columns.

9. Wrapping of text around the image.

10. Following features of menu option must be covered

FILE Complete menu EDIT Complete menu VIEW Complete menu INSERT Complete menu FORMAT Complete menu TABLE Complete menu WINDOW Complete menu HELP Complete menu TOOLS All options except Online collaboration, Tools on Macro, Templates

MS Excel

1. Enter the Following data in Excel Sheet

REGIONAL SALES PROJECTION

State	Qtr1	Qtr2	Qtr3	QTR4	Qtr Total Rate Amount
Delhi	2020	2400	2100	3000	15
Punjab	1100	1300	1500	1400	20
U.P.	3000	3200	2600	2800	17



 Rajasthan
 2100
 2000
 1800
 2200
 2700

 TOTAL
 AVERAGE
 2000
 1800
 2200
 2000
 2000

- (a) Apply Formatting as follow:
 - I.Title in TIMES NEW ROMAN
 - ii. Font Size 14
 - iii. Remaining text ARIAL, Font Size -10
 - iv. State names and Qtr. Heading Bold, Italic with Gray Fill Color.
 - v. Numbers in two decimal places.
 - vi. Qtr. Heading in center Alignment.
 - vii. Apply Border to whole data.
- (b) Calculate State and Qtr. Total
- (c) Calculate Average for each quarter
- (d) Calculate Amount = Rate * Total.

2. Given the following worksheet

А В С D 1 Roll No. Name Marks Grade 2 1001 Sachin 99 3 1002 Sehwag 65 4 1003 Rahul 41 5 1004 Sourav 89 6 1005 Bhajan 56

Calculate the grade of these students on the basis of following guidelines: If Marks Then Grade

II Marks	Then G
>= 80	A+
>= 60 < 80	А
>= 50 < 60	В
< 50	F

3. Given the following worksheet

			-				
	А	В	С	D	E	F	G
1	Salesman			Sales i	in (Rs.)		
2	No.	Qtr1	Qtr2	Qtr3	Qtr4	Total	Commission
3	S001	5000	8500	12000	9000		
4	S002	7000	4000	7500	11000		
5	S003	4000	9000	6500	8200		
6	S004	5500	6900	4500	10500		
7	S005	7400	8500	9200	8300		
8	S006	5300	7600	9800	6100		

Calculate the commission earned by the salesmen on the basis of following Candidates:

If Total Sales	Commission
< 20000	0% of sales



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20000 and < 25000 4% of sales > 25000 and < 30000 5.5% of sales > 30000 and < 35000 8% of sales >= 3500011% of sales

The total sales is sum of sales of all the four quarters.

4. A company XYZ Ltd. pays a monthly salary to its employees which consists of basic salary, allowances & deductions. The details of allowances and deductions are as follows: Allowances

• HRA Dependent on Basic 30% of Basic if Basic <=1000 25% of Basic if Basic>1000 & Basic<=3000 20% of Basic if Basic >3000 • DA Fixed for all employees, 30% of Basic Conveyance Allowance Rs. 50/- if Basic is <=1000 Rs. 75/- if Basic >1000 & Basic <= 2000 Rs. 100 if Basic >2000 • Entertainment Allowance NIL if Basic is <=1000 Rs. 100/- if Basic > 1000 **Deductions** • Provident Fund 6% of Basic Group Insurance Premium Rs. 40/- if Basic is <=1500 Rs. 60/- if Basic > 1500 & Basic <= 3000 Rs. 80/- if Basic >3000

Calculate the following:

Gross Salary = Basic + HRA + DA + Conveyance + Entertainment Total deduction = Provident Fund + Group Insurance Premium Net Salary = Gross Salary – Total Deduction

5. Create Payment Table for a fixed Principal amount, variable rate of interests and time in the format below:

No. of Instalments 5% 6% 7% 8% 9%

3	XX	XX	XX	XX	XX
4	XX	XX	XX	XX	XX
5	XX	XX	XX	XX	XX
6	XX	XX	XX	XX	XX

6. Use an array formula to calculate Simple Interest for given principal amounts given the rate of Interest and time

Rate of Interest	8%
Time	5 Years
Principal	Simple Interest
1000	?
18000	?
5200	?



The following table gives year wise sale figure of five salesmen in Rs.

Salesman	2000	2001	2002	2003
S 1	10000	12000	20000	50000
S2	15000	18000	50000	60000
S 3	20000	22000	70000	70000
S 4	30000	30000	100000	80000
S5	40000	45000	125000	90000

(a) Calculate total sale year wise.

(b) Calculate the net sale made by each salesman

(c) Calculate the maximum sale made by the salesman

(d) Calculate the commission for each salesman under the condition.

(i) If total sales >4,00,000 give 5% commission on total sale made by the salesman.

(ii) Otherwise give 2% commission.

(e) Draw a bar graph representing the sale made by each salesman.

(f) Draw a pie graph representing the sale made by salesman in 2000.

8. Enter the following data in Excel Sheet

PERSONAL BUDGET FOR FIRST QUARTER

Montiny Income (.	(Net): 1,4/	3			
EXPENSES	JAN	FEB	MARCH	QUARTER TOTAL	QUARTER AVERAGE
Rent	600.00	600.00	600.00		
Telephone	48.25	43.50	60.00		
Utilities	67.27	110.00	0 70.00		
Credit Card	200.00	110.00	0 70.00		
Oil	100.00	150.00	90.00		
AV to Insurance	150.00				
Cable TV	40.75	40.75	6 40.75		
Monthly Total					

Calculate Quarter total and Quarter average.

(a) Calculate Monthly total.

(b) Surplus = Monthly income - Monthly total.

(c) What would be total surplus if monthly income is 1500.

(d) How much does telephone expense for March differ from quarter average.

(e) Create a 3D column graph for telephone and utilities.

(f) Create a pie chart for monthly expenses.

9. Enter the following data in Excel Sheet

TOTAL REVENUE EARNED FOR SAM'S BOOKSTALL

Publisher name	1997	1998	1999	2000	total
А	Rs. 1,000.00	Rs. 1100.00	Rs. 1,300.00	Rs. 800.00	
В	Rs. 1,500.00	Rs. 700.00	Rs. 1,000.00	Rs. 2,000.00	
С	Rs. 700.00	Rs. 900.00	Rs. 1,500.00	Rs. 600.00	
D	Rs. 1,200.00	Rs. 500.00	Rs. 200.00	Rs. 1,100.00	
E	Rs 800.00	Rs. 1,000.00	Rs. 3,000.00	Rs. 560.00	

7.



(a) Compute the total revenue earned.

(b) Plot the line chart to compare the revenue of all publisher for 4 years.

(b) Chart Title should be _Total Revenue of sam's Bookstall (1997-2000)'

(c) Give appropriate categories and value axis title.

10. Generate 25 random numbers between 0 & 100 and find their sum, average and count. How

many no. are in range 50-60



BCA – 201 Data Structure

Course Objectives: The goal of this subject is to introduce the theory and develop the algorithm of different types of data structure. Understanding the operation of different data structure and implement in C++. Explain use and application in real life for different data structure.

Course Outcomes: At the end of the course, students will be able to

- CO-1: Understand how data structures map onto physical memory.
- CO-2: Develop knowledge of basic data structures for storage and retrieval of ordered or unordered data. Data structures include: arrays, linked lists, binary trees, heaps, and hash tables.
- CO-3: Knowledge of applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching, and sorting of each data structure.
- CO-4: Compare different implementations of the same or different data structure.

Course Contents:

Unit-I

Introduction To Data Structure, Array, Records, Stacks Introduction to Stack & Primitive Operation on Stack, Stack as an Abstract Data Type, Multiple Stack, Stacks Application: Infix, Post Fix, Prefix and Recursion, Introduction to Queues, Primitive Operations on the Queues, Queue as an Abstract Data Type, Circular Queue, Dequeue, Priority Queue, Applications of Queue.

Unit-II

Pointer, It's Limitation and Operation. Linked List & their type: linear, circular & Doubly linked list, Operations on various type of linked list, application of Linked list: Polynomial manipulation.

Unit-III

Tree: General & Binary Tree. Conversion of General to Binary Tree. Binary Search Tree (BST) & It's Representation And Operation. Traversal Methods- In Order, Preorder & Post Order, Application of Binary Tree: Manipulation of Arithmetic Expression. Multiway Search Tree, Balance Tree & Their Types.

Unit-IV

Graph: Graph & Their Category & Representations, Traversing Technique: Breadth First & Depth First Search. Spanning Trees (St), Technique of Minimun Spanning Tree (MST), Application of Graphs: Pert & Related Techniques.

Unit-V

Heaps and Hash Table. Introduction to file organization; Sequential, Indexed sequential, Relative & Direct file organization. Searching : Linear & Binary Search. Sorting: Concept, selection sort, Bubble sort merge Sort, Tree sort & Partition - Exchange sort.

Suggested Text Books:

1. Trembley & Sorrenson. Data Structure. Tata Mcgraw Hill.



2. Salaria R.S. Data Structures and Algorithms using C++. Khanna

Publishing.

3. Lipschuists. Data Structure. Schaum's Outline Series. Mcgraw Hill Publication.

Reference Books:

- 1. Kruse R.L. Data Structure and Program design in C. PHI
- 2. Sahni S. & Horowitz E. Fundamentals of Data Structure. Galgotia Publication.

BCA – 201P Data Structure Lab

- 1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
- 2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
- 3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
- 4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
- 5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
- 6. Perform Stack operations using Linked List implementation.
- 7. Perform Stack operations using Array implementation. Use Templates.
- 8. Perform Queues operations using Circular Array implementation. Use Templates.
- 9. Perform Queue operations using Linked List implementation.
- 10. WAP to scan a polynomial using linked list and add two polynomial.
- 11. WAP to perform following operation on BST:
 - (a) Insert a Node
 - (b) Delete a Node
 - (c) Search a Node
 - (d) Traversing BST using (Inorder, Preorder, Postorder)
 - (e) Find Max Node
 - (f) Find Min Node
 - (g) Count Internal Node
 - (h) Count External Node
 - (i) Count Total Node.
- 12. WAP to perform following operation on Graph:
 - (a) Insert a Node
 - (b) Insert a Edge
 - (c) Search a Node
 - (d) Traversing(BFS, DFS)



BCA – 202 Data Base Management System (DBMS)

Course Objective: This course covers fundamentals of database architecture, database management systems, and database systems. Principles and methodologies of database design, and techniques for database application development.

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

- CO-1: Understand key concepts of database, ER model and relational model, principles of transaction concept and distributed database.
- CO-2: Acquire knowledge about Integrity rules and apply various normalization techniques.
- CO-3: Execute various advance SQL queries related to relational algebra.
- CO-4: Develop an enterprise data model that reflects the organization's fundamental business rules.
- CO-5: Knowledge about Protection of database against crashes, Backup and Integrity violation.

Course Contents:

Unit-I

Introduction: Database system concepts, Data base system, Advantages of database systems; Data Architecture of data system: View/Schema, logical, conceptual and physical and their interrelationship DDL, DML and data dictionary, Data base administrator. Entity Relationship Model as a tool of conceptual design: Entities &Entity set, Relationship & Relationship set, Attributes, Mapping Constraints, Keys, Entity-Relationship diagram (E-R diagram): Strong & weak entities, Generalization, Specialization, Aggregation, Reducing ER diagram to tables.

Unit-II

Relational, Hierarchical and Network Model their advantages and disadvantages, storage organization for Relations. Rational Model: Structure tupple Attributes, Normalization: First, Second, Third & BCNF Normal Forms, key, primary key, Candidate key, Integrity rules: Entity integrity, Referential integrity rule.

Unit-III

Relational Algebra: Select, Project, Cross Product, Different types of Joins i.e. Theta Join, Equi Join, Natural join, Outer Join, Set Operations, Definition of Union, Set Difference, Cartesian Product, Selection, Intersection, Relational Query Language.

Unit-IV

Functional Protection and Crash Recovery: Protection, against crashes, Different types of crashes, Backup, Journal, Rollback, Committed and Uncommitted transactions, Security on Database.

Unit-V

Transaction concept, Transaction state, serializability security or <u>D</u>atabase: user identification. Physical Protection and maintenance, Transmitted of Rights. Integrity: Integrity violation, Implementation of check's in enforcing integrity; Concept of Distributed database.



Suggested Text Books:

- 1. Ullman. Principles of Database Systems, 2e. Galgotia Publications.
- 2. Silberschatz, Korth, & Sudershan. Database System Concepts, 5e. McGraw Hill.
- 3. Desai, Bipin C. An Introduction to Database System. Galgotia Publications.

Reference Books

- 1. Date, C.J. An Introduction to Data Base Systems, 8e. Narosa Publications.
- 2. Patric, O`neil, & Elizabeth, O`neil. *Database Principles, Programming and Performance, 2e.* Margon Kaufmann Publishers Inc.
- 3. Ramez, Elmasri, & Shamkant. B. *Fundamentals of Database Systems, 6e.* Navathe Addison-Wesley.

BCA – 202P Data Base Management System (DBMS) Lab

Create and use the following database schema to answer the given queries. **Employee Schema**

Field	Туре	NULL]	KEY	DEFAULT
Eno	Char(3)	NO	PRI	NIL
Ename	Varchar(50)	NO		NIL
Job_type	Varchar(50)	NO		NIL
Manager	Char(3)	Yes	FK	NIL
Hire_date	Date	NO		NIL
Dno	Integer	YES	FK	NIL
Commission	Decimal(10,2)	YES		NIL
Salary	Decimal(7,2)	NO		NIL

DEPARTMENT Schema

Field	Туре	NULL KEY	DEFAULT
Dno	Integer	No PRI	NULL
Dname	Varchar(50)	Yes	NULL
Location	Varchar(50)	Yes	New Delhi

Query List

- 1. Query to display Employee Name, Job, Hire Date, Employee Number; for each employee with the Employee Number appearing first.
- 2. Query to display all the data from the Employee Table. Separate each Column by a comma and name the said column as THE_OUTPUT.
- 3. Query to display the Employee Name and Salary of all the employees earning more than \$2850.
- 4. Query to display Employee Name and Department Number for the Employee No= 7900.
- 5. Query to display Employee Name and Salary for all employees whose salary is not in the range of \$1500 and \$2850.
- 6. Query to display Employee Name and Department No. of all the employees



in Dept 10 and Dept 30 in the alphabetical order by name.

- 7.
- 7. Query to display Name and Hire Date of every Employee who was hired in 1981.
- 8. Query to display Name and Job of all employees who don't have a current Manager.
- 9. Query to display the Name, Salary and Commission for all the employees who earn commission.
- 10. Sort the data in descending order of Salary and Commission.
- 11. Query to display Name of all the employees where the third letter of their name is 'A'.
- 12. Query to display Name of all employees either have two 'R's or have two 'A's in their name and are either in Dept No = 30 or their Manger's Employee No = 7788.
- 13. Query to display Name, Salary and Commission for all employees whose Commission Amount is 14 greater than their Salary increased by 5%.
- 14. Query to display the Current Date.
- 15. Query to display Name, Hire Date and Salary Review Date which is the 1st Monday after six months of employment.
- 16. Query to display Name and calculate the number of months between today and the date each employee was hired.
- 17. Query to display the following for each employee <E-Name> earns < Salary> monthly but wants < 3 * Current Salary >. Label the Column as Dream Salary.
- 18. Query to display Name with the 1st letter capitalized and all other letter lower case and length of their name of all the employees whose name starts with 'J', 'A' and 'M'.
- 19. Query to display Name, Hire Date and Day of the week on which the employee started.
- 20. Query to display Name, Department Name and Department No for all the employees.
- 21. Query to display Unique Listing of all Jobs that are in Department # 30.
- 22. Query to display Name, Dept Name of all employees who have an 'A' in their name.
- 23. Query to display Name, Job, Department No. And Department Name for all the employees working at the Dallas location.
- 24. Query to display Name and Employee no. Along with their Manger's Name and the Manager's employee no; along with the Employees' Name who do not have a Manager.
- 25. Query to display Name, Dept No. And Salary of any employee whose department No. and salary matches both the department no. And the salary of any employee who earns a commission.
- 26. Query to display the Highest, Lowest, Sum and Average Salaries of all the employees
- 27. Query to display the number of employees performing the same Job type functions.
- 28. Query to display the Department Name, Location Name, No. of Employees and the average salary for all employees in that department.
- 29. Query to display Name and Hire Date for all employees in the same dept. as Blake.
- 30. Query to display the Employee No. And Name for all employees who earn more than the average salary.



BCA – 203 Mathematics –II (Calculus)

Course Objective: The objective of this course is to familiarize the students with core concepts of calculus.

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

- CO-1. Understand the key concept of differentiation, Partial derivative, tracing of curves and ordinary differential equation.
- CO-2. Evaluate differentiation at different points of given interval using different theorems.
- CO-3. Analyse asymptotes and tracing of curves.
- CO-4. Solve simultaneous differential equation of first order.
- CO-5. Knowledge about various methods to solve differential equations of first order and first degree.

Course Contents:

Unit-I

Successive, Leibnitz Theorem, Taylor's & Maclaurin's series, Tests for Concavity and Convexity, Points of Inflexion, Asymptotes, Tracing of Curves in Cartesian co-ordinates.

Unit-II

Partial differentiation: Function of several variables, Limits, continuity and differentiability, Partial derivatives, Euler's Theorem, Mean value theorem & Taylor's theorem for functions of two variables.

Unit-III

Envelope, Maxima, Minima and saddle points of functions of two variables, Lagrange's multiplier method.

Unit-IV

Differential Equations of First Order and First Degree: Separation of variables, Homogeneous Differential Equations, Reducible to Homogeneous Differential Equations, Linear Differential Equations, Reducible to Linear Differential Equations, Bernoulli's Equation, Exact Differential Equations, Change of Variables.

Unit–V

Linear Differential Equations of Higher order with constant coefficients, Differential Equations reducible to Linear Differential Equations with Constant Coefficients, Simultaneous differential equation of first order.

- 1. Agrawal, D.C. Advanced Calculus. Shree Sai Prakashan, Meerut
- 2. Apostol, Tom M. One-Variable Calculus with an Introduction to Linear Algebra, Vol (1), 2e. Wiley Eastern.
- 3. Raisinghania, M. D. Ordinary and Partial Differential Equations. S. Chand & Company Ltd.



Reference Books:

- 1. Stewart, J. Calculus with Early Transcendental Functions, 7e. Cengage Learning India
- 2. Hallett H. Calculus Single and Multivariable, 6e. John-Wiley and Sons.



BCA – 204 Communication Techniques

Course Objective: The course is designed to enable students to enhance ability to comprehension of spoken and written English (and use English) required for effective communication in their professional work.

Course Outcomes: On successful completion of this course students will be able to

- CO-1. Distinguish among various levels of organizational communication and communication barriers while developing an understanding of communication as a process in an organization
- CO-2. Draft effective business correspondence with brevity and clarity.
- CO-3. Demonstrate his verbal and non-verbal communication ability through presentations.
- CO-4. Use technology to communicate effectively in various settings and contexts.
- CO-5. Understand and apply knowledge of human communication and language processes as they occur across various contexts, e.g., interpersonal, intrapersonal, small group, organizational, media, gender, family, intercultural communication, technologically mediated communication, etc. from multiple perspectives.

Course Contents:

Unit-I

Language Skills (Listening, Speaking, Reading, Writing): An introduction, Communication: Its Process, Types and Significance, Media, Channels, Role of Communication. Communication: Principles of Communication, Barriers to Communication, Seven C'S, Verbal and Non Verbal Communication, Body Language.

Unit-II

Listening: Effective and efficient listening in various situations (discussions, lectures, news, seminars, speech, telephone calls etc.); Strategies for effective listening, Difference between Listening and Hearing.

Reading: Purpose; Comprehension; Tactics and strategies for good reading; Writing: Guidelines for good writing; various writing styles (General and Technical writing styles).

Unit-III

Presentation and delivery; role of speaker and audience; style and body language. Business Reports, Business letters, Memos, Presentation Skills, Press management, Meetings, Agenda, Notices, Minutes, Seminars, Conferences, Workshops.

Unit-IV

Group Discussion, Interview Process, Frequently asked questions, Writing Emails, PPT Presentations, Telephone Etiquettes, Negotiation Skills.

Unit-V

General and Technical documents (correspondence (applications, letters, Resumes), drafts, proposals, précis, synopsis,)

References:

- 1. Ajmani, J. C. (2011). Good English: getting it right. Rupa Publications.
- 2. Hasson, G. (2012). Brilliant communication skills: What the best communicators know, do and say. Pearson UK.
- 3. Raman, M., & Sharma, S. (2015). *Technical communication: Principles and practice*. Oxford University Press.



Course Objectives: This course aims to familiarize the students with basic components of a computer operating system along with the interactions among those components. The course will cover an introduction to the policies of CPU scheduling, deadlocks, memory management strategies, process synchronization and system calls

Course Outcomes: On successful completion of this course, the students will be able to

- CO1: Analyze the structure of computer system and basic architectural components involved in OS design.
- CO2: Develop and understanding of the concepts related to process and its life cycle.
- CO3: Evaluate CPU scheduling algorithms and solve numerical problems related to the same.
- CO4: Demonstrate a grasp on the concepts of process synchronization and inter process communication.
- CO5: Illustrate an in-depth understanding of deadlocks and techniques of handling deadlocks.
- CO6: Explore various algorithms pertaining to memory allocation and memory management techniques.

Course Contents:

Unit-I

Computer System Overview, Basic Components of Computer System, Operating System Services, Functions of Operating System, Types of Operating Systems: Instruction Execution Cycle, Interrupts & System Calls, Interrupt Processing, Processor Registers, I/O Communication techniques

Unit-II

Process Management: Concept of Process, Creation & Termination of Process, Process Attributes; Process Control Block, Process State Models- Two State, Five State, and Seven State. CPU Scheduling: Scheduling Criteria, Scheduling Algorithms, Multiple Processor Scheduling, Real-Time Scheduling.

Unit-III

Process Synchronization: The Critical Section Problem, Peterson's Solution, Semaphores, Classical Problems of Synchronization, Monitors, Atomic Transactions.

Unit-IV

Deadlocks: System Model, Deadlock Characterization: Necessary Conditions for Deadlock, Resource Allocation Graph; Method for Handling Deadlocks: Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Unit-V

Memory Management Strategies: Memory Hierarchy, Cache Memory, Swapping, Loading and Linking, Information Protection, Memory Allocation, Fixed partitioning, dynamic partitioning, Paging, Segmentation, Segmetation with Paging, Virtual Memory, Demand Paging, Performance of Demand Paging, Page Replacement, Page Replacement Algorithms



Suggested Textbooks:

- 1. Silberschatz, Abraham, Peter Baer Galvin, Greg Gagne (2009). *Operating System Concepts, 8e.* Wiley Publications
- 2. Stallings, W. (2013). *Operating Systems: Internals and Design Principles*, *7e.* Pearson Education India

Reference Books:

- 1. Tanenbaum, Andrew S. (2016). Modern Operating Systems, 4e. Pearson Education India
- 2. Bach, Maurice J. (2015). *Design of the UNIX Operating System, 1e.* Pearson Education India
- 3. Arpaci-Dusseau, Remzi H. & Andrea C. Arpaci-dusseau (2018). *Operating Systems: Three Easy Pieces*. Amazon Digital Services



BCA – 302 Object Oriented Programming in C++

Course Objectives:

- 1. To strengthen the problem solving ability by applying the characteristics of an objectoriented approach.
- 2. Demonstrate adeptness of object oriented programming in developing solutions to problems demonstrating usage of data abstraction, encapsulation, and inheritance.
- 3. To introduce object oriented concepts in C++.

Course Outcomes: At the end of the course, students will be able to

- CO-1: Explain what constitutes an object-oriented approach to programming and identify potential benefits of Object-oriented programming over other approaches.
- CO-2: Analyze and decompose problem specifications from Object Oriented Perspectives
- CO-3: Understanding the concept of different features of OOPs.
- CO-4: Develop console application, using object-oriented approach.
- CO-5: Use of File handing in CPP programming.

Course Contents:

Unit-I

Introduction, OOP languages, characteristics of OOP's languages, application of OOP's, OOP's paradigm, concepts, benefits of OOP's, disadvantage of OOP's. Application of OOP's., Classes & Objects: Specifying a Class, Creating Objects, Accessing Class members, Defining member function, Outside Member Functions as inline, Accessing Member Functions within the class, Static data member, Access Specifiers: Private, Protected and Public Members. Passing objects to function, Returning objects, Object assignment, This pointer.

Unit-II

Constructor & Destructor: Introduction, Constructor, Parameterized constructor, Multiple constructor in a class, Constructor with default argument, Copy constructor, Default Argument, Destructor.

Array, Pointers, and references: Array of objects, Pointers to object, , Pointer to class members. References: Reference parameter, Passing references to objects, Returning reference, Independent reference, The Dynamic Allocation operators, Initializing allocated memory, Allocating Array, Allocating objects.

Unit-III

Function & operator overloading : Function overloading, Overloading constructor function finding the address of an overloaded function, Operator Overloading: Creating a member operator function, Creating Prefix & Postfix forms of the increment & decrement operation, Overloading the shorthand operation (i.e. +=,-= etc), Operator overloading restrictions, Operator overloading using friend function, Overloading New & Delete, Overloading some special operators, Overloading [], (), -, comma operator, Overloading << and >> .

Unit-IV

Inheritance: Base class Access control, Inheritance & protected members, Protected base class inheritance, Inheriting multiple base classes, Constructors, destructors & Inheritance, When constructor & destructor function are executed, Passing parameters to base class



constructors, Granting access, Virtual base classes. Virtual functions & Polymorphism: Virtual function, Pure Virtual functions, Early Vs. late binding

Unit-V

The C++ I/O system basics: C++ streams, The basic stream classes: C++ predefined streams, Formatted I/O: Formatting using the ios members, Using manipulators to format I/O, Creating your own manipulators, -File Management: Introduction – File handling, File structure, File handling function, File types, Streams, Text, Binary, File system basics, The file pointer, Opening a file, Closing a file, Reading and Writing File.

Suggested Text Books:

- 1. R. Subburaj. *Object Oriented Programming With C++*. Vikas Publishing House, New Delhi.
- 2. E. Balguruswamy. *C*++. TMH Publication.

Reference Books:

- 1. Schildt H. C++ The complete reference. TMH Publication.
- 2. Stroustrup B. *The C++ Programming Language*. Addison-Wesley.

BCA – 302P Object Oriented Programming in C++ Lab

Practical No.: 1

Objective: To illustrate the use of simple Input and output using cout , cin and to use arithmetic operators.

- 1. Write a program which calculates the salary by given basic salary.Hra is 20 % of basic and da is 40% of basic.
- 2. Write a program, which converts temperature in degree to Fahrenheit.
- 3. Write a program which calculates the Bill from given qty. and price and 10% discount.

Practical No.: 2

Objective: To Illustrate the Control statements (Branching and Looping).

1. Write a program to print the following output.

```
*
* *
* * *
* * *
```

2. Write a program which prints the grade of a student according to give percentage.

100 to 70 %	HONOURS
69 to 60 %	First
59 to 50 %	Second
else	Fail.
Using nested IF.	

3. Write a program to find greatest among three numbers.



Practical No.: 3

Objective: To Implement Function Overloading, Inline function and the advantages of using them.

- Write a program which defines three overloaded functions Sum(int, int) Sum(int, float) Sum(int, float,int) Calculates the sum of given parameters.
 Write a program which defines following. Overloaded functions
- 2. Write a program which defines following Overloaded functions Max(int, int, int) Max(int, float) Max(float, float, float) Max(float, int, float, int) The above functions prints the maximum number of given parameters.
- Write an Inline function square (float) which prints the square of the given parameter.
- 4. Write a CPP program to represent Default Arguments.

Practical No.: 4

Objective: To Implement the Classes and Objects. Use of public and private access specifiers. To implement the Constructors and Destructors.

- 1. Write a program which defines a Class **Employee** with member variables **name**, **address**, **basic**, **netsal**. And following functions **getdata()**, **calculatesal()**, **display()**.
- Write a program which defines a Class Employee with member variables name, address, basic, netsal. And following functions getdata(), calculatesal(), display().Define a constructor which initialize basic and netsal to 0 (Zero).Define a Destructor.

Practical No.: 5

Objective: To implement Operator Overloading unary and binary operator.

- 1. Write a program which overloads ++ operator (pre and post) which increments the object.
- 2. Write a program that overloads operator, which changes all the variables of class to negative.
- 3. Write a program to overload binary operator + which perform following operations. **Obj** + **100**.

Obj3 = Obj1+Obj2;

- 4. Write a program that Concatenates two string by overloading + operator.
- 5. Write a program that adds polar coordinates by overloading + operators.



Practical No.: 6

Objective: To implement simple ,multiple Inheritence

1. WAP to calculate students grade using Inheritance show in figure like:



- 2. WAP to implement Multiple Inheritance by using any example.
- 3. WAP to implement Hierarchical inheritance.

Practical No.: 7

Objective: Implementation of Pointers Virtual function and Dynamic binding.

1. Create following structure of classes.



Define a variables I in class A. In main assign the value 10 to I using object of D using virtual inheritance.

2. Define a class Media with members title ,price.define two derived classes Book (with member pages ,read(),display()) and Tape (with member runtime ,read() and display()) Declare a pointer type object of class Media .Read the type of media from user and call corresponding functions. Hint: Use dynamic polymorphysm.

Practical No.: 8

Objective: To read and write data to File using Files and Streams.

- 1. Write a program which defines a class Emp with members name, age, sal, read() write the data to a file Data.dat .Then read the data from that file and display the data.
- 2. Define a Class Person with members **Name**, **Age**, **Sal and address** and function get() which read these members and a function put() which writes these members to a file **Data.dat**.



PAPER CODE BCA – 303

Numerical Methods

Course Objective

To introduce the concept of Computer Oriented Numerical Methods.

Learning Outcomes

- CO-1. Able to understand the concept of approximate numbers, errors in numbers, representation of number in computer's memory and zeroes or roots of polynomial and/or transcendental equations.
- CO-2. To understand and learn various iterative techniques to solve simultaneous linear equations.
- CO-3. Able to understand various types of difference operators and their relationships.
- CO-4. To develop mathematical relationships for given observations of the variable using Interpolation techniques.
- CO-5. Able to understand the concept concerning numerical differentiation and Integration for a class of equidistant and unequal arguments.
- CO-6. To learn and understand numerical solution of ODE by techniques of Iterative methods.

Course Contents

UNIT – I

Floating point representation and computer arithmetic, Normalization and their consequences, Emphasis on computational Algorithms, Numerical Errors, Iterative methods, Zeros of a single transcendental equation and zeros of polynomials using Bisection, False position, Newton- Raphson and Secant methods, convergence of solutions.

UNIT – II

Simultaneous linear equations, Solution of simultaneous linear equations: Gauss elimination method with pivoting, Gauss – Jordan method, Jacobi's iteration method and Gauss – Seidel iteration method, Ill-conditioned equations and refinement of solutions.

UNIT – III

Difference Operators and Interpolation: Definition of Forward, Backward, Shifting, Divided difference, Central and Averaging Operators and their relationships, Newton's forward difference, backward difference and divided difference interpolation formulae, Lagrange's Interpolation formula.

$\mathbf{UNIT} - \mathbf{IV}$

Numerical Differentiation and Integration:

Numerical Differentiation using Newton's forward difference, backward difference and divided difference interpolation formulae, General Quadrature formula, Newton Cote's integration, Trapezoidal rule, Simpson's one – third and three – eight rules.



UNIT – V

Numerical Solution of Ordinary Differential equations by Euler's Method, Modified Euler's method, Taylor's series method, Picard's method, Runge Kutta, second order and fourth order methods, Predictor-corrector methods.

Suggested Readings:

Main Text Books

1. Numerical Methods for Scientific & Engg. Computer by Jain & Iyenger. New Age International Publishers

- 2. Numerical Method by E Balaguruswamy. TMH
- 3. Computer Oriented Numerical Method by R S Salaria. Khanna Publishers

Reference Books

- 1. Numerical Methods by B.S.Grewal. Khanna Publishers
- 2. Computer Oriented Numerical Methods by V.Rajaraman. PHI
- 3. Numerical Analysis by S.S.Sastry. PHI



BCA – 304 Visual C#.Net

Course Objective: This course is designed to familiarize students with the syntax of C#.NET, design of windows applications and connectivity with databases.

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

- CO-1. Understand .NET Framework and describe some of the major enhancements to the new version of Visual Studio IDE.
- CO-2. Describe the basic structure of a C#.NET project and use main features of the integrated development environment (IDE).
- CO-3. Create applications using Microsoft Windows Forms and ADO.NET.

Course Contents:

Unit- I

.NET Framework: Introduction, Common Language Runtime, Common Type System, Common, Language Specification, Base Class Library, .NET class library Intermediate language, Just inTime compilation, Garbage Collection, Application installation & Assemblies. Visual Studio IDE: Start Page, Menu and Tool Bar, Toolbox, Solution Explorer, Properties Window, Task List and Output Window, Server Explorer.

Unit –II

Programming in C#: Overview of C#, variables, datatypes, Operators: Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Assignment Operators, Unary Operators, Ternary Operators Misc Operators, keywords. Control statements, Functions, Arrays, Enum, structure.

Unit-III

Oop's Concept: encapsulation. Inheritance. Polymorphism, abstraction, class, object, methods, constructors, destructors. Collections, String functions, Exception handling, File I/O : file stream, StreamReader, StreamWriter, TextWriter, TextReader, binaryWriter, binaryWriter, StringReader, StringWriter. C# Attributes. C# Properties, C# Reflection.

Unit-IV

Basics of Windows Programming- Event Driven Programming, Windows Forms, Using common controls-Labels, textboxes, buttons, check boxes, radio button, progress bar, combo box, list box. Components-timer, imagelist, Menus, Modal and Modeless Dialog Boxes, MDI, Mouse and keyboard event handling.

Unit-V

Introduction to ADO.Net-Object Model- System. Data Namespace- Data Bound controls-Connected Mechanism-Disconnected mechanism-.Net Data Providers.

Suggested Text Books:

- 1. C# 4.0 the Complete Reference by Herbert Schildt
- 2. Latest version of Andrew Trolsens C# text from Apress(Pro C# 5.0 and the .NET Framework 4.5)

Reference Books:

1. Robert Powel, Richard Weeks, C# and the .NET Framework, Techmedia.



BCA – 401 Programming in Java

Course Objectives: This course intends to impart knowledge about basic Java language syntax and semantics to write Java programs. The course will cover the use of fundamentals of object-oriented programming in Java along with various concepts related to String creation and management, Java multithreaded model, and GUI programming using AWT & Swing.

Course Outcomes: On successful completion of this course, the students will be able to

- CO-1. Demonstrate an in-depth understanding of conceptual foundations and basics of string handling in Java
- CO-2. Successfully describe and define OOP principles in context to Java and write basic Java programs
- CO-3. Identify and illustrate the usage of collections framework in Java
- CO-4. Analyze the usage of Java's exception handling mechanism
- CO-5. Explore and implement interfaces in Java
- CO-6. Effectively create and manage packages in Java
- CO-7. Develop and implement multithreaded applications using Java
- CO-8. Use of various UI components like windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, through AWT & Swing and apply event handling on these components

Course Contents:

Unit-I

Introduction to Java: Versions of Java, Features of java, C++ V/s Java, Setting up Java environment, Java virtual machine. Constants & Variables, Declaration of Variables, Types of Variables, Scope of Variables, Data Types in Java, Operators in Java, Control Statements in Java. **Arrays:** Creating One Dimensional & Two Dimensional Arrays

Unit-II

Basic concepts of OOPS: OOPS terminology, Classes, Methods, Creating Instance & Class Variables, Accessing Class Members, Constructors, Method Overloading, Inheritance and its Types in Java, Method Overriding, Final Variables, Methods and Classes, finalize method, Abstract Methods & Classes, Visibility Control in Java, **Interfaces**: Defining Interfaces, Implementing and Inheriting Interfaces.

Unit-III

Concept of Package: In-built Packages, Using In-Built Packages, Creating User Defined Packages, Accessing a User-Defined Package, Adding a Class to a Package, **Working with Strings:** String, StringBuffer, and StringBuilder. **Collections Framework:** Set, List, Queue, Maps.

Unit-IV

Exception Handling in Java: Types of Exceptions in Java, Try-Catch-Finally, Using Multiple Catch Blocks, Nested Try, Throw and Throws Keyword. **Multithreading in Java:** Java Thread Model, Life Cycle Of a Thread, Creating Threads, Extending Thread Class, Stopping & Blocking A Thread, Thread Exceptions, Thread Priority, Thread Synchronization, Implementing Runnable Interface, Inter Thread Communication.

Unit-V

Introduction to GUI Programming in Java: AWT: Basic GUI Components of AWT,



Event Handling, Java Swing: Basic GUI Components of Swing, Difference between AWT and Swing

Suggested Textbooks:

- 1. Schildt, H. (2017). Java- The Complete Reference Tenth Edition. McGraw Hill Education
- 2. Balaguruswamy, E. (2019). Programming with Java Sixth Edition. McGraw-Hill
- Publications Performed Booker

Reference Books:

- 1. Sierra, Kathy & Bert Bates (2009). Head First Java. O'Reilly Publications
- 2. Horstmann, Cay S. & Gary Cornell (2007). *Core Java, Volume I—Fundamentals*. Prentice Hall Publications
- 3. Horstmann, Cay S. (2017). *Core Java Volume II Advanced Features*. Pearson Education

BCA – 401P Programming in Java Lab

- 1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate b2 -4ac is negative, display a message stating that there are no real solutions
- 2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that prints the nth value in the Fibonacci sequence
- 3. Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer. (use Scanner class to read input)
- 4. Write a Java program to multiply two given matrices
- 5. Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util)
- 6. Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome
- 7. Write a Java program for sorting list of names. Read input from command line
- 8. Write a Java program to create a Student class with following fields
 - a. Hall ticket number
 - b. Student Name
 - c. Department

Create 'n' number of Student objects where 'n' value is passed as input to constructor

- 9. Write a Java program to demonstrate String comparison using == and equals method
- 10. Write a java program to create an abstract class named Shape that contains an empty method named numberOfSides(). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method numberOfSides() that shows the number of sides in the given geometrical figures
- 11. Write a Java program that creates three threads. First thread displays "Good Morning" everyone second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds
- 12. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication
- 13. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is



turned on, and only one light can be on at a time No light is on when the program starts

- 14. Write a Java program that allows the user to draw lines, rectangles, and ovals.
- 15. Develop an applet that displays a simple message in center of the screen



BCA – 402 Web Technologies

Course Objective:

To understand the role of web technologies (HTML, JavaScript, PHP, MYSQL etc..) to develop static and dynamic web pages through practical.

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

- CO-1. Understand the use and key concept of HTML, CSS, JavaScript, Jquery, PHP and MySql
- CO-2. Implements the database (MySql) and web technologies (HTML, CSS, JavaScript, Jquery and PHP) to create static and dynamic web pages.
- CO-3. Demonstrate the use of web controls according to the requirements in web application.
- CO-4. Apply JavaScript validation, Jquery Validation to maintain the consistency in applications.
- CO-5. Evaluate the use of web application develop by using web technologies.

Unit-I

Overview of HTML: Concept of Hypertext, Versions of HTML, Elements of HTML, Formatting Tags, Links, Hyperlinks, Image & Image map, List, Tables, Frames, Forms, Style sheets, Background and Color Controls, Cascading Style Sheets (CSS): CSS Properties, Creating Classes and IDs, Generating External Style Sheets, Types of styles, specifying class within HTML document, Style placement: Inline style, Span & div tags, header styles, Text and font attributes: Font Vs CSS, changing fonts, text attributes, Advance CSS properties: Backgrounds, Box properties and Positioning.

Unit-II

Introduction to scripting: overview of Java Script, advantages, client side java Script, capturing user input, writing JavaScript into HTML; Basic JavaScript Techniques: Data types, literals, variables and operators, Java Script arrays, dense array, operators, expressions; Java Script Programming Construct: Assignment, data declaration, if, switch, while, for, do while, label, break, Continue, function call, return, with, delete, method invocation.

JQuery Introduction: What is jQuery, Structure of jQuery, Using jQuery and including .js file to HTML, Type of Selectors, Handling Events with jQuery

Unit-III

PHP introduction, inventions and versions, important tools and software requirements (like Web Server, Database, Editors etc.), PHP with other technologies, scope of PHP, Basic Syntax, PHP variables and constants, Types of data in PHP, Expressions, scopes of a variable (local, global); PHP Operators: Arithmetic, Assignment, Relational, Logical operators, Bitwise, ternary and MOD operator, PHP operator Precedence and associativity;

Handling HTML form with PHP: Capturing Form Data, GET and POST form methods, Dealing with multi value fields, Redirecting a form after submission;

Unit-IV

PHP conditional events and Loops: PHP IF Else conditional statements (Nested IF and Else), Switch case, while, For and Do While Loop, goto, Break, Continue and exit; PHP Functions: Function, Need of Function, declaration and calling of a function, PHP Function with arguments, Default Arguments in Function, Function argument with call by value, call by



reference, Scope of Function Global and Local; String Manipulation and Regular Expression: Creating and accessing String, Searching & Replacing String, Formatting, joining and splitting String, String Related Library functions, Use and advantage of regular

expression over inbuilt function, Use of preg_match(), preg_replace(), preg_split() functions in regular expression, Array: Anatomy of an Array ,Creating index based and Associative array ,Accessing array, Looping with Index based array, with associative array using each() and foreach(), Some useful Library function.

Unit-V

Introducing MySQL; database design concepts; the Structured Query, Language (SQL); communicating with a MySQL backend via the PHP.

Suggested Text Books:

- 1. Fuller, R. G., & Ulrich, L. A. (2004). *HTML in 10 Simple steps or Less*. John Wiley & Sons.
- 2. Gilmore, W. J. (2010). Beginning PHP and MySQL: from novice to professional. Apress.
- 3. Holzner, S. (2007). PHP: the complete reference. Tata McGraw-Hill Education.

Reference Books:

- 1. Psinas, M. E. (2008). PHP and MySQL: Create-modify-reuse. John Wiley & Sons.
- 2. Nixon, R. (2014). Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5. " O'Reilly Media, Inc.".
- 3. Welling, L., & Thompson, L. (2008). *PHP and MySQL Web Development, 4e.* Addison-Wesley Professional, 2008.



PAPER CODE BCA – 403 Statistical Methods

Course Objective

The objective of this course is to acquaint the students with basic concept of statistics that are useful in decision making problems.

Learning Outcomes

By completing this course the student will learn to perform the following:

- CO-1. How to calculate and apply measures of location and measures of dispersion -- grouped and ungrouped data cases.
- CO-2. How to apply discrete and continuous probability distributions to various business problems.
- CO-3. Compute and interpret the results of bivariate Regression and Correlation Analysis.
- CO-4. Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases. Understand the concept of p-values.
- CO-5. Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit.

Course Contents

UNIT-I

Introduction: Frequency distribution and Frequency charts, Histogram, Frequency polygons, Frequency curves and Cumulative frequency distribution, Ogive curves. **Measures of Central Tendency:** Arithmetic mean, weighted arithmetic mean, median, mode, Partition values. **Measures of Dispersion:** Range, mean deviation, semi-inter quartile range for quartile deviation, absolute and relative dispersion, coefficient of variation, Moments, Skewness and Kurtosis.

UNIT-II

Probability Theory: Sample space, events, classical definition of probability, theorems on total and compound probability, independent and dependent events, mutually exclusive events, mathematical expectation.

UNIT-III

Probability Distributions: Discrete and continuous probability distributions, basic concepts and applications of Binomial, Poisson, Rectangular, Exponential and Normal distributions, their properties and uses.

UNIT-IV

Regression and Correlation: Regression analysis, Least square fit, polynomial and curve fitting, Linear correlation, measures of correlation, coefficient of correlation, rank correlation, multiple and partial correlation for three variables.



UNIT-V

Testing of Hypotheses: Simple and composite hypothesis, errors of kind-I and kind-II, critical region, level of significance. **Tests of Significance:** Tests for simple hypotheses, Chi-square, t, F and Z-statistics.

Suggested Readings:

Main Text Books

- 1. C.B. Gupta An Introduction to Statistical Methods. Vikas Publ. House
- 2. S.C. Gupta Fundamental of Statistics. Sultan Chand & Sons
- 3. H.C Saxena and J.N Kapoor- Mathematical Statistics. S. Chand and Company

Reference Books

- 1. Ken Black Business Statistics. Wiley India
- 2. Render and Stair JR Quantitative Analysis for Management. Prentice Hall Publ.
- 3. Beri G.C. Business Statistics. Tata McGraw Hill Education



BCA – 404 Python Programming

Course Objectives: This course aims to make the students familiar with the programming paradigms brought in by Python programming language along with a focus on file handling and regular expressions

Course Outcomes: On successful completion of this course, the students will be able to:

- CO-1. Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements
- CO-2. Express proficiency in the handling of strings and functions
- CO-3. Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets
- CO-4. Identify the commonly used operations involving file systems and regular expressions
- CO-5. Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python

Course Contents:

Unit-I

History & Features of Python; Introduction to Python: Python Interpreter, Python shell, Indentation. Atoms: Identifiers and keywords, Literals; Variables & Data Types: Numeric types, Sequence types, Mapping types, Set types, Boolean type, Binary types; Operators: Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, precedence of operators; Comments in Python

Unit-II

Input and Output Statements; Conditional statements: conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for, nested loop, state iteration in python, break, continue, pass; String Manipulation: Accessing string, Basic operations, String slices, String functions and methods

Unit-III

Python Collections: Lists: Accessing List, List Operations, Working with Lists, List Functions & Methods; Tuples: Accessing Tuples, Tuple Operations, Working with Tuples, Tuple Functions & Methods; Dictionaries: Accessing Values in dictionaries, Dictionary Operations, Working with Dictionary, Dictionary Properties, Dictionary Functions & Methods; Sets: Working with Set & Frozen Set

Unit-IV

Functions: Defining & Calling a function, Types of functions, Default Arguments, Why Default Arguments?, Default Function Object Argument Example, Variable-length Arguments, Non-keyword Variable Arguments (Tuple), Keyword Variable Arguments (Dictionary), Anonymous functions, Global & Local variables

Exception handling: Exception classes hierarchy, try, except, finally, Raising an exception, user defined exceptions

Unit-V

Object Oriented Programming in Python; Regular Expressions; Importing & Exploring Data using Python Modules: Introduction of numpy module, numpy operations, Working with



Arrays using numpy; Introduction of pandas module, pandas operations

Suggested Text Book and Reference Books:

- Chun, J Wesley, Core Python Programming, Second Edition, Pearson, 2007 Reprint 2010
- 2. Barry, Paul, Head First Python, 2nd Edition, O Rielly, 2010
- 3. Lutz, Mark, Learning Python, 4th Edition, O Rielly, 2009

Python Programming lab:

List of Programs

- 1. Create a stone-paper-scissor game program
- 2. Explore string functions
- 3. Implement Selection Sort
- 4. Read and write into a file
- 5. Demonstrate usage of basic regular expression
- 6. Demonstrate use of advanced regular expressions for data validation.
- 7. Demonstrate use of List
- 8. Demonstrate use of Dictionaries
- 9. Demonstrate use of set
- 10 Demonstrate use of tuples
- 11. Create Comma Separate Files (CSV), Load CSV files into internal Data Structure
- 12. Write script to work like a SQL SELECT statement for internal Data Structure made in earlier exercise
- 13. Write script to work like a SQL Inner Join for an internal Data Structuremade in earlier exercise
- 14. Demonstrate Exceptions in Python



BCA – 501 Programming in Advance Java

Course Objectives: This course is designed with intent to acquaint the students with tools and techniques for creating a dynamic web application that can interact with databases using Java technologies like JDBC, Servlets, JSP and JavaBeans.

Course Outcomes: On successful completion of this course, the students will be able to:

- CO-1. Analyze the key differences between static and dynamic web applications
- CO-2. Establish a relevance of various web architecture models
- CO-3. Demonstrate an in-depth knowledge of accessing databases through a Java application using Java database Connectivity (JDBC)
- CO-4. Analyze & build dynamic web pages using servlets and JSP
- CO-5. Develop reusable software components using JavaBeans concepts
- CO-6. Design GUI based web applications that can interact with databases, using in-built frameworks of Java

Course Contents:

Unit-I

Starting with Web Applications in Java: Introduction to web applications, Benefits of web applications, Web Architecture Models- Model 1 Architecture, Model 2 Architecture, Introduction to MVC Architecture: Model component, View component, Controller component.

Unit-II

Introduction to JDBC: Introducing JDBC, Communicating with Database: Obtaining Connection, Creating JDBC Statement Object, Types of Statement Objects: Statement, Prepared Statement, Callable Statement, Executing SQL Statement, Closing a Database Connection, Creating DSN and Understanding Various JDBC Drivers; Creating Table by Using JDBC, Working With ResultSet Object.

Unit-III

Introduction to Servlets: Need for Server Side Programming, What is a Servlet, Advantages of using Servlets, Understanding the Servlet API, Generic Servlet Class, Servlet Life Cycle, Servlet Request, Redirection, Servlet Config, Servlet Context, Session Tracking with Servlets, deploying a Servlet Application,.

Unit-IV

Introduction to JSP: Understanding JSP, JSP Architecture, Advantages of JSP, JSP Life Cycle, JSP Scripting Elements: Scriptlet, Expression, Declaration; JSP Implicit Objects, Directive Elements: Page, Include, Taglib; JSP Action Elements: Forward, useBean, Include, setProperty & getProperty, JSTL

Unit-V

Introduction to JavaBeans: Concept of JavaBeans, Advantages of using JavaBeans, Components of JavaBeans: Properties, Methods and Events; JavaBean API

Suggested Textbooks:

1. Schildt, Herbert (2017). Java- The Complete Reference. McGraw Hill Education

Reference Books:

- 1. Sierra, Kathy & Bert Bates (2009). Head First Java. O'Reilly Publications
- 2. Sierra, Kathy & Bert Bates (2011). Head First Servlets & JSP. O'Reilly Publications



BCA – 502 Software Engineering

Course Objectives: The course objectives of Software Engineering Program are to produce graduates who, within three years after graduation, are able to:

- 1. Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility;
- 2. Demonstrate the ability to work effectively as a team member and/or leader in an ever-changing professional environment; and
- 3. Progress through advanced degree or certificate programs in computing, science, engineering, business, and other professionally related fields.

Course Outcomes: On successful completion of this course, the students will be able to:

- CO-1. Basic knowledge and understanding of the analysis and design of complex systems.
- CO-2. Ability to apply software engineering principles and techniques and to develop, maintain and evaluate large-scale software systems.
- CO-3. To produce efficient, reliable, robust and cost-effective software solutions.
- CO-4. Ability to perform independent research and analysis.
- CO-5. Ability to work as an effective member or leader of software engineering teams.
- CO-6. To manage time, processes and resources effectively by prioritising competing demands to achieve personal and team goals Identify and analyzes the common threats in each domain.

Course Contents:

Unit-I

Introduction: Evolving Role of Software, Software characteristics, Software Designing Processes: Software Engineering, Software Process and Characteristics, Need of Software Development Life Cycle Models, Waterfall, Prototype, Spiral Model, RAD Model;

Unit-II

Software Requirement Analysis and Specification: Requirement Elicitation Technique: Interview, Form Analysis, SRS and its Characteristics. Software Project Planning: Issues involved in Software Estimation, Size Estimation like lines of code and Function point method, Cost Estimation Model: COCOMO, Risk Management.

Unit-III

Software Project Management Process: Feasibility Study, Project Planning, Project Execution, Project Termination. System Models: Data-flow models, Semantic data models, Object models, Inheritance models, Object aggregation, Service usage models, Data Dictionaries. Basics Software Design: Design Process, Design Fundamentals, Software Design Levels: Architectural Design, High Level design, detail design, Design Notations, Specification and Modularization, Design Structure Chart, Pseudo Codes, Flow charts, Coupling and Cohesion measures.

Unit-IV



Design Strategies: Function Oriented Design, Object Oriented Design, Basic concept of object-oriented analysis & Design. Traditional paradigm versus object oriented paradigm, software design approaches: Top-Down and Bottom-Up Design. Object-oriented design: Object aggregation; Service Usage; Object Interface Design: Design evolution, Function oriented design: Data –flow design; Structural Decomposition: Detailed design.

Unit-V

Software Metrics: Software measurements What & Why, Token Count, Halstead Software Science Measures, Design Metrics, software testing. Test cases. Software Maintenance: Types of software Maintenance, Software maintenance model, Concept of Software Reengineering & Software Reverse engineering- Definition, purposes and objectives. Introduction to UML class diagram object diagram, use case diagram, sequence diagram, activity diagram, component diagram, collaboration diagram.

Suggested Text Books:

- 1. Software Engineering A practitioner's approach"- R.S.Pressman,5th Ed., McGraw Hill Int.
- 2. Software Engineering (Principle & Practices Waman S. Jawadekar), Tata Mccraw Hill
- 3. An Integrated approach to software Engineering, Pankaj Jalote, Narosa Publication

Reference Books:

Software Engineering- Shari Lawrence, Pfleeger. Pearson edu.



BCA – 503 Artificial Intelligence

Course Objectives: This course is designed to familiarize the students with basic principles, techniques, and applications of Artificial Intelligence.

Course Outcomes: On successful completion of this course, the students will be able to:

- CO-1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
- CO-2. Analyze and apply different searching techniques for solving problems of different nature.
- CO-3. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- CO-4. Demonstrate awareness and fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.
- CO-5. Display an in-depth knowledge of Fuzzy Sets and Fuzzy Logic.

Course Contents:

Unit-I

Introduction: Introduction to Artificial Intelligence, Historical Backdrop, what is Intelligence, The bottom line. Defining the problem as state space search, production system and their types, characteristics of problem and production system.

Unit-II

State Space Search: Generate and test, Simple search, Depth First Search (DFS), Breadth First Search (BFS), Comparison of BFS and DFS, Quality of solution, Depth Bounded DFS (DBDFS), Depth First Iterative Deepening(DFID). Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Local Maxima, Solution Space Search, Variable Neighborhood Descent, Beam Search, Tabu Search, Peak to Peak Methods.

Unit-III

Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and no monotonic reasoning.

Unit-IV

Learning: Introduction to learning, Neural Networks: Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multilayer Perceptrons, Multiclass Representation, Backpropagation Algorithm, Learning rate and it's significance.

Unit-V

Activation functions: sigmoid, tanh, relu, softmax, etc; problems of overfitting in neural networks; regularization techniques: L1 and L2 regularization, dropout, data augmentation, early stopping.

Fuzzy Sets and Fuzzy Logic: Introduction to Classical Sets and Fuzzy Sets. Classical set and Fuzzy sets – Operations and Properties. Fuzzy Relations – Equivalence & Tolerance. Membership Functions, Fuzzification, Membership Value Assignment. Fuzzy to Crisp



Conversion.

Suggested Textbooks:

- 1. Patterson, Dan W. (2007). Introduction to AI and ES. Pearson Education
- 2. Rich, Elaine & Kevin Knight. Artificial Intelligence. Tata McGraw Hill
- 3. Russel, Stuart & Peter Norvig (2007). AI- A Modern Approac, 2e. Pearson Education

Reference Books:

- 1. Clocksin, W.F. & Mellish (2001). *Programming in PROLOG, 3e*. Narosa Publishing House
- 2. Bratko, Ivan (2000). *Prolog Programming for Artificial Intelligence,3e*. Addison-Wesley, Pearson Education



BCA – 601 Machine Learning

Course Objective

The main objective of this course is to help students learn and understand the concept of machine learning approaches with the help of Supporting Programming Language.

Course Outcomes

On successful completion of this course, students will be able to -

CO-1: Understand the concept of machine learning, supervised, unsupervised learning and statistical learning.

CO-2: Acquire knowledge about software for machine learning.

CO-3: Understand various applications using machine learning techniques. CO-4: Solve the problems of Matrices and vectors with available tool.

CO-5: Knowledge about regularization and its utility.

Unit-I

Introduction: Concept of Machine Learning, Applications of Machine Learning, Key elements of Machine Learning, Supervised vs. Unsupervised Learning, Statistical Learning: Bayesian Method, The Naive Bayes Classifier.

Unit-II

Software for Machine Learning and Linear Algebra Overview: Plotting of Data, Vectorization, Matrices and Vectors: Addition, Multiplication, Transpose and Inverse using available tool such as Python.

Unit-III

Linear Regression: Prediction using Linear Regression, Gradient Descent, Linear Regression with one variable, Linear Regression with multiple variables, Polynomial Regression, Feature Scaling /Selection.

Unit-IV

Logistic Regression: Classification using Logistic Regression, Logistic Regression vs. Linear Regression, Logistic Regression with one variable and with multiple variables.

Unit-V

Regularization: Regularization and its utility: The problem of Overfitting, Application of Regularization in Linear and Logistic Regression, Regularization and Bias/Variance.

Reference Books

- 1. Ethem Alpaydin, "Introduction to Machine Learning" 2nd Edition, The MIT Press, 2009.
- 2. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
- 3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" by Springer, 2007.



4. Mevin P. Murphy, "Machine Learning: A Probabilistic Perspective" by The MIT Press, 2012.

BCA – 602 Software Testing

Course Objectives: The Objective of this course is to learn and apply basic skills needed to create and automate the test plan of a software project, to know how to plan, develop, and execute an automated test plan. Students should learn testing concepts, Test planning, Creating a test plan in Test Director, Breaking the test plan into manageable components, Designing test cases and test steps, Analyzing the test plan, understanding of Automation testing, Creating a script through recording.

Course Outcomes: At the end of the course, students will be able to

CO-1. Apply various test processes and continuous quality improvement

CO-2. Understand and define the types of errors and fault models

CO-3. Using methods of test generation from requirements

Course Contents:

Unit-I

Introduction: Testing as an Engineering Activity, Testing as a process, testing axioms, basic Definitions Software Testing Principles, The Tester's Role in a software Development organization, The Defect Repository and Test Design, Developer/Tester Support for Developing a Defect Repository. Defect Prevention Strategies.

Unit-II

Test Case Design : Test Case Design Strategies, Using Black Box Approach to Test case design, Random Testing, Requirements based testing, Boundary Value Analysis, Decision tables, Equivalence class partitioning, State-based testing, Cause-effect graphing, Error guessing, Compatibility Testing.

Unit-III

Using White Box Approach to Test design, Test Adequacy Criteria, static testing vs. structural testing, code functional testing, Coverage and Control flow Graphs. Covering Code Logic, paths, their role in White box Based Test Design, Evaluating Test Adequacy Criteria. **Unit-IV**

Levels Of Testing : The Need for Levels of Testing, Unit Test, Unit Test planning, Designing the Unit tests, The Test harness, Running the unit tests and Recording results, Integration tests, Designing integration Tests, Integration Test Planning, scenario testing, Defect bash elimination. System Testing, Acceptance testing, Performance testing, Regression testing, testing OO systems, testing the documentation.

Unit-V

Introduction to automatic testing & tools: Drawback of manual testing, Benefits of automatic testing, demerits of automatic testing, functional testing tools. Performance testing tools. Overview of automatic tool QTP: history, benefits, anatomy, main parts of QTP.

Suggested Text Books:

- 1. Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing ' Principles and Practices', Pearson education.
- 2. Renu Rajani, Pradeep Oak, Software Testing Effective Methods, Tools and Techniques, TataMcGraw Hill.

Reference Books:

- 1. Boris Beizer, Software Testing Techniques, Second Edition, Dreamtech.
- 2. Elfriede Dustin, Effective Software Testing, First Edition, Pearson Education.



BCA – 603 Computer Networks

Course Objectives:

- 1. Build an understanding of the fundamental concepts of computer networking.
- 2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- 3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- 4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes: At the end of the course, students will be able to

- CO-1: Independently understand basic computer network technology.
- CO-2: Understand and explain Data Communications System and its components.
- CO-3: Identify the different types of network topologies, protocols and n/w devices.
- CO-4: Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
- CO-5: Understand and building the skills of sub netting and routing mechanisms.

Course Contents:

Unit-I

Data Communication System: Purpose, Components: Source, transmitter, transmission System, receiver, and destination. Data transmission: Frequency, Spectrum and Bandwidth. Time-domain and frequency domain Concepts. Relationship between data-rate and Bandwidth. Network topology with advantages and disadvantages.

Unit-II

Analog and digital data transmission. Data and signal. Analog and digital signaling of analog and digital data. Modem, modulation techniques, codec, digital transmitter etc. Transmission impairments: attenuation and attenuation distortion, delay distortion, noise.

Unit-III

Introduction to Network, OSI reference model, TCP/IP reference model. Transmission Media: Magnetic Media, Twisted-Pair cables, Baseband & Broadband Coaxial cables, Fiber Optics. Wireless Transmission: Radio Transmission, Microwave Transmission, Bluetooth, Infrared, Virtual LAN.

Unit-IV

ISDN; ATM; data link layer: services, framing, error control, error-detecting & correcting codes. Data link protocols: stop-and-wait protocol, sliding window protocol. HDLC; static & dynamic channel allocation in LANS & MANS, FDDI.

Unit-V

Multiple Access Protocols: ALOHA, CSMA/CD; IEEE standards 1002.3 and Ethernet, 1002.4: Token Bus; 1002.5: Token Ring. Bridges, Routers, Gateways, Routing Algorithm, Congestion control Algorithm, Internetworking, The TCP/IP Protocol, IP Addressing, Subnets, Supernets, IPv6.

Suggested Text Books:

1. Tanenbaum A. Computer Networks. Prentice Hall- publisher.

2. Forouzan. Data Communication & Networking. Mc Graw Hill Publisher.

Reference Books:

1. Stallins W. Data & Computer Communications. PHI- Publisher.



BCA – 701 Data Mining

Course Objectives:

- 1. Be familiar with mathematical foundations of data mining tools.
- 2. Understand and implement classical models and algorithms in data warehouses and data mining.
- 3. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
- 4. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes: At the end of the course, students will be able to

- CO-1. Understand the functionality of the various data mining and data warehousing component.
- CO-2. Appreciate the strengths and limitations of various data mining and data warehousing models.

CO-3. Explain the analyzing techniques of various data.

Course Contents:

Unit-I

Introduction: Data Mining – Motivation, Importance of DM Functionalities, Basic Data Mining Tasks, DM Applications, and Social Implications

Unit-II

Data Warehousing: Differences between Operational Database and Data Warehouse – Multidimensional Data Model - From Tables to Data Cubes. Schemas, Measures, DW Implementation – Efficient Computation of Data Cubes.

Unit-III

Data Reprocessing, Data Mining Primitives, Languages: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept of Hierarchy Generation, Task relevant Data, Background Knowledge, Presentation and Visualization of Discovered Patterns.

Unit-IV

Data Mining Algorithms: Association Rule Mining, Classification and Prediction – Decision Tree, Bayesian Classification Back Propagation, Cluster Analysis, Outlier Analysis.

Unit-V

Web, Temporal and Spatial Data Mining: Web Content Mining, Web Structure Mining, Web Usages Mining, Spatial Mining, Generalization and specialization, Spatial Rules, Spatial Classification and Clustering Algorithms, Temporal Mining, Modeling Temporal Events, Times Series, Pattern Detection, Sequences.

Reference Text Books:

- 1. Jiawei I-lan & Micheline Kambler, "Data Mining: Concepts and Techniques", Harcourt India Pvt. Ltd., First Indian Reprint, 2001
- 2. Margaret H. Dunham, "Data Mining : Introduction and Advance Topics", Pearson Education, First Indian Reprint, 2003
- 3. Arun K. Pujari, "Data Mining Techniques", University Press (India) Limited, First edition, 2001 4. Efrem O, Mallach, "Decision Support and Data Warehousing



Systems", Mcgraw-Hill International Edition, 2000 BCA – 702 Research Methodology

Course Objective

The course explains the application of research to various functions of management.

Course Outcomes

Upon completion of the course the students will be able to:

- CO-1: Understand the concept, process, design, tools and techniques of RM.
- CO-2: Apply tools, techniques/methods to assist various functions of management.
- CO-3: Analyse the data collected.
- CO-4: Evaluating the results, interpret and present findings.
- CO-5: Prepare research report

Course Contents:

Unit-I

Introduction to Research Methodology: Meaning of Research, Objectives of Research, Motivations in Research, types of Research, Significance of Research, Research Process, Criteria of Good Research, Problem Identification & Formulation – Research Question – Investigation Question, Research Ethics and Integrity.

Unit-II

Literature Review Development, Argumentation and Synthesis, Referencing, Setting Objectives, Hypothesis, Qualities of a good Hypothesis, Types of Hypothesis, Null Hypothesis & Alternative Hypothesis.

Unit-III

Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Hypothesis Testing- Logic & Importance. Measurement: Concept of measurement: Problems in measurement in research – Validity and Reliability, Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Unit-IV

Sampling: Concepts of Statistical Population, Sampling plan, Sampling Techniques-Probability & Non-probability Sampling. Data Preparation- Coding, Editing, Data Analysis: Univariate analysis (frequency tables, bar charts, pie charts, percentages), Testing Reliability, Tests of Association: Bivariate/Mutivariate analysis –Correlations and Regression,

Unit-V

Tests of Differences: t-tests, ANOVA, Interpretation of Data and Report Writing, Types and Layout of Research Report, Precautions in preparing the Research Report, Bibliography, Footnotes and Annexure in the Report. Plagiarism Issues.



Note: The course has to be taught with the help of MS Excel and IBM SPSS

wherever needed.

- 1. Chapman, C. (2015). R for marketing research and analytics. New York, NY: Springer Science Business Media, LLC.
- 2. Cooper, R., & Schindler, P.S. (2014). Business research methods (Twelf the dition). New York, NY: McGraw-Hill/Irwin.
- Malhotra, N.K., & Birks, D.F.(2007). MarketingResearch:AnAppliedApproach(3ed).Harlow: Financial Times Prentice Hall.
- 4. Poynter, R. (2010). The handbook of online and social media research: tools and techniques for market researchers. New York: Wiley.
- 5. Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). Business research methods. Cengage Learning.



BCA – 703 Data science using Python

Course Objective

Course Outcomes

Upon completion of the course the students will be able to:

Unit – I: Introduction

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Unit - II: Data Collection and Data Pre-Processing

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

Unit – III: Exploratory Data Analytics

Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.

Unit – IV: Model Development

Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.

Unit – V: Model Evaluation

Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search.

- 1. Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.
- 2. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
- 3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
- 4. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.



BCA – 801 Mobile Application Development

Course Objectives: The goal of this subject is to understand the different types of command use for different purpose in Linux. Understanding the mobile application technology using Android and develop the mobile apps by Android Studio.

Course Outcomes: At the end of the course, students will be able to

- CO-1: Understand Linux features & their Architecture.
- CO-2: Use of different commands (Related to Files, Directory, Disk, etc.)
- CO-3: Comparison of Mobile Operating System like Android, IOS & Windows.
- CO-4: Knowledge about Android API level and different version, features and architecture.
- CO-5: Use of Android Studio for developing mobile apps.
- CO-6: Android Components and use of Java and XML file for developing apps.
- CO-7: Develop and execute on real physical mobile.

Course Contents:

Unit-I

Linux introduction and file system - Basic Features, Advantages, Installing requirement, Basic Architecture of Unix/Linux system, Kernel, Shell., Linux standard directories. Commands for files and directories cd, ls, cp, md, rm, mkdir, rmdir, pwd, file, more, less, creating and viewing files using cat, file comparisons – cmp & comm, View files, disk related commands, Filters, Redirection Operator and File permission command.

Unit-II

An Introduction to Mobile Computing- mobile Application Programming, Different Platforms. Operating systems-Architecture and working of Android, iOS and Windows phone, Comparison of Android, iOS and Windows phone, Android Development Environment -Advantages and Future of Android, Android Origin, Version and API level, Use of Android Studio.

Unit-III

Android Software Development Platform - Understanding Java SE and the Dalvik Virtual Machine, The Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder Leveraging Android XML, Screen Sizes, Launching Your Application, Configure Virtual Device/Real Device for execute Android Apps.

Unit-IV

Android Framework Overview- The Foundation of OOP: The APK File, Android Application Components, And Android Activities: Defining the UI, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications, Activity Life Cycle, Fragment and Intents.

Unit-V

Working with the User Interface Using Views and ViewGroups, Different Layouts, Handling UI Events, Handling Pictures and Menu with Views, Storing the Data Persistently.

- 1. Cinar O. Beginning Android 4. Apress Publication.
- 2. Meier R. Professional Android 4 Application Development. Wrox Publication.



Reference Books:

- 1. Kothari P. Android Application Development. Black Book. Dream Tech Publication.
- 2. Novák I., Arvai Z., Balássy G., Fulop D. Beginning Windows 8 Application Development. Wrox Publication.

BCA – 801P Mobile Application Development Tutorial

- 1. Develop android application to print welcome message on a screen?
- 2. Develop android application to show the output of activity life cycle?
- 3. Develop android application to calculate simple Arithmetic Operation on Android?
- 4. Develop android application to show the fragment?
- 5. Develop android application to pass parameter from one activity into another activity?
- 6. Develop android application to perform operation through intent object?
 - (i) Open Google website
 - (ii) Dial a number
 - (iii)Sending message
- 7. Develop SMS APPLICATION on Android?
- 8. Develop android application to show the different layout?
- 9. Develop android application to create menus?
- 10. Develop android application for image gallery?
- 11. Develop android application to perform following operation?
 - (i) Display of progress bar
 - (ii) Use of dialogue box
 - (iii)Set the time
 - (iv)Set the date
- 12. Develop android application for Creating Dialog box?
- 13. Develop android application for login Screen?



BCA – 802 Cloud Computing

Course Objectives

- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
- To enable students exploring some important cloud computing driven commercial systems and applications.
- To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Outcomes

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

CO-1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.

CO-2: Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.

CO-3: Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.

CO-4: Analyze various cloud programming models and apply them to solve problems on the cloud.

Unit-I

Cloud Computing Overview – Origins of Cloud computing – Cloud components - Essential characteristics On- demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service. Cloud scenarios – Benefits: scalability, simplicity, vendors, security. Limitations – Sensitive information - Application development – Security concerns - privacy concern with a third party - security level of third party - security benefits

Unit-II

Cloud Computing Architecture: Cloud computing stack - Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services Service Models (XaaS) - Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS)

Unit-III

Cloud Computing Architecture: Deployment Models – Public cloud, Private cloud, hybrid cloud, Community cloud; Cloud security: Infrastructure security, data security and storage, Identity and access Management, Access control.

Unit-IV

Virtualization: Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations; Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services, choosing a Cloud platform for an organization based on application requirements,



economic constraints and business needs

Unit-V

Setting up your own Cloud: How to build private cloud using open source tools, understanding various cloud plugins, setting up your own cloud environment- Auto provisioning, Custom images, Integrating tools like Nagios; Integration of Public and Private cloud. Future Directions: Cloud Domain and scope of work, Cloud Computing Programming Introduction, Trends and market of cloud

Text Books

- 1. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]
- 2. Cloud computing a practical approach Anthony T.Velte, Toby J. Velte Robert Elsenpeter TATAMcGraw-Hill, New Delhi 2010 [ISBN: 0071626948]
- 3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]
- 4. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online -Michael Miller Que 2008

Reference Books

- 1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
- 2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M.Goscinski Wile, 2011
- 3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
- 4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell DeanVines, Wiley-India, 2010