Scheme and Syllabus
of
Bachelor of Computer Applications
(BCA)

3 YEARS PROGRAMME

CHOICE BASED CREDIT BASED SYSTEM
(70:30)

(w.e.f. session 2020-21)

Department of Computer Science& Engineering
Guru Jambheshwar University of Science & Technology, Hisar

Scheme of Examination for
Bachelor of Computer Applications (BCA)
Three-Year Programme under CBCS Scheme
w.e.f. Academic Session 2020-21

BCA SEMESTER-I

Course Code	Course Title	Credit	Int.	Ext.	Total
BCA-PC(L)-111	Environmental Studies	4	30	70	100
BCA-PC(L)-112	Mathematical Foundation	3	30	70	100
BCA-PC(L)-113	Computer and Programming Fundamentals	3	30	70	100
BCA-PC(L)-114	PC Software	3	30	70	100
BCA-PC(L)-115	Problem Solving Through C	3	30	70	100
BCA-PC(P)-116	Problem Solving Through C Lab	2	30	70	100
BCA-PC(P)-117	PC Software Lab	2	30	70	100
Total		**20**	**210**	**490**	**700**

BCA SEMESTER –II

Course No.	Course Title	Credit	Int.	Ext.	Total
BCA-PC(L)-121	Communication Skills and Personality Development	3	30	70	100
BCA-PC(L)-122	Computer Oriented Numerical Methods	3	30	70	100
BCA-PC(L)-123	Data Structures	3	30	70	100
BCA-PC(L)-124	Operating System	3	30	70	100
BCA-PC(L)-125	Management Information System	3	30	70	100
BCA-PC(P)-126	Data Structures Lab	2	30	70	100
BCA-PC(P)-127	Operating System Lab	2	30	70	100
Total		**19**	**210**	**490**	**700**

BCA SEMESTER-III

Course No.	Course Title	Credit	Int.	Ext.	Total
BCA-PC(L)-231	Object Oriented Programming using C++	3	30	70	100
BCA-PC(L)-232	Web Designing	3	30	70	100
BCA-PC(L)-233	Digital Electronics	3	30	70	100
BCA-PC(L)-234	Introduction to Database Systems	3	30	70	100
BCA-PC(L)-235	Advanced Data Structures	3	30	70	100
BCA-PC(P)-236	Object Oriented Programming using C++ Lab	2	30	70	100
BCA-PC(P)-237	Web Designing Lab	2	30	70	100
Total		**19**	**210**	**490**	**700**

BCA SEMESTER-IV

Course No.	Course Title	Credit	Int.	Ext.	Total
BCA-PC(L)-241	Java Programming	3	30	70	100
BCA-PC(L)-242	RDBMS	3	30	70	100
BCA-PC(L)-243	Computer Architecture	3	30	70	100
BCA-PC(L)-244	Computer Networks	3	30	70	100
	Elective-I	3	30	70	100
BCA-PC(P)-246	Java Programming Lab	2	30	70	100
BCA-PC(P)-247	RDBMS Lab	2	30	70	100
Total		**19**	**210**	**490**	**700**

Paper No	Elective 1 Choice
BCA-PE(L)-241	Advanced Web Designing
BCA-PE(L)-242	Mobile Application Development
BCA-PE(L)-243	System Administration & Maintenance

BCA SEMESTER-V

Course No.	Course Title	Credit	Int.	Ext.	Total
BCA-PC(L)-351	Programming using Python	3	30	70	100
BCA-PC(L)-352	Computer Graphics	3	30	70	100
BCA-PC(L)-353	Software Engineering	3	30	70	100
BCA-PC(L)-354	Data Warehousing and Data Mining	3	30	70	100
	Elective 2	3	30	70	100
BCA-PC(P)-356	Python Programming Lab	2	30	70	100
BCA-PC(P)-357	Computer Graphics Lab	2	30	70	100
BCA-PC(P)-358	Minor Project*	2	30	70	100
Total		**21**	**240**	**560**	**800**

Paper No	List of Elective Courses (Elective2)
BCA-PE(L)-351	Theory of Computation
BCA-PE(L)-352	Open Source Software
BCA-PE(L)-353	Cloud Computing

BCA SEMESTER-VI

Course No.	Course Title	Credit	Int.	Ext.	Total
BCA-PC(L)-361	Internet Technology	3	30	70	100
BCA-PC(L)-362	E-Commerce	3	30	70	100
BCA-PC(L)-363	Data Analytics using R	3	30	70	100
BCA-PC(L)-364	Artificial Intelligence	3	30	70	100
	Elective 3	3	30	70	100
BCA-PC(P)-365	Data Analytics using R Lab	2	30	70	100
BCA-PC(P)-366	Major Project *	5	30	70	100
Total		**22**	**210**	**490**	**700**

Paper No	List of Elective Courses (Elective 3)
BCA-PE(L)-361	Information and Cyber Security
BCA-PE(L)-362	Multimedia Technologies
BCA-PE(L)-363	Software Testing and Quality Assurance

ENVIRONMENTAL STUDIES

General Course Information

Course Code: BCA-PC(L)-111 Course Credits: 4 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Brief knowledge of nature of environment Studies, Natural Resources, Forest resources, Environment Pollution.

About the Course:
This is a mandatory course to enhance the awareness, knowledge, skills, interaction and attitude of the graduating engineers with the environment. By studying this course students will understand our natural environment, Natural Resources and associated problems, Forest resources Design, Environment Pollution and its relationship with human activities.

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

CO1. **Conceptualize** the processes, various factors, issues and challenges in involved in the formation of environment.
CO2. **Demonstrate** the understanding of various environment hazards and means of protection against these hazards.
CO3. **Apply** irreplaceable tool to provide first-hand knowledge on various environmental aspects in the entire learning process.
CO4. **Envision** the impacts of human activities on environment and role of society in these impacts.
CO5. **Analyze** impacts of human business and developmental activities on the environment.
CO6. **Propose** and evaluate strategies for sustainable management of environmental eco-systems.

COURSE CONTENTS

UNIT-I

Multidisciplinary nature of environment Studies: Definition, Scope and Importance, Need for Public Awareness; Concept, Structure and Function of an ecosystem; Producer, Consumers and Decomposition, Energy Flow in the ecosystem, Ecological Succession, Food Chains, Food Webs and Ecological Pyramids; Introduction, characteristics, features, Structure and Functions of different ecosystems such as Forest Ecosystem, Grassland Ecosystem, Dessert Ecosystem, Aquatic Ecosystem (Pond, Stream, Lake, River, Ocean, Estuaries); Biodiversity: Introduction, Definition: Generic, Species and Ecosystem diversity. Bio-geographical classification of India, Ecosystem and Biodiversity services: Ecological, Economic, Social, Consumptive use, Social Ethical, aesthetic and option Values; Biodiversity at global, national and local level, India as a mega-diversity nation, Global Hot-Spot of Biodiversity. Threats to biodiversity: habitat loss, Poaching of Wildlife, Man-Wildlife Conflicts, Biological Invasions, Endangered and endemic species of India, Conservation of Biodiversity: In-Situ and Ex-situ conservation of biodiversity.

UNIT-II

Renewable and non-renewable resources, Natural Resources and associated problems, Forest resources: use and over-exploitation, Deforestation, Case studies, Timber extraction, Mining, Dams and their effects on forests and tribal people; Water resources: Use and Over Utilization of Surface and ground water, Floods, Droughts conflicts over water, Dams benefits and problems; Minerals, resources: use and exploitation, environmental effects of extracting and mineral resources: World food problems; changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: land as a resources, Land degradation, man induced landslides, soil erosion and desertification.

UNIT-III

Definition of Environment Pollution: Cause, effects and control measures of Air Pollution, Soil Pollution, Noise Pollution, Nuclear hazards and human health risk; Soil Waste Management: Cause, effects and control measures of urban and industrial waste: Pollution case studies; Disaster Management: Floods, Earthquake, Cyclone and Landslides; Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion; Different Laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control) Act, Wildlife Protection Act, Forest Conservation Act; International Agreements: Montreal & Kyoto Protocol & Nature reserves, Tribal Populations and Human Health.

UNIT-IV

Concept of Sustainability & Sustainable development, Water conservation, Rain Water Harvesting, Watersheds management, Resettlement and rehabilitation of Project affected persons; Case Studies; Environment ethics: role of Indian and other religions and cultures in environment conservation, Environment Communication and Public awareness, case studies (e.g. CNG vehicles in Delhi); Human Population growth: Impact on environment, Human health & welfare, Environmental Movements: Chipko, Silent Valley, Bishnois of Rajasthan.

Field Work: Visit to a Local area of document environmental assets- River/Forest/Grassland/ Mountain; Study of Simple ecosystem-Ponds, River, Hill Slopes etc; Study of common Plants, Insects, birds; Visit to a local Polluted Site- Urban/Rural/Industrial/Agriculture.

TEXT AND REFERENCE BOOKS:

1. Dr. D. D. Mishra, Fundamental Concepts in Environmental Studies, S. Chand Publications, New Delhi, 2008.
2. ErachBharucha, Environmental Studies for Undergraduates Courses, University Granted Commission and BharatiVidyapeeth Institute of Environmental Education and Research, Pune, University Press Pvt. Ltd., 2013.
3. Dr. S.V.S. Rana, Essentials of Ecology and Environmental Sciences, PHI Learning Pvt. Ltd. Delhi, 2013.
4. Anil Kumar, Environmental Chemistry, De.Wiley Eastern Ltd, 2007.
5. T.G. Miller, Environment Science, Wadsworth Publishing Co., 2010.
6. P.D. Sharma, Ecology and Environment, Rastogi Publications, 2011.

MATHEMATICAL FOUNDATION

General Course Information

Course Code: BCA-PC(L)-112 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basics of Mathematics

About the Course

This is an advanced mathematics course that offers the knowledge of Sets and operations on sets, Hyperbolic functions, Matrices and Theorems. These concepts are essential for students to solve problems in digital signal processing and other related engineering fields.

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

CO1. **Identify** fundamental concepts and terminology of sets, functions, equivalence relations and boolean algebra etc.
CO2. **Solve** problems using logical notations to formulate and reason about mathematical concepts such as sets, relations, functions and algebraic structures.
CO3. **Pertain / Apply** principles of Logarithmic, Exponential, Trigonometric and Inverse trigonometrically and hyperbolic functions to solve computational problems.
CO4. **Compare** various concepts related to square matrix, Hermitian and skew- Hermitan matrices.
CO5. **Choose** suitable method for System of Linear equation problems and related domain.
CO6. **Integrate** the knowledge of Cayley-Hamilton Theorem for solving real world problems.

COURSE CONTENTS

UNIT-I

Set, Subsets and operations on sets, Venn Diagram of Sets, Power set of a set. Equivalence relation on a set and partition of a set, partially ordered sets. Boolean algebra (definition and examples).

UNIT-II

Basic properties of limits, Continuous functions and classifications of discontinuities, Derivative of a function, Derivatives of Logarithmic, Exponential, Trigonometric, Inverse Trigonometrically and hyperbolic functions. Higher order derivatives.

UNIT-III

Addition and multiplication of matrices, Laws of matrix algebra, Singular and non-singular matrices, Inverse of a matrix, Rank of a matrix, Rank of the Product of two matrices, System of Linear equations i.e. AX=0 and AX=B

UNIT-IV

Characteristic equations of a square matrix, Cayley-Hamilton Theorem, Eigenvalues and eigenvectors, Eigenvalues and eigenvectors of symmetric skew symmetric, Hermitian and skew-Hermitan matrices.

TEXT AND REFERENCE BOOKS:

1. D. A. Murray, Introductory course in Differential Equations, Orient Blackswan, 1967.
2. S. L. Ross, Differential Equations, Wiley, 2007
3. Babu Ram, Discrete Mathematics, Pearson Education India, 2010.
4. Shanti Naryana, A Textbook of Matrices, S Chand & Company, 2010.

COMPUTER AND PROGRAMMING FUNDAMENTALS

General Course Information

Course Code: BCA-PC(L)-113 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Brief knowledge of Computer Fundamentals and Computer hardware & software.

About the Course

Computer and programming fundamentals is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces computer fundamentals like components of computer, characteristics Applications of computer and their use in real world problems. It includes various programming concepts, Programming methodologies, sorting and searching algorithms as well. These concepts are essential for students to solve problems in programming related engineering fields.

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

CO1. **Conceptualize** fundamental concepts of computers and a broad perspective about the use of computers in engineering industry.
CO2. **Discuss** concepts related to algorithm and algorithmic thinking.
CO3. **Apply** the principles of solving problems and develop algorithm to solve the real world problems.
CO4: **Develop** the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
CO5. **Exercise** different data structures and create / manipulate basic data files and developing applications for real world problems.

COURSE CONTENTS

UNIT-I

Computer Fundamentals: Definition, Block Diagram along with its components, characteristics and classification of computers, Applications of computer in various fields.
Memory: Concept of primary and secondary memory, RAM, ROM, types of ROM, flash memory, Secondary storage devices, Sequential and direct access devices, viz. magnetic tape, magnetic disk, CD, DVD.

UNIT-II

Computer hardware & software: I/O Devices, definition of software, relationship b/w hardware and software, types of software.
Overview of operating system: Definition, functions of operating system, concept of multiprogramming, multi-tasking, multi-threading, multi-processing, time-sharing, real time, single user & multi-user operating system.

UNIT-III

Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation.

Techniques of problem solving: Flowcharting, algorithm, pseudo code, decision table, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

UNIT-IV

Searching, Sorting & Merging: Linear and binary searching, Bubble, Selection and Insertion sorting.

Computer Languages: Analogy with natural language, machine language, assembly language, high-level language, compiler, interpreter, assembler, characteristics of a good programming language.

Computer Virus: Definition, Types of viruses, Characteristics of viruses, anti-virus software.

TEXT AND REFERENCE BOOKS:

1. P. K. Sinha and Priti, Computer Fundamentals, BPB, 2007.
2. R. G. Dromey, How to Solve it by Computer, PHI, 2010.
3. E. Balagurusamy, Computing Fundamentals and C Programming, Tata McGraw Hill, 2008.
4. Norton and Peter, Introduction to Computer, McGraw Hill, 2008.
5. Leon, Alexis & Leon, Mathews, Introduction to Computers, Leon Tech World, 2009

PC SOFTWARE

General Course Information

Course Code: BCA-PC(L)-114 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Brief knowledge of MS Windows, MS-Word, MS-Excel and MS- PowerPoint.

About the Course

PC software is an essential course which basic computer operating system MS Windows and documentation in computer and their use in real world problems. It includes various documentation concepts, methodologies and different styles as well. These concepts are essential for students to solve problems in operating system and documentation related to engineering fields.

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

CO1. **Describe** fundamental concepts of MS Windows operating system and a broad perspective about the use of windows in computer engineering industry.

CO2. **Demonstrate** concepts related to MS Windows, MS-Word, MS-Excel and MS-PowerPoint.

CO3. **Apply** the Concept of MS Windows, MS-Word, MS-Excel and MS- PowerPoint to solve the real world problems.

CO4. **Compare** the suitability of MS-Word, MS-Excel and MS- PowerPoint and prescribed operations for various problem situations.

CO5: **Design** documents for a given problem statement to implement and develops the basic concepts and terminology of MS Windows, MS-Word, MS-Excel and MS- PowerPoint in general.

COURSE CONTENTS

UNIT-I

MS Windows: Operating system- Definition and functions, basics of Windows, Basic components of windows, icons, types of icons, taskbar, activating windows, using desktop, title bar, running applications, exploring computer, managing files and folders, copying and moving files and folders. Control panel- display properties, adding and removing software and hardware, setting date and time, screen saver and appearance.

UNIT-II

Documentation using MS-Word- Introduction to Office Automation, Creating and Editing Document, Formatting Document, Auto-text, Autocorrect, Spelling and Grammar Tool, Document Dictionary, Page Formatting, Bookmark. Advance Features of MS-Word-Mail Merge, Macros, Tables, Printing, Styles, linking and embedding objects, Template.

UNIT-III

Electronic Spreadsheet using MS-Excel- Introduction to MS-Excel, Creating and Editing Worksheet, Formatting and Essential Operations, Formulas and Functions, Charts, Advance features of MS-Excel-Pivot table & Pivot Chart, Linking and Consolidation, Database Management using Excel- Sorting, Filtering, Table, Validation.

UNIT-IV

Presentation using MS- PowerPoint: Presentations, Creating, Manipulating & Enhancing Slides, Organizational Charts, Excel Charts, Word Art, Layering art objects, Animations and Sounds, Inserting Animated Pictures or Accessing through object, Inserting Recorded Sound Effects or In-Built- Sound Effect.

TEXT AND REFERENCE BOOKS:

1. Russell A. Stultz, Learn Microsoft Office, BPB Publications, 2000.
2. Courter, G Marquis, Microsoft Office 2000: Professional Edition. BPB, 1999.
3. Koers, D, Microsoft Office XP Fast and Easy. PHI, 2001.
4. Microsoft Office- Complete Reference- BPB Publications.

PROBLEM SOLVING THROUGH C

General Course Information

Course Code: BCA-PC(L)-115 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of computer related concepts.

About the Course

Problem solving through C is a core and an essential course for every graduate in Computer Science. The student is given an opportunity to grasp various algorithms for problem solving. Programming and Different algorithms add value to the subject contents.

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

CO1. **List** the concepts related to the history and basic concepts of programming in C Programming language.
CO2. **Elaborate** concepts related to Decision making in looping in C Programming language.
CO3. **Apply** the Concept of arrays, strings, classes, pointers in C Programming language for problem solving.
CO4. **Design** a program for a given problem statement problem solving through C.
CO5. **Implement** debug & document a program for a given problem statement

COURSE CONTENTS

UNIT-I

Overview of C: History of C, Importance of C, Structure of a C Program.
Elements of C: C character set, identifiers and keywords, Data types, Constants and Variables, Assignment statement, Symbolic constant.
Operator & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity.

UNIT-II

Decision making & looping: Decision making with IF Statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement, while and do-while loop, jump in loops, break, continue statement.
Functions: Definition, Prototype, Passing parameters, Recursion.

UNIT-III

Arrays in 'C': definition, types, initialization, processing an array, passing arrays to functions.
Strings & Arrays: Declaration and initialization of string, String I/O, Array of strings, String manipulation functions: String length, copy, compare, concatenate, search for a substring.

UNIT-IV

Storage classes in C: auto, extern, register and static storage class, their scope, storage, & lifetime. Pointers: Introduction, Pointer variables, Pointer operators, Pointer assignment, Pointer conversion, Pointer arithmetic, Pointer comparison, Pointers and arrays, Pointers and functions, Pointers and strings, dynamic allocation using pointers.

TEXT AND REFERENCE BOOKS:

1. Byron S. Gottfried, Programming with C, Tata McGraw Hill, 2005.
2. E. Balagurusamy, Programming in ANSI C, 4th Edition, Tata McGraw Hill, 2010.
3. YashwantKanetker, Let Us C, BPB, 16th Edition, 2017
4. V. Rajaraman, Computer Programming in C, PHI, 1994.
5. YashwantKanetker, Working with C, BPB, 2003

PROBLEM SOLVING THROUGH C LAB

General Course Information

Course Code: BCA-PC(P)-116 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic knowledge of computer related concepts.

About the course:
The lab course provides the opportunity to students to solve problems using C language. This includes implementing the concepts of various types of operators, looping, arrays, classes and pointers. The lab assignments are evenly spread over the semester. Every student is required to prepare a file of laboratory experiments done.

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

CO1. **Implement** various C problems using various concepts of C for problem solving.
CO2. **Analyse** the syntax and logical errors in C programs.
CO3. **Evaluate** problem-solving and programming skills using C concept.
CO4. **Design** an object oriented solution to solve a real life problem.
CO5. **Create** a lab record of assignments including problem definitions, design of solutions and conclusions.
CO6. **Demonstrate** ethical practices and solve problems individually or in a group.

Note: The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

PC SOFTWARE LAB

General Course Information

Course Code: BCA-PC(P)-117 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Brief knowledge of computer Software.

About the course:
The lab course provides the opportunity to students to interact with most common used computer operating system MS Windows and documentation in computer and their use in real world problems. This includes implementing the concepts of documentation and different styles.

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

CO1. **Implement** MS Windows operating system concepts for problem solving.
CO2. **Detect** syntax and logical errors in MS-Word, MS-Excel and MS- PowerPoint.
CO3. **Apply** office Automation for making robust documentation.
CO4. **Design** documents using various Advance features of MS-Word, MS-Excel and MS PowerPoint.
CO5. **Create** lab record of the solutions of assignments that includes problem definitions, solutions and conclusions.
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

Note: The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT

General Course Information

Course Code: BCA-PC(L)-121 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic Knowledge of computer fundamentals and programming in C.

About the Course

The objective of this course is to help students become familiar with the fundamental concepts of operatingsystems and provide them with enough understanding of operating system design.

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

CO1. **List** Student able to list his/her various abilities strength and weak point.
CO2. **Explain** Student able to explain his/her idea to others.
CO3. **Apply** Students learn to apply best use of his skill and personality.
CO4. **Analyze** Student observe and analyze the others very confidentially.
CO5. **Design** students design the solution for real time problems.

COURSE CONTENTS

UNIT-I

Personality: Definition, Elements, Determinants.
Personal Grooming: Personal Hygiene, Social Effectiveness, Business Etiquettes (Power Dressing).

UNIT-II

Body Language: Non-Verbal Communication, Types of Body Language, Functions of Body Language, Role of Body Language, Proxemics.
Art of Good Communication: Verbal & Non-Verbal Communication, Difference between Oral and Written Communication, 7' Cs of Effective Communication, Importance of Effective Communication.

UNIT-III

Team: Team Behaviour, Types of Teams, Team Roles and Behaviour.
Group Discussion: Do's and Don't.

UNIT-IV

Interview Preparation: Introduction, Resume Writing, Dress Code, Mock- Interview, How to be successful in an Interview.

TEXT AND REFERENCE BOOKS:

1. C. S. Venkata Ratanam and B. K. Srivastava, Personal management and Human Resources, Tata McGraw Hill Publishing Ltd. New Delhi, 2005.
2. Keith Davis, Human Behaviour at Work, Tata McGraw Hill Publishing Ltd. New Delhi, 1975.
3. Thomas A. Harris, I'm OK, You're OK, Pan Books, London and Sydney, 1973.
4. Ranjana Salgaocar, Pleasure of your Company, Pyramid Publishers, Goa, 1995.
5. Arun Agarwal, How to get the job you want, Vision Books, New Delhi, 1997.
6. Rohit Anand and Sanjeev Bikhachandani, Get That Job, Harper Collins, 1996.

COMPUTER ORIENTED NUMERICAL METHODS

General Course Information

Course Code: BCA-PC(L)-122 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of mathematical foundation of computer science.

About the Course

Due to advancement of computer technology and tools, it is very important to develop efficient algorithms for problem solving. The objective of this course is to make students familiar with numerical methods so that they are able to do numerical analysis and to solve based problems as well as to provide the practical knowledge through the implementation of these methods using computer system. This course is also helpful to the students in order to clear their concept regarding error analysis, prediction and correction. This course on Computer Oriented Numerical Methods is going to cover Floating point arithmetic, Iterative method, Interpolation, Simultaneous linear equations.

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

CO1. **Recognize** the error in the number generated by the solution.
CO2. **Apply** Student learn to apply different s numerical methods.
CO3. **Analyze** Student learn about different error occur during finding a solution to a problem.
CO4. **Design** students design more accurate solution by using different method.

COURSE CONTENTS

UNIT-I

Computer Arithmetic: Floating point representation of numbers, Arithmetic Operations with normalized floating- point numbers and their consequences, significant figure.
Error in Number Representation: inherent error, truncation, absolute, related, percentage and round off errors.
Iterative Methods: Bisection, False position, Newton-Raphson method. Iteration method, discussion of convergence.

UNIT-II

Solution of Simultaneous Linear Equations & Ordinary Differential Equations: Gauss Elimination method, pivoting, Ill-conditioned equation, refinement of solutions. Gauss-Seidel iterative method, Euler method, Euler modified method, Taylor-series method, Runge-Kutta methods, Predictor-Corrector methods.

UNIT-III

Interpolation and Approximation:

Polynomial Interpolation: Newton, Lagranges, Difference tables, Approximation of functions by Taylor Series.

UNIT-IV

Numerical Differentiation and Integration: Differentiation formula based on polynomial fit, pitfalls in differentiation, Trapezoidal & Simpson Rules, Gaussian Quadrature.

TEXT AND REFERENCE BOOKS:

1. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall, India, 1993.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, 2012.
3. H.C. Saxena, Finite Differences and Numerical Analysis, 2010.
4. Modes A, Numerical Analysis for Computer Science.
5. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publication, 2007.

DATA STRUCTURES

General Course Information

Course Code: BCA-PC(L)-123 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of mathematical foundation of computer science.

About the Course

Data Structure is a basic and an essential course for every graduate in Computer Science. This course introduces data structures like arrays, linked lists, trees, graphs etc. and various operations performed on these data structures for solving real world problems.

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

CO1.**Describe** various types of data structures and operations that can be implemented on these data structures.
CO2.**Demonstrate** the use of various data structures and their related operations.
CO3.**Apply** data structure to solve computational problems.
CO4.**Compare** the suitability of alternative data structures and prescribed operations for various problemsituations.
CO5.**Defend** solutions with respect to effective storage of data and efficiency of the required operations forsolving real world problems.

COURSE CONTENTS

UNIT-I

Introduction: Elementary data organization, Data Structure definition, Data type vs. Data structure, Categories of data structure, Data structure operations, Applications of data structure, Algorithms complexity and time-space trade-off, Big-O notation.

UNIT-II

Strings: Introduction, Storing strings, String operations.
Array: Introduction, Linear Arrays, Representation of linear array in memory, Traversal, Insertion, Deletion in an array, Multi-dimensional arrays.

UNIT-III

Linked List: Introduction, Array vs. Linked List, Representation of Linked lists in memory, Traversal, Insertion, Deletion and Searching in a Linked List, Header Linked List, Circular Linked List, Two-Way Linked List, Applications of Linked Lists.
Stack: Introduction, Array and Linked representation of stack, operations on stack, Applications of stack: Polish Notation, Recursion.

UNIT-IV

Stack: Introduction, Array and linked representation of stacks, Operations on stacks, Applications of Stacks: Polish Notation, Recursion.

Queue: Introduction, Array and linked representation of Queue, Operations on Queues, Dequeues, Priority Queues, Applications of Queues.

TEXT AND REFERENCE BOOKS:

1. Seymour Lipschutz, Data Structure, Tata McGraw Hill, 2014.
2. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structure in C, Orient Longman, BlackSwan, 2008
3. Trembley, J.P. And Sorenson P.G., An Introduction to Data Structures with Applications, McGraw- Hill International Student Edition, New York, 1984.
4. Yedidyan Langsam, Moshe J. Augenstein and Aaron M. Tenenbaum, Data Structures using C, Prentice Hall of India Pvt. Ltd., New Delhi, 1996.
5. Mark Allen Weiss, Data structures and Algorithm Analysis in C, Addison-Wesley (An Imprint of Pearson Education), Mexico City, Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.

OPERATING SYSTEM

General Course Information

Course Code: BCA-PC(L)-124 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of computer fundamentals.

About the Course

The objective of this course is to help students become familiar with the fundamental concepts of operatingsystems and provide them with enough understanding of operating system design.

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

CO1. **List** various functions and design characteristics of operating systems.
CO2. **Explain** fundamental concepts of operating systems.
CO3. **Apply** operating system design concepts for solving problems regarding scheduling, memorymanagement, disk management and deadlocks etc.
CO4. **Analyze** the issues related to various operating systems.
CO5. **Design** solutions for the memory and process management problems.

COURSE CONTENTS

UNIT-I

Introduction: Introduction to Operating System Concepts (Including Multitasking, Multiprogramming, Multi User, Multithreading etc.), Types of Operating Systems: Batch Operating System, Time-Sharing System, Distributed Operating System, Network Operating System, Real Time Operating System, Various Operating System services, architecture, System Programs and Calls.

UNIT-II

Process Management: Process Concept, Process Scheduling, Operations on Processes; CPU Scheduling, Scheduling Criteria, Scheduling Algorithms- First come First Serve(FCFS), Shortest-Job- First (SJF), Priority Scheduling, Round Robin(RR).
Deadlock: Methods for handling deadlock- Deadlock prevention, Avoidance & Detection.

UNIT-III

Memory Management: Logical & Physical Address Space, Swapping, Contiguous Memory allocation, non-contiguous memory allocation paging and segmentation techniques; Virtual Memory Management- Demand Paging & Page Replacement Algorithm; Demand Segmentation.

UNIT-IV

File System: Different types of files and their access methods, directory structures, various allocation methods, disk scheduling and management and its associated algorithms.

TEXT AND REFERENCE BOOKS:

1. Silberschatz et al, Operating System Concepts, 5th Edition, Addison-Wesley, 1998.
2. A. Tanenbaum, Modern Operating System, Prentice Hall, 1992.
3. Peterson, Operating System, AW, 1985.
4. Milankovik, Operating System, THM, 1990.
5. Colin Ritche, Operating System Incorporating with Unix & Windows, THM, 1974.

MANAGEMENT INFORMATION SYSTEM

General Course Information

Course Code: BCA-PC(L)-125 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of computer terminologies, databases and programming language(s) will help in understanding the given concepts very easily.

About the Course

The objective of this course is to help students to:-

- study of people, technology, organizations, and the relationships among them.
- understand basic needs of an organization required to design and develop an efficient and effective MIS.
- understand various control and security issues to be taken care at the time of development of an MIS
- learn various tools and methods required to develop an effective and efficient MIS.

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

CO1. **Demonstrate** technology, people, organizations, developments & trends and the relationships among them.
CO2. **Understand** the basic needs of an organization to design and develop an efficient and effective MIS tool for decision-making.
CO3. **Develop** computer-based secure MIS that provides decision-makers with the tools to organize.
CO4. **Evaluate** and efficiently manage various functions within an organization.

COURSE CONTENTS

UNIT-I

Introduction to System and Basic System Concepts, Types of Systems, The Systems Approach, Information System: Definition & Characteristics, Types of information, Role of Information in Decision-Making.

UNIT-II

An overview of Management Information System: Definition & Characteristics, Components of MIS, Framework for Understanding MIS: Information requirements & Levels of Management, Simon's Model of decision-Making, Structured Vs Unstructured decisions, Formal vs. Informal Systems.

UNIT-III

Developing Information Systems: Analysis & Design of Information Systems, Implementation & Evaluation, Pitfalls in MIS Development.

UNIT-IV

Functional MIS: A Study of Personnel, Financial and Production MIS, Introduction to E-Business Systems, E-Commerce- Technologies, Applications, Decision Support Systems- Support Systems for Planning, Control and Decision- Making.

TEXT AND REFERENCE BOOKS:

1. J. Kanter, Management/Information Systems, PHI, 1983.
2. Gordon B. Davis, M. H. Olson, Management Information Systems- Conceptual Foundations, Structure and Development, McGraw Hill, 1985.
3. James A. O'brien, Management Information Systems, Tata McGraw Hill, 2006.
4. Lucas, Analysis, Design & Implementation, McGraw Hill
5. James A. Senn, Analysis, Design of Information Systems, Second Edition, McGraw Hill, 1984

DATA STRUCTURES LAB

General Course Information

Course Code: BCA-PC(P)-126 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Brief knowledge of computer Software.

About the course:

This lab course involves implementation of basic and advance data structures and various operations on these data structures. The objective of the lab course is to train the students to solve the problems related to data structures and choose the appropriate data structure for solving computational problem efficiently.

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

CO1. **Implement** various data structures and the related operations

CO2. **Analyze** space and time complexity of algorithms.

CO3. **Compare** solutions on the basis of the appropriateness of data structure used and the efficiency of theoperations implemented. (HOTS: Level 5: Evaluate)

CO4. **Integrate** knowledge of data structures to solve real world problems related to data structure andalgorithms.

CO5. **Create** written records for the given assignments with problem definition, design of solution andconclusions.

CO6. **Demonstrate** ethical practices while solving problems individually or in groups.

Note: The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

OPERATING SYSTEM LAB

General Course Information

Course Code: BCA-PC(P)-127 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic programming skills.

About the course:

This lab course on data science involves a training of Operating system. It incorporates solving problems related to data science in statistical and predictive modeling framework. The objective of the lab course is to equip the students with practical knowledge of operating system.

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

CO1. **Apply** commands related to operating system which utilizes the file systems.
CO2. **Learn** basic operation related to operating system.
CO3. **Analyze** the results of memory management and disk management commands.
CO4. **Evaluate** solutions for different operating system problems such as scheduling, memory managementand file management.
CO5. **Create** lab record for assignments that includes problem definitions, design of solutions andconclusions.
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit.

Note: The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

OBJECT ORIENTED PROGRAMMING USING C++

General Course Information

Course Code: BCA-PC(L)-231 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of computer fundamentals and problem solving using C programming

About the Course

Objected Oriented Programming using C++ is an essential course for every graduate in Computer Science and Engineering. This course introduces the Object Oriented concepts such as data encapsulation, data hiding, data abstraction, reusability, exception handling etc., and their implementation using C++.

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

CO1. **List** the concepts related to object oriented paradigms.
CO2. **Distinguish** between structured and object oriented approaches to programming.
CO3. **Apply** object oriented constructs for problem solving.
CO4. **Detect** logical and run time errors and suggest appropriate modifications.
CO5. **Justify** the design of a program for a given problem.
CO6. **Design** solutions to programming problems using multiple object oriented programming constructs together.

COURSE CONTENTS

UNIT- I

Introduction to C++, C++ Standard Library, Basics of a Typical C++ Environment, Header Files and Namespaces, Library files. Introduction to Objects and Object Oriented Programming, Encapsulation, Access Modifiers; Controlling access to a class, method or variable (public, private, protected, package), Other Modifiers, Polymorphism; overloading, Inheritance, Overriding Methods, Abstract classes, Reusability.

UNIT- II

Classes and Data Abstraction: Introduction, Structure Definitions, Accessing Members of Structure, Class Scope and Accessing Class Members, Initializing Class Objects, Constructor, Using Default Arguments with Constructor, Using Destructor, Classes: Const(Constant) Object and Const Member Function, Object as Member of Classes, Friend Function and Friend class, Function Overloading.

Operator Overloading: Introduction, Fundamentals of Operator Overloading, Restrictions on Operator Overloading, Operator Functions as Class Members vs. as Friend Function, Overloading, <<,>> Overloading Unary Operators, Overloading Binary Operators.

UNIT- III

Inheritance: Introduction, Inheritance: Base Classes and Derived Classes, Protected Members, Casting Base-Class Pointers to Derived-Class Pointer, Using Member Functions, Overriding Base-class members in a Derived class, Public, Protected, and Private Inheritance, Using Constructors and Destructors in Derived Classes, Implicit Derived-Class Object to Base-Class Object Conversion.

UNIT- IV

Virtual Functions and Polymorphism: Introduction to Virtual Functions, Abstract Base Classes and Concrete Classes, Polymorphism, New Classes and Dynamic Binding, Virtual Destructor, Polymorphism, Dynamic Binding.

File and I/O Streams: Files and Streams, Creating a Sequential Access File, Reading Data From A Sequential Access File, Updating Sequential Access File, Random Access File, Creating A Random Access File, Writing Data Randomly to a Random Access File, Reading Data Sequential from a Random Access File.

TEXT AND REFERENCE BOOKS:

1. H. M Deitel and P.J Deitel, C++ How to Program, Prentice Hall, 1998.
2. Robert Lafore, Object Oriented Programming in Turbo C++, Galgotia Publications Pvt. Ltd., 1994.
3. D. Raichandan, Programming with C++, T.M.H, 2003.
4. Balagurusamy, Object Oriented Programming with C++ , Tata McGraw-Hill, 2001.

WEB DESIGNING

General Course Information

Course Code: BCA-PC(L)-232 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of computer fundamentals.

About the Course

This course includes a detailed coverage of HTML. Students learn HTML, XML and design various web pages and its uses in web designing process with HTML. They study about Client Side Programming and Server Side Programming.

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

CO1. **Describe** Web Designing Complete Process
CO2. **Discuss** Client Side and Server Side Programming.
CO3. **Apply** basic web designing tools (HTML, XML).
CO4. **Contrast** All Markup Languages.
CO5. **Design** a report describing or making recommendations for a website design.

COURSE CONTENTS

UNIT- I

Introduction to Internet and World Wide Web; Evolution and History of Word Wide Web; Basic features; Web Browsers; Web servers; Hypertext Transfer Protocol; URLs; Searching and Web-Casting Techniques; Search Engines and Search Tools

UNIT- II

Web Publishing: Hosting your Site; Internet Services provider; Planning and designing your Web Site; Steps for developing Your site; Choosing the contents; Home page; Domain Name**s**

UNIT- III

Web Development: Introduction to HTML; Hypertext and HTML; HTML Document Features; HTML command Tags; Creating Links; Headers; Text styles; Text Structuring; Text colors and Background; Formatting text; Page layouts

UNIT- IV

Images; Ordered and Unordered lists; Inserting Graphics; Table Creation and Layouts; Frame Creation and layouts; Working with Forms and menus; Working with Radio buttons; Checks Boxes; Text Boxes

TEXT AND REFERENCE BOOKS:

1. Raj Kamal, Internet and Web Technologies, Tata McGraw- Hill, 2002.

2. Ramesh Bangia, Multimedia and Web Technologies, Firewall Media, 2007
3. Thomas A. Powell, Web Design: The complete Reference, 4/e, Tata McGraw- Hill, 2003.
4. Wendy Willard, HTML Beginners Guide, Tata McGraw- Hill, 2009.
5. Deitel and Goldberg, Internet and World Wide Web, How to Program, PHI, 2004.

DIGITAL ELECTRONICS

General Course Information

Course Code: BCA-PC(L)-233 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of computer fundamentals.

About the Course

Digital electronics is a basic and an essential course for every computer graduate. This course includes a detailed coverage of number system, combinational circuits and sequential logics. The students will learn various types of conversions in number system and designing different logic circuits.

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

CO1. **Understand** the general concepts of digital electronics.
CO2. **Contrast** different types of logic circuits.
CO3. **Analyze** design combinatorial logic circuits and sequential logic circuits.
CO4. **Develop** a digital logic and apply it to solve real life problems
CO5. **Design** combinatorial logic circuits and sequential logic circuits

COURSE CONTENTS

UNIT- I

Information Representation: Number Systems, Binary Arithmetic Operations, Fixed-point and Floating point representation of numbers, BCD Codes, Error detecting and correcting codes, Character Representation – ASCII, EBCDIC, Unicode, Binary Logic: Boolean Algebra, Boolean Theorems, Boolean Functions Truth Tables, Canonical and Standard forms of Boolean functions , Simplification of Boolean Functions - Venn Diagram, Karnaugh Maps

UNIT- II

Digital Logic: Basic Gates -AND, OR, NOT, Universal Gates - NAND, NOR, Other Gates - XOR, XNOR etc. NAND, NOR, AND-OR-INVERT and OR-AND-INVERT implementations of digital circuits, Combinational Logic – Characteristics, Design Procedures, analysis procedures, Multilevel NAND and NOR circuits.

UNIT- III

Combinational Circuits: Half-Adder, Full-Adder, Half-Subtractor, Full-Subtractor, Encoders, Decoders, Multiplexers, Demultiplexers, Comparators, Code Converters BCD to Seven Segment Decoder.

UNIT- IV

Sequential Logic: Characteristics, Flip-Flops, Clocked RS, D type, JK, T type and Master Slave flip-flops. State table, State diagram and State equations. Flip-flop excitation tables.

TEXT AND REFERENCE BOOKS:

1. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd., 2004.
2. V. Rajaraman and T. Radhakrishnan, An Introduction to Digital Computer Design, Prentice Hall of India Pvt. Ltd., 2004
3. Andrew S. Tanenbaum, Structured Computer Organization, Prentice Hall of India Pvt. Ltd., 1984.
4. Nicholas Carter, Schaum's Outlines Computer Architecture, Tata McGraw-Hill., 2002.

INTRODUCTION TO DATABASE SYSTEMS

General Course Information

Course Code: BCA-PC(L)-234 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of UNIX, Windows, a programming language and data structures

About the Course

This course includes a detailed coverage of principles of database design and models. Students learn designing database using ER model, hierarchical model, object based models etc.

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

CO1. **Describe** fundamental elements of Database Management System.
CO2. **Discuss** principles of database modeling.
CO3. **Analyze** different models of database design
CO4. **Compare** various data model designing techniques
CO5. **Design** models of databases using ER modeling.

COURSE CONTENTS

UNIT- I

Basic Concepts- Data, Information, Records and Files. Traditional file –based System- File based Approach-Limitations of File based Approach, Database Approach- Characteristics of File based Approach, Database Management System(DBMS), Components of DBMS Environment, DBMS Functions and Components, Advantages and Disadvantages of DBMS.

UNIT- II

Roles In the Database Environment – Data and Database Administrator, Database Designers, Applications Developers and Users. Database System Architecture – Three Levels of Architecture, External, Conceptual and Internal Levels, Schemas, Mappings and Instances. Data Independence – Logical and Physical data Independence.

UNIT- III

Classification of Database Management System, centralized and Client Server Architecture to DBMS. Data Models: Records-based data Models, Object-based Data models, Physical Data Models and Conceptual Modeling.

UNIT- IV

Entity-Relationship model – Entity Types, Entity Sets, Attributes relationship Types, Relationship Instances and ER Diagrams. Basic Concepts of Hierarchical and Network Data Model.

TEXT AND REFERENCE BOOKS:

1. Elmasri and Navathe, Fundamentals of Database System, 5th Edition, Pearson Education, 2006.
2. Thomas Connolly, Carolyn Begg., and Carolyn E. Begg., DS: A practical Approach to Design, Implementation and Management, 3rd Edition, Pearson Education, 2002.
3. C.J. Date, An Introduction to Database System, 8th Edition, Addison Wesley N.Delhi, 2003.

ADVANCED DATA STRUCTURES

General Course Information

Course Code: BCA-PC(L)-235 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of basic data structures

About the Course

Data Structure is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces data structures like arrays, linked lists, trees and graphs etc. and various operations to be implemented on these data structures for solving real world problems. It includes various sorting and searching algorithms as well. Further, it incorporates complexity analysis of algorithms implemented on various data structures.

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

CO1. **Describe** various types of advanced data structures and operations that can be implemented on these data structures.
CO2. **Demonstrate** the use of various data structures and their related operations.
CO3. **Apply** data structure to solve computational problems.
CO4. **Compare** the suitability of alternative data structures and prescribed operations for various problem situations.
CO5. **Defend** solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems.

COURSE CONTENTS

UNIT-I

Tree: Introduction, Definition, Representing Binary tree in memory, Traversing binary trees, Traversal algorithm using stacks, Header nodes, Threads, Binary search trees- Searching, Insertion and Deletion.

UNIT-II

AVL search trees: Introduction, Insertion and Deletion, m-way search tree: searching, insertion and deletion, B-tree: Insertion and deletion. Hashing: Introduction, Collision resolution.

UNIT-III

Graphs: Introduction, Graph theory terminology, Sequential and linked representation of graphs, Warshall's algorithm for shortest path, Dijkstra algorithm for shortest path, Operations on graphs, Traversal of graph.

UNIT-IV

Sorting: Internal & external sorting, Radix sort, Quick sort, Heap sort, Merge sort, Comparison of various sorting and searching algorithms on the basis of their complexity.

TEXT AND REFERENCE BOOKS:

1. Seymour Lipschutz, Data Structure, Tata McGraw Hill, 2014.
2. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structure in C, Orient Longman, BlackSwan, 2008.
3. Trembley, J.P. And Sorenson P.G., An Introduction to Data Structures with Applications, McGraw- Hill International Student Edition, New York, 1984.
4. Yedidyan Langsam, Moshe J. Augenstein and Aaron M. Tenenbaum, Data Structures using C, Prentice Hall of India Pvt. Ltd., New Delhi, 1996.

OBJECT ORIENTED PROGRAMMING USING C++ LAB

General Course Information

Course Code: BCA-PC(P)-236 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Problem solving using C Lab.

About the Course:
The lab course provides the opportunity to students to solve problems using Object Oriented Framework in C++ language. This includes implementing the concepts of data abstraction, data hiding, and encapsulation, reuse of code and, compile and runtime polymorphism.

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

CO1. **Implement** problems with object oriented framework.
CO2. **Analyze** the structure of programs for modular design.
CO3. **Evaluate** robustness of a program by testing it on test/use cases.
CO4. **Design** class hierarchies for implementing inheritance/polymorphism.
CO5. **Create** a lab record of assignments including problem definitions, design of solutions and conclusions.
CO6. **Demonstrate** ethical practices and solve problems individually or in a group.

List of experiments/assignments

1. Two assignments related to creating classes and methods.
2. Two assignments associated with overloading.
3. Two assignments on inheritance
4. Two assignments on polymorphism.
5. Two assignments on files.
6. One assignment on challenging problems on data structures to be given in groups.

Note: The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

WEB DESIGNING LAB

General Course Information

Course Code: BCA-PC(P)-237 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic programming skills and knowledge of surfing internet.

About the Course:
This lab course on web development involves learning web-based programming languages. It incorporates the development of web pages by structuring information provided for the website design. The objective of the lab course is to equip the students to design web pages using modern web development tools.

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

CO1. **Implement** object models for website design using modern tools like HTML, XML and JAVA scripting etc.
CO2. **Analyze** the design of websites.
CO3. **Test** the design of websites.
CO4. **Design** websites that consider socio-cultural values.
CO5. **Create** a written report for website designed.
CO6. **Use** ethical practices and socio-cultural values while designing websites.

List of experiments/assignments

1. Create a simple webpage using HTML.
2. Designing of registration form with table and use of hyperlink.
3. Design a page with frames to include Images and Videos.
4. Add a cascading style sheet for designing the web page.
5. Use user defined function to get array of values and sort them in ascending order on web page
6. Design a dynamic web page with validation of form field using JavaScript.
7. Design a catalogue in ASP.
8. Event Handling Validation of registration form.
9. Open a Window from the current window on Mouse Over event.
10. Create a simple application to demonstrate Servlets Request and Response object.
11. Demonstrate Array Objects and Date Object's predefined methods
12. Display calendar for the month and year selected from combo box
13. Create a welcome Cookie (Hit for a page) and display different image and text content each time when the user hit the page
14. Demonstrate Request and Response object using HTML Form.
15. Database Connection to display all the values in the table.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester

JAVA PROGRAMMING

General Course Information

Course Code: BCA-PC(L)-241 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: The course assumes knowledge of Object-Oriented Concepts and programming in any Object-Oriented language.

About the Course

Java is a general-purpose, concurrent, class-based, object-oriented computer programming language that is specifically designed to have as few implementation dependencies as possible. The aim of this course is to provide the students basic knowledge about object-oriented development and in-depth knowledge about syntax and programming techniques in Java. The course is very comprehensive and covers all the important Java concepts, e.g., Java basics, Object-Oriented Programming, Multithreading, File handling, Exception handling and more.

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

CO1. **List** object oriented characteristics peculiar to JAVA programming.
CO2. **Describe** object-oriented principles and paradigms implemented by Java programming language.
CO3. **Apply** object-oriented principles for solving problems using JAVA.
CO4. **Identify** classes, interfaces methods, hierarchy in the classes for a given programming problem in JAVA.
CO5. **Design** Graphical User Interface applications and Web based applications in Java by importing applet, AWT and SWING packages.

COURSE CONTENTS

UNIT-I

Introduction to JAVA & Principles of Object Oriented Programming: Basic Concepts of OOPs and its Benefits; Applications of OOPs; The Creation of JAVA; Importance of JAVA for the Internet; JAVA's Magic: The Byte-code; Features of Java.

Data Type, Array & Strings: Data types & Operators available in JAVA; Control Structures: if, while, do while, for, switch; Break & Continue Statement;

Array and Strings: Arrays, Arrays of Characters, String handling Using String Class; Operations of String Handling; String Buffer Class.

UNIT-II

Object Oriented:Object Oriented Programming in JAVA, JAVA Program Structure. Defining of a Class, Definition of Methods, Constructors, Creating Objects of a Class, Assigning Object Reference Variables, The keyword "this", Defining and Using a Class, Automatic Garbage Collection. Extending Class and Inheritance: Using Existing Classes, Classes Inheritance,

Choosing Base Class, Access Attributes, Polymorphism, Multiple Levels of Inheritance, Abstraction through Abstract Classes, Using Final Modifier, the Universal Super class-Object Class.

UNIT-III

Package & Exception Handling: Understanding Packages, Defining Package, Packaging up your Classes, Adding Classes from a Package to your Program, Understanding CLASSPATH, Standard Packages, Access Protection in Package.

Exception Handling: The Idea behind Exceptions , Types of Exceptions, Dealing with Exceptions, Exception Objects, Defining your own Exception, Checked and Unchecked Exceptions.

UNIT-IV

Creating Applets in JAVA: Applet basics, Applets architecture, Applets life cycle, simple Applet display methods; requesting repainting; using the status window; the html applet tag; passing parameters to applets.

Multithreading Programming: The JAVA Thread Model, Understanding Threads, The Main Thread, Creating a Thread: extending Thread and implementing Runnable Interface, Creating multiple Threads, Threads Priorities, Synchronization, Deadlocks Inter-thread Communication, Deadlocks.

Input/Output in JAVA : I/O Basics, Byte and Character Structure, I/O classes, Reading Console Input, Writing to Console, Reading and Writing on Files, Random Access Files, Storing and Retrieving Objects from File, Stream Benefits.

TEXT AND REFERENCE BOOKS:

1. E. Balagurusamy, Programming with JAVA, Tata McGraw Hill, 2014.
2. Herbert Schildt, The Complete Reference JAVA, TMH Publication, 2017.
3. Ivor Horton, Beginning JAVA, WROX Public, 2005.
4. JAVA 2 UNLEASHED, Tech Media Publications / Jamie Jaworski, Java 2 Platform Unleashed, SAMS, 1999.
5. Patrick Naughton and Herbertz Schildt, Java-2 The Complete Reference, TMH, 1999.

RDBMS

General Course Information

Course Code: BCA-PC(L)-242 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: The course assumes knowledge of basics of database management systems.

About the Course

This course aims at making students understand the concepts of relational calculus. The student will also learn SQL queries for data definition and manipulation. This course covers all concepts of normalization in detail.

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

CO1. **Understand** the basic concepts of relational database management systems
CO2. **List** various dependencies and differentiating between them and
CO3. **Analyze** the use of SQL queries for extracting information
CO4. **Compare** various normalization techniques.
CO5. **Design** database using various concepts of relational database.

COURSE CONTENTS

UNIT- I

Relational Model concepts, Codd's Rules for Relational Model, Relational Algebra:- Selection and Projection, Set Operation, Renaming, Join and Division. Relational calculus: Tuple Relational Calculus and Domain Relational Calculus.

UNIT-II

Functional Dependencies and Normalization: Purpose, Data Redundancy and Update Anomalies.
Functional Dependencies: Full Functional Dependencies and Transitive Functional Dependencies, Characteristics of Functional Dependencies.
Decomposition and Normal Forms (1NF, 2NF, 3NF & BCNF)

UNIT- III

SQL: Data Definition and data types, Specifying Constraints in SQL, Schema, change statement, Basic Queries in SQL, Insert, Delete and Update Statement, Views.

UNIT- IV

PL/SQL: Introduction Advantages of PL/SQL, The Generic PL/SQL Block: PL/SQL Exception Environment, PL/SQL Character set and Data Types, Control Structure in PL/SQL.

TEXT AND REFERENCE BOOKS:

1. Elmasri and Navathe, Fundamentals of Database systems, 5th Edition, Pearson Education, 2006.
2. Ivan Bayross, SQL, PL/SQL-The Program Language of ORACLE, BPB Publication, 2010.
3. H. Korth, A. Silberschatz and S. Sudarshan, Database System Concept, 4th Edition, McGraw Hill International Edition, 2001.
4. C.J.Date, An Introduction to Databases Systems, 8th Edition, Addison Wesley, New Delhi, 2003.

COMPUTER ARCHITECTURE

General Course Information

Course Code: BCA-PC(L)-243 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Digital Electronics and computer systems.

About the Course

Computer Architecture and organization describes the role of instruction set architecture in digital computer, main memory, and input/output devices. It illustrates the simple data path and control design for processors. It helps to understand the different operations and concept of instructions. It would enable the students to learn the basic function and architecture of modern computer systems.

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

CO1. **Outline** the general concepts of digital electronics and computer organization and architecture.
CO2. **Discuss** the basic components and their interfacing.
CO3. **Apply** instructions for performing different operations.
CO4. **Analyze** the effect of addressing modes on the execution time of a program.
CO5. **Contrast** different types of memory, their architecture and access methods.
CO6. **Design** of simple computer with different instruction sets.

COURSE CONTENTS

UNIT- I

Architecture Unit: Main sub-units: Memory data register, accumulator, multiplier quotient register, adder and logic processor, shift counter, status flip-flops. Arithmetic operations – addition and subtraction, shifting, data transfer, multiplication, division, logic operations, storing.
Innovations in Arithmetic Unit: Speed of addition: addition without carries, carry storage adders, carry anticipation, the carry look ahead scheme.

UNIT- II

Memory Systems: Speed imbalance between the arithmetic and memory units, advantages of memory hierarchies, memory interleaving, problems of management of memory hierarchies, operation of virtual memories. Associative memories. Cache memories – operation of the cache, comparison of cache and virtual memory system, schemes for cache organization, word or block replacement, writing into the cache, multi level caches.

UNIT- III

General Organization and Control: Addressing schemes – one, two and three address schemes, no-address scheme, address modification and index registers, general purpose registers, addressing modes, stack organization, use of stack for evaluation of expressions, interrupt processing,

subroutine return, storing local variables, storing parameters, implementation of stacks, stack organized processors. Register Transfer Language.

UNIT- IV

I/O Units**:** Early I/O devices, dot-matrix printers, inkjet printers, laser printers. Information exchange between devices – serial and parallel modes of transfer, synchronous and asynchronous modes of transfer–source-initiated, destination-initiated asynchronous data transfer, handshaking. Buffered I/O, Internal buffering. DMA & transfer modes. Data Channel organization, I/O bus, external interface, device controller and internal interface, processor and memory interfaces, ways of connecting devices on a bus, PCI.

TEXT AND REFERENCE BOOKS:

1. P.V.S. Rao, ComputerSystem Architecture, PHI, 2009.
2. John D. Carpinelli, Computer System Organization and Architecture, Pearson, 2009.
3. M. Morris Mano, Computer Architecture", 3rd Edition, PHI, 2001.
4. John P. Hayes, Computer Architecture and Organization, McGraw-Hill, 1998.
5. W. Stallings, Computer Organization & Architecture, Pearson Education, 2006.

COMPUTER NETWORKS

General Course Information

Course Code: BCA-PC(L)-244 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of Digital and Analog Communication.

About the Course

This course has been designed with an aim to provide students with an overview of the concepts and fundamentals of data communication and computer networks. The learner is given an opportunity to grasp various algorithms for routing of data, forwarding data and switching the data from hop to hop. Layered Architecture adds value to the subject contents.

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

CO1. **Outline** various models, topologies and devices of Computer Networks.
CO2. **Explain** the functions of various layers in Network Reference Model.
CO3. **Apply** different network concepts in various network communication protocols.
CO4. **Analyze** performance of various protocols in different scenarios.
CO5. **Design** network for an organization.

COURSE CONTENTS

UNIT- I

Introduction to Computer Communications and Networking Technologies, Uses of Computer Networks, Network Devices, Nodes, and Hosts, Types of Computer Networks and their Topologies; Network Software: Network Design issues and Protocols; Connection-Oriented and Connectionless Services; Network Applications and Application Protocols; Computer Communications and Networking Models: Decentralized and Centralized Systems, Distributed Systems, Client/Server Model; Network Architecture and the OSI Reference Model, Example Network: The Internet, X.25, Frame relay;

UNIT- II

Analog and Digital Communications Concepts: Representing Data as Analog Signals, Representing Data as Digital Signals, Data Rate and Bandwidth, Capacity, Baud Rate; Digital Carrier Systems; Guided and Wireless Transmission Media; Communication Satellites; Switching and Multiplexing; Dial Up Networking; Analog Modem Concepts; DSL Service

UNIT- III

Data Link Layer: Framing, Flow Control, Error Control, Error Detection and Correction, Sliding Window Protocols, Media Access Control, Random Access Protocols, Token Passing Protocols,

Token Ring, Introduction to LAN technologies: Ethernet, switched Ethernet, VLAN, Fast Ethernet, gigabit Ethernet, token ring, FDDI, Wireless LANs; Bluetooth;

UNIT- IV

Network Hardware Components: Connectors, Transceivers, Repeaters, Hubs, Network Interface Cards and PC Cards, Bridge, Switches, Routers, Gateways;

Routing Concepts: Virtual Circuits and Datagrams, Routing Algorithms, Flooding, Shortest Path Routing, Distance Vector Routing, Link State Routing, Hierarchical Routing, Congestion Control Algorithms, Internetworking;

TEXT AND REFERENCE BOOKS:

1. Michael A. Gallo and William M. Hancock, Computer Communications and Networking Technologies, Course Technology, 2001.
2. Andrew S. Tanenbaum, Computer Networks, 5th Edition, Pearson Education, 2013.
3. James F. Kurose, Keith W. Ross, Computer Networking, Pearson Education, 2013.
4. Behrouz A Forouzan, Data Communications and Networking, McGraw Hill, 2017.

ADVANCED WEB DESIGNING

General Course Information

Course Code: BCA-PE(L)-241 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of web designing.

About the Course:
This course has been designed with an aim to provide students with knowledge about VB, Java script and markup languages for web designing. This course will enable learner to use PHP, flash, java script and various markup languages for web designing.

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

CO1. **Describe** Web Designing Complete Process
CO2. **Discuss** Client Side and Server Side Programming.
CO3. **Apply** basic web designing tools (HTML, XML).
CO4. **Implement** object models for website design using modern tools like HTML, XML and JAVA scripting etc.
CO4. **Contrast** All Markup Languages.

COURSE CONTENTS

UNIT- I

Brief Introduction to Interactivity tools: CGI; Features of Java; Java Script; Features of ASP; VBScript; Macromedia Flash; Macromedia Dreamweaver; PHP

UNIT- II

Introduction and Features of Adobe Photoshop; Microsoft FrontPage Introduction; Features; Title Bar, Menu bar, Front Page Toolbar, Style, Front Face and Formatting Bar; Scroll Bars

UNIT- III

Introduction to DHTML and its features; Events; Cascading Style Sheets, Creating Style Sheets; Common Tasks with CSS: Text, Font, Margins, Links, Tables, Colors; Marquee; Mouseovers; Filters and Transitions; Adding Links; Adding Tables; Adding Forms; Adding Image and Sound

UNIT- IV

Extensible Mark-up Language(XML): Introduction, Features, XML Support and Usage, Structure of XML Documents, Structures in XML, Creating Document Type Declarations, Flow Objects, Working with Text and Font, Color and Background properties.

TEXT AND REFERENCE BOOKS:

1. Raj Kamal, Internet and Web Technologies, Tata McGraw-Hill, 2002.
2. Ramesh Bangia, Multimedia and Web Technology, Firewall Media, 2011.
3. DOAEC, Internet and Web Design, ITLESL Research and Development Wing, Macmillan India.
4. Thomas A. Powell, Web Design: The Complete Reference, 4 Edition, Tata McGraw-Hill, 2003.
5. H. M. Deitel, P. Deitel and A. B. Goldberg, Internet and World Wide Web, How to Program, PHI, 2004.

MOBILE APPLICATION DEVELOPMENT

General Course Information

Course Code: BCA-PE(L)-242 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Java Programming and Object-Oriented programming, Knowledge of RDBMS and OLTP.

About the Course:
Mobile Application Development has been introduced as a Professional Elective course for students keeping in view the Employers' requirements. Android Platform forms the basis for developing Mobile Applications since the last decade as compared to IOS Platform for Apple Products. The Environment requires User Interface to be developed using Buttons, Check-Boxes, Alert Dialog and its kind.

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

CO1. **State** basic of Android, its Evolution and its Architecture.
CO2. **Demonstrate** the Lifecycle of Software for Android Mobile Applications.
CO3. **Prepare** Mobile Applications on the Android Platform.
CO4. **Compare** working with Buttons and other Widgets for Visual Environment.
CO5. **Develop** Mobile Applications using data storage in SQLite Database and evaluate its Performance.

COURSE CONTENTS

UNIT- I

Getting started with Mobility: Mobility landscape, mobile platform, mobile apps development, overview of android platform, setting up the mobile app development environment along with an emulator, a case study on mobile app development.

UNIT- II

Building blocks of mobile apps: Apps user: Interface designing-mobile UI resources (Layout, UI elements, Draw-able, Menu), activity-states and life-cycle, interaction amongst activities. app-functionality beyond user interface- threads, async task, service –state and life cycle, notification, broadcast receivers, telephony and smsapis native data handling- on device file I/O, shared preferences, mobile database such as SQLite, and enterprise data access (via Internet/Intranet)

UNIT- III

Sprucing up mobile apps:Graphics and animation- custom views, canvas, animation APIs, multimedia-audio/video playback and record, location awareness, and native hardware access (sensor such as accelerometer and gyroscope).

UNIT-IV

Testing mobile apps: Debugging mobile apps, white box testing, black box testing, and test automation of mobile app, JUNIT-for Android, Robotium, Monkey Talk. Taking apps to market: Versioning signing and packaging mobile apps, distributing apps on mobile marketplace.

TEXT AND REFERENCE BOOKS:

1. Barry Burd, Android Application Development All in One for Dummies, Johen Wiley & Sons Inc., Edition I , 2011.
2. Anubhav Pradhan and Anil V Deshpandy, Mobile App Development, Edition I.

SYSTEM ADMINISTRATION AND MAINTENANCE

General Course Information

Course Code: BCA-PE(L)-243 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Networking, protocols defined in layered Architecture, programming fundamentals**.**

About the Course:
System Administration and Maintenance is a Professional Elective course deemed to be necessary during the present era of Information Technology and Computer Science. This course deals with analyzing Network for statistics such as protocols, servers, memory, CPU etc. Network Monitoring and Management deals with different events in various types of platforms for response.

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

CO1. **Define system** Administration and its various components.
CO2. **Distinguish system** Administration and its Management on various platforms.
CO3. **Classify** the output for different responses to events by interpreting Network Monitoring statistics.
CO4. **Separate** portions of Network for troubleshooting using various tools.
CO5. **Combine** Network Administration, Network Management and Network Monitoring into a one scenario and compute the performance of the integrated environment.

COURSE CONTENTS

UNIT-I

Exploring different Operating Systems: Introduction to Linux/Unix based operating systems, introduction to Windows based operating systems, difference between Linux/Unix and other operating systems, introduction to server based operating systems, difference between desktop based (Windows 10) and server based operating systems like Windows server 2003/2008.

UNIT-II

Linux/Ubuntu System Environment: Configuring desktop environment and desktop settings, installing and configuring software and hardware, exploring file structure, terminal, shell, basic Unix Commands like cat, ls, cd, date, cal, man, echo, pwd, mkdir, rm, rmdirps, kill etc.

UNIT-III

Windows System Environment: Configuring desktop environment and desktop settings, installing and configuring software and hardware, explore system configuration using control panel, creating users, add/ delete users, difference between workgroup and domain, concept of user profiles –

creating and roaming, concept of Active Directory, process and disk management, Windows task manager, exploring file structure and file properties, backup and recovery.

UNIT-IV

Network Administration: Examine network settings using commands like ipconfig/ifconfig, hostname, net, netstat, whoami etc., troubleshoot network connectivity issues using commands like: ipconfig, ping, tracert, route etc., sharing resources (files, printers etc.) on the network, accessing a system remotely using remote desktop.

TEXT AND REFERENCE BOOKS:

1. W. Panek and T. Wentworth, Mastering Windows 7 administration, Wiley Publishing Inc., 2010.
2. G. Snyder, T. R. Hein, and B. W. EviNemeth, UNIX and Linux System Administration Handbook, 5th Edition, Pearson, 2018.
3. M. S. Sobell, A Practical Guide to Ubuntu Linux, 4th Edition, Prentice Hall, 2014.
4. M. Burges, Principles of Network and System Administration. John Wiley & sons Ltd., 2003.
5. T.A. Limoncelli, C. Hogan and S. R. Chalup, The Practice of System and Network Administration, Addison-Wesley, 2007.

JAVA PROGRAMMING LAB

General Course Information

Course Code: BCA-PC(P)-246 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: The course assumes knowledge of Object-Oriented Concepts and programming.

About the Course:
This Java course will provide a strong understanding of basic Java programming elements and data abstraction using problem representation and the object-oriented framework. The objective of the lab course is to inculcate proficiency in students to design and develop market-based software applications.

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

CO1. **Implement** Java programs using object oriented concepts for problem solving.
CO2. **Detect** syntax and logical errors in java programs
CO3. **Apply** exception handling for making robust JAVA code.
CO4. **Design** java applications using File I/O and GUI.
CO5. **Create** lab record of the solutions of assignments that includes problem definitions, solutions and conclusions.
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments:

1. Use eclipse or NetBeans platform and acquaint with the various menus, create a test project, add a test class and run it to see how you can use auto suggestions and auto fill functionalities. Try code formatter and code refactoring like renaming variables, methods and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
2. Two assignments illustrating class, objects, methods, arrays and various data types in java.
3. Two assignments on the use of control, looping statements and user defined functions.
4. One assignment illustrating the implementation of various forms of inheritance.
5. One assignment on method overloading.
6. One assignment on polymorphism and method overriding.
7. One assignment on implementing exception handling.
8. One assignment to illustrate interfaces in java.
9. One assignment to create package in java.
10. One assignment to design of multithreaded programs in java.
11. One new assignment on event handling.
12. Two assignments related to java applets.
13. One assignment to design a GUI application.
14. One assignment to access and update data from a database using JDBC.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester

RDBMS LAB

General Course Information

Course Code: BCA-PC(P)-247 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab File and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Exposure to a programming language, MS Access.

About the Course:
This lab. course on DBMS involves a rigorous training on Oracle programming. It provides a strong formal foundation in database concepts, technology and practice to the students to groom them into well-informed database application developers. The objective of the lab course is to develop proficiency in the execution of commands of the database design and query using Oracle.

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

CO1. **Implement** database problems using Oracle DML/DDL commands.
CO2. **Enforce** integrity constraints on a database using a state-of-the-art RDBMS.
CO3. **Analyze** the design of a relational database.
CO4. **Design** a relational database for a given schema.
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions.
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments:

1. Use oracle software and login with valid user id and password. Explore its GUI and practice some basic commands of it.
2. Three assignments related to creation of database with tables having different fields and data types.
3. Two assignments on the creation of table with different types of constraints.
4. Two assignments on insert, delete and modify records from the tables.
5. Two assignments on modifying the table using the alter command.
6. Two assignments on exploring select statement using various clauses like where, order by, group by, having and aggregate functions.
7. Two assignments on the use of set operations to query the tables.
8. Two assignments on creating joins and views on the tables.
9. One assignment on generating sub-queries.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester

PROGRAMMING USING PYTHON

General Course Information

Course Code: BCA-PC(L)-351 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basics of Programming Language.

About the Course: Python is a popular open source programming language used for both standalone programs and scripting applications in a wide variety of domains. It is free, portable and powerful as well as relatively easy to use. This is introductory course and covers most of the basic concepts required for basic python programming.

Course Outcome: By the end of the course students will be able to:

CO1. **Understand** about the various programming constructs of python including operators, functions, control structures, aggregated data (list), strings etc.
CO2. **Identify** the usage of string operations and functions.
CO3. **Apply** basic object oriented concepts.
CO4. **Design** basic Python scripts.

COURSE CONTENTS

UNIT-I

Introduction to Python: History and Features of Python Programming, Python Interpreter. Variable, identifiers and literal. Token, keywords. Data Types. Arithmetic operators, Relational operators, Logical operators, Bitwise operators, Assignment operators, Membership operators, Identity operators. Operator precedence. Comment, Indentation, Need for indentation

Built-in Functions: input, eval, composition, print, type, round, min and max, pow. Type Conversion, Random Number Generation. Mathematical Functions. Getting help on a function, Assert Statement.

UNIT-II

Control Statements: if Conditional Statement, for and while Statements. break, continue and pass statements. Functions: Function Definition and Call, Function Arguments-Variable Function Arguments, Default Arguments, Keyword Arguments, Arbitrary Arguments. Command Line Arguments. Global and local Variables. Accessing local variables outside the scope, Using Global and Local variables in same code, Using Global variable and Local variable with same Name.

UNIT-III

Strings: String as a compound data type. String operations- Concatenation, Repetition, Membership operation, Slicing operation. String methods-count, find, rfind, capitalize, title, lower,

upper, swapcase, islower, isupperistitle, replace, isalpha, isdigit, isalnum. String Processing examples.
Lists: List operations-multiplication, concatenation, length, indexing, slicing, min, max, sum, membership operator; List functions-append, extend, remove, pop, count, index, insert, sort, reverse.

UNIT- IV

Object Oriented Programming: Introduction to Classes, Method, Class object, Instance object, Method object. Class as abstract data type, Date Class. Access attributes using functions-getattr, hasattr, setattr, delattr. Built-In Class Attributes of Class object (__dict__, __doc__ , __name__, module__).

TEXT AND REFERENCE BOOKS:

1. Sheetal Taneja and Naveen Kumar, Python Programming A modular Approach, Pearson, 2017.
2. ReemaThareja, Python Programming Using Problem Solving Approach, Oxford Publications.
3. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2013.
4. Ashok Namdev Kamthane, Programming and Problem Solving with Python, Mc Graw Hill Education Publication, 2018.

COMPUTER GRAPHICS

General Course Information

Course Code: BCA-PC(L)-352 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Programming skills in C/C++ and Data structures.

About the Course:
This course introduces students to Computer Graphics process and describes the quality of graphics & animation objects process and its role to design shapes and motion of objects. During the course, students learn about the geometric transformations methods, clipping techniques and creating good shapes to improve the quality of objects.

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

CO1. **Recall** the process of Points and lines methods and filled area primitives.
CO2. **Demonstrate** 2-D & 3-D geometrical transformation and viewing objects.
CO3. **Apply** viewport coordinate transformation and algorithms on various applications.
CO4. **Identify** various Geometric Transformations techniques.
CO5. **Plan** test different projection and clipping transforms techniques.
CO6. **Predict** various basic illumination models and polygon-rendering methods.

COURSE CONTENTS

UNIT-I

Graphics Primitives: Introduction to computer graphics, Basics of Graphics systems, Application areas of Computer Graphics, overview of graphics systems, video-display devices, and raster-scan systems, random scan systems, graphics monitors and workstations and input devices.
Output Primitives: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary fill and floodfillalgorithms .

UNIT-II

2-D Geometrical Transforms: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.
2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to viewport coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

UNIT-III

3-D Object Representation: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon-rendering methods.

UNIT-IV

3-D Geometric Transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations.

3-D Viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

TEXT AND REFERENCE BOOKS:

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI Publications, 1997.
2. Plastock, Theory & Problem of Computer Gaphics, Schaum Series, 1986.
3. Foley and Van Dam, Fundamentals of Interactive Computer Graphics, Addison-Wesley, 1982.
4. M. W. Newman, Principles of Interactive Computer Graphics, McGraw Hill, 2016.
5. L.K. Tosijasu, Computer Graphics, Springer-Verleg.

SOFTWARE ENGINEERING

General Course Information

Course Code: BCA-PC(L)-353 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of algorithms, flow charts and a programming language

About the Course:
Software Development is generally a quite complex and time-consuming process. Moreover, depending on the nature and complexity of the software requirements, Software Engineering plays an important role. This course will help the students to understand the systematic approach to requirement analysis, design, development, operations and maintenance of software systems. Besides this, it also guides students in developing the optimal software systems.

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

CO1. **Define** the various concepts related to software engineering.
CO2. **Demonstrate** the use of stages of various Software Life Cycle Models.
CO3. **Apply** the Software Requirement Analysis and Software Design Process.
CO4. **Analyze** the quality and maintenance of a software system.
CO5. **Construct** the software model according to the requirements of a user.

COURSE CONTENTS

UNIT- I

Software Crisis – problem and causes, Software life cycle models:Waterfall, Prototype, Evolutionary and Spiral models. Software Project Planning: Cost estimation: COCOMO model, Project scheduling, project monitoring.

UNIT- II

Software Requirement Analysis and Specifications: Structured Analysis, Data Flow Diagram, Data Dictionaries, Software Requirement and Specifications, Behavioral and non-behavioral requirements. Software Design: Design fundamentals, problem partitioning and abstraction, design methodology, Cohesion & Coupling, Classification of Cohesiveness & Coupling.

UNIT- III

Software Configuration Management, Quality Assurance, Risk Management, Software Maintenance:Type of maintenance, Management of maintenance..

UNIT- IV

Coding: Programming style, structured programming. Software testing: Testing fundamentals, Functional testing: Boundary Value Analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Software testing strategies:UNIT-testing,integration testing, validation testing, System testing, Alpha and Beta testing.

TEXT AND REFERENCE BOOKS:

1. R.S. Pressman, Software Engineering- A Practitioner's Approach, Tata McGraw- Hill, 2014.
2. K.K. Aggarwal and Yogesh Singh, Software Engineering, New Age Pub, 2008.
3. P. Jalote, An Integrated approach to Software Engineering, Narosa, 2005.
4. Sommerville, Software Engineering, Addison Wesley, 2006.
5. R. Fairley, Software Engineering Concepts, Tata McGraw- Hill, 1997.
6. James Peter, W Pedrycz, Software Engineering, John Wiley & Sons, 2000.

DATA WAREHOUSING AND DATA MINING

General Course Information

Course Code: BCA-PC(L)-354 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of database systems, elementary knowledge of statistics and probability

About the Course:
Data is growing exponentially day by day. There is a need to process and analyze the data to extract knowledge from it, so that one can use that knowledge for decision-making. This course provides introductory concepts of data mining and data warehousing. The course will be taught with a database as well as machine learning perspectives. The objective of the course is to provide a comprehensive understanding of data prep-processing, data mining tasks and evaluation of results obtained out of data mining processes.

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

CO1. **Outline** various types of data mining and data warehouse concepts and techniques.
CO2. **Explain** characteristics, architecture of a data warehouse, OLAP operations and data mining tasks.
CO3. **Apply** various pre-processing and data mining techniques for extracting valuable information from data.
CO4. **Evaluate** data mining models.
CO5. **Design** a data mining process for discovering knowledge from real-world databases.

COURSE CONTENTS

UNIT-I

Data Mining: Introduction, Kind of data to be mined, Data Mining Functionalities, Technologies used in Data Mining, Applications of data Mining, Major Issues in Data Mining.

UNIT-II

Data Pre-Processing: Introduction, Need of preprocessing, Data Objects and Attribute type, Statistical description of data, Data Visualization, Measuring similarity and dissimilarity of data, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization

UNIT-III

Data Warehouse: Introduction, Data Warehouse and Database Systems, Data Warehouse Architecture, Data Warehouse Models, Data Cube and OLAP, Multidimensional data Model, Concept Hierarchies, OLAP operations, Data Warehouse Implementation

UNIT-IV

Mining Frequent Patterns, Associations and Correlations: Introduction, Frequent Itemset Mining using Apriori Algorithm ,Generating Association Rule from Frequent Itemsets. Improving efficiency of Apriori, Pattern Growth Approach for Mining Frequent Itemsets, Pattern evaluation Methods.

TEXT AND REFERENCE BOOKS:

1. Jiawei Han, MichelineKamber and Jian Pei, Data Mining Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publishers, July 2011
2. AlexBerson And Stephen J. Smith, Data Warehousing, Data Mining & Olap, TataMcgraw – Hill Edition, 2004.
3. Michael Steinbach and Vipin Kumar, Introduction To Data Mining, Pang-Ning Tan, Pearson Education, 2014.
4. K.P. Soman, Shyam Diwakar and V. Ajay, Insight Into Data Mining Theory And Practice, Easter Economy Edition, Prentice Hall Of India, 2009.
5. G. K. Gupta, Introduction To Data Mining With Case Studies, Easter Economy Edition, Prentice Hall Of India, 2006.
6. Daniel T. Larose, Data Mining Methods And Models, Wiley, 2006.
7. W.H. Inmon, Building The Data Warehouse, 4th Edition, Wiley India,2005.

THEORY OF COMPUTATION

General Course Information

Course Code: BCA-PE(L)-351 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: The fundamentals of Discrete Mathematics, Data Structure and Algorithms.

About the Course: Theory of computation deals with the concepts of automata, formal languages, grammar, computability and decidability pushdown automata and Turing machine. The course presents the theoretical features of computer science. The automata theory have direct bearing on practices such as Automata on circuit design, compiler design, and search algorithms; Formal Languages and Grammars on compiler design; and Complexity on cryptography and optimization problems in manufacturing, business, and management.

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

CO1. **Describe** the basic terminology related to theory of computation.
CO2. **Understand** the concepts of basic machines like FA, NFA, Moore, Mealy etc.
CO3. **Construct** automata for any given pattern and find its equivalent regular expressions.
CO4. **Analyse** different types of grammar.
CO5. **Design** various types of machine for given grammar.

COURSE CONTENTS

UNIT-I

Finite Automata and Regular Expressions: Definition and Description of Finite Automaton , Non-Deterministic finite automata (NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA, Finite automata with E-moves, Regular Expressions, Equivalence of finite automata and Regular Expressions, Regular expression conversion and vice versa

UNIT-II

Introduction to Machines: Concept of basic Machine, Properties and limitations of FSM. Moore and mealy Machines, Equivalence of Moore and Mealy machines, Conversion of NFA to DFA by Arden's Method.

Properties of Regular Sets: The Pumping Lemma for Regular Sets, Applications of the pumping lemma, Closure properties of regular sets, Minimization of finite Automata

UNIT-III

Grammars: Definition, Language generated by a Grammer, Chomsky Classification of Languages, Relation between classes of Languages, Opeartions on Languages

Context Free Language: Context Free Grammer, Ambiguity in Context Free Grammer, Reduced Form, Removal of Useless Symbols and UNIT-Production, Chomsky Normal Form

UNIT-IV

Pushdown Automata: Introduction to Pushdown Machines, Application of Pushdown Machines
Turing Machines: Deterministic and Non-Deterministic Turing Machines, Design of T.M, Halting problem of T.M.

TEXT AND REFERENCE BOOKS:

1. Introduction to automata theory, language & computations- Hopcroaft & O.D.Ullman, R Mothwani, 2001, AW.
2. Theory of Computer Sc. (Automata, Languages and computation):K.L.P.Mishra & N.Chandrasekaran, 2000, PHI.
3. Introduction to Formal Languages & Automata-Peter Linz, 2001, Narosa Publ.
4. Introduction to languages and the Theory of Computation by John C. Martin 2003, T.M.H.

OPEN SOURCE SOFTWARE

General Course Information

Course Code: BCA-PE(L)-352 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Knowledge of software systems, Operating systems.

About the course:
This course of open-source software is designed to make the students aware of the freeware software systems in respect of software cost, modification, updating and distribution. After completion of this course, learners will be able to differentiate commercial software from open-source software and understand the public license agreements of open-source software so as to use open-source software for applications and production.

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

CO1. **Define** the commercial software and open-source software.
CO2. **Illustrate** the booting of Linux Operating System using various loaders as non-commercial software.
CO3. **Judge** kinds of license to agree for open-source software.
CO4. **Distinguish** between free software, freeware and open-source software.
CO5. **Contrast** application software of Linux Operating System and other commercial software.
CO6. **Combine** the attributes of open-source software to analyze productivity.

COURSE CONTENTS

UNIT-I

Introduction: History of Open Source Software (OSS), commercial software vs OSS, free software vs freeware, open source software examples - the GNU projects, copy right issues about open source software.

UNIT-II

The Linux operating system : Linux installation and hardware configuration – boot process - Linux loader (LILO) – Grand Unified Boot loader (GRUB), user account, accessing, starting and shutting processes, log in and log out, command line, simple commands, Unix file system, Unix files, i-node structure and file system related commands.

UNIT-III

Basic principles of copyright law, open source licensing, issues with copyright and patent, warranty, MIT license, BSD License, Apache license, Academic Free License, Mozilla Public License, GPL, LGPL. 59

UNIT-IV

Study of commercial application software vs OSS, Open Office.
GIMP: Installation, GIMP user interface, creating new windows.
GIMP: Freehand drawing in GIMP, drawing regular shapes, image editing- cropping and resizing, masking.
GIMP: Language support

TEXT AND REFERENCE BOOKS:

1. A.M. Laurent, Understanding Open Source and Free Software Licensing. O'Reilly Media, 2004.
2. M. N. Rao, Fundamentals of Open Source Software, 1st Edition, PHI Learning, 2014.
3. W.E. Shotts, The Linux Command Line: A Complete Introduction, No Starch Press, 2012.
4. O. Lecarme and K. Delvare, The Book of GIMP, No Starch Press, 2013.
5. J. Smith and R. Joost, GIMP for Absolute Beginners, Apress, 2012.

CLOUD COMPUTING

General Course Information

Course Code: BCA-PE(L)-353 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Distributed and Grid Computing.

About the course:
Cloud Computing is one of the best emerging technologies. This course introduces students to cloud computing techniques, its types and various applications. During the course students learns about Software as a Service, Platform as a Service and Infrastructure as a Service and cloud service provider.

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

CO1. **Express** various cloud computing techniques and its types.
CO2. **Understand** the strength and weakness of cloud computing and possible services.
CO3. **Apply** various cloud tools and techniques for private, public and hybrid cloud services.
CO4. **Identify** the architecture, infrastructure of cloud environment and SaaS, PaaS and IaaS.
CO5. **Develop** business and other applications using various techniques available in market.

COURSE CONTENTS

UNIT-I

Cloud Computing: Introduction to client server computing, Peer to Peer computing, Distributed computing, collaborative computing and cloud computing, Importance of cloud computing in current era, Characteristics, advantages and disadvantages of cloud computing.

UNIT-II

Cloud Services: Functioning of cloud computing, Classification of cloud on the basis of services: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (Iaas): Definition, characteristics and their benefits.

UNIT-III

Cloud Architecture: Cloud computing Logical and service architecture, Types of clouds: Private cloud, Public cloud and Hybrid cloud, Comparison of a Private, public and hybrid clouds, Migrating to a cloud, Seven step model to migrate.

UNIT-IV

Applications: Business opportunities using cloud, Managing Desktop and devices in cloud, cloud as a type of distributed infrastructure, Application of cloud computing for centralizing Email

communication, collaboration on schedules, calendars. Overview of major cloud service providers - Amazon Ec2, Google App Engine.

TEXT AND REFERENCE BOOKS:

1. Srinivasan, A. Cloud Computing: A Practical Approach for Learning and Implementation, Pearson Education India, 2014.
2. Velte, Anthony T., Toby J. Velte, Robert C. Elsenpeter, and Robert C. Elsenpeter, Cloud computing: a practical approach, New York: McGraw-Hill, 2010.

PYTHON PROGRAMMING LAB

General Course Information

Course Code: BCA-PC(P)-356 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. File and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basics of Programming Language.

About the Course:
This lab on Programming using Python involves learning about programming language and its core concept from scratch with basic script creation. It helps to have a strong knowledge about the programming paradigms with it implementation in python. The objective of the lab course is to accomplish the experimental procedures in Python using IDE.

Course Outcome: By the end of the course, students will be able to:

CO1. **Implement,** test and debug basic python programs.
CO2. **Enforce** various operators (Arithmetic, Logical, etc.) and conditional statements in python program.
CO3. **Analyze** various built-in functions, string functions and represent compound data using List and Strings.
CO5. **Design** classes and Access built-in class attributes of a class object.
CO6. **Demonstrate** creativity, learning, work ethic and team spirit.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester

COMPUTER GRAPHICS LAB

General Course Information

Course Code: BCA-PC(P)-357 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. File and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisition: Explore to Computer graphics using programming languages such as C, C++.

About the Course:
This lab course on computer graphics involves a rigorous training on languages C, C++. It provides a strong formal foundation on Computer Graphics process, technology and practice to the students to groom them into well informed graphics application developer .The objective of the lab course is to develop proficiency in the execution of commands of the computer graphics design and query using animation.

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

CO1. **Implement** computer graphics problems using C/C++ in labs.
CO2.**Enforce** integrity constraints on computer graphics assignments using geometrical transformation techniques.
CO3. **Analysis** the design of computer animation**.**
CO4 **Design** different projection and clipping transforms techniques.
CO5. **Create** lab assignment record that includes problem definition, solutions, results and conclusions.
CO6. **Demonstrate** ethical practice**,** self-learning and team spirits.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester

MINOR PROJECT

General Course Information

Course Code: BCA-PC(P)-358 Course Credits: 2 Mode: Self learning in industry. Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods ((internal: 30; external: 70))** An internal evaluation is done by the course coordinator. Significance and originality of the problem addressed and the solution provided: 20 Knowledge of the problem domain and the tool used (VIVA-VOCE):25 Report Writing: 20 Judgment of the tools learnt and quality of the solution developed:20 Level of Ethics followed: 15

Prerequisite: Knowledge of UNIX, Windows, a programming language and data structures

About the Minor Project:
Students do a minor project in industry after fourth semester. They are expected to learn any tool/software and develop applications that can be completed within 4 to 6 weeks.

Course Outcomes: After doing mini project, students will be able to:
CO1: **Define** the appropriate problem from the surrounding environment.
CO2: **Observe** and consider the similar problems and make an outline.
CO3: **Approve** satisfactory domain and modern tools.
CO4: **Design** the problem considering productive and novel approach.
CO5: **Convey** the information related to application verbally and written report.
CO6: **Capture** moral and ethical values, **e**nhance the problem solving ability, learn team work and appreciate role of each of the team members.

Note: An internal practical examination is conducted by the course coordinator. The end semester examination is conducted jointly by external and internal examiners.
Project work will be carried out under supervision of teacher of the College/Department. Evaluation & viva-voce to be done jointly by internal and external examiners.

INTERNET TECHNOLOGY

General Course Information

Course Code: BCA-PC(L)-361 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Data Communication, Basic Knowledge of Computer Network Terminology.

About the Course:
This course introduces students to Computer Network, its working and Internet working as well as network technologies. During the course students learns about the functionality of network, communication process among devices, addressing of network devices and creating different cases for network topologies design for increasing the efficiency of network.

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

CO1. **Recall** the functions of each layer in TCP/ IP model and network terminologies.
CO2. **Demonstrate** IP addressing, sub-netting, super-netting, topologies.
CO3. **Apply** Design network using various topologies on available software.
CO4. **Identify** various network design cases.
CO5. **Plan** test cases for application layer protocols and real and virtual networks.
CO6. **Predict** network efficiency over local and internet based on various network efficiency parameters.

COURSE CONTENTS

UNIT- I

Internet and TCP/IP: Introduction to the Internet, Internet History, Internet Administration; Internet and Intranet; Internet Service; TCP/IP Model and its protocols; IP addresses: IPv4; Subnetting, IPv4 addresses; Supernetting; Next generation Internet Protocol(IPv6); The need forIPv6; Packet Format; IPv6 Addresses; Extension Headers.

UNIT- II

TCP/IPs Transport and Network Layer Protocols: Role of TCP, UDP, IP and Port Numbers; Format of TCP, UDP and IP; TCP services; TCP connection management; Remote Procedure Call; SCTP; IP address resolution- Domain Name Space; DNS mapping; Recursive and Iterative resolution; Resource records; Mapping Internet Address to Physical Addresses; ARP, RARP, BOOTP, DHCP; ICMO; IGMP.

UNIT- III

TCP/IP Application Level Protocols; Electronic Mail: Architecture; SMTP, MIME, POP, IMAP; Web Based Mail; File Access and transfer: FTP, Anonymous FTP, TFTP, NFS; Remote login using

TELNET; Voice and Video over IP: RTP, RTCP, IP Telephony and Signaling, Resource Reservation and Quality of service, RSVP.

UNIT- IV

Routing in Internet: RIP, OSPF, BGP; Internet Multicasting; Mobile IP; Private Network Interconnection: Network Address Translation(NAT), Virtual Private network(VPN); Internet Management: SNMP; Internet Security; IPSec, EMail Security; Web Security, Firewalls; Digital Signatures; Certificates.

TEXT AND REFERENCE BOOKS:

1. Douglas E. Corner, Internetworking with TCP/IP Volume-I, Principles, Protocols, and Architecture, Fourth Edition, Pearson Education, 2018.
2. Andrew S. Tanenbaum, Computer networks, Pearson Education, 2013.
3. Behrouz A Forouzan, Data Communications and Networking, McGraw Hill, 2017.
4. Michael A. Gallo and William M. Hancock, Computer Communications and Networking Technologies, Course Technology, 2001.
5. James F. Kurose and Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Pearson Education.
6. Wayne Tomasi, “Introduction to Data Communications and Networking”, Pearson Education.

E-COMMERCE

General Course Information

Course Code: BCA-PC(L)-362 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Understanding of business communication, fundamentals of internet technologies

About the course: E-commerce brings its own unique advantages and contribution to the business. This course exposes students to environment for E-commerce. It provides an introduction to information systems for business and management. It is designed to familiarize students with organizational and managerial foundations of systems, the technical foundation for understanding information systems.

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

CO1. **Understand** the basic concepts of E-commerce.
CO2. **Describe** the major types of E-commerce.
CO3. **Analyze** the impact of E-commerce on business models and strategy.
CO4. **Discuss** the techniques and technologies used to process online payments.
CO5. **Identify** the key security threats in the E-commerce environment.

COURSE CONTENTS

UNIT-I

Introduction to E-Commerce-Business operations, E-commerce practices vs. traditional business practices; concepts of b2b,b2c,c2c,b2g,g2c; Features of E-Commerce, Types of Ecommerce Systems, Elements of E-Commerce, Benefits and Limitations of E-Commerce.

UNIT-II

Concepts of EDI (Electronic Data Interchange), EDI vs. Traditional methods, Benefits of EDI, Drawbacks of EDI, Components of EDI, EDI Implementation, Applications of EDI, Financial EDI, Concept of E-Governance.

UNIT-III

Products in b2c model, e-brokers; Broker-based services on-line; Benefits and impact of e-commerce on travel industry; Online banking and its benefits; On-line financial services, E-auctions-implementations and benefits.

UNIT-IV

Electronic Payment System and its types, define E-money and E-wallets, Electronic fund transfer, Security Issues in E-commerce, Essential Security Requirements for safe Electronic Payments, Security Schemes.

TEXT AND REFERENCE BOOKS:

1. E. Turban, J. Lee, D. King and H. M Chung, Electronic commerce-a Managerial Perspective, Prentice-Hall International, Inc., 2002.
2. V. Bhatia, E-commerce, Khanna Book Pub. Co.(P) Ltd., Delhi, 2000
3. Bharat Bhasker, Electronic Commerce -Framework, technologies and Applications, TMH Publications, 2013
4. David Whitely, Electronic Commerce, TMH, N Delhi, 2000.
5. Shurety, E-business with Net Commerce, Addison Wesley Longman, 1999.
6. Kosiur, Understanding E—Commerce, Prentice Hall of India, N. Delhi

Data Analytics using R

General Course Information

Course Code: BCA-PC(L)-363 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic programming skills and basic knowledge of probability and statistics

About the course: Data Analytics is a broad field. It works in combination with information technology, statistics and business. This course includes working with data in various ways with the help of programming in R. This course will introduces students about R's environment, factors, arrays and matrices, data frames, functions and I/O in R. With this course students learn about how to visualize data in R. It also involves predictive modelling.

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

CO1. **Define** the data analytics terminology and concepts related to R programming.
CO2. **Describe** the operations on data stored in vectors, matrices and data frames**.**
CO3. **Apply** the required operations to manipulate data stored in various R objects.
CO4. **Compare** various data objects and their related operations in R.
CO5. **Create** appropriate plots for data visualization.
CO6. **Build and interpret** predictive models.

COURSE CONTENTS

UNIT-I

About R's Environment: Basics of R and RStudio, Setting Variables, Knowing about objects in R, Attributes of objects, str() and summary() functions, R's workspace, Creating sequences in R, Operators in R, Packages in R, Creating script files in R.

Vectors in R: Type of vectors, Accessing and manipulating vectors, Basic arithmetic operations on numeric vectors, Finding descriptive summary like mean, median, mod, range, quartiles, standard deviation etc. of numeric vectors, Comparing vectors, sorting vectors, Character vectors and operations on character vectors.

UNIT-II

Factors in R: What are factors in R? Useful operations on factors,

Arrays and Matrices in R: Arrays in R, Creating, accessing and manipulating matrices, Naming the dimensions of matrices, Arithmetic operations on matrices, Concatenating matrices, Replicating matrices, Various operations on matrices.

UNIT-III

Data Frames: Creating and accessing data frames, Finding and assigning column and row names to data frames, Binding data frames, Various operations on data frames, Lists in R. **Control Structures**: If, If-Then, If-else if, else and switch statements, For and While loops, Break and next statements.
Functions in R: Defining functions, Calling functions, Scope of variables in functions, Returning values from functions.

UNIT-IV

Input Output in R: Reading and writing txt and CSV files in R.
Visualizing Data in R: Creating bar chart, scatter plots, histograms, polygons, density curves, boxplots.
Building Predictive Models: Difference between classification and regression, KNN Classification model and its implementation, Diving data into training and test, Building a model, Predicting from the model, Evaluating the model, Interpreting Confusion matrix, Accuracy, Precision, Recall, Sensitivity, Specificity and F measure.

TEXT AND REFERENCE BOOKS:

1. Venables W. N., Smith D. M. and the R Core Team, "An Introduction to R, 2016.
2. Teetor Paul, R Cookbook, O'Reilly Media, 2011.
3. Chang Winston, R Graphics Cookbook, O'Reilly, 2012.
4. Peng Roger D., R Programming for Data Science, Leanpub book, 2015.

ARTIFICIAL INTELLIGENCE

General Course Information

Course Code: BCA-PC(L)-364 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of Algorithms, LISP, PROLOG.

About the course: Artificial Intelligence is a core and an essential course for every graduate Computer Science. This course introduces the concepts of Artificial Intelligence and challenges in building intelligent systems. It includes general purpose problem solving, the role of knowledge representation, Heuristic search techniques, Natural language processing, learning and Expert system.

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

CO1. **Outline** various Artificial Intelligence techniques.
CO2. **Apply** search and knowledge representation techniques to solve AI problems.
CO3. **Compare** strength and weakness of AI algorithms.
CO4. **Analyze** various learning techniques in intelligent systems.
CO5. **Combine** various AI techniques to solve intelligent systems problems.

COURSE CONTENTS

UNIT-I

Overview of Artificial Intelligence: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Problems, Problem Space and search: Defining the problem as a state space search, Production system and its characteristics, Issue in the design of search problem.

UNIT-II

Knowledge representation: Definition and importance of knowledge, Knowledge representation, various approaches used in knowledge representation, Issues in knowledge representation, Using Predicate Logic: Representing simple facts in logic.

UNIT-III

Heuristic Search Technique: Generate and test, hill climbing, Best first search technique, Problem Reduction, Constraint Satisfaction.

Natural language processing: Introduction syntactic processing, Semantic processing, Discourse and pragmatic processing.

UNIT-IV

Learning: Introduction learning, Rote learning, learning by taking advice, Learning in problem solving, learning from example-induction, Explanation based learning.
Expert system: Introduction, Representing using domain specific knowledge, Expert system shells, LISP and other AI programming languages.

TEXT AND REFERENCE BOOKS:

1. E. Rich and K. Knight, Artificial intelligence, TMH, 2nd Edition,1999.
2. D. W. Patterson, Introduction to AI and Expert Systems, PHI, 1999.
3. Nils J Nilsson, Artificial intelligence –A new Synthesis, 2nd Edition, Harcourt Asia Ltd., 2000.

INFORMATION AND CYBER SECURITY

General Course Information

Course Code: BCA-PE(L)-361 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of Number systems and computer networks.

About the Course: Cyber Security is a specialized field in Information Technology. It encompasses threats to computer hardware, software and data including theft, hacking and more. Cyber Security course aims to equip students with the knowledge and skills required to defend the computer operating systems, networks and data from cyber-attacks.

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

CO1. **Enlist** various cryptographic and cryptanalysis algorithms.
CO2. **Describe** the intricacies involved in security of systems (hardware and software).
CO3. **Apply** the ethics/netiquettes while surfing around in the cyber space protecting the Intellectual property rights.
CO4. **Compare** and contrast methods of detection of fraudster activities/cybercrime.
CO5. **Rate** the security complexity provided by the Indian IT Act to World's other countries.
CO6. **Integrate** the cryptographic security provided by algorithms and cyber security to provide complete security to an organization.

COURSE CONTENTS

UNIT-I

Cryptography: Overview of Information Security, Basic Concepts, Cryptosystems, Cryptanalysis, Ciphers & Cipher modes, Symmetric Key Cryptography DES, AES. Asymmetric Key Cryptography, RSA algorithm, Diffie Hellman Algorithm. Digital Signature-Digital Signatures.

UNIT-II

System Security: Program Security, Malicious Logic, Protection. Database Security- Access Controls, Security & Integrity Threats, Defence Mechanisms. OS Security-Protection of System Resources.

UNIT-III

Ethics in Cyber Security: Privacy, Intellectual Property in cyberspace, Professional Ethics, Freedom of Speech, Fair User and Ethical Hacking, Trademarks, Internet Fraud, Electronic Evidence, forensic Technologies, Digital Evidence collections. Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking.

UNIT-IV

Cybercrimes and Cybersecurity: Cybercrime and Legal Landscape around the world, Cyberlaws, The Indian IT Act, Challenges, Digital Signatures and Indian IT Act, Amendments to the Indian IT Act, Cybercrime and punishment, Cost of Cybercrimes and IPR Issues, Web threats for Organizations, Social Computing and associated Challenges for Organizations.

TEXT AND REFERENCE BOOKS:

1. Cryptography and Network security-Principles and Practices, Pearson Education, 9th Indian Reprint, 2005
2. Charlie Kaufman , Network Security : Private communication in Public World, Prentice-Hall International, Inc. April 2008
3. Nina Godhole and SUNIT-Belapure, Cyber Security, Wiley India, 2011.
4. James Graham and Ryan Olson, Cyber Security Essentials, Rick Howard CRC Press, Taylor & Francis, 2011.

MULTIMEDIA TECHNOLOGY

General Course Information

Course Code: BCA-PE(L)-362 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic Software and Hardware Knowledge.

About the Course: Multimedia is combination of text, graphics, audio, video and animation. This course introduces students to use different multimedia technologies. By implementing their own skills, students can create dynamic multimedia projects with use of graphics and animation. The objectives of this course is to introduce the students with the use of Images, Sound and Video in digital form on Computer and to teach students how to develop multimedia programs.

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

CO1. **Describe** the types of media and Define Multimedia system.
CO2. **Develop** conceptual maps for content and process for interactive multimedia programs.
CO3. **Use** different tools for image processing, video, sound and animation.
CO4. **Apply** methodology to develop a multimedia system.
CO5. **Implement** the acquired knowledge in the field of multimedia in practice and continue to expand knowledge in this field.

COURSE CONTENTS

UNIT-I

Introduction to Multimedia: Components of Multimedia; Hypermedia and Multimedia; Overview of Multimedia Software Tools; Multimedia Hardware and Software; Basic Software Tools; Making Instant Multimedia; Presentation Tools; Multimedia Authoring; Types of Authoring Tools; Page-Based Authoring Tools; Icon-Based Authoring tools; Time-Based Authoring Tools.

UNIT-II

Graphics and Image Data Representation: Graphics/Image Data Types, Popular File Formats; Color Models in Images and Video; Types of Video Signals Analog and Digital Video: Broadcast Video Standards: NTSC, HDTV; Chroma Subsampling.

UNIT-III

Digital Audio: Digitization of Sound; MIDI Versus Digital Audio; Quantization and Transmission of audio: Coding of Audio; Pulse Code Mo Differential Coding of Audio; Lossless Predictive Coding; DPCM.

UNIT-IV

Multimedia Data Compression: Run-Length Coding; Variable-Length Coding; Dictionary-Based Coding; Transform Coding; Image Compression Standards-JPEG standard; Video Compression Technique: MPEG.

TEXT AND REFERENCE BOOKS:

1. Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Pearson Education, 2003.
2. Tay Vaughan, Multimedia Making it Work, Tata McGraw-Hill, 1999.
3. Ramesh Bangia, Multimedia and Web Technology, Firewall Media, 2007.
4. John F. Koegel Buford, Multimedia systems, Addison Wesley, Pearson Education, 1994.
5. Ana Weston Solomon, Introduction to Multimedia, Tata McGraw-Hill

SOFTWARE TESTING AND QUALITY ASSURANCE

General Course Information

Course Code: BCA-PE(L)-363 Course Credits: 3 Mode: Lectures (L) Maximum Marks: 100 Minimum Pass marks: 40 Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Software Engineering.

About the Course:
This course introduces students to software testing process and describes the quality assurance process and its role in software development. During the course students learns about the testing methods and tools, creating good test cases to improve the quality of software.

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

CO1. **Recall** the process of software testing life cycle models and quality assurance.
CO2. **Demonstrate** reusability testing on software applications.
CO3. **Apply** software testing tools for predicting the behaviour of software applications.
CO4. **Identify** the test cases for software applications.
CO5. **Plan** test cases and quality management activities.
CO6. **Predict** software quality based on quality parameters and quality models.

COURSE CONTENTS

UNIT-I

Introduction: Some Terminologies, Failures, Testing Process, Limitations of Testing and V-Shaped Software Life-Cycle Model.
Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, and Cause Effect Graphing Technique.
Structural Testing: Control Flow Testing, Data Flow Testing, Slice Based Testing and Mutation Testing.
Software Verification: Verification Methods, Software Requirement Specification Document Verification, Software Design Description Document Verification.

UNIT-II

Selection, Minimization and Prioritization of Test Cases for Regression Testing: Regression Testing, regression Test Case Selection, Reducing the Number of Test Cases, Risk Analysis and Code Coverage Prioritization Techniques. Software Testing Activities Levels of Testing, Debugging, Software Testing Tools, Software Test Plan.
Object Oriented Testing: Object Orientation, Object Oriented Testing, Path Testing, State Based Testing and class testing.

Metrics in Software Testing: Software Metrics, Categories of Metrics, Object Oriented Metrics in Testing.

UNIT-III

Software Quality concepts: Meaning and scope, software quality factors, software quality metrics, relationship between quality factors and quality metrics, quality management system,
Concepts of Quality Control, Quality Assurance, Quality Management - Total Quality Management; Cost of Quality; QC tools, Business Process Re-engineering - Zero Defect, Six Sigma, Quality Function Deployment, Benchmarking, Statistical process control.
Software measurement: Fundamentals of measurement, Measurements in Software Engineering, Measurement of internal product attributes - size and structure, External product attributes - measurement of quality, Software quality metrics - Software Process, Project and Product Metrics, metrics for software maintenance.

UNIT-IV

Quality assurance models: ISO-9000 Series and SEI-CMM standards of software quality assurance. People Capability Maturity Model, Capability Maturity Model Integration, Malcolm Baldrige Award, FCMM.
Software Quality Assurance related topics
Software Process - Definition and implementation; internal Auditing and Assessments; Software testing - Concepts, Tools, software reviews, formal technical reviews, Inspections & Walkthroughs; correctness proof, statistical quality assurance, clean room software engineering.

TEXT AND REFERENCE BOOKS:

1. Software Testing, Yogesh Singh, Cambridge University Press, 2012.
2. Effective Methods for Software Testing, William E. Perry, John Wiley and Sons, 2002.
3. Software Testing: Principle, Techniques and Tools, M. G. Limaye, Tata McGraw Hill, 2009.
4. Software Engineering, K. K. Aggarwal and Yogesh Singh, New Age International Publishers, Third Edition, 2008.
5. The Art of Software Testing, Glenford J.Myers, Tom Badgett and Corey Sandler, Wiley & Sons, Third Edition, 2012.
6. Metrics and Models in Software Quality Engineering, Stefan H Khan, Addison-Wesley; 2nd edition, 2014.
7. Software Quality: Theory and Management, Alan Gillies, lulu.com; Third Edition, 2011.

DATA ANALYTICS USING R LAB

General Course Information

Course Code: BCA-PC(P)-365 Course Credits: 2 Mode: Lab practice and assignments Maximum Marks: 100 Minimum Pass marks: 40	**Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. File and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic programming skills and basic knowledge of probability and statistics.

About the Course: This course

- provide an overview of language R used for data science.
- introduce students to the programming environment
- introduce students about the use of libraries and packages
- familiarize students with how various statistics concepts for data exploration
- make understand about data visualization techniques in R.

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

CO1. **Manipulate** data stored in various objects in R.
CO2. **Implement** functions and loops in R.
CO3. **Do** basic descriptive and inferential statistics in R.
CO4. **Create** appropriate plots for data visualization in R.
CO5. **Write** R programs of moderate difficulty.
CO6. **Build** and **interpret** predictive models.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester

MAJOR PROJECT

General Course Information

Course Code: BCA-PC(P)-366 Course Credits: 5 Mode: Self learning under the guidance of a faculty member.	**Course Assessment Methods (internal: 30; external: 70)** Evaluation is done by the internal examiner (project guide) and external examiner appointed by Controller of Examination. The criteria for evaluation are given below. 1. Review of literature related to problem domain: 15 2. Significance and originality of the solution presented: 15 3. Application of software engineering principles and project management: 15 4. Significance and Scope of results: 20 5. Organization and presentation of major project report: 20 6. Level of Ethics and societal issues covered: 15

About the Project Work:

Students start working on their project work in the beginning of sixth semester. Students do the background research for identifying appropriate problems, methodology and tools for their respective project works. They prepare a synopsis of the project work to be carried out. Each student is required to prepare a synopsis in the format provided and present it in front of a committee constituted by the Chairperson of the Department. Students can carry out projects in groups of two. In case of group project, the size of the problem should be significant, and members of the group must specify their individual contribution.

After approval by the internal committee, they continue working on their project work throughout 6^{th} semester. They carry out implementation of their respective projects based on the problem identified, methodology and tools suggested in the approved synopsis. They are required to complete their project work by the end of 6^{th} semester. They prepare the final project reports according to the format provided. At the end of sixth semester, each student is required to present his/her project work in front of internal project guide and external examiner appointed by Controller of Examination.

Course Outcomes: After doing major project, students will be able to:

CO1: **Review** the currently available solutions and strategies in the literature.
CO2: **Procedure** followed should be in agreement with the concepts of project management.
CO3: **Formulate** original solution to the problems using modern tools.
CO4: **Verify** the outcomes gained by the project work.
CO5: **Communicate** and structure the objectives clearly using verbal and symbolic form.
CO6: **Develop** solutions following the scope of ethics, society and validity.

Note: An internal practical examination is conducted by the course coordinator. The end semester practical examination is conducted jointly by external and internal examiners.

Project work will be carried out under supervision of official / Engineer / teacher of industry/company/institute/College. Evaluation & viva-voce to be done jointly by internal and external examiners.