Detailed Syllabus for Bachelor of Computer Application

Specialization in:

Data Science
Cloud Computing
Big Data Analytics
Block Chain Technology
Cyber Forensics & Information Security
Artificial Intelligence & Machine Learning

DEPT. OF COMPUTER SCIENCE & ENGINEERING

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

PREAMBLE

Education plays an enormously significant role in the building of a nation. There are quite a large number of educational institutions, engaged in imparting education in our country. Majority of them have entered recently into semester system to match with international educational pattern. However, our present education system is churning out youth who have to compete locally, regionally, nationally as well as globally. The present alarming situation necessitates transformation and/or redesigning of system, not only by introducing innovations but developing "learner-centric approach".

Majority of Indian higher education institutions have been following marks or percentage-based evaluation system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions. There is need to allow the flexibility in education system, so that students depending upon their interests can choose inter-disciplinary, intra-disciplinary and skill-based courses. This can only be possible when choice based credit system (CBCS), an internationally acknowledged system, is adopted. The choice based credit system not only offers opportunities and avenues to learn core subjects but also explore additional avenues of learning beyond the core subjects for holistic development of an individual. The CBCS will undoubtedly facilitate benchmarking of our courses with best international academic practices.

Advantages of the choice based credit system:

•Shift in focus from the teacher-centric to student-centric education.

•Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).

•CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

•CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations.

•CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students). Credits earned at one institution can be transferred to another institution.

CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the Choice Based Credit System. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The Choice Based Credit System provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses to acquire more than the required credits and adopt an interdisciplinary approach to learning.

Detailed Syllabus for Bachelor of Computer Application

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

It has been a necessity to align higher education with the emerging needs of the economy so as to ensure that the graduates of higher education system have adequate knowledge and skills for employment and entrepreneurship since last few years. The higher education system has to incorporate the requirements of various industries in its curriculum, in an innovative and flexible manner while developing a well-groomed graduate. CSE department aims to encourage research and innovation in the field of Machine Learning, Cyber security, Artificial Intelligence and other allied areas such as Computational Theory, Cloud Computing, Block chain Technology, Data Science, Big Data Analytics and many more. The objective of the BCA program in Bachelor of Computer Application is to prepare students to undertake careers involving innovative technologies, develop a problem solving capability, or to opt for advanced studies for research oriented careers.

In order to give due importance to practical applications as well as theoretical aspects of BCA, the curriculum for the Bachelor of Computer Application program covers most of the foundational aspects as well as develops application skills for problem solving. Students in the BCA degree programme gain the knowledge and skills necessary for success in the rapidly evolving and dynamic field of computing.

JOB OPPORTUNITIES

Booming IT sector in India has plenty of jobs for fresh computer science graduates. Candidates with a high percentage of mark and good communication skills as well as sound computer knowledge do not face problem in getting a job. Computer engineers can get jobs in non-IT companies like universities, research, private and public industries, government departments, business organizations, commercial organizations and the manufacturing sector, etc. Besides the Computer Engineers have plenty of options to work in IT companies in departments such as design, development, assembly, manufacture, and maintenance, etc. Software Developers: Software developers are professionals who are concerned with facets of the software development process which involves activities such as design and coding, computer programming, project management, etc.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 01: Teach the appropriate computer application methods: Graduates of the program will engage in the effective practice of computer application to identify and solve important problems in a diverse range of application areas such as functional programming and object-oriented programming paradigms to enable participants to analyses, design, implement and evaluate computerized solutions (such as developing computer program) to real-life problems.

PEO 02: Real Life Problem Solving: Demonstrate the critical thinking and communication skills required in a technical environment and synthesize data and technical concepts to create novel products and solutions for the real life problems.

PEO 03: Leadership: Graduates of the program will engage in successful careers in industry, academia and attain positions of importance where they have impact on their business, profession and community.

PEO 04: Lifelong Learning: Help participants acquire the knowledge, skills, experience and values to become lifelong learners and be able to obtain employment in a computer-related field or go on to graduate study.

PROGRAM OUTCOMES (PO)

PO	Summary	Description
PO1	**Application knowledge**	Apply the knowledge of mathematics, science, application fundamentals, and Impart proficiency in the basic mathematics and programming methods as employed in computer science.
PO2	**Problem analysis**	Identify, formulate, research literature, and analyze complex problems reaching substantiated conclusions using first principles of mathematics, natural sciences and computer application.
PO3	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO4	**Environment and sustainability**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO5	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO6	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO7	**Communication**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and

		design documentation, make effective presentations, and give and receive clear instructions.
PO8	**Project management and finance**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO9	**Life-Long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

TYPES OF COURSES

1. Courses are the subjects that comprise the Bachelor of Computer Application Programme.

2. A course may be designed to comprise lectures, tutorials, laboratory work, fieldwork, outreach activities, project work, vocational training, viva, seminars, term papers, assignments, presentations, self-study etc. or a combination of some of these components.

3. The learning outcomes of each course will be defined before the start of a semester.

4. Following are the course types:

   i. **Core Course (CC):** This is a course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of BCA in Bachelor of Computer Application.

   ii. **Elective Course:** An elective course is a course, which can be chosen from a pool of courses. It is intended to support the discipline of study by providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student's proficiency and skill. An elective may be of following types:

   a) **Discipline Elective Courses (DE):** It is an elective course that adds proficiency to the students in the discipline.

   b) **Specialization Elective Courses (SE):** This is a course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of Bachelor of Computer Application with Specialization in Cloud Computing/Big Data Analytics/Data Science/Blockchain Technology/Cyber Forensics & Internet Security/Artificial Intelligence & Machine Learning.

   iii. **Obligatory Courses:**

   a) **Mandatory Courses (MC)**: It can be taken from among a pool of foundation courses, which aim at value-based education. They may provide hands-on training to improve competencies and skills or provide education on human, societal, environmental and national values.

   b) **Internship/Training/Project/Dissertation (PTI):** Course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies

such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project

c) **Humanities, Social Sciences & Management (HSM):** It is an elective course taken from non-engineering disciplines (humanities, social sciences and management) that broadens the perspective of an engineering student.

d) **Basic Science Courses (BSC):** It is based upon content that leads to fundamental knowledge enhancement in sciences, and basic application principles.

e) **General Studies Courses (GSC):** "Essential Studies for Professionals Skill & Skill Development for Professionals" courses designed to encourage and enrich the students for the technical and professional exams.

5. Each credit course contributes certain credits to the programme. A course can be offered either as a full course (4 credits) or as a half course (2 credits). A full course is conducted with 3 hours of lectures and either 1 hour of tutorial or 2 hours of practical work per week. A half course is conducted with 2 hours of lectures. There are also some exceptional electives with 3 credits and 1 credit.

Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week Or 2 Hr. Practical (Lab)/week	0.5 Credits Or 1 Credit

6. A project work/dissertation is considered as a special course involving application of the knowledge gained during the course of study in exploring, analyzing and solving complex problems in real life applications. A candidate completes such a course with an advisory support by a faculty member.

7. **Mandatory Courses** may be offered. They do not carry credits but aim at expanding knowledge or bridging deficiency in knowledge or skill.

8. A course may have pre-requisite course(s) that are given in the Semester-wise Course Allocation scheme.

9. A student can opt for a course only if he/she has successfully passed its pre-requisite(s).

10. A student has to register for all courses before the start of a semester.

11. **Program codes:** Bachelor of Computer Application(BCA)

12. **Departmental Course Codes:** The codes for departmental core courses and discipline-specific electives are specific to each discipline. The first two characters are derived from departmental codes listed above. The third character is 'C' for core courses and 'D' for discipline-specific courses and 'INT' for Dissertation/Project/Training/Internship. This is followed by a digit sequence number:

   i. BCAyyy: Core Course

   ii. BCDyyy: Discipline-Specific Elective Courses

   iii. XXXyyy: Specialization Specific Elective Courses (Depends on the Specialization)

   iv. INTyyy: Project/Training/Internship/ Dissertation

13. **Common Elective Course Codes:** All disciplines will follow a common code as shown below. The 3-digit sequence number 'yyy' is taken from the respective tables of different types of courses.

   i. HSMyyy: Humanities, Social Sciences & Management Course

   ii. BSCyyy: Basic Science Course

   iii. MCyyy: Mandatory Course

   iv. GSCyyy: General Studies Courses

Detailed Syllabus for Bachelor of Computer Application

Here, yyy will be follow by a sequence of digit.

14. The opting of a course by the student will depend upon the requisites for that course and with the consent of the course advisor.
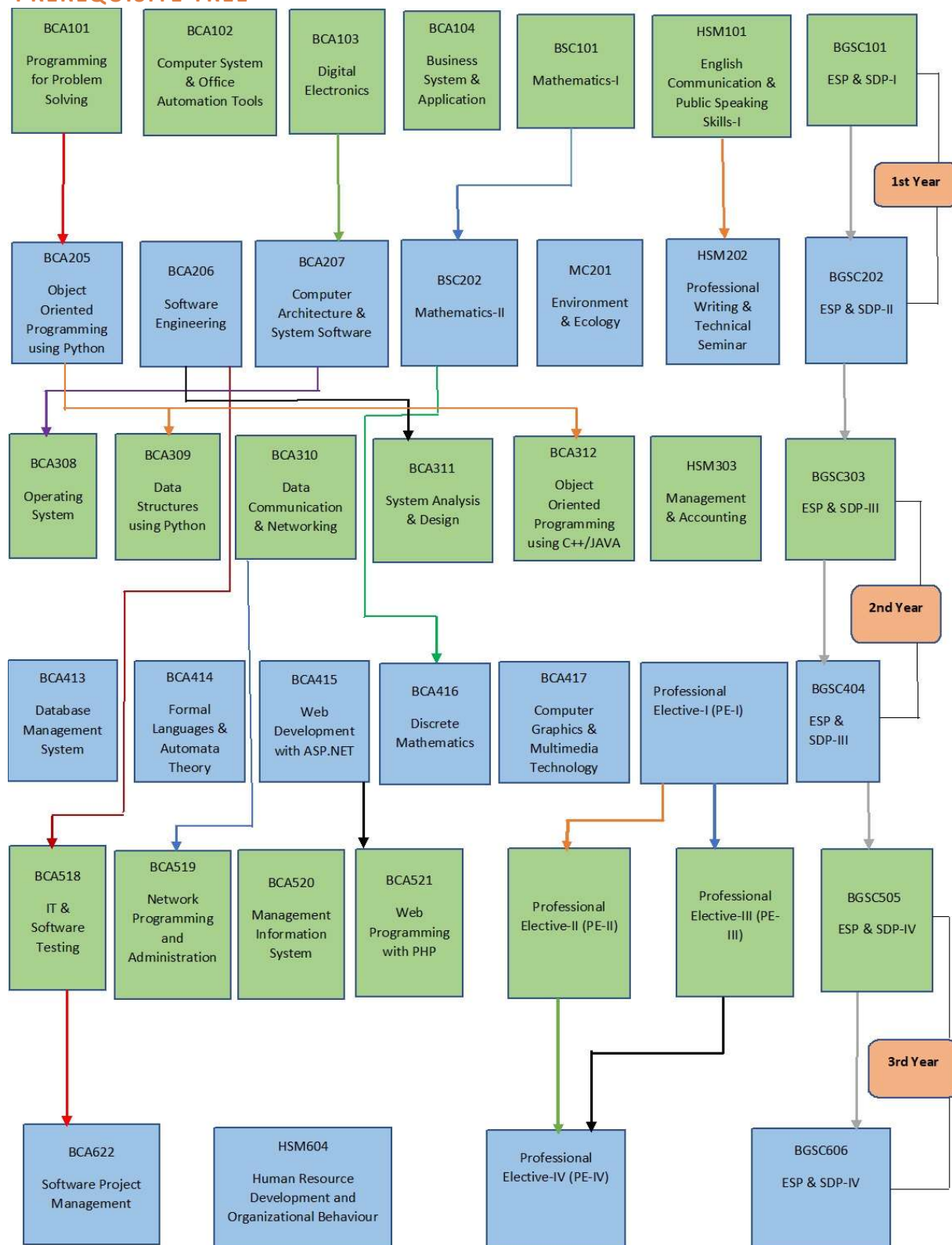
PROCESS FOR DESIGNING THE PROGRAM CURRICULUM

The process for designing the program curriculum involves consideration of the following aspects:

i) Feedback from stakeholders

ii) Institutional and Departmental Vision, Mission and PEOs

iii) Recent trends in industry and research

PREREQUISITE TREE

BCA101
Programming for Problem Solving

BCA102
Computer System & Office Automation Tools

BCA103
Digital Electronics

BCA104
Business System & Application

BSC101
Mathematics-I

HSM101
English Communication & Public Speaking Skills-I

BGSC101
ESP & SDP-I

1st Year

BCA205
Object Oriented Programming using Python

BCA206
Software Engineering

BCA207
Computer Architecture & System Software

BSC202
Mathematics-II

MC201
Environment & Ecology

HSM202
Professional Writing & Technical Seminar

BGSC202
ESP & SDP-II

BCA308
Operating System

BCA309
Data Structures using Python

BCA310
Data Communication & Networking

BCA311
System Analysis & Design

BCA312
Object Oriented Programming using C++/JAVA

HSM303
Management & Accounting

BGSC303
ESP & SDP-III

2nd Year

BCA413
Database Management System

BCA414
Formal Languages & Automata Theory

BCA415
Web Development with ASP.NET

BCA416
Discrete Mathematics

BCA417
Computer Graphics & Multimedia Technology

Professional Elective-I (PE-I)

BGSC404
ESP & SDP-III

BCA518
IT & Software Testing

BCA519
Network Programming and Administration

BCA520
Management Information System

BCA521
Web Programming with PHP

Professional Elective-II (PE-II)

Professional Elective-III (PE-III)

BGSC505
ESP & SDP-IV

3rd Year

BCA622
Software Project Management

HSM604
Human Resource Development and Organizational Behaviour

Professional Elective-IV (PE-IV)

BGSC606
ESP & SDP-IV

Detailed Syllabus for Bachelor of Computer Application

SCHEME – SEMESTER WISE COURSE ALLOCATION

First Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	BCA101	Programming for Problem Solving Using C	3	0	2	0	4
2.	CC	BCA102	Computer System & Office Automation Tools	3	0	2	0	4
3.	CC	BCA103	Digital Electronics	3	0	2	0	4
4.	CC	BCA104	Business System & Administration	3	0	0	0	3
5.	BSC	BSC101	Mathematics-I	3	0	0	0	3
6.	HSM	HSM101	English Communication & Public Speaking Skills-I	2	0	2	0	3
7.	GSC	BGSC101	ESP & SDP-I	2	0	0	1	2
			Total	19	0	8	1	23/28

#Students will undergo a mandatory Induction Program

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: PROGRAMMING FOR PROBLEM SOLVING USING C
COURSE CODE: BCA101
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Students must have basic knowledge of mathematics.

Introduction:
The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Course Outcomes (COs):
Upon successful completion of the course, a student will be able to:
CO1: Appreciate and understand the working of a digital computer
CO2: Analyze a given problem and develop an algorithm to solve the problem
CO3: Improve upon a solution to a problem
CO4: Use the 'C' language constructs in the right way
CO5: Design, develop and test programs written in 'C'

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓			✓	
CO2	✓			✓					✓
CO3	✓	✓	✓			✓			
CO4	✓	✓	✓		✓			✓	
CO5	✓	✓	✓		✓		✓		

Course Contents:
Module 1: Introduction to Computers – Generations, Classifications, Applications, Basic Organization. Input and output devices. Basic concept of Computer memory, Computer software and networks.
Module 2: Number system – Decimal, Binary, Octal, Hexa-decimal. Conversion of numbers, Addition and subtraction of two numbers. Two's compliment, Multiplication and division of binary numbers. Working with fractions, signed number representation in binary form, Logic gates.
Module 3: Introduction to C – compiling and executing C programs, using comments, keywords, identifiers, Data type, variables, constants, input/output statements in C, operators in C, type conversion and type casting.
Module 4: Decision Control and looping statements – conditional branching statement, iterative statements, nested loops, break and continue statements, goto statement.
Module 5: Arrays – Declaration, accessing elements of array, storing values, calculating the length of array, two dimensional arrays. Strings – reading and writing strings, suppressing input, string taxonomy, string operations – using and without using library function, array of strings.
Module 6: Functions – Declaration, prototype, definition, function call, return statement, passing parameters to the function, scope of variable, storage classes, recursive functions.
Module 7: Pointers – introduction, declaration, Pointer expression and arithmetic, null pointer, generic pointer, passing arguments to functions using pointer, pointers and arrays, passing an array to function, difference between array name and pointer, pointers and strings, array of pointers, function pointers, pointers to pointers, dynamic memory allocation, drawbacks of pointers.
Module 8: Structure, nested structure, array of structure, union, array of union variable, unions inside structure. Files – Reading –writing etc. Preprocessor directives.

Text Books

1. Brian Kernighan and Dennis Ritchie, The C Programming Language, 2nd Ed, Prentice Hall, PTR, 1988.
2. Reema Thareja, Computer fundamentals and Programming in C, Oxford university press, 2012.

TITLE OF COURSE: PROGRAMMING FOR PROBLEM SOLVING LAB
COURSE CODE: BCA191
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Students must have already registered for the course, Networking, Linux.

Introduction:
The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Course Outcomes (CO):
Students will also be able develop applications.
CO1: Appreciate and understand the working of a digital computer
CO2: Analyze a given problem and develop an algorithm to solve the problem
CO3: Improve upon a solution to a problem
CO4: Use the 'C' language constructs in the right way
CO5: Design, develop and test programs written in 'C'

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓			✓	
CO2	✓			✓					✓
CO3	✓	✓	✓			✓			
CO4	✓	✓	✓		✓			✓	
CO5	✓	✓	✓		✓		✓		

Course Contents:
Module-1: Introduction to Computers
Generations, Classifications, Applications, Basic Organization, Input and output devices, Basic concept of Computer memory, Computer software and networks
Module-2: Number system
Decimal, Binary, Octal, Hexa-decimal, Conversion of numbers, Addition and subtraction of two numbers, Two's compliment, Multiplication and division of binary numbers, working with fractions, signed number representation in binary form, Logic gates
Module-3: Introduction to C
Compiling and executing C programs, using comments, keywords, identifiers, Data type, variables, constants, input/output statements in C, operators in C, type conversion and type casting.
Module-4: Decision Control and looping statements
Conditional branching statement, iterative statements, nested loops, break and continue statements, goto statement

Module-5: Arrays & Strings
Declaration, accessing elements of array, storing values, calculating the length of array, two dimensional arrays, reading and writing strings, suppressing input, string taxonomy, string operations – using and without using library function, array of strings

Module-6: Functions
Declaration, prototype, definition, function call, return statement, passing parameters to the function, scope of variable, storage classes, recursive functions

Module-7: Pointers
introduction, declaration, Pointer expression and arithmetic, null pointer, generic pointer, passing arguments to functions using pointer, pointers and arrays, passing an array to function, difference between array name and pointer, pointers and strings, array of pointers, function pointers, pointers to pointers, dynamic memory allocation, drawbacks

Module-8: Structure-union, Files, Preprocessor directives
Structure, nested structure, array of structure, union, array of union variable, unions inside structure, Files – Reading –writing etc, Preprocessor directives

List of Experiments
Experiment 1: Write a program in C to compute the average of a few inputs given by the use.
Experiment 2: Write a program in C to swap 2 numbers using a user defined function and print the values in main.
Experiment 3: Write down the importance of type conversion with example.
Experiment 4: Write a program in C to reverse a number.
Experiment 5: Write a program to find largest number between two numbers.
Experiment 6: Write a program to find a character is vowel or not using switch case.
Experiment 7: Write a program to find a given number is even or odd?
Experiment 8: Write a program in C that will find the sum of the series:
Experiment 9: Write a C program to print the following pattern using loop control instructions. Experiment 10: Write a program to calculate the sum of cubes of first n numbers
Experiment 11: Write a C program to determine the factorial of a given number
Experiment 12: Write a program in C that will find the sum of the following series:
Experiment 13: Write a C program to print the following pattern using loop control instructions: Experiment 14: Write a program in C that will concatenate two strings.
Experiment 15: Write a C program to calculate the number of vowels present in the string.
Experiment 16: Write a program in C to calculate number of characters present in a string.
Experiment 17: How does one-dimensional array differ from two-dimensional array?
Experiment 18. Experiment 18Write a program in C that will reverse a string.
Experiment 19: Write a program in C to sort a single dimension array in an ascending order.
Experiment 20: Write a program in C that will find area and circumference of a circle using a user defined function calc(). Take input and display the output in main().
Experiment 21: Write a program of factorial using recursive function.
Experiment 22: Write a program to define a structure of a student which contains roll, name, section etc. Then you need to find a record using a given roll.
Experiment 23: Write a program to read and write a file.

Text Books
1. Let Us C by Yashavant P. Kanetkar
2. Programming in C by Reema Thareja
3. Computer Fundamentals and C Programming by Sumitabha Das
4. Programming in ANSI C by Balagurusamy

References
1. Programming with C by Byron S Gottfried
2. Computer Programming in C Dr. Syed Jalal Ahmad, Arshad Ahmad Khan Mohammad

TITLE OF COURSE: COMPUTER SYSTEM & OFFICE AUTOMATION TOOLS
COURSE CODE: BCA102
L-T-P: 3-0-2
COURSE CREDITS: 4

Pre-requisite: Basic knowledge is assumed about computer components and software system.

Introduction:
This course examines operating system design concepts, internet technologies, and software and hardware basics. The Topics to be covered (tentatively) include:
• Computer and operating system structures
• Process and working of computer
• Software &Hardware
• Memory
• File system and management
• I/O devices management
• Selected examples in networking, protection and security
This course in Computer Science for the BCA students; therefore, it deals with the basic concepts of computers. It discusses about the computer hardware, its components and basic computer architecture. The course also deals with the basic computer software including the operating system and its concepts. This course also highlights some of the open source software technologies. Finally the course highlights the applications of computers that include web applications, social networking.

Course Outcomes:
CO1: Understand the theory and logic behind the design and construction of operating systems.
CO2: Will differentiate between various operating systems functionalities in terms of performance.
CO3: Become aware of the issues in the management of resources like processor, memory and input-output.
CO4: Understand the need and features of open source software.
CO5: Learn File systems and methods of accessing
CO6: Understanding various internet technologies.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓	✓	✓			
CO2	✓				✓				
CO3		✓		✓	✓		✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓			✓
CO5			✓		✓	✓			
CO6	✓	✓			✓				✓

Course Contents:
MODULE 1: Basics of Computer Hardware
Module 1: Computer their Origin and Applications A bit of history highlighting the concepts, Abacas, Difference Engine, Electro-magnetic Computers, Discrete components, IC circuits, Current hardware Platforms, Description of current applications of computer highlighting role of computers, Limitations of Computers.

Module 2 : Functioning of a Computer Components of a computer and their role, Number system, Codes ASCII Unicode Concept of Instruction – a simple example, Role of ALU and CU with the help of an example.

Module 3: Memory System Type of memories and their characteristics, what is the need of memory hierarchy? Memory Hierarchy with examples of each level, Current trends in memory.

Module 4: I/O devices and their functions I/O devices, Current trends in I/O.

Module 5: My Personal Computer Explain the configuration of PC and its components in respect of identification of various components so that a student can relate all the terms discussed in Module 1 to 4 to this configuration.

MODULE 2: Basics of Computer Software

Module 1: Software Evolution Different type of software and its evolution, System and application software, Utility software, perverse software, Open Source software

Module 2: Operating System Concepts Need and Functions, Type of OS starting from Batch, Multiprogramming and real time Network and distributed OS, Web OS, Examples of OS and their features

Module 3: Concept of Programming Languages Some basic constructs, Editors, Compilers and interpreters, Assemblers

Module 4: Computer Applications Concepts of Open Source Software, Philosophy – licensing, copyright, Project Management Software, Timesheet system, Office Applications, Word Processing – Creating a Memo for a number of people, Spreadsheet – Creating a sheet of Income & deduction and calculation of IT Database – a small application with data records, a form, a query and a report Email – Sending mail to a number of people in a group.

MODULE 3: Internet Technologies

Module 1: Networking and Internet Basic of Networking Concepts, Advantages of Networking, Basic model of Networks, Network Devices, TCP/IP, Web addresses, DNS, IP addresses

Module 2: Web Applications I Browsing, E-mail, Messenger/Chat

Module 3: Web Applications II Blogging, E-Learning and wiki, Collaboration, Social Networking

Text Books
1. Ramesh Bangia, "PC Software Made Easy (SIXTEEN-IN-ONE)", Khanna Publishing.

References
1. Sinha P K, Computer Fundamentals, Bpb Publications-New Delhi.

TITLE OF COURSE: COMPUTER SYSTEM & OFFICE AUTOMATION TOOLS LABS
LAB COURSE CODE: BCA192
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic knowledge is assumed about computer components and software system.

Introduction:
The main objectives of PC Software Lab course are to familiarize with basic operations of:
1. Operating systems such as Windows and Linux.
2. Word Processor such as Open Office and MSWord.
3. Workbook, worksheet, graphics and Spreadsheets.
4. PowerPoint including animation and sounds.
5. Address book, Spam and Filtering in E-mail.
6. Browsing, Search, Discussion forum and Wiki's.

Course Outcomes:
The students will have a detailed knowledge of the concepts of process and memory, learn the basics behind file systems and input output systems and understand the fundamentals of network and operating systems.

CO1: Understand and implement basic services and functionalities of the operating system using system calls.
CO2: Understand the features of MS office tools such as word, excel, PowerPoint.
CO3: Understand the concept of searching and email.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓	✓	✓			
CO2	✓				✓			✓	
CO3		✓		✓	✓		✓	✓	✓

Course Contents:
Exercises that must be done in this course are listed below:
Section 1: Operating System
Session 1: Familiarization (Keyboard, Memory, I/O Port),
Session 2: Windows (2 Session)
Session 3: Linux (2 Session)
Section 2: Word Processor (Open Office and MS Word)
Session 1: Basic Operations (Font selection, Justification, Spell check, Table,
Indentation),
Session 2: Table of Contents, Track Changes and Commenting.
Session 3: Mail Merge, Printing, Practice session.
Section 3 : Spread sheet (Concept of Worksheet, Workbook and cell)
Session 1 : Data entry, Data editing and Formula
Session 2 : Functioning
Session 3 : Graphics and Practice session
Section 4 : PowerPoint
Session 1 : Basics operation
Session 2 : Animation and Sounds
Section 5 : E-mail
Session 1 : Basic Operation,
Session 2: Address Book, Spam and Filtering
Section 6 : Browsing and Discussion Forum
Session 1 : Browsing and Search (2 Sessions)
Session 2 : Discussion Forum, Wiki and Google Doc (3 Sessions)

Text Book:
1. Ramesh Bangia, "PC Software Made Easy (SIXTEEN-IN-ONE)", Khanna Publishing.
2. Sinha P K, Computer Fundamentals, Bpb Publications-New Delhi.
Recommended Systems/Software Requirements:
1. Microsoft Office 2007, 2010.
2. Windows XP or Linux Operating System.

TITLE OF COURSE: DIGITAL ELECTRONICS
COURSE CODE: BCA103
L-T-P: 3-0-2
CREDITS: 4

Introduction: Digital electronics or digital (electronic) circuits are electronics that operate on digital signals. In contrast, analog circuits manipulate analog signals whose performance is more subject to manufacturing tolerance, signal attenuation and noise. Digital techniques are helpful because it is a lot

easier to get an electronic device to switch into one of a number of known states than to accurately reproduce a continuous range of values.
1. To acquire knowledge on basics of digital circuits and its applications.
2. This course deals with the basics of Boolean algebra, Digital principles and circuits.
3. The course starts with the basics of Boolean algebra and Boolean expression minimization techniques. Then it explains simple combinational networks like Multiplexers, decoders etc.
4. Sequential and combinational digital circuits are the building blocks of any processor, irrespective of its application.
5. After this the difference between the combinational technologies and sequential circuits is dealt with. Finally, it gives the method to realize the basic gates using different technologies.

Course Outcomes (CO):
CO1: Able to explain the basic concepts of digital electronics circuits
CO2: Able to describe different types of logics, complexity, circuit specifications.
CO3: On successful completion of this Course, the students would be able to minimize functions using any type of minimizing algorithms (Boolean algebra, Karnaugh map).
CO4: Define the problem (Inputs and Outputs), write its functions. Implement functions using digital circuit (Combinational or Sequential) and knowledge in analyzing and designing procedures of Combinational and Sequential circuits.
CO5: To be able to differentiate electronic from electrical systems and identify the basic blocks in any electronic system

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓	✓			
CO2				✓	✓				
CO3		✓			✓			✓	
CO4		✓		✓	✓			✓	✓
CO5	✓		✓		✓	✓	✓		✓

Course Contents:
Module 1: Data and number systems; Binary, Octal and Hexadecimal representation and their Conversions; BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic [5]
Module 2: Venn diagram, Boolean algebra; Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method [6]
Module 3: Combinational circuits- Adder and Subtract or circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator. [8]
Module 4: Memory Systems: RAM, ROM, EPROM, EEROM; Design of combinational circuit using ROM, Programming logic devices and gate arrays. (PLAs and PLDs) [5]
Module 5: Sequential Circuits- Basic memory element-S-R, J-K, D and T Flip Flops, various types of Registers and counters and their design, Irregular counter, State table and state transition diagram, sequential circuits design methodology. [9]
Module 6: Different types of A/D and D/A conversion techniques; Logic families- TTL, ECL, MOS & CMOS, their operation and specifications. [6]

Text Books
1. A.Anand Kumar, Fundamentals of Digital Circuits- PHI
2. A.K.Maini- Digital Electronics- Wiley-India
3. Kharate- Digital Electronics- Oxford

TITLE OF COURSE: DIGITAL ELECTRONICS LAB
COURSE CODE: BCA193
L-T-P: 0-0-2
CREDITS: 1

Prerequisite: Knowledge is also assumed of basic concepts of electronics.

Introduction:
Students will be able to acquire knowledge about digital electronics circuit, use of digital kit, integrated circuit, LED and implement complete circuit. They would also be able to understand Data and Number System, Boolean algebra Combinational Circuit, Sequential Circuit

Course Outcomes (CO):
CO1: Able to explain the basic concepts of digital electronics circuits
CO2: Able to describe different types of logics, complexity, circuit specifications.
CO3: On successful completion of this Course, the students would be able to minimize functions using any type of minimizing algorithms (Boolean algebra, Karnaugh map).
CO4: Define the problem (Inputs and Outputs), write its functions. Implement functions using digital circuit (Combinational or Sequential) and knowledge in analyzing and designing procedures of Combinational and Sequential circuits.
CO5: To be able to differentiate electronic from electrical systems and identify the basic blocks in any electronic system

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓			✓	✓				
CO3					✓			✓	
CO4		✓		✓	✓			✓	✓
CO5	✓		✓		✓	✓	✓		✓

Course Contents:

Module-1: Implementation of Basic gates and Universal logic gates.
Module-2: Implementation of Half adder, Full adder, Half subtractor, Full subtractor, Parallel adder, Parallel subtractor, 1's complement, 2's complement, n'th complement, (n-1)'s complement, K-map,
Module-3: BCD, 7 segment, Gray code, Binary, Octal, Hexadecimal number system, Conversion in number system, Binary addition, subtraction, Multiplication. Multiplexer, Encoder and Decoder.
Module-4: Flip Flop (SR, JK, D,T),
Module-5: Ring counter and Johnson's counter

List of Experiments
1. Realization of basic gates using Universal logic gates (IC 7408, IC7432, IC7486, IC7404,

IC7400, 7402).
2. Implementation of Half adder, Full adder, Half subtractor, Full subtractor using basic gates.
3. Code conversion circuits- BCD to Gray code and vice-versa using basic gates.
4. Four-bit parity generator and comparator circuits using basic gates.
5. Construction of simple Decoder and Multiplexer circuits using logic gates.
6. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
7. Construction of parallel -Adder, Subtractor using basic gates.
8. Realization of RS-JK and D flip-flops using Universal logic gates.
9. Realization of Universal Register using JK flip-flops and logic gates.
10. Realization of Universal Register using multiplexer and flip-flops.
11. Construction of Adder circuit using Shift Register and full Adder.
12. Realization of Asynchronous Up/Down counter.
13. Realization of Synchronous Up/Down counter.
14. Design of Sequential Counter with irregular sequences.
15. Realization of Ring counter and Johnson's counter using basic gates.
16. Construction of adder circuit using Shift Register and full Adder.

Text Books:
1. S. Salivahanan, S. Arivazhagan "Digital Circuit and Design", Vikas pulishin house PVT LTD

References
1. A. Anand Kumar, Fundamentals of Digital Circuits-PHI

TITLE OF COURSE: BUSINESS SYSTEM & ADMINISTRATION
COURSE CODE: BCA104
L-T-P: 3-0-0
CREDITS: 3

Introduction:
Business system application, especially e-business systems, use computer and web-based technology to deliver existing business models or promote new ones. This module examines existing business systems, applications and environments, as well as emerging ones that support these business models and system management. The primary focus is on the various business systems, applications and management and understanding how an enterprise framework and integration of disparate application environments facilitate functioning of business and enable development of new models.

Course Outcomes (CO):
CO1: Fully understand how e-business systems can contribute to broader enterprise management issues
CO2: Comprehensively evaluate and critically analyze various business systems (including e- business systems), applications and management
CO3: Compare and evaluate alternative business application environments that enable business systems
CO4: Demonstrate a good understanding of architectural options for implementing and facilitating business systems and management
CO5: Research and evaluate interdependencies between business systems and the rest of the enterprise management environment
CO6: Critically analyze the impact of business systems and applications on enterprise performance and development of society.
CO7: Demonstrate interpersonal skills and the ability to work effectively with others to achieve common goals.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓		✓	
CO2				✓	✓				
CO3	✓	✓			✓			✓	✓
CO4		✓		✓	✓			✓	
CO5			✓		✓	✓	✓		✓
CO6	✓		✓		✓				
CO7					✓				✓

Course Contents:

Module -1: Use of computers for managerial applications, Technology issues and data processing in organizations, Introduction to Information Systems, shift in Information system thinking, latest trends in Information Technology.

Module -2: Computer Based Information Systems- office automation systems, Decision making and MIS, transaction processing systems.

Module -3: Decision support system, Group Decision Support, Executive Information systems, DSS generator.

Module -4: Introduction to: Artificial Intelligence Based Systems, End user computing, distributed data processing.

Module -5: Deciding on IS architecture, IT leadership & IS strategic planning.

Module -6: Introduction to: IS strategy and effects of IT on competition.

Module -7: Introduction to: ERP, re-engineering work processes for IT applications, Business Process Redesign.

Module -8: Knowledge engineering and data warehouse.

Text Books:

1. Management Information System, O'Brien, TMH
2. Management Information System: A Concise Study,Kelkar,PHI
3. Decision support Systems, Janaki Raman, PHI

References

1. Business Information Systems, Munish Kumar, VIKAS
2. Business Application of Computers, M.M. Oka, EPH

TITLE OF COURSE: MATHEMATICS-I
COURSE CODE: BSC101
L-T-P: 3-0-0

CREDITS: 3

Introduction:
The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.

Detailed Syllabus for Bachelor of Computer Application

Course Outcomes (CO):

The students will learn:

CO1: Find intervals where a function is concave up or concave down.

CO2: Find inflection points.

CO3: Use the second derivative test to find local extrema.

CO4: Evaluate definite integrals to find net area between a curve and the x-axis using the fundamental Theorem of Calculus.

CO5: Use basic integration properties to solve graphical net area problems.

CO6: Find the equilibrium point of supply and demand.

CO7: Use definite integrals to calculate consumer and producer surplus.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓			✓	
CO2		✓		✓			✓		✓
CO3	✓	✓						✓	✓
CO4	✓	✓		✓	✓			✓	
CO5			✓		✓		✓		✓
CO6	✓		✓		✓				
CO7	✓								✓

Course Contents:

Module 1: Function (5L)

Definition, domain and range of function, types of functions (into, onto, one to one), composite function.

Module 2: Limit (3L)

Definition, first principle, properties, and simple problems related to limit. Some standard limits.

Module 3: Continuity (4L)

Definition, continuity of sum, product, difference and quotient of two continuous functions, simple problems.

Module 4: Differentiation (10L)

Definition, differentiation of simple functions using first principle, differentiation of trigonometric functions and inverse circular functions, method of substitution, differentiation of product and quotient of functions, maxima and minima of a function of single variable.

Module 5: Integration (10L)

Definition, integration of simple functions using substitution, integration of trigonometric and inverse circular functions and related problems, integration by parts, integration of rational functions. Definite integral and their properties, simple problems. Reduction formula and simple problems.

Text Books
1. Mathematics for Class 12 by R D Sharma
2. NCERT Mathematics for Class 12

TITLE OF COURSE: ENGLISH COMMUNICATION & PUBLIC SPEAKING SKILLS-I
COURSE CODE: HSM101
L-T-P: 2-0-2
CREDITS: 3

Pre-requisite: Basics of English.

Introduction:
Learn the English speaking and writing skills with this Basic English structure and soft skills.

Course Outcomes (CO):
It is a well-balanced course that focuses on the four core language skills:
CO1: Students would be able to Listening English language
CO2: Students would be able to Speaking English language
CO3: Students would be able to Reading English language
CO4: Students would be able to Writing English language
CO5: Use the English language more effectively.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1									✓
CO2									✓
CO3									✓
CO4									✓
CO5									✓

Course Contents:
Module 1: ENGLISH LANGUAGE: GRAMMAR & VOCABULARY (6L)
Correction of Errors in Sentences , Building Vocabulary, Word formation, Single Word for a group of Words, Fill in the blanks using correct Words, Sentence Structures and Transformation, Active & Passive Voice, Direct & Indirect Narration (MCQ Practice during classes)
Module 2: READING COMPREHENSION (6L)
Strategies for Reading Comprehension, Short Stories for Comprehension, Practicing Technical & Non-Technical Texts for Global/Local/Inferential/Referential comprehension; Précis Writing, Essay/Paragraph writing
Module 3: TECHNICAL COMMUNICATION (6L)
The Theory of Communication –Definition & Scope, Barriers of Communication, Different Communication Models, Effective Communication (Verbal / Non verbal), Presentation / Public Speaking Skills, (MCQ Practice during classes)
Module 4: MASTERING TECHNICAL COMMUNICATION (6L)
Technical Report (formal drafting); Business Letter (formal drafting); Job Application (formal drafting); Organizational Communication: Memo, Notice, Agenda, Minutes Group Discussion –Principle & Practice

Text Books
1. Communication Skills, Sanjay Kumar and Pushpa Lata,(OUP),2015
2. Objective English, Prasad and Sinha, Tata McGraw Hill Education Pvt. Ltd, 2013
3. English Grammar, Wren and Martin, Regular Edition
4. Fantasy- A Collection of Short Stories,V. Sashikumar,Orient Black swan (Reprint 2006)

References
1. Proficiency in Reading Comprehension, Ajay Singh, Paperback, 2015
2. Selected Contemporary Essays, Soumitra Mohan, Paperback, 2016

TITLE OF COURSE: ENGLISH COMMUNICATION & PUBLIC SPEAKING SKILLS-I LAB
COURSE CODE: HSM191
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basics of English.

Introduction:
Learn the English speaking and writing skills with this Basic English structure and soft skills.

Course Outcomes (CO):
It is a well-balanced course that focuses on the four core language skills:
CO1: Listening
CO2: Speaking
CO3: Reading
CO4: Writing
CO5: Use the English language more effectively.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1									✓
CO2									✓
CO3									✓
CO4									✓
CO5									

Course Contents:

Module -1 (LISTENING):

Listening Skill & its sub skills (Assignment: Listening to story or read aloud passage or newspaper reading, and then answering the questions set from that passage), like-, Oral Comprehension-Story, Oral Comprehension-Newspaper report, Oral comprehension-Conversation played by audio-visual devices

Module -2 (SPEAKING):

Speaking Skill & its sub skills (Assignment: Storytelling, Debate, Oral Presentation) for helping students to master Linguistic/Paralinguistic features (Pronunciation, Phonetics, Voice modulation, Stress, Intonation, Pitch &Accent) of connected speech (Assignment: Language Functions-Permission, Request, Order, etc), like- Story telling practice- Individual work, Story telling- Pair work, Story telling-Group work, Just-a Minute(JAM) Session, Face to face conversation, Telephonic conversation, Role Play Mode, Mobile Phone

Module -3 (READING):

Reading Skills and its sub skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non Technical Passages; Learning Global / Contextual / Inferential Comprehension (Assignment: Comprehension passages: Question answer sessions), like- Newspaper reading, Technical topics reading, Story reading and summarizing.

Module -4 (WRITNG):

Writing Skill: Practice Sessions. Writing practice hones expressive potential of students, thereby accentuating the correct usage of vocabulary. (Assignment: Story writing, Essay writing, etc) like Paragraph Writing, Instruction Writing, Essay Writing, Rearranging jumbled sentences, Antonyms and Synonyms, Word formation : Prefixes and Suffixes, Word formation : Homonyms and Homophones, Comprehension passages: Question answer sessions.

Text Books
1. Communication Skills, Sanjay Kumar and Pushpa Lata,(OUP),2015
2. Objective English, Prasad and Sinha, Tata McGraw Hill Education Pvt. Ltd, 2013
3. English Grammar, Wren and Martin, Regular Edition
4. Fantasy- A Collection of Short Stories,V. Sashikumar,Orient Black swan (Reprint 2006)

References
1. Proficiency in Reading Comprehension, Ajay Singh, Paperback, 2015

2. Selected Contemporary Essays, Soumitra Mohan, Paperback, 2016

TITLE OF COURSE: ESP & SDP-I
COURSE CODE: BGSC101
L-T-P: 2-0-1
CREDITS: 2

Pre-requisite: Basic concepts in mathematics, English

Introduction:
The Topics to be covered (tentatively): Aptitude, Indian Constitution and Governance, Basic English and Data Interpretation**.**
Course Outcomes (CO):
Students are expected to be capable numerical problems, literature, and basic of Indian constitution. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any basic numerical problem properly.
CO2: Students would be able to know basic English language and communicate with the society.
CO3: Students would be able to know basic Indian constitution.
CO4: Students would be able to stress management by doing Yoga
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Detailed Syllabus for Bachelor of Computer Application

Course Contents:

Essential Studies for Professionals-I
Section-A: Employment Enhancement Skills:
Module-1: Number System:

Numbers, Face value and place value of a digit, Types of numbers, Tests of Divisibility, Factorial of a number, Modulus of a number, greatest integral value, Multiplication by short cut methods, Division Algorithm.

Module-2: HCF and LCM of Numbers:
Factors and Multiples, HCF or GCD, LCM, Product of two numbers, Co-primes, HCF and LCM of fractions, HCF and LCM of decimal fractions, Comparison of fractions,
Module-3: Average & Percentage:
Concepts, Results on population, Results on Depreciation
Module-4: Profit and Loss:
Cost Price, Selling Price, Profit or Gain, Loss

Section B: Yoga, Games and Meditation:
Module-1: Asana sitting postures and Karate, Asana lying in supine & prone position and karate, Surya Namaskar, Asana standing posture and Karate, Kriyas, Pranayam and Karate, Meditation and Karate, Meditative posture and Karate, Tratak, Kapalbhati and Meditation.
Meditation and Stress Management, Meditation, Stretching and Self Defense. Meditation, Kicking and Punching of Karate. (Games and Sports will be evaluated on the basis of the participation and performance in different sports events that the students shall participate in).

Section C: Skill Development for Professionals-I
Module-1: Parts of speech: Introduction, Brief discussion of Parts of speech, noun, Kinds of Noun, Rules & Application. Pronoun, Examples, Rules & Application, Verb, Kinds of Verb, Rules & Application, Definition of Tense, Different types of Tenses, Examples, Rules & Application, Adjective, Kinds of Adjective, Rules & Application, Adverb, Kinds of Adverb, Rules & Application, Preposition, Examples, Rules & Application, Interjection, Examples, Rules & Its Application, Conjunction, Examples, Rules & Application, Articles, Examples, Rules & Application English Grammar.
Vocabulary- : Synonyms, Antonyms with examples, one word Substitution, Idioms & Phrases, Spotting Errors.
Reading Comprehension (Level I)

Module-2: Indian Constitution and Governance: Historical background (in brief) - The company Rule (1773-1858), the crown rule (1858-1947), making of constitutions, features of constitution. The Preamble- Ingredients, keywords, amendment of preamble. Part & schedule, Citizenship (in brief) - Constitutional provisions, Citizenship act, Comparing PIO & OCI card holders, Fundamental Rights- Concept & different articles, Right to equality, prohibition of discrimination on certain ground, Equality of opportunity, abolition of untouchability & titles, right to freedom, right to education, right against exploitation, right to freedom of religion, cultural & educational rights, different writes & scopes, DPSP- Classification of directive principle, sanctioned of directive principal, criticism, Distinction between fundamental rights & directive principle List of Fundamental duties, criticism, significance, Verma committee. Features of parliament govt. Features of Presidential Govt. Merits & Demerits. Duties of Honorable President & Vice President & their selection, Provision & scopes, Duties of PM, CM & Governor & their selections
Module-3: Data Interpretation Level-I
Newspaper reading: The Hindu & Economic Times

Text Books
1. Quantitative Aptitude for Competitive Examinations by R S Aggarwal
2. Introduction to the Constitution of India, by D D Basu
3. The Constitution of India by Dr. B.R. Ambedkar Under Chairmanship of Dr. Rajendra Prasad Including Coloured Preamble, Signatures

References
1. The Constitution of India by Dr. B.R. Ambedkar 2020.

Second Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	BCA205	Object Oriented Programming using Python	3	0	2	0	4
2.	CC	BCA206	Software Engineering	3	0	2	0	4
3.	CC	BCA207	Computer Architecture & System Software	3	0	2	0	4
4.	BSC	BSC202	Mathematics-II	3	0	0	0	3
5.	MC	MC201	Environment & Ecology	3	0	0	0	3
6.	HSM	HSM202	Professional Writing & Technical Seminar	2	0	2	0	3
7.	GSC	BGSC202	ESP & SDP-II	2	0	0	1	2
			Total	19	0	8	1	23/28

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: OBJECT ORIENTED PROGRAMMING USING PYTHON
COURSE CODE: BCA205
L-T-P: 3-0-2

CREDITS: 4

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and basic mathematics.

Introduction:
- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

Course Outcomes (CO):
After completion of the course, students will able:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, and dictionaries.
CO6: Read and write data from/to files in Python Programs.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓			✓	
CO2		✓		✓			✓		
CO3	✓	✓				✓		✓	✓
CO4		✓		✓	✓			✓	
CO5	✓		✓				✓		✓
CO6	✓		✓		✓			✓	✓

Course Contents:
Module-1: ALGORITHMIC PROBLEM SOLVING
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.
Module-2: DATA, EXPRESSIONS, STATEMENTS
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.
Module-3: CONTROL FLOW, FUNCTIONS

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

Module-4: LISTS, TUPLES, DICTIONARIES
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

Module-5: FILES, MODULES, PACKAGES
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Text Books
1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist", 2nd edition,
Updated for Python 3, Shroff/O'Reilly Publishers.
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

References
1. John V Guttag, ―Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

TITLE OF COURSE: INTRODUCTION TO PYTHON PROGRAMMING LAB
COURSE CODE: BCA295
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and basic mathematics.

Introduction:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

Course Outcomes (CO):
After completion of the course, students will able:
CO1: Write, test, and debug simple Python programs.
CO2: Implement Python programs with conditionals and loops.
CO3: Develop Python programs step-wise by defining functions and calling them.

CO4: Use Python lists, tuples, dictionaries for representing compound data.
CO5: Read and write data from/to files in Python.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓			✓	✓
CO2		✓		✓			✓		
CO3	✓	✓		✓		✓	✓	✓	
CO4		✓		✓	✓			✓	
CO5	✓		✓		✓		✓		✓

Course Contents:
Experiment No: 1. Compute the GCD of two numbers.
Experiment No: 2. Find the square root of a number (Newton's method)
Experiment No: 3. Exponentiation (power of a number)
Experiment No: 4. Find the maximum of a list of numbers
Experiment No: 5. linear search and Binary search
Experiment No: 6. Selection sort, Insertion sort
Experiment No: 7. Merge sort
Experiment No: 8. First n prime numbers
Experiment No: 9. multiply matrices
Experiment No: 10. Programs that take command line arguments (word count)
Experiment No: 11. Find the most frequent words in a text read from a file
Experiment No: 12. Simulate elliptical orbits in Pygame
Experiment No: 13. Simulate bouncing ball using Pygame

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

Text Books
1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers.
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

References
1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: SOFTWARE ENGINEERING
COURSE CODE: BCA206
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and computer architecture.

Introduction:
Software engineering concepts include the collection of tools, procedures, methodologies, and accumulated knowledge about the development and maintenance of software-based systems. This course is strongly suggested for any student planning to take an internship in Computer Science. After an overview of the phases of the software lifecycle, current methodologies, tools, and techniques being applied to each phase will be discussed in depth with localized exercises given to reinforce learning of concepts.

Course Outcomes (CO):

This course will serve to broaden the student's understanding of the issues and latest developments in the area of software development and maintenance. To reach this goal, the following objectives need to be met:

CO1: How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.
CO2: An ability to work in one or more significant application domains.
CO3: Work as an individual and as part of a multidisciplinary team to develop and deliver quality software.
CO4: Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.
CO5: Demonstrate an ability to use the techniques and tools necessary for engineering practice.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓					✓	✓	✓
CO2	✓				✓	✓		✓	✓
CO3	✓			✓	✓				✓
CO4	✓		✓				✓	✓	✓
CO5	✓	✓	✓						✓

Course Contents:

Module-1: Interactive Systems, Usability, Introduction to software engineering, Software Process Models, Software life cycle.
Module-2: Requirement Engineering: Requirement Elicitation, Analysis, Specification, SRS, Formal system development techniques.
Module-3: Analysis and Modeling: Data modeling, Functional modeling Software Architecture and Design: Data design, Architectural Design Process, SADT, OOAD, function-oriented design, Design Patterns: Structural Patterns, Behavioral Patterns, and Creational Patterns.

Detailed Syllabus for Bachelor of Computer Application

Module-4:- UML**:** Use case diagram, State chart diagram, Activity Diagram, Class Diagram, Sequence diagram, Collaboration diagram, Deployment Diagram, Event trace diagram.

Module-5: Software Estimation: Software Project Estimating Size, Effort and Cost: Metric for Analysis, Metric for Design, COCOMO model, Putnam Model etc., Implementation and Integration: Coding standard and practices.

Module-6: Software Testing: Top-Down and Bottom–up Approach, Verification and Validation, Structural testing, functional Testing, Testing Strategies, Test Case design.

Module-7: Software Reliability and Quality Management: Total Quality Management, Quality Assurance and Reliability ISO 9000, SEI-CMM, CMMI

Model-8: Software Maintenance: Types, Cost of Software, maintenance, Software Maintenance Models, CASE Tool Taxonomy: Business Process Engineering tool, Process modeling and management tool, project planning tool, requirement tracking tool, Metric and management tool, documentation tool, system software tool etc.

Text Books

1. Software Engineering: A practitioner's approach: Roger Pressman, McGraw- Hill Pub (6th Edi).

2. Fundamentals of Software Engineering: Mall, Rajib, Prentice Hall of India, New Delhi (2nd Edition.

References

1. Software Testing Techniques, B. Beizer.

2. Structured Systems Analysis: Tools and Techniques, Gane and Sarson.

3. Software Engineering, Sommerville, Addison Wesley.

4. Modern Structured Analysis, E.Yourdon.

5. An Integrated approach to Software Engineering: PankajJalote, Narosa PublishingHouse.

6. Structured design, E. Yourdon and L.Constantine.

7. Fundamentals of Software Engineering: Ghezzi, Jazayeri, Mandriol, PHI

TITLE OF COURSE: SOFTWARE ENGINEERING LAB
COURSE CODE: BCA296
L-T-P: 0-0-2
CREDITS: 1

Prerequisite: Students must have already registered for the course, "Software Engineering".

Objectives:

Students will be capable to acquire the generic software development skill through various stages of software life cycle. He will also be able to ensure the quality of software through software development with various protocol based environment.

Course Outcomes (CO):

Students will also be able to handle software development models through rational method. After completion of course student will be able to generate test cases for software testing.

CO1: How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.

CO2: An ability to work in one or more significant application domains.

CO3: Work as an individual and as part of a multidisciplinary team to develop and deliver quality software.

CO4: Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.

CO5: Demonstrate an ability to use the techniques and tools necessary for engineering practice.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓					✓	✓	✓
CO2	✓				✓	✓		✓	✓
CO3	✓			✓	✓				✓
CO4	✓		✓				✓	✓	✓
CO5	✓	✓	✓						✓

Course Contents:

Module-1: Software Process Model: A Model of Software Development

Module-2: Requirement Analysis: Requirement Elicitation, specification, IEEE standard template for SRS, Requirement Engineering tools.

Module-3: UML Modeling: Use case diagram, State diagram, Activity Diagram, Class Diagram, Sequence diagram, Collaboration diagram, Deployment Diagram, Component Diagram, Event trace diagram, C++ code generation.

Module-4: Software Metrics: Product, process and project metrics.

Module-5: Software Testing: Structural testing, functional Testing, Testing Strategies and Tactics, Test Case design.

List of Experiments

1. Identifying the Requirements from Problem Statements Requirements, Characteristics of Requirements, Categorization of Requirements, Functional Requirements, Identifying Functional Requirements.

2. E-R Modeling from the Problem Statements, Entity Relationship Model, Entity Set and Relationship Set, Attributes of Entity, Keys, Weak Entity, Entity Generalization and Specialization, Mapping Cardinalities, ER Diagram, Graphical Notations for ER Diagram Importance of ER modeling.

3. Identifying Domain Classes from the Problem Statements, Domain Class, Traditional Techniques for Identification of Classes, Grammatical Approach Using Nouns, Advantages, Disadvantages, Using Generalization, Using Subclasses, Steps to Identify Domain Classes from Problem Statement, Advanced Concepts

4. Modeling UML Use Case Diagrams and Capturing Use Case Scenarios, Use case diagrams, Actor, Use Case, Subject, Graphical Representation, Association between Actors and Use Cases, Use Case Relationships, Include

5. Modeling UML Class Diagrams and Sequence diagrams, Structural and Behavioral aspects, Class diagram, Elements in class diagram, Class Relationships, Sequence diagram, Elements in sequence diagram, Object, Life-line bar, Messages.

6. Modeling Data Flow Diagrams, Data Flow Diagram, Graphical notations for Data Flow Diagram, Explanation of Symbols used in DFD, Context diagram and leveling DFD

7. State chart and Activity Modeling State chart Diagrams, Building Blocks of a State chart Diagram State, Transition, Action, Guidelines for drawing State chart Diagrams, Activity Diagrams, Components of an Activity Diagram, Activity, Flow Decision, Merge, Fork, Join, Note, Partition, A Simple Example, Guidelines for drawing an Activity Diagram

8. Estimation of Project Metrics Project Estimation Techniques, COCOMO, Basic COCOMO Model, Intermediate COCOMO Model, Complete COCOMO Model, Advantages of COCOMO, Drawbacks of COCOMO, Halstead's Complexity Metrics.

9. Estimation of Test Coverage Metrics and Structural Complexity, Control Flow Graph, Terminologies,

McCabe's Cyclomatic Complexity, Computing Cyclomatic Complexity, Optimum Value of Cyclomatic Complexity, Merits, Demerits

10. Ant - Deploying Applications, build.xml, Ant - Executing Java code, Ant - Creating WAR files, basedir, compress, Keepcompression, destfile, duplicate, excludes, excludesfile, includes, includesfile, update.

References
1. R.S. Pressman, "Software Engineering: A Practitioner's Approach", 7Edition, McGraw Hill, 2010
2. Fundamentals of Software Engineering: Mall, Rajib, Prentice Hall of India, New Delhi (2nd Ed).
3. Sommerville, "Introduction to Software Engineering", 8th Edition, Addison-Wesley, 2007
4. Ghezzi, Jazayeri and Mandrioli, "Fundamentals of Software Engineering", 2nd Ed, Prentice Hall
5. Peters and Pedrycz, "Software Engineering: An Engineering Approach, John Wiley, 2004
6. Len Bass, "Software Architecture in Practice", 2Edn. Addison Wesley, 2003

TITLE OF COURSE: COMPUTER ARCHITECTURE & SYSTEM SOFTWARE
COURSE CODE: BCA207
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Knowledge is required in Basic Computation and any of the high level programming language.

Introduction:
All students should acquire some understanding and appreciation of a computer system's functional components, their characteristics, their performance, and their interactions. Students need to understand computer architecture in order to structure a program so that it runs more efficiently on a real machine. The course provides an overview of computer architecture and teaches students the operation of a typical computing machine. It covers the basic principles, while acknowledging the complexity of existing commercial systems.
The format of the course will be lecture-discussions, assignments. Students are strongly encouraged to participate actively in class discussions.

Course Outcomes (CO):
The course is intended to create an appreciation for contemporary concepts in high performance mutli-core super scalar architectures and appreciate their implementation in modern multi processors. To reach this goal, the following objectives need to be met:
CO1: Draw the functional block diagram of single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.
CO2: Write assembly language program for specified microprocessor for computing 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).
CO3: Write a flowchart for Concurrent access to memory and cache coherency in Parallel Processors and describe the process.
CO4: Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.
CO5: Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				

CO2	✓	✓		✓				✓	✓
CO3	✓		✓			✓		✓	
CO4	✓	✓	✓		✓		✓		✓
CO5	✓					✓			

Course Contents:
Module-1:
Functional blocks of a computer: CPU, memory, input-output subsystems, control Module. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.
Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.
Module-2:
Introduction to x86 architecture.
CPU control Module design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.
Memory system design: semiconductor memory technologies, memory organization.
Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers– program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB
Module-3:
Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.
Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.
Module-4:
Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, and write policies.

Text Books
1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education.

References
1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill.
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

TITLE OF COURSE: COMPUTER ARCHITECTURE & SYSTEM SOFTWARE LAB
COURSE CODE: BCA297
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Students must have already registered for the course, "Computer Organization & Architecture".

Introduction:
To learn the fundamental aspects of computer architecture design and analysis. This lab course provides a comprehensive introduction to understand the underlying of VHDL (VHSIC Hardware Description Language) which is a hardware description language used to describe a logic circuit by function. In particular defined data flow, behavior or structure. It can also be used as a general purpose parallel programming language i.e. commands, which correspond to logic gates, are executed (computed) in parallel, as soon as a new input arrives. The emphasis of the course will be placed on understanding HDL Programming using xilinx to implement different type of circuit.

Course Outcomes:
Students can understand the functions, structures and history of VHDL programming. Understand the data flow model, behavioral model, structural model.
CO1: Draw the functional block diagram of single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.
CO2: Write assembly language program for specified microprocessor for computing 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).
CO3: Write a flowchart for Concurrent access to memory and cache coherency in Parallel Processors and describe the process.
CO4: Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.
CO5: Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓				✓
CO2	✓			✓		✓		✓	✓
CO3	✓		✓			✓		✓	
CO4	✓	✓	✓		✓		✓		
CO5	✓			✓		✓			

Course Contents:
Module-1: Implement AND NOT, OR Gate. Module-2: Implement NAND, NOR, XOR Gate,
Module-2: Implement Half Adder and Full Adder,
Module-3: Implement Half-subtractor and Full-subtractor,
Module-4: Implement Flip-Flop, S-R Flip Flop, J-K Flip Flop, D Flip Flop, T Flip Flop.
List of Experiments
1. Implement the basic gates using Data flow, behavioral model in Xilinx.
2. Implement the universal gates using Data flow, behavioral model in Xilinx.
3. Implement different gates using universal gates.
4. Implement half adder and half subtractor in both data flow and behavioral model.
5. Implement full adder and full subtractor in both data flow and behavioral model.
6. Implement parallel and serial adder which can add two 8 bit numbers.
7. Implement Encoder (8: 3) and Decoder (3: 8).
8. Implement Multiplexer and De-multiplexer.
9. Implement Different flip-flops using data flow and behavioral model.\

Detailed Syllabus for Bachelor of Computer Application

10. Implement ring counter.
11. Implement a basic ALU which can perform different arithmetic and logical operations.

References
1. "Essential of Computer Architecture", Douglas E. Corner, Pearson.
2. "Computer Organization and Design" David A. Patterson, John L. Hennessy, Elsevier.

TITLE OF COURSE: MATHEMATICS- II
COURSE CODE: BSC202
L-T-P: 3-0-0
CREDITS: 3

Introduction:
The undergrad curriculum in Statistics provides majors with the skills needed to utilize statistical techniques for addressing quantitative, data-based problems in fields such as biological and social sciences, engineering and technology, business and finance, law, and health and education

Course Outcomes:
The students will learn:
CO1: Statistical reasoning and inferential methods
CO2: Statistical modeling and its limitations
CO3: Interpreting and communicating the results of a statistical analysis
CO4: Data analysis using statistical computing tools and software
CO5: Probability and the mathematical foundations of statistics
CO6: Knowledge and Understanding: Students are able to understand the nature and operations of Numerical Analysis.
CO7: Intellectual Skills: By the end of the course the student is expected to solve real-life and engineering applications.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓		✓		✓	
CO3	✓		✓			✓		✓	
CO4	✓	✓	✓		✓		✓		
CO5	✓					✓			✓
CO6	✓	✓		✓		✓			
CO7	✓			✓			✓		✓

Course contents:
Statistics:

Module 1: Basic Statistics
Scope, functions and limitations of statistics, Collection and presentation of data– Tabular and diagrammatic

representation, Frequency distribution, relative frequency, cumulative frequency; Bar graphs and pie charts; Histogram.

Module 2: Measures of Central tendency
Mean, Median, Mode, Percentiles, Quartiles

Module 3: Measures of Dispersion
Range, Interquartile range, Mean deviation, Mean Absolute deviation, Standard deviation, Variance, Coefficient of Variation. Measures of shape and relative location; Skewness and Kurtosis, Simple correlation and regression analysis
Numerical Methods:

Module 4 : Finite Differences
Definition of operators and relations among them (All operators)

Module 5: Interpolation
Interpolation With Equal Intervals: Newton's forward difference formula, Newton's backward difference formula. Interpolation with unequal intervals: Lagrange's Method, Newton divided Difference.

Module 6: Solution of Algebraic and Transcendental Equations
Bisection method, Regula-Falsi method, Newton-Raphson Method, Iterative method.

Text Books:
1. R. K. Jain, S.R.K. Iyengar & M.K. Jain, "Numerical Methods", New Age International Publishers, 2013.
2. B. S. Grewal, "Numerical Methods", Khanna publications, 2014.
3. S. C. Gupta, "Fundamentals of statistics", Sultan Chand & Sons, Delhi, 2006.
4. Goon, Gupta & Das Gupta, "Fundamentals of statistics", The World Press Pvt. Ltd., Kolkata, 2008.

Reference:
1. Mathews & Fink, "Numerical Methods using MATLAB", Pearson, 2010.
2. Gerald and Wheately, "Applied Numerical Analysis", Pearson, 2010
3. Rohtagi, V.K., "An Introduction to Mathematical Statistics", John Wiley & Sons, 1976.
4. Mood A.M., Greybill, F.A. and Bose D.C, "Introduction to the Theory of Statistics",Mc Graw Hill, 1974.

TITLE OF COURSE: ENVIRONMENT & ECOLOGY
COURSE CODE: MC201
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in social Science.

Introduction:
This course examines basic environment. The Topics to be covered (tentatively) include: Renewable and non-renewable resources, Ecosystems in INDIA, Environmental Pollution, Social Issues and the Environment.

Course Outcomes (CO):
Students are expected to be capable of understanding the Indian society for environment, their advantages and drawbacks, how to implement them in ecology aspect, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to know Environment problem properly.
CO2: Students would be able to know ecology system in India, national plan to protect ecology.
CO3: By analyzing student will be proper person to guide our society
CO4: To become an efficient human being for the society.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		✓	✓		✓		✓	✓	✓
CO2				✓			✓	✓	✓
CO3		✓	✓				✓	✓	✓
CO4		✓	✓		✓		✓	✓	✓

Course Contents:
Module-1: Basic Ideas of Environment & Ecology, Environmental Geology & Microbiology, Multidisciplinary nature of environmental studies, Definition, scope and importance Need for public awareness,
Module-2: 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 forest and tribal people.
Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

 Module-3: Ecosystems in INDIA : Basic Concept of an ecosystem, Structure and function of an ecosystem, Energy Flow in Ecosystem, Ecosystem, Biogeochemical Cycles, Nitrogen Cycle, Biodiversity, Biodiversity Hotspots in India, IUCN Red List Conservation of Biodiversity, Importance of Biodiversity, Loss of Biodiversity, Causes of Loss of Biodiversity, Food chains, food webs and ecological pyramids.
Biosphere Reserves in India, Tiger Conservation of India Wildlife, Protection Act 1972, Climate Change in India Alien Invasive Species, Paris Agreement, UNFCCC, Kyoto Protocol, Albedo of Earth, National Green Tribunal Montreal Protocol, Kigali Agreement, Green House Gases (GHGs), Air Pollutants Central Board, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
National Health Mission, National Action Plan on Climate Change, National Water Mission, National Mission for Sustaining Himalayan Ecosystem (NMSHE), National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, Green India Mission
Module-5: Environmental Pollution: Environmental ethics, Cause, effects and control of:- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, global warming, acid rain, Climate change, ozone layer depletion, nuclear accidents and holocaust.
Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.
Module-7: Social Issues and the Environment: Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

Module-7: Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Program, Environment and human health, Human Rights, Value Education, Women and Child Welfare, Role of Information Technology in Environment and human health, Virus and vaccination.

Text Books
1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., India,
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001,
6. Environmental Encyclopedia, Jaico Publ. House, Mumbai,
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.

Reference:
1. Down to Earth, Centre for Science and Environment (R)
2. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev, Environment & Security. Stockholm Env. Institute Oxford Univ. Press.
3. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay.

TITLE OF COURSE: PROFESSIONAL WRITING & TECHNICAL SEMINAR
COURSE CODE: HSM202
L-T-P: 2-0-2
CREDITS: 3

Pre-requisite: Basic knowledge is assumed about grammar, comprehension, English speaking, reading and writing skills.

Introduction: This course will help the students to get idea about the professional world. The course is designed to provide students and faculty with a means for assessment of technical competence of students as well as written, oral, and presentation communication skills that are critically important for success in their professional careers.

Course Outcomes (CO):
On successful completion of this module, students should be able to learn:
CO1: How to write professional letter etc.
CO2: Public speaking
CO3: Use the English language more effectively.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							✓		✓
CO2							✓		✓
CO3							✓		✓

Detailed Syllabus for Bachelor of Computer Application

Course Contents:
Module 1: Elements of Communication: Definition and Meaning of communication, Process of Communication, Essential components of the Process of Communication, Importance and Objectives of Communication, Differences between general and technical communication.
Module 2: Types of Communication: Extra personal communication, Intrapersonal communication, Interpersonal communication, Organizational communication, Mass communication
Module 3: Verbal and Non-Verbal Communication: Verbal communication, Oral Communication, Advantages of Oral Communication, limitation/Disadvantages of Oral Communication, Non-verbal communication, Body Languages, Sign Languages, Space Languages, Paralanguages, Time Languages, Haptics or Languages of Touch, Color Languages, difference between verbal and non-verbal communication.
Module 4: Formal and Informal Channels of Communication Down ward Communication, Upward Communication, Horizontal /Lateral Communication, Diagonal /Clockwise Communication, and Merits & demerits of each type of communication.
Module 5: Barriers to Communication, Physical Barrier, Semantic/language Barrier, Socio psychological Barrier, Organitional/hierarchical Barrier, Emotional Barrier, Cultural Barrier, Information overload, Poor listening, Wrong assumption, Selective perception, Methods to overcome barriers to Communication, Qualities of Good Communication
Module 6: Composition. Need and function of Business Letter, planning and layout of Business Letter, kinds of Business Letter, Drafting of business Letter: Sales, Credit, Enquiry, Order, Claim, Complaint, Job Applications, etc.
Module 7: Preparation of Notices & circular, Memo, Declaration, Telephone etiquettes, E-mail writing

Text Book:

1. Hari Mohan Prasad, "Objective English", Tata Mcgraw Hill
2. A.Amin,R.Eravelly & F.J.Ibrahim, "Grammar Builder Level", ISBN :9780521744843

TITLE OF COURSE: PROFESSIONAL WRITING & TECHNICAL SEMINAR LAB
COURSE CODE: HSM292
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic Grammar, Comprehension, Writing skills.

Introduction:
To enable students listen, speak, read and write effectively for academic purposes and face real life situations

Course Outcomes (CO):
On successful completion of this module, students should be able to learn:
CO1: How to write professional letter etc.
CO2: Public speaking
CO3: Use the English language more effectively.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							✓		✓
CO2							✓		✓
CO3							✓		✓

Detailed Syllabus for Bachelor of Computer Application

Course Contents:
Module-1
Listening: Listening Skill & its sub skills helps the students to improve their concentration power, simultaneously honing their vocabulary. (Assignment: Listening to passages read aloud and then answering the questions set from that passage, and so forth), like- Dialogue Practice Sessions, Oral Comprehension. Conversation Practice Sessions: Situational Dialogue, Role Play, Use of Audio aids for Conversation Practice, Use of Video Clips for Conversation Practice

Module-2
Presentation: It helps to teach students effective communication through innovative methods of learning, like Individual Presentation, Group Presentation, Using Powerpoint/OHP in Presentation, Project Work on PowerPoint Presentation, Paper Presentation. Public Speaking and Soft Skills: Just A Minute (JAM) Sessions

Module- 3
Grammar and Vocabulary: Students will be able to communicate ideas effectively and powerfully using correct grammar and appropriate vocabulary. Related areas include topics like-Connectives, Modifiers, Idiomatic Usage, Online exercises on Grammar and Vocabulary. Report Writing: Report Writing - Principles and Practice

Module-4
GROUP DISCUSSION: Prepares BCA first year students for various aspects of their social and professional lives through interactive sessions, handouts, workshops, self-assessment, peer assessment, and teacher assessment. Related activities include, Group Discussion - Principles and Practice

Text Books
1. Advanced English Communication Skills Lab, Lakshminarayan, Paperback, 2015
2. English Language Laboratories-A Comprehensive Manual, Nira Konar, (OUP), 2016
3. Advanced Grammar in Use with Answers: A Self-Study Reference and Practice Book for Advanced Learners of English 3rd Edition, Martin Hewings, Paperback, 2015
4. Communication Skills, Sanjay Kumar and Pushpa Lata,(OUP),2015

References
1. English Grammar, Wren and Martin, Regular Edition
2. The Art of Public Speaking, 10th Edition, Stephen E. Lucas, McGraw-Hill, 2008

TITLE OF COURSE: ESP & SDP-II
COURSE CODE: BGSC202
L-T-P: 2-0-2
CREDITS: 2

Pre-requisite: Basic concepts in mathematics, English

Introduction:
The Topics to be covered (tentatively): Aptitude, Indian Constitution and Governance, Basic English and Data Interpretation**.**

Course Outcomes (CO):
Students are expected to be capable numerical problems, literature, and basic of Indian constitution. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any basic numerical problem properly.

CO2: Students would be able to know basic English language and communicate with the society.
CO3: Students would be able to know basic Indian constitution.
CO4: Students would be able to stress management by doing Yoga

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Essential Studies for Professionals-II
Section-A: Employment Enhancement Skills

Module 1: Ratio and Proportion
Ratio, Proportion, Proportional, Comparison of Ratios, Compounded Ratios, Duplicate Ratio, Triplicate Ratio, Variation.

Module 2: Time, Work and Distance
Time, Speed and Distance, Relative Speed

Module 3: Alligation or Mixture
Alligation, Mean price, Rule of Alligation

Module 4: Clocks and Calendar (2 lectures)
Clocks, Odd days, Leap Year, Ordinary year, Counting of odd days, Day of the week related to odd days.

Module 5: Permutations and Combinations
Factorial n, Permutations, Combinations.

Module-6: Logical Reasoning
1) Cube Dice, Miscellaneous Problems
2) Data Sufficiency
a) Problems on Blood Relation, ages, Numbers b) Logical Test Based on Data Sufficiency
3) Non Verbal Reasoning
a) Image Formation b) Water –Images c) Mirror Image
d) Image completion
e) Paper Cutting and Folding

Section B: Yoga, Games and Meditation
Module-1: Asana sitting postures and Karate, Asana lying in supine & prone position and karate, Surya Namaskar, Asana standing posture and Karate, Kriyas, Pranayam and Karate, Meditation and Karate, Meditative posture and Karate, Tratak, Kapalbhati and Meditation.
Meditation and Stress Management, Meditation, Stretching and Self Defense. Meditation, Kicking and Punching of Karate. (Games and Sports will be evaluated on the basis of the participation and performance in different sports events that the students shall participate in).

Section C: Skill Development for Professionals -II
Course Contents:

Module-1: Listening

Listening to stories, newspaper articles, Oral Comprehension, Dialogue/ Conversation

Module-2: Speaking

Group discussion, debate, Oral Presentation, Just A Minute (JAM)

Language Function Permission – Request, Order

Practice of Phonetics, Pronunciation, Voice modulation, Accent and voice through passage reading

Story-telling, Role play model (telephonic conversation, situation)

Module-3: Reading Comprehension

Read and analyze through passages, diagrams, graphics, technical and non-technical passages

Learn to read Global, inferential, Contextual Comprehension.

Story writing, Passage writing, Essay writing, Rearranging Jumbled Sentences, Word formation: Prefixes and Suffixes, Homonyms and Homophones, Question and Answer – Comprehension Passages.

Module-4: Indian Constitution and Governance

Central State relation, Interstate relation,

Supreme Court-Appointment of Chief Justice, Acting Chief Justice, Qualification, Oath or Affirmation, Tenure of Judge, Removal of Judges, Salaries & allowance, Adhoc Judge, Procedure of the court, write jurisdiction, Power of Judicial review.

High Court-Appointment of Chief Justice, Acting Chief Justice, Qualification, Oath or Affirmation, Tenure of Judge, Removal of Judges, Salaries & allowance, Adhoc Judge, Procedure of the court, write jurisdiction, Power of Judicial review

Duties & Powers of **Attorney & Advocate General** (in brief)

Panchayati Raj- Three tier system, Different committees recommendation

Municipality, Municipal Council & Corporation, Official Languages & related Articles.

UPSC (in brief): Formation, Related Articles, Scope & Power, Duties of **CAG**, Formation **SPSC**, Related Articles, Scope & Power.

Election Commission (in brief) - Related Articles, Power & Function & Provision of Election

Emergency Provisions (in brief)- Related Articles, Conditions Application, Supreme power during emergency.

National Commission for SC/ST/OBC (in brief)**:** Function of the commissions, Special offer & related articles for SC/ST/OBC

Different amendments (in brief) of Indian Constitution & the related articles

Module-5: Data Interpretation level-II

Newspaper reading: The Hindu & Economic Times

Text Books
1. Quantitative Aptitude for Competitive Examinations by R S Aggarwal
2. Introduction to the Constitution of India, by D D Basu
3. The Constitution of India by Dr. B.R. Ambedkar Under Chairmanship of Dr. Rajendra Prasad Including Coloured Preamble, Signatures

References
1. The Constitution of India by Dr. B.R. Ambedkar 2020

Third Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	BCA308	Operating System	3	0	2	0	4
2.	CC	BCA309	Data Structures using Python	3	0	2	0	4
3.	CC	BCA310	Data Communication & Networking	3	0	2	0	4
4.	CC	BCA311	System Analysis & Design	3	0	0	0	3
5.	CC	BCA312	Object Oriented Programming using C++/JAVA	2	0	2	0	3
6.	HSM	HSM203	Management & Accounting	2	0	0	0	2
7.	GSC	BGSC303	ESP & SDP-III	2	0	0	1	2
8.	PTI	INT301	Project-I	0	0	0	1	1
			Total	19	0	8	2	23/29

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: OPERATING SYSTEM
COURSE CODE: BCA308
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Basic knowledge of programming languages (specially C), elementary data structures and algorithms, computer architecture is needed.

Introduction:
This course examines operating system design concepts, data structures and algorithms, and systems programming basics. The Topics to be covered (tentatively) include: Computer and operating system structures, Process and thread management, Process synchronization and communication, Memory management, Virtual memory, File system, I/O subsystem and device management, selected examples in networking, protection and security.

Course Outcomes (CO):
CO1: Understand the theory and logic behind the design and construction of operating systems.
CO2: You will examine the algorithms used for various operations on operating systems.
CO3: You will differentiate between various operating systems functionalities in terms of performance.
CO4: Become aware of the issues in the management of resources like processor, memory and input-output.
CO5: Know the problems in the design of operating system and study the probable solutions.
CO6: Learn to calculate the performance of CPU scheduling and disk scheduling
CO7: Learn File systems and methods of accessing

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓	✓		✓		✓		✓
CO5	✓					✓			
CO6	✓			✓			✓		
CO7	✓		✓						

Course Contents:

Module 1: Introduction, Operating system structure - Monolithic systems, Layered systems, Virtual machines, Client-Server model.

Module 2: Process Management – process creation, deletion, inter process communication tools: pipe, FIFO, shared memory, process synchronization, synchronization primitives and Classical IPC problems.
Module 3: Process scheduling, Processor Allocation - Allocation Model, Design issues for processor allocation algorithms, Threads and Deadlock.

Module 4: Memory Management, paging scheme, segmentation, virtual memory concept, page replacement algorithms, threshing, working set model, issues in Virtual memory management.

Module 5: File System management. Input output management, Disk scheduling, Case study of UNIX/LINUX.

Text Books

1. Silberschatz, P. Galvin and Greg Gagne, "Operating System Concepts", Wiley International Company.
2. A.S. Tanenbaum, Modern Operating Systems, Prentice Hall India.

References

1. J. Archer Harris, Operating systems – Schuam's outlines, Tata Mc Graw Hill.
2. Gary Nutt, Operating Systems – A modern perspective, Pearson Education.

TITLE OF COURSE: OPERATING SYSTEM LAB
COURSE CODE: BCA398
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic knowledge of programming languages (specially C), elementary data structures and algorithms, computer architecture is needed.

Introduction:

1. To learn and understand system calls related to files, processes, signals, semaphores and Implement system programs based on that.
2. To provide an understanding of the design aspects of operating system.
3. To provide an efficient understanding of the language translation peculiarities by designing a complete translator for a mini language.

Course Outcomes (CO):

The students will have a detailed knowledge of the concepts of process and shared memory, aware of a variety of approaches to process management and main-memory management, including interference, deadlock, scheduling, fragmentation, thrashing, learn the basics behind file systems and input output systems and understand the fundamentals of network and distributed operating systems. Upon the completion of Operating Systems practical course, the student will be able to:

CO1: Understand and implement basic services and functionalities of the operating system using system calls.

CO2: Use modern operating system calls and synchronization libraries in software/ hardware interfaces.

CO3: Understand the benefits of thread over process and implement synchronized programs using multithreading concepts.

CO4: Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.

CO5: Implement memory management schemes and page replacement schemes.

CO6: Simulate file allocation and organization techniques.

CO7: Understand the concepts of deadlock in operating systems and implement them in multiprogramming system.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				

Detailed Syllabus for Bachelor of Computer Application

CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓	✓		✓		✓		✓
CO5	✓					✓			
CO6	✓			✓			✓		
CO7	✓		✓						

Course Contents:

Exercise No.1: CPU scheduling
Exercise No. 2: File allocation Strategy
Exercise No. 3: Simulate MVT, MFT (Multiprogramming Fixed and Variable)
Exercise No. 4: Simulate all File Organization Techniques
Exercise No. 5: Simulate Banker's Algorithm for Dead Lock Avoidance Exercise
No. 6: Simulate Banker's Algorithm for Dead Lock Prevention Exercise No. 7:
Simulate all page replacement Strategies
Exercise No. 8: Simulate Paging Technique of Memory Management
Exercise No. 9: Shell programming (cut, grep, sed)
Exercise No. 10: Process

Text Book:

1. Maurice J. Bach, Design of the UNIX Operating System, PHI.

Recommended Systems/Software Requirements:
1. Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.
2. Turbo C or TC3 complier in Windows XP or Linux Operating System.

TITLE OF COURSE: DATA STRUCTURES USING PYTHON
COURSE CODE: BCA309
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Basic concepts in mathematics and programming languages.

Introduction:
This course examines data structures and algorithms basics using python. The Topics to be covered (tentatively) include: an introduction to programming and problem solving in Python with basic concepts such as conditionals, loops, functions, lists, strings and tuples; Time and space analysis of algorithms; Linear Data structures like array, linked list, stack, queue; Non- linear Data structures like graph and tree; Sorting; Searching and Hashing.

Course Outcomes (CO):
In this course we will study the basic components of data structure and algorithm. Students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them

in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Know about basic concepts of python programming.

CO2: To learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the run-time) or for better memory utilization, based on the priority of the implementation

CO3: To implement different types of linear data structure.

CO4: Study the Python dictionaries as well as classes and objects for defining non liner data structure like graph and tree.

CO5: Understand different types of sorting, searching and hashing technique.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓						
CO4	✓	✓	✓				✓		✓
CO5	✓					✓			

Course Contents:

Module-1: Basics of python: data types, assignment statements, control flow, strings, lists, functions, simple input output.

Module-2: Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Module-3: Linear Data structures–Array, Matrix, Linked List, Stack, Queue and Recursion with their types, different operations and applications.

Module-4: Nonlinear Data structures–Graph, Trees, Minimum spanning treewith their types, different operations and applications.

Module-5: Sorting, Searching and Hashing- Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort. Sequential search and binary search. Hashing functions, collision resolution techniques.

Text Books
1. Data Structures and Algorithms in Python: Michael H. Goldwasser, Roberto Tamassia, Michael T. Goodrich, Publisher: John Wiley & Sons
2. Data Structure and Algorithmic Thinking with Python : Nara simha Karumanchi; Career monk publication.

References
1. Problem Solving in Data Structures & Algorithms Using Python: Programming Interview Guide: Hemant Jain; Createspace Independent Pub
2. Data Structures and Algorithms Using Python: Necaise Rance D; Wiley publisher

TITLE OF COURSE: DATA STRUCTURES USING PYTHON LAB
COURSE CODE: BCA399
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic concepts in mathematics and programming languages.

Introduction:
This course examines data structures and algorithms basics using python. The Topics to be covered (tentatively) include: an introduction to programming and problem solving in Python with basic concepts such as conditionals, loops, functions, lists, strings and tuples; Time and space analysis of algorithms; Linear Data structures like array, linked list, stack, queue; Non- linear Data structures like graph and tree; Sorting; Searching and Hashing.

Course Outcomes (CO):
CO1: Develop problem solving ability using Programming.
CO2: Develop ability to design and analyze algorithms.
CO3: Introduce students to data abstraction and fundamental data structures.
CO4: Develop ability to design and evaluate Abstract Data Types and data structures.
CO5: Apply data structure concepts to various examples and real life applications

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓						
CO4	✓	✓	✓				✓		✓
CO5	✓					✓			

Course Contents:
Exercises that must be done in this course are listed below:
Exercise No.1: Implementation of array operations
Exercise No. 2: Stacks and Queues: adding, deleting elements
Exercise No. 3: Circular Queue: Adding & deleting elements
Exercise No. 4: Merging Problem: Evaluation of expressions operations on multiple stacks & Queues
Exercise No. 5: Implementation of linked lists: inserting, deleting, and inverting a linked list.
Exercise No. 6: Implementation of stacks & queues using linked lists, Polynomial addition, and Polynomial multiplication
Exercise No. 7: Sparse Matrices: Multiplication, addition.
Exercise No. 8: Recursive and Non-recursive traversal of Trees
Exercise No. 9: Threaded binary tree traversal. AVL tree implementation
Exercise No. 10: Application of Trees. Application of sorting and searching algorithms

Text Books
1. Data Structures and Algorithms in Python: Michael H. Goldwasser, Roberto Tamassia,
2. Data Structure and Algorithmic Thinking with Python:Narasimha Karumanchi; Careermonk publication.

References
1. Problem Solving in Data Structures & Algorithms Using Python: Programming Interview Guide:Hemant Jain; Createspace Independent Pub
2. Data Structures and Algorithms Using Python: Necaise Rance D; Wiley publisher

TITLE OF COURSE: DATA COMMUNICATION & NETWORKING
COURSE CODE: BCA310
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Basic knowledge of programming, operating system and computer architecture is needed.

Introduction:

This course is to provide students with an overview of the concepts and fundamentals of data communication and computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols. The course is supplemented by a practical component covered in CS692 concurrently.

Course Outcomes (CO):

After completing this course the student must demonstrate the knowledge and ability to:

C01: Independently understand basic computer network technology.
C02. Understand and explain Data Communications System and its components.
C03. Identify the different types of network topologies and protocols.
C04. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
C05. Identify the different types of network devices and their functions within a network6. Understand and building the skills of subnetting and routing mechanisms.
C06. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.
C07. 8. Analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓		✓				
CO4	✓	✓	✓				✓		✓
CO5	✓					✓		✓	

Detailed Syllabus for Bachelor of Computer Application

CO6	✓								
CO7	✓								✓

Application:
1. To configure and implement network topology.
2. To configure and implement local area network.
3. To design network and assign IP address
4. Connect Remote computers
5. Analyze the network.

Course Contents:
Module -1: Introduction: Data communications: components, data representation (ASCII,ISO etc.),direction of data flow(simplex, half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN);Internet: brief history, internet today; Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.
Physical layer: Overview of data (analog & digital), signal (analog &digital), transmission (analog & digital) & transmission media (guided & non-guided); TDM, FDM, WDM; Circuit switching: time division & space division switch.

Module -2: Data link layer: Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;

Medium access sub layer: Point to point protocol, LCP, FDDI, token bus, token ring; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA;

Module -3: Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: Internet address, classful address, subnetting; Routing: techniques, static vs. dynamic routing, routing table for classful address; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.
Transport layer: Process to process delivery; UDP; TCP; Quality of service: techniques to improve QoS.

Module -4: Application layer: DNS; SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography, user authentication, security protocols in internet, Firewalls.

Modern topics: ISDN services & ATM; DSL technology, Cable modem, SONET. Wireless LAN: IEEE 802.11; Introduction to blue-tooth, VLAN's, Cellular telephony & Satellite network.

Text Books:
1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) "– TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas

Reference Books:

1. Kurose and Rose – "Computer networking -A top down approach featuring the internet" Pearson Edu.
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

TITLE OF COURSE: DATA COMMUNICATION & NETWORKING LAB
COURSE CODE: BCA390
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic knowledge of programming, operating system and computer architecture is needed.

Introduction:
This practical course provides students with hands on training regarding the design, troubleshooting, modeling and evaluation of computer networks. In this course, students are going to experiment in a real and simulation based test-bed networking environment, and learn about network design and troubleshooting topics and tools such as: network addressing, Address Resolution Protocol, basic troubleshooting tools (like ping, ICMP), IP routing (e.g. RIP), TCP and UDP,DHCP,ACL and many others. Student will have the opportModuley to build some simple networking models using the tool and perform simulations that will help them evaluate their design approaches and expected network performance.

Course Outcomes (CO):
The students will have a detailed knowledge network topology, Local area network, IP addressing, familiarization with network simulator, idea about networking devices, network cable and connectors, different types routing protocols, concept of remote access and different types of application layer protocol. Upon the completion of Computer network practical course, the student will be able to:

CO1: Learn various network commands.
CO2: Understand and implement basic of Network and Network Topology.
CO3: To get idea about IP addressing schemes.
CO4: Understand the benefits of network.
CO5: Configure and simulate various protocols.
CO6: Access remote desktop.
CO7: Connect to different computer using LAN.
CO8: Understand the concepts of access control.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓		✓				
CO4	✓	✓	✓				✓		✓
CO5	✓					✓		✓	
CO6	✓								
CO7	✓								✓
CO8	✓								✓

Detailed Syllabus for Bachelor of Computer Application

Course Contents:
Exercises that must be done in this course are listed below:
Exercise No.1: Study of different types of Network cables and practically implements the cross-wired cable and straight through cable using clamping tool.
Exercise No. 2: Familiarization with some network devices.
Exercise No. 3: Study of Network IP.
Exercise No. 4: Connect the computers in LAN.
Exercise No. 5: Introduction to Packet Tracer.
Exercise No. 6: Configure network topology using packet tracer.
Exercise No. 7: Configure network topology using packet tracer to find the routing path by IP Route Command.
Exercise No. 8: Network Configuration using distance vector routing protocol. Exercise No. 9: Configuration of DHCP Protocol
Exercise No. 10: Telnet Configuration.
Exercise No. 11: Configuration of Access Control List.

Text Book:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) "– TMH

Reference Book:

1. Authorized Self-Study Guide "Interconnecting Cisco Network Devices, Part 1(ICND1), 2nd Edition, January, 2008.

Recommended Systems/Software Requirements:
1. CAT-5/CAT-6 Cables, RJ 45, Cutter, Clamping Tool, Router, Switch and Hub.
2. Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.
3. Turbo C or TC3 complier in Windows XP or Linux Operating System.

TITLE OF COURSE: SYSTEM ANALYSIS & DESIGN
COURSE CODE: BCA311
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Familiarity with programming languages and knowledge of databases.

Introduction:
The course deals with planning the development of information systems. The course deals with concepts, methodologies, techniques and tools required for solving business problems.

Course Outcomes (CO):
The course will teach techniques in data requirements collection and analysis along with methods to model data needs. To reach this goal, the following objectives need to be met:

CO1: Be able to develop requirements document to detail and model an information system design.
CO2: Demonstrate ability to initiate, specify, and prioritize information systems projects and determine various aspects of feasibility of these projects.
CO3: Be able to gather data to analyze and specify the requirements of a system.
CO4: Apply knowledge of data flow diagrams, entity relationship modeling and state process modeling in user requirement analysis.

CO5: Be able to recognize and incorporate user requirements, business rules and constraints into the design of an information system.

CO6: Display awareness of the alternative methods for system development and tools and techniques used in system analysis and design.

CO7: Apply specific modeling methodology to analyze, design and specify requirements for a business situation using a formal technique.

CO8: Exhibit competence in applying contemporary analysis and design techniques in business process improvement.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓		✓				
CO4	✓	✓	✓				✓		✓
CO5	✓					✓		✓	
CO6	✓		✓						
CO7	✓			✓					✓
CO8	✓								✓

Course Contents:

Module-1: Fundamentals of Data and Information: Types of information: operational, tactical, strategic and statutory, need for information systems, management structure, Information requirements at different levels of management, functional allocation of management, requirements of information for various functions, Information quality

Module-2: Systems Analysis and Design Life Cycle: Requirements Specifications, Feasibility analysis, Final specifications, System design & implementation, System evaluation & modification. Role of systems analyst, Tools used in system analysis.

Module-3: Feasibility analysis: Deciding project goals, examining alternative solutions, cost, benefit analysis, quantifications of costs and benefits, payback period, system proposal preparation for managements, Tools for prototype creation.

Module-4: Analysis Process: Data flow diagrams, case study for use of DFD, good conventions, leveling of DFDs, logical and physical DFDs, Describing process specifications and structured decision, software tools to create DFDs.

Module-5: Essentials Of System Design: Procedure specifications in structured English, Decision tables for complex logical specifications, specification oriented design vs procedure oriented design.

Module-6: Advanced Systems Design Concepts: Data oriented system design, ER model and diagram, relation normalization and need, Object oriented system design, classification of objects in an application, System modeling using objects.

Module-7: System analysis and design case study: E-commerce system architecture, physical+ networks, logical network, World Wide Web, web-services.

Text Books

1. J. W. Satzinger, R. B. Jackson and S. D. Burd – "Systems Analysis and Design in a Changing

World" – 6th Ed. – Thomas Course Technology.
2. Kenneth E. Kendall, Julie E.Kendall – "Systems Analysis and Design" – 9th Ed. – Pearson.

References

1. Brijendra Singh – "Systems Analysis and Design" – New Age International Publishers
2. Jeffrey Whitten & Lonnie Bentley–"Systems Analysis and DesignMethods" – SIE Publishers
3. Valacich, George,Hoffer – "Essentials Of System Analysis & Design" – PHI Publishers
4. Charles Wasson – "System Engineering Analysis, Design, and Development: Concepts, Principles, and Practices " – Wiley series
5. Silver & Silver- "System Analysis and Design"-5th Ed.- Addison Wesley.

TITLE OF COURSE: OBJECT ORIENTED PROGRAMMING USING JAVA
COURSE CODE: BCA312
L-T-P: 2-0-2
CREDITS: 3

Prerequisite: Knowledge is assumed of basic concepts in any programming language.

Introduction: This course contains object oriented programming and able to explain the difference between object oriented programming and procedural programming. Be able to program using java features such as composition of data types, classes, objects, inheritance and polymorphism, file I/O, exception handling, methods, string and array manipulation, Thread, and Java applets.

Course Outcomes (CO):
This course will serve to broaden the student's understanding of the issues and latest developments in the area of Object Oriented Programming. To reach this goal, the following objectives need to be met:

CO1: To know different properties of object oriented programming language, advantages and disadvantages of java over C and C++, to know different steps of java source code compilation and execution

CO2: To know encapsulation, polymorphism, why java is called platform independent programming language.

CO3: To know different access specifiers of java, finalize and garbage collection of java.

CO4: To know the significant of static keyword, String vs String Buffer class and different methods of String.

CO5: To know different inheritance with examples.

CO6: To know uses of this, this(), super, super(), abstract class and interface.

CO7: To know member access for packages.

CO8: To know different ways of exception handling.

CO9: To know different ways of implementing concept of multithreading, problems in multithreading and their solutions.

CO10: To know benefits and uses of applet and implementation of applet.

CO11: To know different components of swing, event handling and layouts in swing.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓		✓				✓	✓

CO3	✓	✓	✓		✓				
CO4	✓	✓	✓				✓		✓
CO5	✓					✓		✓	
CO6	✓		✓						
CO7	✓			✓					✓
CO8	✓				✓				✓
CO9	✓						✓		
C10	✓								
C11	✓					✓		✓	

Course Contents:
Module-1: Introduction: Different Programming Paradigms, Why use the Object Oriented Paradigm, Object Oriented Principles, Concept of Class, Object, inheritance, encapsulation, and polymorphism
Module-2: An Overview of Java: Advantage of JAVA , Feature of JAVA in object oriented programming Concept of byte-code & JVM, Basic JAVA Syntax, Basic Data Type, Control Statement using Java, Concept of Arrays in JAVA, Concept of Method in JAVA
Module-3: Introducing Class & Method: Objects and classes in java, defining classes Module-4: Building our own Classes: Analyzing the class, Methods to access the data, Method Overloading, Static Method, Constructors, Object Construction, Default Constructors, Constructor Overloading, and Garbage Collection
Module-4: Inheritance & other features: Inheritance, Abstract Classes, Final Classes in JAVA, Access specifiers in java, Method overriding, Interface, Polymorphism in java
Module-5: Packages: Concept of Package in JAVA, Member access for packages
Module-6: Exception Handling: Concept of exception, Exception, Hierarchy, Catching Exceptions, Declaring you own Exception
Module-7: String & Thread: Basic string handling concepts, Discuss Basic method of String, Life Cycle of a Thread, Create, Thread, Thread Methods, Multi Thread
Module-8: Applet & Swing: Concept of Applet, Life Cycle of an Applet, Basic Applet Programming, Concept of Swing , Swing Controls, Event handling And Listener in Swing Swing Layout Manager

Text Books
1. Grady Booch et al, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 2007.
2. Michael Blaha and James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education,2005.
3. PatricNaughton , Herbert Schildt, "Java 2 Complete Reference", Tata McGraw Hill, 1999.

References

1. Joshua Bloch, "Effective Java", Addison-Wesley; 3rd Edition, 2018.
2. Bruce Eckel, "Thinking in Java", Prentice Hall; 4th Edition, 2006.
3. Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, "Design Patterns: Elements of Reusable Object-oriented Software", Pearson Education India, 2004.

TITLE OF COURSE: OBJECT ORIENTED PROGRAMMING USING JAVA LAB
COURSE CODE: BCA392
L-T-P: 0-0-2
CREDITS: 1

Prerequisite: Students must have already registered for the course, basic computation.

Introduction: The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections. How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java. How to test, document and prepare a professional looking package for each business project using Javadoc.

Course Outcomes (CO):
Students will also be able to handle software development models through rational method. After completion of course student will be able to generate test cases for software testing.
CO1: Explain what constitutes an object-oriented approach to programming and identify potential benefits of Object-oriented programming over other approaches.
CO2: Explain the benefits of object oriented design and the types of systems in which it is an appropriate methodology.
CO3: Apply an object-oriented approach to developing applications of varying complexities.
CO4: Augment a class definition using constructors, member functions and custom input/output operators to add functionality to a programming solution.
CO5: Read from and write to files using objects from the standard input output library and custom file operators for future restoration.
CO6: Model specialization using single inheritance and abstract base classes to minimize code duplication.
CO7: Design and compile java programs manipulating strings and text documents.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓		✓		
CO2	✓	✓		✓				✓	✓
CO3	✓	✓			✓				
CO4	✓	✓	✓				✓	✓	✓
CO5	✓					✓		✓	
CO6	✓		✓					✓	
CO7	✓	✓		✓		✓			✓

Course Contents:
Module 1: Concepts of object oriented programming language, Major and minor elements, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta-class, grouping constructs.
Module 2: Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism.

Module 3: Basic concepts of java programming – advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts- String (discuss charAt() , compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray() , toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods) & StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods), concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input using Buffered Reader & Scanner classes.

Module 4: Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.

Module 5: Exception handling basics, different types of exception classes, use of try & catch with throw, Throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread Communication, deadlocks for threads, suspending & resuming threads.

Module 6: Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in Applets, use of repaint (), getDocumentBase(), getCodeBase() methods, layout manager (basic concept), creation of buttons (JButton class only) & text fields.

List of Experiments

Experiment 1: Write a program that reads the radius of a circle as input taken dynamically while Running and then computes the circumference and area.

Experiment 2: Write a java program to print the following pattern using "for" loops

1
2 3
4 5 6

Experiment 3: Write a java program to eliminate the duplicate elements from the given set of input elements

Sample input: 1 2 3 4 4 5 3 2

Sample Output: 1 2 3 4 5

Experiment 4: Write a java program to find the nth smallest number in the given set of elements

Sample input 2 4 3 5 8 7 N=3

Sample output: The third smallest element is:4

Experiment 5: Write a java program to sort the elements of the matrix in row wise

Sample input 1 3 2 sample output: 1 2 3

6 5 4 4 5 6
9 7 8 7 8 9

Experiment 6: Write a java program to find the N prime numbers

Sample input:7

Sample output: 2 3 5 7 11 13 17

Experiment 7: Write a program to use concept of packages with access specifiers.

Experiment 8. Write a code to implement user defined exception.

Experiment 9: Write a program to implement thread in java.

Experiment 10: How can you change priority of a thread?

Experiment 11: When synchronization problem is occurred in thread program? Explain with code.

Experiment 12: Explain the life cycle of Applet with program.

Experiment 13: Write down the importance of Applet Program.

Experiment 14: Design a swing application to store student data in a file. Use JFrame, JPanel, JLabel, JTextField, Jbutton to design the application.

Detailed Syllabus for Bachelor of Computer Application

Experiment 15: Write down the use of use of repaint(), getDocumentBase(),getCodeBase() methods.

Experiment 16: Explain use of different events in java.

Experiment 17: Explain use of different Layout manager.

Text Book:

1. Grady Booch et al, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 2007.
2. Michael Blaha and James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education,2005.
3. PatricNaughton , Herbert Schildt, "Java 2 Complete Reference", Tata McGraw Hill, 1999.
4. Joshua Bloch, "Effective Java", Addison-Wesley; 3rd Edition, 2018.
5. Bruce Eckel, "Thinking in Java", Prentice Hall; 4th Edition, 2006.
6. Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, "Design Patterns: Elements of Reusable Object-oriented Software", Pearson Education India, 2004.

TITLE OF COURSE: MANAGEMENT & ACCOUNTING
COURSE CODE: HSM203
L-T-P: 2-0-0
CREDITS: 2

Pre-requisite: Knowledge is also assumed of basic concepts in Management Accounting.

Introduction:

This course provides the students an understanding of relevance of cost in managerial decision making. This course provides a comprehensive knowledge of classification of cost, apportionment of overheads, process costing, activity based costing, segmental reporting, preparation of budgets and cost -volume profit analysis for decision making and cost control.

Course Outcomes (CO):

At the end of the course, students are able to

CO1: Explain the concepts of Module costing activity based costing, apportionment of overheads, process costing, segmental reporting and budgeting.

CO2: Exhibit skills in Identifying, Measuring and analyzing costing data.

CO3: Provide alternative solutions to cost control and related cost management applications in practice.

Mapping of Course Outcomes (CO) and Program Outcomes (PO)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓				✓	✓
CO3	✓	✓							✓

Course Contents:

Module: 1: Background-Nature of Management Accounting: Financial Analysis- Cash Flow Statement (asperAS3), Financial Statements Analysis

Module: 2: Cost Accumulation –Fundamentals of Job-Order Batch & Process Costing, Variable Costing and Absorption (Full) Costing, Activity Based Costing System

Module: 3: Profit Planning-Cost -Volume- Profit Analysis, Budgeting and Profit Planning, Flexible Budgeting

Module: 4: Cost Control- Standard Costs and quality Costs, Cost Variance Analysis, Revenue and Profit Variance Analysis, Responsibility Accounting RelevantCosting–Introduction–RelevantCostsandRevenues-CostConcepts– Out sourcing Decision– Decision to accept or reject a special order–Decision to continue or abandon a project.

Module: 5 Total Cost Management – Introduction – TCM and Business competitive edge - TCM Principles and implementation.

Text Books
1. Jiambalvo, lames. (2004), Managerial Accounting, 2nd Edition, Wiley India Publications, New Delhi.

References
1. Khan, MY. Jain, P K (2000), Management Accounting, 3rd Edition; Tata McGraw Hill, New Delhi.
2. Jain, S P. Narang, K L. (2012), Cost Accounting: Principles and Practice, 23rd. Edition, Kalyani Publishers, Ludhiana.

TITLE OF COURSE: ESP & SDP-III
COURSE CODE: BGSC303
L-T-P: 2-0-1
CREDITS 2

Pre-requisite: Basic concepts in mathematics and Basic English languages.

Introduction:
This course examines economy, governance. The Topics to be covered, (tentatively): Economic Affairs, Quantitative Aptitude, Reasoning, Ancient & Medieval History.

Course Outcomes (CO):
In this course we will study the basic components of Indian economy and Reasoning. Students are expected to be capable of understanding their advantages and drawbacks, how to implement them it all over the country, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Understand the values of tax payment and mutual Fund
CO2: Understand the values of literature, languages etc.
CO3: Understand Working & Policies, Money Market & Capital Market.
CO4: Know about different short cut techniques to solve any kind of aptitudes.
CO5: Know about different short cut techniques to solve any kind of reasoning.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓	✓	✓		✓
CO2		✓			✓			✓	
CO3	✓	✓							✓
CO4	✓	✓	✓		✓	✓		✓	
CO5		✓				✓		✓	

Course Contents:

Section A: Employment Enhancement Skills-III

Module-1: GK & CA, National income: Concept of GDP, GNP, NNP both in FC & MP, PCI

Tax: Concept of TAX, objective of TAX, Direct & Indirect Tax, Progressive, Regressive & Proportional tax.

Module-2: Market structure: Perfect competition, monopoly, oligopoly, duopoly, monophony, duopoly, Oligopoly. SEBI, IRDA, NHB –Working & Policies, Money Market & Capital Market, functions of Banks & Types of accounts, cheques & loans, Mutual Fund, Banking Terminologies.

Module-3: Science, Technology, Literature (with current updates): Monuments, sculptures, Literature, Languages, Visual arts – paintings etc. Performing arts – classical and folk dances, puppetry etc. ,Religious diversity, Satellite, GPS, SIM, GSM, CDMA, Indian Regional Navigation Satellite System (IRNSS), NAVIC,WIFI, SIM, GPRS, ISRO, NASA.

Module-4: Ancient & Medieval History at a glance: From Indus valley civilization to Pre-Foreign (British, Dutch, French) Invasion. Current Affairs.

Section B: Skill Development for Professional – III
Module-1: Quantitative Aptitude: Basic concept of SI & CI, different formulas & their applications, concept of Growth & Contraction of Business. Data Interpretation- Tables, pie chart, histogram, Bar chart, solution tricks & techniques. Quant Review- Miscellaneous problems from different chapters & short cuts. Indices & Surds- Basic concept, Formulae & their applications, Finding out the square roots, Elimination of Surds, Equation solve. Quadratic Equation- Polynomials, degree, powers, Equation & factors Solution. Progression- Concept of AP, GP & HP

Module-2: Reasoning:

Syllogism: a) Logical Venn diagram b) The If Else Statement

Puzzles a) Seating Arrangement b) Classification c) Seating Arrangement with Blood relations

Machine Input-Output: a) Pattern Based I/O

Inequality: a) Coded Inequality, b) Jumbled Inequality, c) Conditional inequality

Sentence: a) Sentence Corrections b) Fill the blanks with appropriate words/articles/ preposition/ verbs/adverbs/conjunction. **d**) Reading Comprehension (Advance Level) d) Vocabulary
Module-3: Advanced Data Interpretation level-III
Newspaper reading: The Hindu & Economic Times

Text Books
1. Quantitative Aptitude for Competitive Examinations by R S Aggarwal
2. The Indian Economy ...An Analysis of Economic Survey 2019-20 & Budget 2020-21by Sanjiv Verma
3. Indian Financial System by Sujatra Bhattacharyya

References
1. Indian Economy for Civil Services, Universities and Other Examinations by Ramesh Singh
   Indian Financial System, by Pathak PEARSON publisher

Fourth Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	BCA413	Database Management System	3	0	2	0	4
2.	CC	BCA414	Formal Languages & Automata Theory	3	0	0	0	3
3.	CC	BCA415	Web Development with ASP.NET	3	0	2	0	4
4.	CC	BCA416	Discrete Mathematics	3	0	0	0	3
5.	CC	BCA417-	Computer Graphics & Multimedia Technology	3	0	2	0	3
6.	PE/SE	----	Professional/Specialization Elective-I	3	0	0	2	3
7.	GSC	BGSC404	ESP & SDP-IV	2	0	0	1	2
8.	PTI	INT402	Project-II	0	0	0	1	1
			Total	20	0	6	4	23/30

 # Students can opt any Professional Track/Specialization from the following table from 4th Semester onwards:

Professional Specific Elective Courses:

Subject Code	IOT, Cybersecurity & Blockchain Track	Subject Code	AI & Machine Learning Track
BCP401	Cyber Security	BCP402	Deep Learning
BCP503	Security Identity & Risk Management	BCP504	Soft Computing
BCP505	Embedded Systems	BCP506	Machine Learning Techniques
BCP507	Blockchain Technology	BCP508	Natural Language Processing
BCP609	Block Chain Business Application & Implication	BCP610	Computer Vision

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: DATABASE MANAGEMENT SYSTEM
COURSE CODE: BCA413
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: The proper understanding of data structures and algorithms and Discrete Mathematics.

Introduction:
Database Management Systems (DBMS) consists of a set of interrelated data and a set of programs to access that data. They underpin any computer system and are therefore fundamental to any program to study in computer science. An understanding of DBMS is crucial in order to appreciate the limitations of data storage and application behavior and to identify why performance problems arise. Students who complete this course are expected to develop the ability to design, implement and manipulate databases. Students will apply and build databases for various day to day real life scenarios and real life applications. The course will by and large be structured but will introduce open-ended data base problems.

Course Outcomes (CO):
This course will serve to broaden the student's understanding of the issues and latest developments in the area of Database Management System and its maintenance. To reach this goal, the following objectives need to be met:
CO1: Ability to build normalized databases.
CO2: Knowledge of Entity Relationship Modeling.
CO3: Familiarity with SQL, embedded SQL and PLSQL.
CO4: Familiarity with query processing and query optimization techniques.
CO5: Understanding of transaction processing.
CO6: Ability to handle recovery and concurrency issues.
CO7: Familiarity with ODBC, JDBC

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓	✓			✓
CO2	✓					✓	✓		
CO3	✓	✓	✓			✓		✓	✓
CO4	✓	✓		✓	✓	✓			
CO5	✓					✓	✓		
CO6	✓			✓		✓			✓
CO7		✓	✓				✓	✓	

Course Contents:
Module 1:
Introduction to DBMS- Concept & overview of DBMS, Data Models & database Language, Database Administrator, Database Users, architecture of DBMS, Three levels of abstraction.
Module 2
Entity Relationship Model – Basic concepts, Design Issues, Entity-Relationship Diagram, Weak Entity Sets, and Extended E-R features.
Relational Model- Structure of relational Databases, Relational Algebra, Relational Algebra Operations, Views

and Modifications of the Database.

Module 3:

SQL and Integrity Constraints: Concept of DDL, DML, DCL, Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, Assertions, views, nested Sub queries.

Module 4:

Relational Database Design: -Functional Dependency, Different anomalies in designing a Database, Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF.

Module 5:

Transaction: -Transaction concept, transaction model, serializability, transaction isolation level, Transaction atomicity and durability, transaction isolation and atomicity. Concurrency control and recovery system: Lock based protocol, dead lock handling, time stamp based and validation based protocol, failure, Classification, storage, recovery algorithm, recovery and atomicity, backup.

Module 6:

Internals of RDBMS:-Physical data structures, Query optimization: join algorithm, Statistics and cost based optimization.

Module 7:

File Organization & Index Structures:-File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Text Books

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 6thEdition, McGraw Hill 2010
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6thEdition, Pearson, Addison- Wesley, 2010.

References

1. C.J. Date, "An Introduction to Database Systems", 8thEdition, Addison-Wesley, 2003.
2. Ramakrishnan &Gherke, Database Management Systems, 2nd Edn., McGraw.
3. Connolly and Begg, "Database Systems", 4thEdn., Addison-Wesley, 2005
4. Toby, Lightstone and Jagadish, "Database Modeling and Design", 5thEdn, Elsevier, 2011

TITLE OF COURSE: DATABASE MANAGEMENT SYSTEM LAB
COURSE CODE: BCA493
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts of DBMS.

Introduction:

At the end of the semester, the students should have clearly understood and implemented the following:
1. Stating a database design problem.
2. Preparing ER diagram
3. Finding the data fields to be used in the database.
4. Selecting fields for keys.
5. Normalizing the database including analysis of functional dependencies.
6. Installing and configuring the database server and the front end tools.
7. Designing database and writing applications for manipulation of data for a standalone and shared database including concepts like concurrency control, transaction roll back, logging, report generation etc.

8. Get acquainted with SQL. In order to achieve the above objectives, it is expected that each students will chose one problem. The implementation shall being with the statement of the objectives to be achieved, preparing ER diagram, designing of database, normalization and finally manipulation of the database including generation of reports, views etc. The problem may first be implemented for a standalone system to be used by a single user. All the above steps may then be followed for development of a database application to be used by multiple users in a client server environment with access control. The application shall NOT use web techniques. One exercise may be assigned on creation of table, manipulation of data and report generation using SQL.

Course Outcomes (CO):
CO1: Ability to build normalized databases.
CO2: Knowledge of Entity Relationship Modelling.
CO3: Familiarity with query processing and query optimization techniques.
CO4: Understanding of transaction processing.
CO5: Ability to handle recovery and concurrency issues.
CO6: Familiarity with ODBC, JDBC.
CO7: Familiarity with SQL, embedded SQL

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓	✓			✓
CO2	✓			✓			✓		
CO3	✓	✓	✓			✓		✓	✓
CO4	✓	✓		✓	✓	✓		✓	
CO5	✓					✓	✓		
CO6	✓			✓		✓			✓
CO7		✓	✓		✓		✓	✓	

Course Contents:
Exercises that must be done in this course are listed below:
Exercise No.1:
ER Model: An entity-relationship model (ERM) is an abstract and conceptual representation of data. Entity-relationship modeling is a database modeling method, used to produce a type of conceptual schema or semantic data model of a system.
Exercise No. 2:
EER Model: In computer science, the enhanced entity-relationship (EER) model is a high-level or conceptual data model incorporating extensions to the original entity-relationship (ER) model, used in the design of databases. It was developed by a need to reflect more precisely properties and constraints that are found in more complex databases.
Exercise No. 3:
Relational Model: The relational model for database management is a database model based on first-order 4predicate logic, first formulated and proposed in 1969 by E.F. Codd. The model uses the concept of a mathematical relation, which looks somewhat like a table of values -as its basic building block, and has its theoretical basis in set theory and first-order predicate logic.
Exercise No. 4:
1 NF: First normal form (1NF or Minimal Form) is a normal form used in database normalization. A relational database table that adheres to 1NF is one that meets a certain minimum set of criteria. These

criteria are basically concerned with ensuring that the table is a faithful representation of a relation and that it is free of repeating groups.

Exercise No. 5:

2 NF: Second normal form (2NF) is a normal form used in database normalization. 2NF was originally defined by E.F. Codd in 1971. A table that is in first normal form(1NF) must

Exercise No. 6:

3 NF: The Third normal form (3NF) is an important form of database normalization. 3NF is said to hold if and only if both of the following conditions hold: • The relation R (table) is in second normal form (2NF) • Every non-prime attribute of R is non-transitively dependent (i.e. directly dependent) on every candidate key of R.

Exercise No. 7:

BCNF: A relation R is in Boyce-Codd normal form (BCNF) if and only if every determinant is a candidate key. 4The definition of BCNF addresses certain (rather unlikely) situations which 3NF does not handle.

Exercise No. 8:

SQL-1: In this Lab., we discuss basic SQL operations like creating a table, deleting a table, changing the schema of the table, primary key and foreign key constraints on a table and creating indexes on tables.

Exercise No. 9:

SQL-2: Its scope includes efficient data insert, query, update and delete, schema creation and modification, and data access control. In this lab., we discuss SQL operations for populating the tables like inserting into a table, deleting values from a table, and updating the content of the tables.

Text Books

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 6thEdition,McGraw Hill, 2010
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6thEdition, Pearson, Addison Wesley,2010
3. Ivan Bayross, "The programming language of oracle", 5thEdition, BPB Publication 2016

References

1. "Database Systems: A Practical Approach to design, Implementation and Management". Thomas Connolly, Carolyn Begg; Third Edition, Pearson Education.
2. "Fundamentals of Database Systems" Elmasri, Navathe, Pearson Education.
3. Bipin C Desai, An Introduction to Database Systems, Galgotia. Publications Pvt Limited, 2001
4. "An Introduction to Database Systems", C.J.Date, Pearson Education.
5. "A first course in Database Systems", Jeffrey D. Ullman, Jennifer Windon, Pearson, Education.
6. "Data Management: databases and organization", Richard T. Watson, Wiley.
7. "Data Modeling Essentials", Graeme C. Simxion, Dreamtech.
8. Introduction to Data Base Management, Naveen Prakash, Tata McGraw Hill
9. "Oracle 10g manuals".

TITLE OF COURSE: FORMAL LANGUAGES & AUTOMATA THEORY
COURSE CODE: BCA414
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in mathematics like set theory.

Introduction:

This course examines formal language and automata theory concepts. The topics to be covered (tentatively) include: Finite state machine, Regular language and finite automata, Context free language and pushdown automata and Turing Machine.

Course Outcomes (CO):

This course introduces the formal language & automata theory. Starting with the most primitive computing device, a finite automaton, the course gradually introduces additional components to the device to enhance its computing power. The course also introduces students to the twin concepts of languages and grammars that correspond to classes of computing devices. Finally the course introduces the idea of a universal computing device and brings out theoretical limits of the very idea of computing. To reach this goal, the following objectives need to be met:

CO1: To design deterministic and nondeterministic finite automata like Mealy machine, Moore machine, DFA and NFA.

CO2: To construct regular expressions and grammars.

CO3: To convert context free grammars to normal forms and eliminate ambiguities.

CO4: To design context free grammar recognizable language like deterministic and non- deterministic PDA.

CO5: To design deterministic and nondeterministic automata and Turing machines. To recognize unsolvable problems and limitations of computing and get familiarity with the seminal works of Turing and Chomsky.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓	✓	✓		✓
CO2		✓			✓			✓	
CO3	✓	✓							✓
CO4	✓	✓	✓		✓	✓		✓	
CO5	✓	✓		✓	✓	✓	✓		

Course contents:

Module-1: Finite Automata: Definition, Application of finite automata. Concept and design of Moore &Mealy machine, Mealy to Moore conversion and vice versa, minimization. Deterministic finite automaton and non-deterministic finite automaton. Transition diagrams and Language recognizers. NFA with Î transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without Î transitions. NFA to DFA conversion.

Module-2: Regular Language and Grammar: Regular sets. Regular expressions, identity rules. Arden's theorem state and prove. Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA, Pumping lemma of regular sets. Closure properties of regular sets (proofs not required). Grammar Formalism: Regular grammars-right linear and left linear grammars. Equivalence between regular linear grammar and FA.

Module-3: Context Free Language and Grammar: Definition of Context Free Grammars, Derivation trees, sentential forms. Right most and leftmost derivation of strings. Ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky normal form and Greibach normal form. Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications.

Module-4: Push Down Automata: Push down automata of definition.Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, inter-conversion. (Proofs not required). Introduction to DCFL and DPDA.

Module-5: Turing Machine: Definition, construction, types of TM. Concepts of Universal Turing machine and Halting problem.

Text Books:

1. Mishra and Chandrashekaran,"Theory of Computer Science , Automata Languages and computation",

2nd edition, PHI.
2. Peter Linz,"Introduction to Formal Language and Automata", 5th edition, Jones and Bartlett's Publications.

References:
1. C.K.Nagpal, "Formal Languages and Automata Theory", Oxford.
2. Hopcroft H.E. and Ullman J. D ,"Introduction to Automata Theory Language and Computation", Pearson Education.
3. John C Martin, "Introduction to languages and the Theory of Computation", TMH

TITLE OF COURSE: WEB DEVELOPMENT WITH ASP.NET
COURSE CODE: BCA415
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Knowledge is also assumed of basic concepts in HTML, CSS, and Other programming knowledge.

Introduction:
To learn and understand Web design. It is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, color, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site.

Course Outcomes (CO):
CO1: Learn the technologies of the .NET framework
CO2: Know the object oriented aspects of C#
CO3: Be aware of application development in .NET
CO4: Learn web based applications on .NET(ASP.NET)

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓			✓	✓			
CO3	✓	✓		✓	✓		✓	✓	✓
CO4	✓		✓		✓	✓			✓

Course Contents:
Module-1: Concepts of networking, Web and HTML. Introduction with Web, Network, Website, Server, Client side, Server side and other terms related to basic website designing concept. Introduction with HTML language.
Module-2: Introduction with .net. Introduction of Microsoft .net, Explain features and phases of the object oriented approach. (C#) Basic Syntax, Reading and writing to a console, Data Types, Type Conversion, Variables, Constants.
Module-3: SQL Server, Introduction with SQL Server, Role of a Database Server, SQL language, Working With Database (Table concepts), SQL query (Data Definition Language, Data Manipulation Language, Data Control Language).
Module-4: Database Integration in ASP.NET Connectivity between web pages and data base with the help of Internal and external data source.

Module-5: Hands on C# language. Introduction of C# and programing basic of C#, Programs on different problems in C#. Introduction with core PHP, Core PHP introduction and programming concepts. Quick start with PHP programs. Database Integration in PHP.

Text Books
1. Learning Web Design, Book by Jennifer Niederst Robbins
2. NET 4.5 Programming Black Book, Kogent learning solutions inc.
3. Professional PHP 6, Publisher: Wiley

References
1. Desktop PC with minimum of 166 MHZ or faster processor with at least 1 GB RAM and 160 GB disk.
2. Visual studio 2012, Microsoft sql server 2008 R2.

TITLE OF COURSE: WEB DEVELOPMENT WITH ASP.NET LAB
COURSE CODE: BCA495
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in HTML, CSS, and Other programming knowledge.

Introduction:

To learn and understand Web design. It is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, color, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site.

Course Outcomes (CO):
CO1: Apply critical thinking and problem solving skills required to successfully design and implement a web site.
CO2: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.
CO3: Apply critical thinking and problem solving skills required to successfully design and implement a web site.
CO4: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.
CO5: Demonstrate knowledge of artistic and design components that are used in the creation of a web site.
CO6: Utilize and apply the technical, ethical and interpersonal skills needed to function in a cooperative environment.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓		✓	✓	✓
CO2	✓	✓			✓	✓			✓
CO3	✓	✓		✓			✓	✓	✓
CO4	✓		✓		✓				✓
CO5	✓			✓	✓	✓		✓	✓
CO6	✓	✓	✓		✓	✓			✓

Detailed Syllabus for Bachelor of Computer Application

Course Contents:

1. Concepts of networking, Web and HTML. Introduction with Web, Network, Website, Server, Client side, Server side and other terms related to basic website designing concept. Introduction with HTML language.
2. Introduction with .net. Introduction of Microsoft .net, Explain features and phases of the object-oriented approach. (C#) Basic Syntax, Reading and writing to a console, Data Types, Type Conversion, Variables, Constants.
3. SQL Server, Introduction with SQL Server, Role of a Database Server, SQL language, Working With Database (Table concepts), SQL query (Data Definition Language, Data Manipulation Language, Data Control Language)
4. Database Integration in ASP.NET Connectivity between web pages and data base with the help of Internal and external data source.

Exercises that must be done in this course are listed below:

Exercise No.1: Create a form in HTML for entering value for some specific fields. (Registration Page)

Exercise No.2: Create table in SQL for storing data of registration page. (Using sql query) Exercise No.3: Create a webpage to show the data which is entered in sql tables through registration page.

Exercise No. 4: Create a web page to file upload option, so user can upload document on web.

Exercise No. 5: Create a webpage to show the uploaded document.

Exercise No. 6: assemble all the web page to create a website for a specific organization. (Minor project).

Exercise No. 7: Create master page for previous developed pages.

Exercise No. 8: Apply validators for all fields which are used in previous developed pages.

Exercise No. 9: Major project.

Text Book:

1. Learning Web Design, Book by Jennifer Niederst Robbins
2. NET 4.5 Programming Black Book, Kogent learning solutions inc.

Recommended Systems/Software Requirements:

1. Desktop PC with minimum of 166 MHZ or faster processor with at least 1 GB RAM and 160 GB disk
2. Visual studio 2012, Microsoft sql server 2008 R2

TITLE OF COURSE: DISCREATE MATHEMATICS
COURSE CODE: BCA416
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: The readers are expected to have a reasonably good understanding of elementary algebra and arithmetic

Introduction:

To develop logical thinking and its application to computer science (to emphasize the importance of proving statements correctly and de-emphasize the hand-waving approach towards correctness of an argument). The subject enhances one's ability to reason and ability to present a coherent and mathematically accurate argument.

Course Outcomes (CO):

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

CO1: Write an argument using logical notation and determine if the argument is or is not valid.
CO2: Demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described.
CO3: Understand the basic principles of sets and operations in sets.
CO4: Prove basic set equalities.
CO5: Apply counting principles to determine probabilities.
CO6: Demonstrate an understanding of relations and functions and be able to determine their properties.
CO7: Demonstrate different traversal methods for trees and graphs.
CO8: Model problems in Computer Science using graphs and trees.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				✓
CO2	✓	✓	✓	✓					✓
CO3	✓			✓					✓
CO4	✓			✓					
CO5				✓					✓
CO6				✓					✓
CO7		✓	✓		✓			✓	
CO8		✓	✓		✓				

Course Contents:
Module 1: Sets and Counting Techniques
Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic. Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination, Disjunctive and Conjunctive Normal Form.
Module 2: Propositional Logic
Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by conditional.
Module 3: Algebraic Structures and Morphism
Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation

Module 4: Advanced Algebraic Structure and Boolean Algebra
Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function.
Module 5: Graphs and Trees

Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, chromatic number, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distance methods.

Text Books
1. Satya narayana & shyam Prasad: discrete mathematics and graph theory, PHI
2. Kishor shinde: Discrete Structure, Everest publishing house
3. Hari Parihar&Ritu Agarwal, discrete mathematical structures, ashirwad

TITLE OF COURSE: COMPUTER GRAPHICS & MULTIMEDIA TECHNOLOGY
COURSE CODE: BCA417
L-T-P: 3-0-2
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and basic mathematics.

Introduction:
Computer Graphics course presents an introduction to computer graphics designed to give the student an overview of fundamental principles. It covers the fundamental concepts in creating graphical images on the computer. Computer graphics uses ideas from Art, Mathematics, and Computer Science to create images. Course work stresses the reduction of concepts to practice in the form of numerous programming assignments. The course will include an overview of common graphics hardware, 2D and 3D transformations and viewing, and basic raster graphics concepts such as scan-conversion and clipping. Methods for modeling objects as polygonal meshes or smooth surfaces, and as rendering such as hidden-surface removal, shading, illumination, and shadows will be investigated.
Multimedia course provides mainstreaming the technological media within what is called "Multimedia" is the pattern which led to infinite applications of computer technologies. The concept of this technology came into being with the appearance of sound cards, then compact disks, then came the use of digital camera, then the video which made computer an essential educational tool. Nowadays, multimedia expanded to become a field on its own.

Course Outcomes (CO):
After completion of the course, students will able:
CO1: To know and be able to understand the core concepts of computer graphics.
CO2: To know and be capable of using OpenGL to create interactive computer graphics.
CO3: To know and be able to understand a typical graphics pipeline.
CO4: To know and be able to make interactive graphics applications in C++ using one or more graphics application programming interfaces.
CO5: To know and be able to demonstrate an understanding of the use of object hierarchy in graphics applications.
CO6: To know and be able to write program functions to implement visibility detection.
CO7: To know and be able to make pictures with their computer.
CO8: To know and be able to describe the general software architecture of programs that use 3D computer graphics
CO9: To know the pictorial representation of various points in an image

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓			✓				✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓
CO4	✓		✓		✓	✓		✓	✓
CO5	✓	✓		✓	✓	✓	✓	✓	
CO6	✓				✓				
CO7				✓	✓		✓		
CO8					✓		✓	✓	
CO9				✓	✓	✓			

Course Contents:

Module-1: **Introduction to computer graphics & graphics systems**

Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.

Scan conversion

Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module-2: **2D transformation & viewing**

Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines , parallel lines, intersecting lines. Viewing pipeline, Window to viewport co- ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.

3D transformation & viewing

3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing

Module-3: Curves

Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves. Hidden surfaces, Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry. Color & shading models Light
& color model; interpolative shading model; Texture.

Module-4: Multimedia

Introduction to Multimedia: Concepts, uses of multimedia, hypertext and hypermedia; Image, video and audio standards. Audio: digital audio, MIDI, processing sound, sampling, compression. Video: MPEG compression standards, compression through spatial and temporal redundancy, inter-frame and intra-frame compression. Animation: types, techniques, key frame animation, utility, morphing. Virtual Reality concepts.

Text Books
1. Hearn, Baker – " Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH

3. D. F. Rogers, J. A. Adams – " Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI
5. Sanhker, Multimedia –A Practical Approach, Jaico

References
1. Buford J. K. – "Multimedia Systems" – Pearson Education
2. Andleigh & Thakrar, Multimedia, PHI
3. Mukherjee Arup, Introduction to Computer Graphics, Vikas
4. Hill,Computer Graphics using open GL, Pearson Education

TITLE OF COURSE: COMPUTER GRAPHICS & MULTIMEDIA TECHNOLOGY LAB
COURSE CODE: BCA497
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and basic mathematics.

Introduction:

This course presents an introduction to computer graphics designed to give the student an overview of fundamental principles. It covers the fundamental concepts in creating graphical images on the computer. Computer graphics uses ideas from Art, Mathematics, and Computer Science to create images. Course work stresses the reduction of concepts to practice in the form of numerous programming assignments. The course will include an overview of common graphics hardware, 2D and 3D transformations and viewing, and basic raster graphics concepts such as scan-conversion and clipping. Methods for modeling objects as polygonal meshes or smooth surfaces, and as rendering such as hidden-surface removal, shading, illumination, and shadows will be investigated.

Course Outcomes (CO):
After completion of the course, students will able:
CO1: To know and be able to understand the core concepts of computer graphics.
CO2: To know and be capable of using OpenGL to create interactive computer graphics.
CO3: To know and be able to understand a typical graphics pipeline.
CO4: To know and be able to make interactive graphics applications in C++ using one or more graphics application programming interfaces.
CO5: To know and be able to demonstrate an understanding of the use of object hierarchy in graphics applications.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓						
CO3	✓	✓	✓	✓	✓	✓	✓		✓
CO4	✓		✓		✓			✓	✓
CO5	✓	✓			✓	✓	✓	✓	

Detailed Syllabus for Bachelor of Computer Application

Course Contents:
Experiments:

1. Study of basic graphics functions defined in "graphics.h"
2. Write a program to draw a any geometrical figure.
3. Write a program to draw a line using Bresenham's algorithm
4. Write a program to draw a line using DDA algorithm
5. Write a program to draw a line using Mid point algorithm
6. Write a program to draw a circle using Midpoint algorithm
7. Write a program to draw a Ellipse using Midpoint algorithm

Recommended Systems/Software Requirements:
1. Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.
2. Turbo C or TC3 complier in Windows XP or Linux Operating System.

Text Books

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" TMH
4. Sanhker, Multimedia –A Practical Approach, Jaico

References
1. Buford J. K. – "Multimedia Systems" – Pearson Education
2. Andleigh & Thakrar, Multimedia, PHI
3. Mukherjee Arup, Introduction to Computer Graphics, Vikas
4. Hill,Computer Graphics using open GL, Pearson Education

TITLE OF COURSE: ESP & SDP-IV
COURSE CODE: BGSC404
L-T-P: 2-0-1
CREDITS: 2

Pre-requisite: Basic concepts in mathematics and economics.

Introduction:
This course examines Taxes in India and market structure. The Topics to be covered (tentatively) include: National income, Market structure, Science & Technology, Logical Reasoning.
Course Outcomes (CO):
In this course we will study the basic components of upcoming Science & technology. Students are expected to be capable of understanding the Indian Tax system, their advantages and drawbacks, how to implement in Indian Economy, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Know about many books and authors.
CO2: Gain knowledge about important dances & festivals of Indian states.
CO3: Understand the values of Important about banks like payment banks, small banks & license system.
CO4: Know about many learning techniques.
CO5: Know about different short cut techniques to solve any kind of aptitudes.
CO6: Know about different short cut techniques to solve any kind of reasoning.
CO7: Know about different short cut techniques to solve any kind of communicating problems.
CO8: Know about different short cut techniques to solve any kind of societal problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓	✓	✓		✓		✓	✓	
CO6	✓			✓			✓	✓	
CO7	✓	✓	✓	✓			✓	✓	
CO8	✓	✓	✓	✓			✓	✓	

Course Contents:

Section A: Employment Enhancement Skills-IV

Module-1: GK & CA, Modern History& National Movement. Indian Geography at a glance (Physical, Regional & Economic)

Tax: Concept of TAX, objective of TAX, Direct & Indirect Tax, Progressive, Regressive & Proportional tax.

Module-2: Calendar etc. capitals of countries, currency of countries, important dates, Sports football, hockey etc. recent events & awards too.

Module-3: Important books & authors, Important Hydropower dams, atomic power plant s, important national parks, Minster & portfolio & constituencies, Population census, Persons in news - most famous, popular recent only,

Module-5: Important dances & festivals of Indian states, International Head Quarters & world organization, important president & pm elected from various countries

Module-6: Important about banks like payment banks, small banks & license system, Awards, Sports, Books & author, National & International affairs.

Section B: Skill Development for Professional – IV
Module-1: Quantitative Aptitude: Permutation & Combination. Probability- basic concepts of probability, different theorems & applications, binomial, poison & normal Distributions. Geometry- Concept of different shapes like triangle, quadrilateral, rectangle, square, circle etc. different theorems & their applications. Mensuration- Formulae on triangles, square, Rhombus, parallelogram, sphere, circle, cone, pyramid etc. Application based problem solving. Coordinate Geometry- Locus, Straight lines, Circle etc

Module-2: Reasoning:

Puzzles: Seating Arrangement

      a) Circular seating arrangement

      b) Square seating Arrangement

      c) Line Arrangement, Calendar and Clock, Miscellaneous Problems

Sentence: a) Sentence Corrections b) Fill the blanks with appropriate words/articles/ preposition/ verbs/adverbs/conjunction. **d**) Reading Comprehension (Advance Level) d) Vocabulary

Logical Reasoning: Alphanumeric series, Analogies, Artificial Language, Blood Relations, Calendars, Cause and Effect, Clocks, Coding-Decoding, Critical path, Cubes and cuboids. Data Sufficiency, Decision Making, Deductive Reasoning/Statement Analysis, Dices, Directions Embedded Images, Figure Matrix, Input-Output, Mirror and Water Images, Odd One Out, Picture Series and Sequences, Paper Folding, Puzzles, Pattern Series and Sequences, Order & Ranking, Seating Arrangements, Shape Construction, Statement and Assumptions, Statement and Conclusions, Syllogism

Module-4: Advanced Data Interpretation level-IV

Newspaper reading: The Hindu & Economic Times

Text Books

1. The Oxford Handbook of Tax System in India: An Analysis of Tax Policy and Governance (Oxford Handbooks) by Mahesh C. Purohit, Vishnu Kanta Purohit
2. Taxation of Income From Non Resident Indian under Direct Tax Law - 2019 Edition by Ram Dutt Sharma

References

1. Marketing Management | marketing cases in the Indian context | Fifteenth Edition | By Pearson by Philip Kotler, Keven Lane Keller
2. A Modern Approach to Logical Reasoning, by R.S. Aggarwal

Fifth Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	BCA518	IT & Software Testing	3	0	0	0	3
2.	CC	BCA519	Network Programming and Administration	3	0	2	0	4
3.	CC	BCA520	Management Information System	3	0	0	0	3
4.	CC	BCA521	Web Programming with PHP	3	0	2	0	4
5.	PE/SE	----	Professional/Specialization Elective-II	3	0	0	2	3
6.	PE/SE	----	Professional/Specialization Elective-III	3	0	0	2	3
7.	GSC	BGSC505	ESP & SDP-V	2	0	0	1	2
8.	PTI	INT503	Industrial Training/Project-III	0	0	0	1	1
			Total	20	0	4	6	23/30

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: IT & SOFTWARE TESTING
COURSE CODE: BCA518
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Familiarity with system design and analysis (SAD), software engineering and Internet technology

Introduction:
This course presents a comprehensive study of software testing and quality control concepts, principles, methodologies, management strategies and techniques. The emphasis is here on understanding software testing process, planning strategy, criteria, and testing methods, as well as software quality assurance concepts & control process.

Course Outcomes (CO):
The Objective of this course is to enable a clear understanding and knowledge of the foundations, techniques, and tools in the area of software testing and its practice in the industry. The course will prepare students to be leaders in software testing. Whether you are a developer or a tester, you must test software. We can learn strengths and weaknesses of a variety of software testing techniques. To reach this goal, the following objectives need to be met:
CO1: After completion of this course the student will be able to plan, develop, and execute an automated test plan.
CO2: To understand fundamentals of software testing and testing techniques.
CO3: To acquire knowledge on software quality management.
CO4: Understand basic concepts and terminology of internet technology.
CO5: Have a basic understanding of HTML, XML, CSS, and WWW.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓		✓		✓	✓
CO2	✓	✓	✓					✓	✓
CO3	✓	✓		✓	✓		✓		✓
CO4	✓								✓
CO5	✓	✓	✓			✓			✓

Course Contents:

Module 1: Introduction: purpose of testing, Causes Of software defects, Testing and Quality, Priority of tests, Testing vs Debugging, Types of bugs.
Module 2: Software development models, Testing and design style, Verification and validation, Test levels-Unit testing, integration testing, system testing, acceptance testing; Functional testing, non-functional testing, Retesting, Regression Testing, Maintenance Testing
Module 3: Static testing techniques, Review process, Types of review, Static analysis, Data flow analysis, Control flow analysis, Domain testing
Module 4: Test conditions and design of test cases, Black box testing, Decision table testing, State transition analysis, Use case testing, White box testing, Statement testing and coverage, Decision coverage, Exploratory testing
Module 5: Test organization (testers, test leaders, test team), Test planning, Exit criteria, Test estimation,

Test approaches, Test metrics, Test reporting

Module 6: Types of test tools, Test management tools, Incident management tools, Static and dynamic test tools, Test harness, Test comparator, Test execution and logging tools, Performance/load/stress testing tools, Benefits of using test tools

Module 7: Introduction of IT: World Wide Web(WWW), HTML, XML, CSS.

Text Books

1. B. Beizer , 2003, Software Testing Techniques, II Edn., DreamTech India, New Delhi.
2. K.V.KK. Prasad, 2005, Software Testing Tools, DreamTech. India, New Delhi.
3. Software testing techniques –Baris Beizerm Dreamtech, Second edition. 2
4. Software Testing Tools – Dr. K.V.K.K. Prasad, Dreamtech.
5. Software Testing Principles and Practices by Naresh Chauhan, Oxford University Press
6. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Chapters 1-5, 7, 8, 9).

Reference Books

1 I. Burnstein, 2003, Practical Software Testing, Springer International Edn.
2. E. Kit, 1995, Software Testing in the Real World: Improving the Process, Pearson Education, Delhi.
3. R.Rajani, and P.P.Oak, 2004, Software Testing, Tata Mcgraw Hill, New Delhi.

TITLE OF COURSE: NETWORK PROGRAMMING & SYSTEM ADMINISTRATION
COURSE CODE: BCA519
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and computer architecture.

Introduction:
This course introduces computer network programming involves writing computer programs that enable processes to communicate with each other across a computer network.

Course Outcomes (CO):

This course will serve to broaden the student's understanding of the issues and latest developments in the area of Network Programming. To reach this goal, the following objectives need to be met:

CO1: To master the terminology and concepts of the OSI reference model and the TCP-IP reference model.

CO2: To master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks,

CO3: To be familiar with wireless networking concepts,

CO4: To be familiar with contemporary issues in networking technologies,

CO5: To be familiar with network tools and network programming

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓			✓	✓

CO2	✓	✓	✓	✓	✓			✓	✓
CO3	✓					✓		✓	✓
CO4	✓	✓	✓				✓		✓
CO5	✓		✓			✓		✓	✓

Course Contents:

Module-1: History / OSI model; Unix commands, High level UDP and TCP/IP; UDP sockets, tftp; Sorcerer's Apprentice

Module-2: Linux basics, C system calls, fork, Signals, Byte ordering, misc. inet functions

Module-3: TCP sockets (SOCK_STREAM); Client / server model; Daemons, Fall 2018 Career Fair - lecture canceled

Module-4: select (I/O Multiplexing); Bonjour (Zeroconf) / Service Discovery, TCP 3 Way Handshake, TCP States, TCP Close, Non-Blocking I/O, TCP congestion control, ACK, windows, ECN

Module-5: Threads, Application Layer Protocols; Telnet; FTP, IRC,

Module-6: Broadcasting, IPv4/IPv6 addressing, DNS, gethost*(), nslookup, Bit Torrent/ DHT / P2P

Module-7: Socket Options, Out of Band Sockets

Module-8: HTTP,Security Basics, Security Basics II

Module-9: SSL, RPISEC Guest Lecture

Module-10: gRPC, IPFS / QUIC, SDNs/ OpenFlow / Mininet, Buffer Bloat

Text Books

1. The Practice of System and Network Administration, Second Edition Thomas A. Limoncelli, Christina J. Hogan , Strata R. Chalup

References

1. Advanced Linux Networking, Roderick W. Smith, Addison-Wesley Professional (Pearson Edu).
2. Linux Network Administrator's Guide, Tony Bautts, Terry Dawson, Gregor N. Purdy, O'Reilly, Third Edition, 2005

TITLE OF COURSE: NETWORK PROGRAMMING & SYSTEM ADMINISTRATION LAB
COURSE CODE: BCA599
L-T-P: 0-0-2
CREDITS: 1

Prerequisite: Students must have already registered for the course, basic computation, linux.

Introduction:

This course provides an intensely practical introduction to basic Unix Systems Management, which involves both administration and programming. The Linux Operating System will be used extensively throughout this course for lecture/tutorial examples and importantly during laboratory classes. In addition to system administration, TCP/IP network service administration and the use of scripting languages will be introduced.

Course Outcomes (CO):

This course is an option course so it is not required to contribute to the development of program learning outcomes (PLOs) though it may assist your achievement of several PLOs.

This course will serve to broaden the student's understanding of the issues and latest developments in the area of Network Programming.

CO1: To master the terminology and concepts of the OSI reference model and TCP-IP reference model.

CO2: To master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks,

CO3: To be familiar with wireless networking concepts

CO4: To be familiar with contemporary issues in networking technologies

CO5: To be familiar with network tools and network programming

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓						✓	✓	✓
CO2	✓			✓			✓	✓	✓
CO3	✓	✓		✓					✓
CO4	✓					✓	✓		✓
CO5	✓	✓							✓

Course Contents:
Module-1: Server/Client Installation over VMware Environment
Module-1: Packet Analysis by using TCPDUMP and WIRESHARK
Module-2: Network Practice with Packet Tracer
Module-3: System Administration: User/Group management, File System Management ….
Module-4: Network Configuration: Start/Stop network Service, network interface configuration
Module-5: Firewall Configuration
Module-6: DNS and DHCP Configuration and Troubleshooting
Module-7: Web and Proxy Server Configuration and Troubleshooting
Module-8: Basic Mail Server Configuration and Troubleshooting
Module-9: SAMBA, NFS, CUPS and FTP configuration and Troubleshooting
Module-10: Webmin/SSH configuration

Text Books

1. The Practice of System and Network Administration, Second Edition Thomas A. Limoncelli, Christina J. Hogan , Strata R. Chalup
2. Advanced Linux Networking, Roderick W. Smith, Addison-Wesley Professional (Pearson Edu), 2002.
3. Linux Network Administrator's Guide, Tony Bautts, Terry Dawson, Gregor N. Purdy, O'Reilly, Third Edition, 2005

TITLE OF COURSE: MANAGEMENT INFORMATION SYSTEM
COURSE CODE: BCA520
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in connection between information systems (IS) and business performance**.**

Introduction:

The use of information and communication technologies (ICT) by individuals and organizations dominates the business world. There is a fundamental change going on in the way that organizations run businesses and interact with each other. New types of infrastructure and applications are developed and utilized such as ERP (enterprise resource planning), IOS (inter- organizational systems), RFID (radio frequency identification), CRM (customer relationship management), to name a few.The aim of the course is to enable students to assess the opportModuleies and problems that managers in a wide range of organizations face as they attempt to use these IT applications to add value to their businesses. It also aims to help students understand transformational changes within and across industries. These changes have strategic implications for many businesses

Course Outcomes (CO):

This course will serve a fundamental change going on in the way that organizations run business and interact with each other:

At the end of the course, you will be able to:
CO1: Explain basic concepts for IT/IS management
CO2: Discuss organizational, business and strategic issues surrounding IT/IS.
CO3: Analyze and evaluate uses of strategic IT/IS in practice.
CO4: Understand and articulate fundamental concepts of information technology management.
CO5: Assess and apply IT to solve common business problems.
CO6: Suggest and defend effective solutions to business problems, and design a database application to solve a business problem.
CO7: Discuss the ethical aspects of information technology use in the organization and its governance issues.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✔						✔	✔	✔
CO2	✔			✔			✔	✔	✔
CO3	✔	✔		✔					✔
CO4	✔					✔	✔		✔
CO5	✔	✔							✔
CO6	✔		✔		✔				✔

CO7	✓		✓			✓		✓	✓

Course Contents:

Module-1 Management Information System (MIS): Definition, Characteristics, Subsystems of MIS (Activity and Functional subsystems), Structure of MIS; Reasons for failure of MIS. Understanding Major Functional Systems: Marketing & Sales Systems, Finance & Accounting Systems, Manufacturing & Production Systems, Human Resource Systems, Inventory Systems; their sub systems, description and organizational levels.

Module-2: Decision Support Systems (DSS): Definition, Relationship with MIS, Evolution of DSS, Characteristics, classification, objectives, components, applications of DSS.

Module-3: ERP, CRM, SCM:

ERP (Enterprise Resource Planning):

a) Concepts of ERP, architecture of ERP, Generic modules of ERP, Applications of ERP, andconcept of XRP (extended ERP)

b) Features of commercial software like SAP, Oracle Apps, MS Dynamics NAV, People soft.

CRM (Customer Relationship Management)

a) Concepts of CRM, Features of CRM (acquisition and retention)

b) Features of commercial software like I2-Rhythm, SIEBEL

SCM (supply Chain Management):

a) Concepts of SCM, drivers of SCM, inbound & outbound

b) Definition, brief description and applicability of: e-Procurement, e-Tailing, e-Logistics, e collaboration, e-integration.

c) Case studies for ERP, CRM, SCM

Module-4: Database Management Systems (DBMS) [e.g. MS-Access/ Oracle/ MS SQL Server / My SQL etc.]

a) What is a DBMS. Need for using DBMS. Concepts of tables, records, attributes, keys, integrity constraints, 3-schema architecture, data independence.

b) SQL: DDL & DML concepts, SQL commands [ANSI standard].

Module-5:Organization and Computer Networks

Introduction, Basics of computer systems, Basic Network Terminologies, Definitions and Application, The Intranet and the Extranet.

Module-6: Data Warehousing and Data Mining

Concepts of Data warehousing, data mart, meta data, multidimensional modeling, Online Analytical Processing (OLAP), Online Transaction Processing (OLTP), Knowledge Management System (KMS), Active Knowledge Management Server (AKMS) Features of commercial software like Informatics Data mining concepts, knowledge discovery v. data mining, data mining applications. Case studies on data warehousing / data mining.

Text Books

1. Dan W. Paterson, Introduction to Artificial Intelligence & Expert System, PHI./Pearson Education.
2. Davis & Olson, Management Information System, Tata McGraw Hill
3. Kroenke, D. M., Gemino, A., & Tingling, P. (201 6). *Experiencing MIS* (4th Canadian Edition). Toronto: Pearson. ISBN-13: 9780134078434

References

1. ISRD, Introduction to Database Management Systems, Tata McGraw Hill
3. Leon : ERP, Leon Tech Press
4. Loney & Koch: The Oracle 9i Complete Reference, Oracle Press
5. Mahadeo Jaiswal & Monica Mittal : Management Information Systems, OUP

TITLE OF COURSE: WEB PROGRAMMING WITH PHP
COURSE CODE: BCA521
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Knowledge is also assumed of basic concepts in computer networks and programming languages.

Introduction:
This course will enable students to
1. Illustrate the Semantic Structure of HTML and CSS
2. Compose forms and tables using HTML and CSS
3. Design Client-Side programs using JavaScript and Server-Side programs using PHP
4. Infer Object Oriented Programming capabilities of PHP
5. Examine JavaScript frameworks such as jQuery and Backbone

Course Outcomes (CO):
After studying this course, students will be able to

CO1: Adapt HTML and CSS syntax and semantics to build web pages.
CO2: Construct and visually format tables and forms using HTML and CSS.
CO3: Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generateand display the contents dynamically.
CO4: Appraise the principles of object oriented development using PHP.
CO5: Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer tofocus on core features.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✔		✔						✔
CO2	✔				✔		✔		✔
CO3	✔	✔		✔				✔	✔
CO4	✔		✔			✔			✔
CO5	✔		✔	✔	✔		✔	✔	✔

Course Contents:
Module 1: Introduction to HTML, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

Module 2: HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout,

Responsive Design, CSS Frameworks.

Module 3: JavaScript: Client-Side Scripting, JavaScript Design Principles, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions

Module 4: PHP Arrays and Super globals, Arrays, $_GET and $_POST Super global Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object- Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, Errors and Exceptions, PHP Error Reporting, PHP Error and Exception Handling

Module 5: Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, HTML5 Web Storage, Caching, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation, Backbone MVC Frameworks, XML Processing and Web Services, XML Processing, JSON, Overview of Web Services.

Text Books

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1stEdition, Pearson Education India.

References

1. Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", 4thEdition, O'Reilly Publications, 2015. (ISBN:978-9352130153)
2. Luke Welling, Laura Thomson, "PHP and MySQL Web Development", 5th Edition, Pearson Education, 2016. (ISBN:978-9332582736)
3. Nicholas C Zakas, "Professional JavaScript for Web Developers", 3rd Edition, Wrox/Wiley India 2012. (ISBN:978-8126535088)
4. David Sawyer Mcfarland, "JavaScript & jQuery: The Missing Manual", 1st Edition O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 2014 (ISBN:978-9351108078)
5. Zak Ruvalcaba Anne Boehm, "Murach's HTML5 and CSS3", 3rdEdition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016.

TITLE OF COURSE: WEB PROGRAMMING WITH PHP LAB
COURSE CODE: BCA591
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is assumed of basic concepts in computer networks and programming languages.

Introduction:
To learn and understand Web design. It is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, color, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site.

Course Outcomes (CO):
CO1: Apply critical thinking and problem solving skills required to successfully design and implement a web site.

CO2: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.

CO3: Apply critical thinking and problem solving skills required to successfully design and implement a web site.

CO4: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.

CO5: Demonstrate knowledge of artistic and design components that are used in the creation of a web site.

CO6: Utilize and apply the technical, ethical and interpersonal skills needed to function in a cooperative environment.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✔		✔						✔
CO2	✔				✔		✔		✔
CO3	✔	✔		✔				✔	✔
CO4	✔		✔			✔			✔
CO5	✔		✔	✔	✔		✔		✔
CO6	✔			✔	✔		✔	✔	✔

Course Contents:

1. Concepts of networking, Web and HTML. Introduction with Web, Network, Website, Server, Client side, Server side and other terms related to basic website designing concept. Introduction with HTML language.
2. Introduction with .net. Introduction of Microsoft .net, Explain features and phases of the object-oriented approach. (C#) Basic Syntax, Reading and writing to a console, Data Types, Type Conversion, Variables, Constants.
3. SQL Server, Introduction with SQL Server, Role of a Database Server, SQL language, Working with Database (Table concepts), SQL query (Data Definition Language, Data Manipulation Language, Data Control Language)
4. Hands on C# language. Introduction of C# and programing basic of C#, Programs on different problems in C#. Introduction with core PHP, Core PHP introduction and programing concepts. Quick start with PHP programs. Database Integration in PHP.

Exercises that must be done in this course are listed below:

Exercise No.1: Create a form in HTML for entering value for some specific fields. (Registration Page)

Exercise No.2: Create table in SQL for storing data of registration page. (Using sql query)

Exercise No.3: Create a webpage to show the data which is entered in sql tables through registration page.

Exercise No. 4: Create a web page to file upload option, so user can upload document on website.

Exercise No. 5: Create a webpage to show the uploaded document.

Exercise No. 6: assemble all the web page to create a website for a specific organization. (Minor project).

Exercise No. 7: Create master page for previous developed pages.

Exercise No. 8: Apply validators for all fields which are used in previous developed pages.
Exercise No. 9: Major project.

Text Book:
1. Learning Web Design, Book by Jennifer Niederst Robbins
2. Professional PHP 6, **Publisher:** Wiley

Recommended Systems/Software Requirements:
Desktop PC with minimum of 166 MHZ or faster processor with at least 1 GB RAM and160 GB disk space. Visual studio 2012, Microsoft sql server 2008 R2

TITLE OF COURSE: ESP & SDP-V
COURSE CODE: BGSC505
L-T-P: 2-0-1
CREDITS: 2

Pre-requisite: Basic concepts in mathematics and English Language.
Introduction:
This course examines basic English language and math. The Topics to be covered (tentatively): The course is on Competitive exam preparation, logical reasoning, English sentence correction, English, Grammar correction, basic arithmetic, Vocabulary, Verbal Reasoning.

Course Outcomes (CO):
In this course we will study the basic components of math and English language. Students are expected to be capable of understanding the better communication, their advantages and drawbacks, how to implement them in daily life, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to know Competitive exam preparation.
CO2: Students would be able to implement verbal and non-verbal communication.
CO3: By analyzing the logic of any arithmetic structure able to solve problem.
CO4: To become an efficient math and English language.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Section A: Employment Enhancement Skills-V
Stream wise Competitive Exam Preparation

Module-1: Programming in C.

Module-2: Programming and Data Structures

Module-3: Digital Logic Design

Module-4: Operating System

Module-5: Database Management Systems

Section B: Skill Development for Professional-V

Module-1: Vocabulary: Vocabulary questions test the candidate's knowledge in English like primary meanings of words, idioms, and phrases, secondary shades of meaning, usage, associated words, antonyms, etc.

Module-2: Grammar: Grammar-based questions test the candidate's capability to mark and correct grammatical errors. Prepositions use of modifiers, subject-verb agreement, parallel construction, phrasal verbs, redundancy, etc.

Module-3: Verbal Reasoning: Verbal Reasoning questions are designed to test the candidate's potential to identify relationships or patterns within sentences or a group of words.

Module-4: Inequalities, Coding – Decoding, Syllogisms, Ranking/ Ordering, Blood Relations, Directions, Input-Output, Seating Arrangement, Puzzles , Decision Making, Analogy, Odd-Man out, Word Formation, Digit Sequence, Critical Reasoning, Statements & Assumptions, Statement & Conclusion, Strong Argument & Weak Arguments.

Learning Materials:

1. Fastrack objective Arithmetic: Arihant
2. Quantitative aptitude for Competitive exam (4th Edition): TATA Mc Graw Hill
3. Quantitative aptitude for Competitive exam (3rd Edition): PEARSON
4. Engineering mathematics-Pearson

Sixth Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	BCA622	Software Project Management	3	0	2	0	4
2.	HSM	HSM604	Human Resource Development and Organizational Behavior	3	0	0	0	3
3.	PE/SE	----	Professional/Specialization Elective-IV	3	0	0	2	3
4.	GSC	BGSC606	ESP & SDP-VI	2	0	0	1	2
5.	PTI	INT604	Industrial Training/Project-IV	0	0	0	1	1
6.	CC	CSC681	Grand Viva	0	0	0	0	2
			Total	11	0	2	6	15/19

Students can opt any Professional Track/Specialization from the following table from 4th Semester onwards:

Specialization Specific Course:

Subject Code	Big Data Analytics	Subject Code	Data Science
BDA401	Fundamental of Big Data Analytics	DS401	Data Mining & Data Ware Housing
BDA502	Big Data Modeling & Management	DS502	Fundamental of Data Analysis
BDA503	Big Data Integration & Modeling	DS503	Data Science with Python
BDA504	Machine Learning With Big Data	DS504	Data Visualization
BDA605	Managing Big Data with SQL	DS605	Data Scientist's Tool Box

Specialization Specific Course:

Subject Code	Cloud Computing	Subject Code	Block Chain
CC401	Introduction Cloud Computing	BC401	Blockchain Technology
CC502	Introduction to Cloud Security	BC502	Blockchain Component & Architecture
CC503	Cloud Adaptation and Migration	BC503	Transaction on Block Chain
CC504	Cloud Architecture & Development Model	BC504	Block Chain Opportunity Analysis
CC605	AWS Fundamental	BC605	Bit Coin and Crypto Currency

Specialization Specific Course:

Subject Code	Artificial Intelligence & Machine Learning	Subject Code	Cyber Forensics & Internet Security
AIML401	Introduction to Artificial Intelligence	IS401	Introduction to Cryptography
AIML502	Machine Learning Techniques	IS502	Introduction to Cyber Security
AIML503	Computer Vision	IS503	Digital Forensics
AIML504	Application of ML in Industries	IS504	Cyber Laws & IPR
AIML605	Recommended System	IS605	Intrusion Detection and Prevention System
AIML606	Human Computer Interaction	IS606	Ethical Hacking

Detailed Syllabus for Bachelor of Computer Application

TITLE OF COURSE: SOFTWARE PROJECT MANAGEMENT
COURSE CODE: BCA622
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Basic knowledge of Software Engineering and Software Project Management.
Introduction: This course is strongly suggested for any student planning to take an internship in Computer Science. After an overview of the phases of the software lifecycle, current methodologies, tools, and techniques being applied to each phase will be discussed in depth with localized exercises given to reinforce learning of concepts.

Introduction: This course is strongly suggested for any student planning to take an internship in Computer Science. After an overview of the phases of the software lifecycle, current methodologies, tools, and techniques being applied to each phase will be discussed in depth with localized exercises given to reinforce learning of concepts.

Course Outcomes: This course will serve to broaden the student's understanding of the issues and latest developments in the area of software development and maintenance. To reach this goal, the following objectives need to be met:
CO1: Describe software process maturity framework.
CO2: Explain conventional software management and software economics.
CO3: Discuss software projects and project planning.
CO4: Analyze project tracking and control.
CO5: Assess the role of project closure analysis.
CO6: Successful Projects - What they have in common
CO7: Teams - Effective management and how to be an effective member
CO8: Risks - What are they and how they can affect a project?
CO9: Plan-Driven process and methodologies, including classic and agile methodologies
CO10: Process - Choosing and adapting to the project
CO11: Estimation and Scheduling - How to get it right, and what can happen if you don't
CO12: beyond the initial project - Product evolution, process improvement, and quality frameworks.

Mapping of Course Outcomes (CO) and Program Outcomes (PO)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓		✓		✓
CO2	✓			✓				✓	✓
CO3	✓	✓							✓
CO4	✓						✓		
CO5	✓						✓		
CO6	✓			✓					✓
CO7	✓							✓	
CO8	✓		✓			✓			
CO9	✓								

Detailed Syllabus for Bachelor of Computer Application

CO10	✓				✓		✓		✓
CO11	✓								
CO12	✓		✓					✓	

Course Contents:
Module-1: Project Evaluation And Project Planning: Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.
Module-2: Project Life Cycle and Effort Estimation: Software process and Process Models, Choice of Process models, mental delivery, Rapid Application development, Agile methods, Extreme Programming, SCRUM, Managing interactive processes, Basics of Software estimation, Effort and Cost estimation techniques, COSMIC Full function points, COCOMO II A Parametric Productivity Model, Staffing Pattern.
Module-3: Activity Planning And Risk Management: Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Network Planning models, Forward Pass & Backward Pass techniques, Critical path (CRM) method, Risk identification, Assessment, Monitoring, PERT technique, Monte Carlo simulation – Resource Allocation, Creation of critical patterns, Cost schedules.
Module-4: Project Management And Control: Framework for Management and control, Collection of data Project termination, Visualizing progress, Cost monitoring, Earned Value Analysis- Project tracking, Change control- Software Configuration Management – Managing contracts – Contract Management.
Module-5: STAFFING IN SOFTWARE PROJECTS: Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications genres – Communication plans.

Text Books
1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

Reference Books
1. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011.
2. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.

TITLE OF COURSE: SOFTWARE PROJECT MANAGEMENT LAB
COURSE CODE: BCA692
L-T-P: 0-0-2-0
CREDITS: 1

Pre-requisite: Basic idea of Software Engineering.

Introduction:
The Software Project Management Lab provides a deep insight into the importance of project planning in the software industry. Project management is simply the planning, organizing and managing of tasks and resources to accomplish a defined objective, usually with constraints on time

and cost.

Course Outcomes (CO):
This course will serve to broaden the student's understanding of the issues and latest developments in the area of software development and maintenance. To reach this goal, the following objectives need to be met:
CO1: Describe software process maturity framework and discuss
CO2: Explain conventional software management and software projects and project planning.
CO3: Analyze project tracking and control and assess the role of project closure analysis.
CO4: To provide a broad introduction to the field of operations management and explain the concepts, strategies, tools and techniques for managing the transformation process that can lead to competitive advantage.
CO5: Conceptualize supply chain designs, which are aligned with business models for manufacturing and service companies
CO6: Configure logistics networks and assess their performance impacts on efficiency and service levels
CO7: Manage inventory efficiently and pool inventory risks across time, products, channels, and geography.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								✓
CO2	✓		✓		✓							✓
CO3	✓	✓		✓								✓
CO4	✓		✓		✓							✓
CO5	✓	✓		✓								✓
CO6	✓		✓		✓							✓
CO7	✓		✓		✓							✓

Course Contents:
Module 1: Create Project Plan
Specify project name and start (or finish) date. ▪ Identify and define project tasks. ▪ Define duration for each project task. ▪ Define milestones in the plan ▪ Define dependency between tasks
Module 2: Create Project Plan contd.
Define project calendar. ▪ Define project resources. ▪ Specify resource type and resource rates ▪ assign resources against each task ▪ Baseline the project plan
Module 3: Execute and Monitor Project Plan
Update % Complete with current task status. ▪ Review the status of each task. ▪ Compare Planned vs Actual Status ▪ Review the status of Critical Path ▪ Review resources assignation status
Module 4: Generate Dashboard and Reports
Dashboard (Project Overview, Cost Overview, Upcoming Tasks), Resource Reports (Over-allocated Resources, Resource Overview), Cost Reports (Earned Value Report, Resource Cost Overview, Task Cost Overview)

Text Books

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki Effective Software Project Management – Wiley Publication, 2011.

References

1. Watts S. Humphrey: An Introduction to the Team Software Process, 1st Edition, Addison- Wesley International Publications, 2000.
2. Watts S. Humphrey, A Discipline to Software Engineering, 1ˢᵗ Edition, Pearson Education, 2008.
3. Pankaj Jalote, Software Project Management in Practice, 1st Edition, Pearson Education, 2011
4. Chris Kemerer, Software Project Management Readings and Cases, 1st Edition, Pearson Edu, 2011

TITLE OF COURSE: HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOR
COURSE CODE: HSM604
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic knowledge of general Management

Introduction:
The main objective of this course is to help the students to acquire and develop skill to take rational decisions. People have always been regarded as important in managing organizations.

Course Outcomes (CO):
During the study of this course,
CO1: student would come to know about the theory and application of human resource management, the broad range of influences acting on human resource management, about the human resources planning and policies through its information system, training and development of human capital of the organization.
CO2: This course emphasis on the knowledge of performance assessment methods, improvements and resultant in terms of employee service condition reviews. Compensation and workers participation in management including the discipline matters and strategic human resources management

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			✓		✓	✓		✓	✓
CO2			✓		✓	✓		✓	✓

Course Contents:
Module 1: Introduction:
Human resources in Organizations, role of Human Resource Management; the historical background, personnel Management, Human Resource Development, Typical Organizational setup of a Human Resource Management department.
Module 2: Human Resource Planning:
Supply and Demand Forecasting methods, Manpower Inventory, Career Planning, Succession Planning, Personnel Policy, Human Resource Information System (HRIS), Recruitment and Selection: Process, Sources, Methods of selection, Interviewing Method, Skills and Errors Performance Appraisal Systems:

Purpose, Methods, Appraisal instruments, 3600 Appraisal HR Score Card, Errors in appraisal, Potential Appraisal, Appraisal Interview.

Module 3:   Human Resource Development:

Policy and Programs, Assessment of HRD Needs, HRD, Methods: Training and Non-Training. Compensation Management: Wages- Concepts, Components; System of Wage Payment, Fringe Benefits, Retirement Benefit.

Module 4: Workers' Participation in Management:

Concept, Practices and Prospects in India, Quality Circles and other Small Group Activities. Discipline Management: Misconduct, Disciplinary action, Domestic Enquiry, Grievance Handling

Module 5: Strategic HRM:

Meaning, Strategic HRM vs Traditional HRM, SHRM Process, Nature of e-HRM, e- Recruitment & Selection ,e-Performance Management, e-Learning

Text Books

1. Agarwala T.-Strategic Human Resource Management, OUP
2. Aswathappa,K.-Human Resource Management, Tata McGraw Hill

References

1.   JyothiP. &Venkatesh, D. N.-Human Resource, Management

TITLE OF COURSE: ESP & SDP- VI
COURSE CODE: BGSC606
L-T-P: 2-0-2
CREDITS: 2

Pre-requisite: Basic concepts in mathematics and English Language.
Introduction:
This course examines basic English language and math. The Topics to be covered (tentatively): The course is on Competitive exam preparation, logical reasoning, English sentence correction, English, Grammar correction, basic arithmetic, Vocabulary, Verbal Reasoning.

Course Outcomes (CO):
In this course we will study the basic components of math and English language. Students are expected to be capable of understanding the better communication, their advantages and drawbacks, how to implement them in daily life, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to know Competetive exam preparation.
CO2: Students would be able to implement verbal and non-verbal communication.
CO3: By analyzing the logic of any arithmetic structure able to solve problem.
CO4: To become an efficient math and English language.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓

CO4	✓	✓	✓		✓				✓

Course Contents:
Section A: Employment Enhancement Skills-VI
Stream wise Competitive Examination Preparation

Module-1: Software Engineering.

Module-2: Computer Networks

Module-3: Computer Organization & Architecture

Section B: Skill Development for Professional-VI
Module-1
Revision and Advanced Problems in Quantitative Aptitude
1) Numbers (+, -, x, etc), Percentages, Ratio, Partnership, Linear Equations, Profit & Loss
2) Averages, Mixtures & Allegations, Number System, Time and Work
3) Simple & Compound Interest, Other / Misc Quantitative Apt., Indices and Surds, Quadratic Equations
4) Permutations & Combinations, Probability, Geometry, Mensuration
5) Data Interpretation, Various Charts, Diagrams, Tables
Module-2
Revision and Advanced Problems in Reasoning
1) Coding, Series & Numbers, Blood Relations, Analogy
2) Cubes, Data Sufficiency, Non-Verbal Reasoning
3) Syllogisms, Puzzles, Machine I/O, Inequality
4) Seating Arrangement, Calendar / Clock
5) Statements, Other / Misc Logical Reasoning, Decision Making (Ethics)
Module-3
Revision and Advanced Questions in Verbal English
1) Grammar,
2) Clauses,
3) Spotting errors,
4) Sentence Correction,
5) Blanks,
6) Reading Comprehensions,
7) Vocabulary
Newspaper reading: The Hindu & Economic Times.

<u>**Learning Materials:**</u>
1. Fastrack objective Arithmetic: Arihant
2. Quantitative aptitude for Competitive exam (4th Edition): TATA Mc Graw Hill
3. Quantitative aptitude for Competitive exam (3rd Edition): PEARSON
4. Engineering mathematics-Pearson

Professional Specific Elective Courses:

Subject Code	IOT, Cybersecurity & Blockchain Track	Subject Code	AI & Machine Learning Track
BCP401	Cyber Security	BCP402	Deep Learning
BCP503	Security Identity & Risk Management	BCP504	Soft Computing
BCP505	Embedded Systems	BCP506	Machine Learning Techniques
BCP507	Blockchain Technology	BCP508	Natural Language Processing
BCP609	Block Chain Business Application & Implication	BCP610	Computer Vision

Specialization Specific Course:

Subject Code	Big Data Analytics	Subject Code	Data Science
BDA401	Fundamental of Big Data Analytics	DS401	Data Mining & Data Ware Housing
BDA502	Big Data Modeling & Management	DS502	Fundamental of Data Analysis
BDA503	Big Data Integration & Modeling	DS503	Data Science with Python
BDA504	Machine Learning With Big Data	DS504	Data Visualization
BDA605	Managing Big Data with SQL	DS605	Data Scientist's Tool Box

Specialization Specific Course:

Subject Code	Cloud Computing	Subject Code	Block Chain
CC401	Introduction Cloud Computing	BC401	Blockchain Technology
CC502	Introduction to Cloud Security	BC502	Blockchain Component & Architecture
CC503	Cloud Adaptation and Migration	BC503	Transaction on Block Chain
CC504	Cloud Architecture & Development Model	BC504	Block Chain Opportunity Analysis
CC605	AWS Fundamental	BC605	Bit Coin and Crypto Currency

Specialization Specific Course:

Subject Code	Artificial Intelligence & Machine Learning	Subject Code	Cyber Forensics & Internet Security
AIML401	Introduction to Artificial Intelligence	IS401	Introduction to Cryptography
AIML502	Machine Learning Techniques	IS502	Introduction to Cyber Security
AIML503	Computer Vision	IS503	Digital Forensics
AIML504	Application of Machine Learning in Industries	IS504	Cyber Laws & IPR
AIML605	Recommended System	IS605	Intrusion Detection and Prevention System
AIML606	Human Computer Interaction	IS606	Ethical Hacking

Detailed Syllabus for Bachelor of Computer Application

Professional Elective Courses
IOT, Cybersecurity & Blockchain Track

TITLE OF COURSE: CYBER SECURITY
COURSE CODE: BCP401
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic knowledge of computer science. Ethical values are very much required.

Introduction:
Computer security, cyber security or information technology security is the protection of computer systems and networks from the theft of or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide.

Course Outcomes (CO):
At the end of this course, students will be expected to be able to:
CO1: Assess the current security landscape, including the nature of the threat, the general status of common vulnerabilities, and the likely consequences of security failures;
CO2: Critique and assess the strengths and weaknesses of general cyber security models, including the CIA triad;
CO3: Appraise the interrelationships among elements that comprise a modern security system, including hardware, software, policies, and people;
CO4: Assess how all domains of security interact to achieve effective system-wide security at the enterprise level.
CO5: Compare the interrelationships among security roles and responsibilities in a modern information-driven enterprise—to include interrelationships across security domains (IT, physical, classification, personnel, and so on);
CO6: Assess the role of strategy and policy in determining the success of information security;
CO7: Estimate the possible consequences of misaligning enterprise strategy, security policy, and security plans;

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							✓
CO2	✓	✓			✓				✓
CO3	✓	✓		✓					✓
CO4	✓	✓		✓					✓
CO5	✓	✓		✓	✓				✓
CO6	✓	✓		✓					✓
CO7	✓	✓		✓	✓				✓

Course Contents:
Module 1: Introduction to Cyber Security

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

Module 2: Cyber Security Vulnerabilities and Cyber Security Safeguards
Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Module 3: Securing Web Application, Services and Servers
Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Module 4: Intrusion Detection and Prevention
Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

Module 5: Cryptography and Network Security
Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

Module 6: Cyberspace and the Law
Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.

Module 7: Cyber Forensics
Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Text Books
1. Jon Erickson, Hacking: The Art of Exploitation (2nd Ed.)
2. Christopher Hadnagy, Social Engineering: The Science of Human Hacking

References
1. Simon Singh, The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography

TITLE OF COURSE: SECURITY IDENTITY & RISK MANAGEMENT
COURSE CODE: BCP503
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in digital network security.
Introduction:
This course examines Security Identity & Risk Management. The Topics to be covered (tentatively) include: an introduction to security management, Threats, Risks and SANS 20, Risk modeling and IT risk framework, Forensic and Exam review, Legal and ethical issues in computer security.

Course Outcomes (CO):
In this course we will study the basic Security Identity & Risk Management. Students are expected to be capable of understanding the Legal and ethical issues in computer security, their advantages and drawbacks, how to implement them in digital world, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to understand the role of Security Management in information technology systems
CO2: Student would be able to understanding of the role of firewalls, guards, proxy servers and intrusion detection in networks on a Linux OS with traffic analysis
CO3: Student would be able to evaluate the residual risk of a protected network
CO4: Student would be able to apply legal and ethical standards in the Information Security context.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Introduction to security management and to the different cyber security courses taught at Morgan State. Cyber risks, basic computer security and network security concepts.
Module-2: Threats, Risks and SANS 20 Critical Controls Overview SANS 20 critical control for security management, cyber security concepts: Threats, Vulnerabilities. SANS 20 critical controls for security management vulnerabilities and threats will be presented, key terms.
Module-3: Risk modeling and IT risk framework, A novel risk framework, Numerical risk computation. Quantification of risk and costs associated with attacks are explained and determined compare the advantages and disadvantages of various risk assessment methodologies. Balance the defense and control to minimize cost associated with successful breach.
Module-4: Risk decisions and IT risk framework analysis. IT risk framework reasonable decisions to minimize the cost of a cyber-attack based on simulation of the risk, evaluate and categorize risk.
Module-5: Risk management: NIST 800-30 and 800-39 documents. Assess security risks and costs based on NIST 800-30/39 document and discuss risk assessment from NIST POV. Various risk, analysis methodologies and decisions on risk management issues based on the NIST guidelines and Program a risk assessment model to relation between risk and system security policy.
Module-6: Forensic and incident response. Monitoring, forensics and incident response. Security monitoring, identify key concepts in forensic analysis, and make recommendation on incident response given any scenario.
Module-7: More on Incident response. we will have a closer look of the NIST SP800-61 document and identify SP800-61 key goals. Also, incident response mechanisms will be explained as well as how to select the best response possible in any given situation.
Module-8: Forensic and Exam review. NIST SP800-86 document, network forensics. Cyber forensics will be studied in details, the best forensic analysis in any given situation.
Module-9: Forensic SP800-86 document, handle an incident, integrate forensic techniques into incident response, and use data from data files for forensic analysis, use data from operating systems for forensic analysis. Lastly, detect and prevent intrusion.
Module-10: Supply Chain Risk Management Practices, NIST SP800-161 (Supply Chain Risk Management Practices for Federal Information Systems and Organizations), identify core components

ICT SCRM controls, integrate ICT SCRM into organization wide risk management, and identify ICT supply chain threat events.

Module-11: Policy, legal and ethical implications of the security management, data security and its importance. Legal, Ethical and compliance issues regarding data security and identity theft. Identify the risk of identity theft, distinguish different data handling policies, and explain different federal and statewide policies related to cyber security and acts addressing issues of data security such as HIPAA/FERPA.

Module-12: Legal and ethical issues in computer security: Evaluating legal, ethical and compliance issues regarding computer security. The key legal terms in computer security such as Patents, copyrights, and IP in Information Concept. Identify different computer crimes, examine a computer fraud case for ethical issues, and comply by the rules of the ethics as dealing with cybercrimes.

Text Books
1. Security Awareness—Applying Practical Security in Your World, 4th Ed. Mark Ciampa Copyright © 2014 Course Technology, ISBN-13: 978-1-111-64418-5

References
1. Computer Forensics and Cyber Crime, An Introduction, 3rd Ed. Marjie Britz, Copyright © 2013 Pearson/Prentice Hall, ISBN-13: 978-0-13-267771-4

TITLE OF COURSE: EMBEDDED SYSTEMS
COURSE CODE: BCP505
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concept of C, CO, Digital Communication etc.

Introduction:
To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around
A modern embedded processor like the Intel ATOM.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
CO1: Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems..
CO1: Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level)
CO3: Become aware of interrupts, hyper threading and software optimization.
CO4: Design real time embedded systems using the concepts of RTOS.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓					✓
CO2	✓	✓	✓	✓	✓				✓

Detailed Syllabus for Bachelor of Computer Application

CO3	✓	✓	✓	✓	✓				✓
CO4	✓		✓		✓				✓

Course Contents:

Module-1: Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice. Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML

Module-2: Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them. Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them.

Module-3: Embedded Serial communication, Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, 10 CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network

Module-4: Real time operating system: POSIX Compliance , Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.

Text Books

1. Raj Kamal, Embedded Systems Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2008.
2. K.V. Shibu, Introduction To Embedded Systems, Tata McGraw, 2009.
3. Peter Barry and Patric Crowley, Intel architecture for Embedded system.

References

1. http://www.tomshardware.com/reviews: Pierre Dandumont, Intel and Declining Power Consumption, 2008.
2. http://download.intel.com/design/intarch/papers/323101.pdf: V. Sanjay, Prashant Paliwal,
3. Guidelines for migrating to Intel® Atom™ Processor from other Processor architecture, 2010.
Lori Matassa and Max Domeika, Break Away with Intel® Atom™ Processors,2010, Intel press.

TITLE OF COURSE: BLOCKCHAIN TECHNOLOGY
COURSE CODE: BCP507
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Computer Networks, Data Structure

Introduction:
Cryptography is an integral part of the inner-workings of blockchain technology. Public-key encryption serves as the basis for blockchain wallets and transactions, cryptographic hash functions provide the trait of immutability, and Merkle trees organize transactions while enabling blockchains to be more efficient.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Learn the methods for evaluating different Cryptosystems
CO2: Learn different functions of Hash Functions, MAC Codes & Digital Signatures and problem solving techniques.
CO3: Learn the concept of Firewalls and Web Security.
CO4: Learn the ideas of Basic Distributed System concepts & Bitcoin.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓	✓	✓	✓	✓
CO2	✓	✓	✓			✓		✓	✓
CO3	✓	✓	✓	✓				✓	
CO4	✓	✓	✓	✓	✓		✓	✓	

Course Contents:
Module-1: Introduction:
Need for Distributed Record Keeping, Modeling faults and adversaries,Byzantine Generals problem,Consensus algorithms and their scalability problems,Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.
Module-2: Basic Distributed Computing:
Atomic Broadcast, Consensus, Byzantine Models of fault tolerance
Module-3: Basic Crypto primitives:
Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems.
Module-4: Blockchain 1.0:
Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.
Module-5: Blockchain 2.0:
Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts.
Module-6: Blockchain 3.0 :
Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain
Module-7: Privacy, Security issues in Blockchain:
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these

Text Books
1. Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.

References
1. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

TITLE OF COURSE: BLOCK CHAIN BUSINESS APPLICATION & IMPLICATION
COURSE CODE: BCP609
L-T-P: 2-0-2
CREDITS: 3

Pre-requisite: Basic concepts in blockchain.

Introduction:
This course examines different type of business application through block chain. The Topics to be covered (tentatively) include: opportunities for blockchain, blockchain changes the deep structures and architecture of the firm, application of block chain in civil society, private sector, Trust and Vulnerability in block chain.

Course Outcomes (CO):
In this course we will study the block chain in business application. Students are expected to be capable of understanding the implementation of block chain, their advantages and drawbacks, how to implement them in industry, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to analyses opportunity in blockchain properly.
CO2: Students would be able to implement any problem by writing their own business idea.
CO3: By analyzing the core idea of efficient business proposal in blockchain.
CO4: To become an efficient blockchain business administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: New Business Models, opportunities for blockchain to disrupt or displace traditional centralized business models. blockchain technology can support "open networked enterprise" business models through the inclusion of native payment systems, reputation systems, uncensorable content, trustless transactions, smart contracts, and autonomous agents.
Module-2: Blockchain and the C-Suite, blockchain changes the deep structures and architecture of the firm, it will consequently transform our models of management and the roles of the C-Suite. Navigating the balance between blockchain's hype and its true potential is a key responsibility of an organization's management team, decisions and changes that business leaders can anticipate when considering how the future of blockchain will unfold within their business.
Module-3: Leadership for the Next Era, Blockchain alone is just a tool, fulfill its long-term promise, humans must lead. Rather than relying on state-based institutions, blockchain must be primarily self-governed through collaborations of civil society, private sector, government, and stakeholders in non-state networks, the idea of blockchain governance networks and explain how they can support blockchain stewardship at three levels: The platform level, the application level, and the ecosystem level. As well, you will learn about the conditions that are necessary for a blockchain-based hub of innovation to succeed.

Module-4: Blueprint for a New Social Contract, digital revolution unfolds, global economy, labor markets, old institutions, and society as a whole. To realize the potential of the blockchain revolution, we need business leaders to come to the table as responsible and active participants in a new social contract for both their own long-term interests as well as in the interest of a healthy society and economy, possible directions for a new social contract—i.e. the agreements, laws, and behaviors that people, companies, civil society, and their governments adhere, catalyze investigation, debate, and action, Trust and Vulnerability Short history of the scaling out of human trust. High and Low trust societies, Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary

Text Books
1 Blockchain Basics: A Non-Technical Introduction in 25 Steps Kindle Edition, by Daniel Drescher

References
1. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten.

Professional Elective Courses
<mark>AI & Machine Learning Track</mark>

TITLE OF COURSE: DEEP LEARNING
COURSE CODE: BCP402
L-T-P: 2-0-2
CREDITS: 3

Pre-requisite: Basics of AI and Machine Learning

Introduction:
Deep learning is a branch of machine learning which is completely based on artificial neural networks, as neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: To have developed an understanding of neural network and deep learning architectures.
CO2: To acquire concepts regarding convolution and related architectures needed to develop computer vision applications.
CO3: To acquire concepts related to sequential data needed to develop text mining applications.
CO4: Students would be able to solve problems using the deep learning functionalities implemented through open-source deep learning frameworks like Tensorflow 2.0 and PyTorch.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓			✓	
CO2	✓			✓			✓		
CO3	✓	✓	✓				✓	✓	
CO4	✓	✓	✓		✓		✓	✓	

Course Contents:
Module-1: Fundamentals of Neural Network & Deep Learning:
Challenges in shallow network; Motivation for deep neural network, Different deep neural network architectures – Perceptron, Feedforward network, etc. Forward and backward propagation, Gradient Descent and related problems, Regularization, Batch normalization, Optimization algorithms (Adam's, RMSprop, etc.), Hyperparameters
Module-2: Convolutional Neural Network:
Foundational concepts of CNN, Building a CNN architecture, Popular CNN architectures – LeNet, AlexNet, ResNet, CNN applications

Module-3: Recurrent Neural Network:
Sequence data, Architecture of RNN, Long Short Term Memory (LSTM), Bi-directional LSTM, Gated Recurrent Module (GRU), and Applications of RNN

Module-4: Important deep learning frameworks:
Tensorflow 2.0, Keras, PyTorch, Theano, Caffe

Text Books
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, Deep Learning, The MIT Press.
2. Fundamentals of Deep Learning – by Nikhil Buduma (O'Reilly).

References
1. Deep Learning – A practitioner's approach – by Josh Patterson & Adam Gibson (O'Reilly).

TITLE OF COURSE: SOFT COMPUTING
COURSE CODE: BCP504
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of artificial intelligence, data base management system.
Introduction:
This course provides a comprehensive introduction to understand the underlying principles, Techniques and approaches fuzzy logic.

Course Outcomes (CO):
The course presents basics of artificial intelligence programming including: Basics of AI, Data Representation, Control structures, Functions, that aims to:
CO1: Understand fuzzy sets and fuzzy logic systems.
CO2: Be able to know Classical Sets and Fuzzy Sets and Fuzzy relations, Membership functions, Fuzzy to Crisp conversions.
CO3: Understand of Neural Network on Hebbian, competitive, Boltzman.
CO4: Understand Genetic Algorithms in different approach. Also understand Other Soft Computing techniques likes Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓								✓
CO2	✓			✓					✓
CO3	✓			✓					✓
CO4	✓			✓					✓

Course Contents:
Module-1: Introduction:
Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm.
Module-2: Fuzzy sets and Fuzzy logic systems:
Classical Sets and Fuzzy Sets and Fuzzy relations : Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy

relations. Membership functions : Features of membership functions, standard forms and boundaries, different fuzzification methods. Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods. Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System-Mamdani Fuzzy Models – Sugeno Fuzzy Models. Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting

Module-3: Neural Network

Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron.

Learning Methods: Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Back-propagation and multi-layer networks. Competitive learning networks: Kohonen self- organizing networks, Hebbian learning; Hopfield Networks. Neuo-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification

Module-4: Genetic Algorithms:

Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA).Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition

Module 5: Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

Text Books
1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and GeneticAlgorithms", PHI
3. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
6. Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH,
7. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
8. A beginners approach to Soft Computing, Samir Roy &UditChakraborty, Pearson

TITLE OF COURSE: MACHINE LEARNING TECHNIQUES
COURSE CODE: BCP506
L-T-P: 3-0-0
CREDITS: 3

Pre-Requisites:
Fundamental knowledge of computer science principles and skills, probability and statistics theory, and the theory and application of linear algebra are required.

Introduction:
Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention.

Course Outcomes (CO):
By the end of the course, students should be able to
CO1: Differentiate various Learning Approaches, and to interpret the Concepts of Supervised Learning.
CO2: Compare the different dimensionality reduction techniques.

CO3: Apply theoretical foundations of Decision Trees to identify best split and Bayesian Classifier to Label data points.
CO4: Illustrate the working of classifier models Like SVM, Neural Networks and Deep Neural Networks Classifier Model for typical Machine Learning Applications.
CO5: Illustrate and apply clustering algorithms and identify Its applicability in real life problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓	✓		✓			✓
CO4	✓	✓	✓	✓					✓
CO5	✓	✓	✓	✓					

Course Contents:
Unit-1: Introductions, Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation
Unit-2: Linear regression, Decision trees, over fitting
Unit-3: Instance based learning, Feature reduction, Collaborative filtering based recommendation, Probability and Bayes learning
Unit-4: Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM
Unit-5: Neural network, Perceptron, multilayer network, back propagation, introduction to deep neural network
Unit-6: Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning

Text Books
1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin

References
1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.

TITLE OF COURSE: NATURAL LANGUAGE PROCESSING
COURSE CODE: BCP508
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in programming languages mathematics etc.

Introduction:
This course introduces the theory and methods of natural language processing (NLP). NLP systems understand and produce human language for applications such as information extraction, machine translation, automatic summarization, question-answering, and interactive dialog systems. The course

covers knowledge-based and statistical approaches to language processing for syntax (language structures), semantics (language meaning), and pragmatics/discourse (the interpretation of language in context).

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
CO1: To tag a given text with basic Language features.
CO2: To design an innovative application using NLP components.
CO3: To implement a rule based system to tackle morphology/syntax of a language.
CO4: To design a tag set to be used for statistical processing for real-time applications.
CO5: To compare and contrast the use of different statistical approaches for different types of NLP applications.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓				✓
CO2	✓		✓		✓				✓
CO3	✓	✓	✓	✓	✓				✓
CO4	✓		✓		✓				✓
CO5	✓	✓	✓	✓	✓				✓

Course Contents:
Module-1: INTRODUCTION
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.
Module-2: WORD LEVEL ANALYSIS
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.
Module-3: SYNTACTIC ANALYSIS
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.
Module-4: SEMANTICS AND PRAGMATICS
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.
Module-5: DISCOURSE ANALYSIS AND LEXICAL RESOURCES
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books
1.   Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2.   Steven Bird, Ewan Klein and Edward Loper,-Natural Language Processing with Python, First Edition, OReilly Media, 2009.

References
3. Breck Baldwin, ―Language processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
4. Richard M Reese, ―Natural Language Processing with Java, OReilly Media, 2015.
5. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
6. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

TITLE OF COURSE: COMPUTER VISION
COURSE CODE: BCP610
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of data structure and algorithm, image processing, programming concepts and linear algebra.

Introduction:
This course examines development of algorithms and techniques to analyze and interpret the visible world around us. The Topics to be covered (tentatively) include:
- Digital Image Formation and low-level processing
- Depth estimation and Multi-camera views
- Feature Extraction
- Image Segmentation
- Pattern Analysis
- Motion Analysis
- Shape from X

Course Outcomes (CO):
CO1: Understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.
CO2: Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision.
CO3: Applications range from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓					✓
CO2	✓	✓	✓	✓	✓				✓
CO3	✓		✓		✓	✓			✓

Course Contents:

Module 1: Introduction: Introduction to Computer Vision, Case study: Face Recognition.

Module 2: Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Module 3: Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel

Module 4: Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis-Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Module 5: Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Module 6: Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Module 7: Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Module 8: Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003

References

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

Specialization Elective Course:
<mark>Big Data Analytics</mark>

TITLE OF COURSE: FUNDAMENTAL OF BIG DATA ANALYTICS
COURSE CODE: BDA401
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

Introduction:
The course enables students to Understand the Big Data Platform and its Use cases, Provide an overview of Apache Hadoop, Provide HDFS Concepts and Interfacing with HDFS, Understand Map Reduce Jobs, Provide hands on Hadoop Eco System, Apply analytics on Structured, Unstructured Data, Exposure to Data Analytics with R.

Course Outcomes (CO):
The students will be able to:
CO1: Identify Big Data and its Business Implications
CO2: List the components of Hadoop and Hadoop Eco-System
CO3: Access and Process Data on Distributed File System
CO4: Manage Job Execution in Hadoop Environment
CO5: Develop Big Data Solutions using Hadoop Eco System

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓		✓		✓				✓
CO3	✓		✓			✓			✓
CO4	✓		✓		✓	✓	✓		✓
CO5	✓		✓					✓	✓

Course Contents:
Module-1: Introduction To Big Data and Hadoop: Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.
Module-2: HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.
Module-3: Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Module-4: Hadoop Eco System Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. HBase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL: Introduction

Module-5: Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Textbooks:
1. Tom White "Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books:
1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press

TITLE OF COURSE: FUNDAMENTAL OF BIG DATA ANALYTICS LAB
COURSE CODE: BDA491
L-T-P: 0-0-2
CREDITS: 2

Pre-requisite: Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

Introduction:

The course enables students to Understand the Big Data Platform and its Use cases, Provide an overview of Apache Hadoop, Provide HDFS Concepts and Interfacing with HDFS, Understand Map Reduce Jobs, Provide hands on Hadoop Eco System, Apply analytics on Structured, Unstructured Data, Exposure to Data Analytics with R.

Course Outcomes (CO):

The students will be able to:
CO1: Set up single and multi-node Hadoop Clusters
CO2: Apply Map Reduce technique for various algorithms

CO3: Design algorithms that uses Map Reduce to apply on Unstructured and structured data

CO4: Develop Scalable machine learning algorithms for various Big data applications using R
CO5: Represent NoSQL data

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			✓	✓	✓	✓			✓
CO2	✓		✓		✓	✓			✓
CO3	✓		✓	✓	✓	✓			✓

CO4	✓		✓	✓	✓	✓			✓
CO5			✓		✓				✓

LIST OF EXPERIMENTS

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. MapReduce application for word counting on Hadoop cluster
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
4. K-means clustering using map reduce
5. Page Rank Computation
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.
7. Application of Recommendation Systems using Hadoop/mahout libraries

TITLE OF COURSE: BIG DATA MODELING & MANAGEMENT
COURSE CODE: BDA502
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Introduction about Big data and Hadoop.

Introduction:
In this course, you will experience various data genres and management tools appropriate for each. You will be able to describe the reasons behind the evolving plethora of new big data platforms from the perspective of big data management systems and analytical tools.

Course Outcomes (CO):
The students will be able to:
CO1: Recognize different data elements in your own work and in everyday life problems.
CO2: Explain why your team needs to design a Big Data Infrastructure Plan and Information System Design.
CO3: Identify the frequent data operations required for various types of data.
CO4: Select a data model to suit the characteristics of your data.
CO5: Apply techniques to handle streaming data.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓				✓			✓
CO2	✓		✓	✓					✓
CO3	✓			✓					✓

CO4	✓			✓	✓				✓
CO5	✓	✓							✓

Course Contents:

Module-1: Introduction to Big Data Modeling and Management, Data Ingestion, Data Storage, Data Quality, Data Operations, Data Scalability and Security, Energy Data Management Challenges at Coned

Module-2: Big Data Modeling, Introduction to Data Models, Data Model Structures, Data Model Operations, Data Model Constraints, Introduction to CSV Data, What is a Relational Data Model?, What is a Semi structured Data Model?, Exploring the Relational Data Model of CSV Files, Exploring the Semi structured Data Model of JSON data, Exploring the Array Data Model of an Image, Exploring Sensor Data.

Module-3: Vector Space Model, Graph Data Model, Other Data Models, Exploring the Lucene Search Engine's Vector Data Model,Exploring Graph Data Models with Gephi.

Module-4: Data Model vs. Data Format, What is a Data Stream? Why is Streaming Data different? Understanding Data Lakes, Exploring Streaming Sensor Data.

Module-5: DBMS-based and non-DBMS-based Approaches to Big Data,From DBMS to BDMS, Redis: An Enhanced Key-Value Store, Aerospike: a New Generation KV Store, Semi structured Data – AsterixDB, Solr: Managing Text, Relational Data – Vertica.

Textbooks:
1. Hands-On Big Data Modeling, By James Lee , Tao Wei & Suresh Kumar Mukhiya
2. Data Management: Databases and Organizations 6th Editionby Richard T. Watson

Reference Books:
1. Big Data Principles and best practices of scalable realtime data systems, Nathan Marz and James Warren

TITLE OF COURSE: BIG DATA INTEGRATION & MODELING
COURSE CODE: BDA503
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Completion of Intro to Big Data is recommended

Introduction:

Nowadays, huge volume of data is collected from many heterogeneous data sources which are generating data in real-time with different qualities — which is called Big Data. The big data integration is very challenging especially after the traditional data integration techniques failed to handle it.

Course Outcomes (CO):

The students will be able to:

CO1: Retrieve data from example database and big data management systems

CO2: Describe the connections between data management operations and the big data processing patterns needed to utilize them in large-scale analytical applications.

CO3: Identify when a big data problem needs data integration

CO4: Execute simple big data integration and processing on Hadoop and Spark platforms

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	✓	✓	✓		✓					✓
CO2	✓			✓						✓
CO3	✓	✓					✓			✓
CO4	✓		✓		✓	✓				✓

Course Contents:
Module-1: introduction to big data integration and processing, big data modeling and management, why is big data processing different? What is data retrieval?, querying two relations, subqueries, querying relational data with postgres.
Module-2: Retrieving Big Data: Querying JSON Data with MongoDB, Aggregation Functions, Querying Aerospike, Querying Documents is MongoDB, Exploring Pandas Data Frames.
Module-3: Big Data Integration: Overview of information integration, A Data integration Scenario, Integration for Multichannel Customer Analytics, Big Data Management and Processing Using Splunk and Datameer, why splunk?, Connected Cars with ford's OpenXC and Splunk, Big Data Management and Processing using Datameer, Installing splunk Enterprise on Windows, Installing splunk enterprise on Linux, Exploring Splunk Queries.
Module-4: Processing Big Data: Big Data Processing Pipelines, Some High-Level Processing Operations in Big Data Pipelines, Aggregation Operations in Big Data Pipelines, Typical Analytical Operations in Big Data Pipelines, Overview of Big Data Processing Systems, The Integration and Processing Layer, Introduction to Apache Spark, Getting Started with Spark, WordCount in Spark.
Module-5: Big Data Analytics using Spark: Spark Core: Programming In Spark using RDDs in Pipelines, Spark Core: Transformations, Spark Core: Actions, Spark SQL, Spark Streaming, Spark MLLib, Spark GraphX, Exploring SparkSQL and Spark DataFrames, Analyzing Sensor Data with Spark Streaming.

Textbooks:
1. Data Integration Blueprint And Modeling: Techniques For A Scalable And Sustainable Architecture (Paperback) (Ibm Press) 1st Edition By Anthony David Giordano
2. Managing Data In Motion: Data Integration Best Practice Techniques And Technologies (The Morgan Kaufmann Series On Business Intelligence) 1st Edition By April Reeve
Reference Books:
1. Principles of Data Integration 1st Edition by An Hai Doan, Alon Halevy , Zachary Ives

TITLE OF COURSE: MACHINE LEARNING WITH BIG DATA
COURSE CODE: BDA504
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Completion of Intro to Big Data is recommended
Introduction:
This course provides an overview of machine learning techniques to explore, analyze, and leverage data. You will be introduced to tools and algorithms you can use to create machine learning models that learn from data, and to scale those models up to big data problems.

Course Outcomes (CO):
The students will be able to:
CO1: Design an approach to leverage data using the steps in the machine learning process.
CO2: Apply machine learning techniques to explore and prepare data for modeling.
CO3: Identify the type of machine learning problem to apply the appropriate set of techniques.
CO4: Construct models that learn from data using widely available open source tools.
CO5: Analyze big data problems using scalable machine learning algorithms on Spark.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓				✓
CO2	✓			✓	✓			✓	✓
CO3	✓	✓	✓					✓	✓
CO4	✓	✓	✓		✓				✓
CO5	✓			✓					✓

Course Contents:
Module-1: Introduction to Machine Learning With Big Data, Summary of Big Data Integration and Processing, Machine Learning Overview, Categories Of Machine Learning Techniques, Machine Learning Process, Goals and Activities in the Machine Learning Process, CRISP-DM, Scaling Up Machine Learning Algorithms
Module-2: Data Exploration: Data Terminology, Data Exploration, Data Exploration through Summary Statistics, Data Exploration through Plots, Exploring Data with KNIME Plots, Data Exploration in Spark.
Module-3: Data Preparation: Data Preparation, Data Quality, Addressing Data Quality Issues, Feature Selection, Feature Transformation, Dimensionality Reduction, Handling Missing Values in KNIME, Handling Missing Values in Spark.
Module-4: Classification: introduction to Classification, Building and Applying a Classification Model, Classification Algorithms, k-Nearest Neighbors, Decision Trees, Naïve Bayes, Classification using Decision Tree in KNIME, Classification in Spark.
Module-5: Evaluation of Machine Learning Models: Generalization and Overfitting, Overfitting in Decision Trees, Using a Validation Set, Metrics to Evaluate Model Performance, Confusion Matrix, Evaluation of Decision Tree in KNIME, Evaluation of Decision Tree in Spark.
Module 6: Regression, Cluster Analysis, and Association Analysis: Regression Overview, Linear Regression, Cluster Analysis, k-Means Clustering, Association Analysis, Association Analysis in Detail, Machine Learning With Big Data - Final Remarks, Cluster Analysis in Spark.

Textbooks:
1. Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners Book by Jared Dean
2. Machine Learning Models and Algorithms for Big Data Classification: Thinking with Examples for Effective Learning Book by Shan Suthaharan.

Reference Books:
1. Big Data and Machine Learning in Quantitative Investment Book by Tony Guida
2. Machine Learning For Big Data Analysis, Edited By Siddhartha Bhattacharyya, Hrishikesh Bhaumik, Anirban Mukherjee, Sourav De

TITLE OF COURSE: MANAGING BIG DATA WITH SQL
COURSE CODE: BDA605
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts Data base management system and SQL Query Language.

Introduction: This course is an introduction to how to use relational databases in business analysis. You will learn how relational databases work, and how to use entity-relationship diagrams to display the structure of the data held within them. This knowledge will help you understand how data needs to be collected in business contexts, and help you identify features you want to consider if you are involved in implementing new data collection efforts.

Course Outcomes (CO):
The students will be able to:
CO1: Understand How Data Needs to Be Collected in Business Contexts.
CO2: Identify Features You Want to Consider If You Are Involved in Implementing New Data Collection Efforts
CO3: Understand How to Execute the Most Useful Query and Table Aggregation Statements For Business Analysts
CO4: Understand Query Practice Using Them with Real Databases.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓		✓			✓
CO2	✓			✓		✓			✓
CO3	✓			✓		✓			✓
CO4	✓	✓	✓			✓		✓	✓

Course Contents:
Module-1: Problems with Having a Lot of Data Used by a Lot of People, How Relational Databases Help Solve Those Problems, Database Design Tools That Will Help You Learn SQL Faster.
Module-2: How Entity-Relationship Diagrams Work, Database Structures Illustrated by Entity-Relationship Diagrams, Relational Schemas, How to Make Entity-Relationship Diagrams using ERDPlus, How to Make Relational Schemas using ERDPlus.
Module-3: Queries to Extract Data from Single Tables: Introduction to Query Syntax, How to Use Jupyter Notebooks, How to Use Your Jupyter Account, How to Use Teradata Viewpoint and SQL Scratchpad.
Module-4: Queries to Summarize Groups of Data from Multiple Tables: What are Joins? Joins with Many to Many Relationships and Duplicates, A Note about Our Join Examples, Retrieve Your Data.
Module-5: Queries to Address More Detailed Business Questions: Design and execute subqueries, Introduce logical conditions into your queries using IF and CASE statements, Implement analyses that accommodate missing data or data mistakes, and Write complex queries that incorporate many tables and clauses.

Textbooks:
1. Sql on big data, technology, architecture, and innovation, authors: pal, sumit.

Reference Books:
1. Oracle database 11g pl/sql programming by mclaughlin, mcgraw hill, by mclaughlin.

TITLE OF COURSE: DATA MINING & DATA WARE HOUSING
COURSE CODE: DS401
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in data base management system, and mathematics.

Introduction:

The recent years have generated explosive expansion of digital data stored in computer databases as well as increased pressure on companies to keep competitive advantage. This has put Data Mining (DM) as a key method for extracting meaningful information from the flood of digital data collected by businesses, government, and scientific agencies.

Course Outcomes (CO):

This course will serve to broaden the student's understanding of the issues and latest developments in the area of data mining. To reach this goal, the following objectives need to be met:

CO1: To understand the basic principles, concepts and applications of data warehousing and data mining

CO2: To introduce the task of data mining as an important phase of knowledge recovery process.

CO3: Ability to do Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment.

CO4: Have a good knowledge of the fundamental concepts that provide the foundation of data mining.

CO5: Design a data warehouse or data mart to present information needed by management in a form that issuable for management client.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓								✓
CO2	✓	✓		✓							✓	✓
CO3	✓	✓	✓		✓				✓		✓	✓
CO4	✓											✓
CO5	✓				✓					✓		✓

Course Contents:

Module 1:

Overview of Data warehousing, Strategic information and the need for Data warehousing, Defining a Data warehouse, Evolution of Data warehousing, Data warehousing and Business Intelligence.

Module 2:

The Building Blocks of Data warehouse, Defining features – Subject-oriented data, Integrated data, Time-variant data, Nonvolatile data, Data granularity, Data warehouses and Data marts, Architectural Types – Centralized, Independent data marts, Federated, Hub-and-Spoke, Data mart bus, Overview of components - Source Data, Data Staging, Data Storage, Information Delivery, Metadata, and Management and Control components. Definition and architecture in the areas of Data acquisition, Data storage, and Information delivery Distinguishing characteristics – Different objectives and scope, Data content, Complex analysis for faster response, Flexible and Dynamic, Metadata-driven etc Architectural Framework – supporting flow of data, and the Management and Control module Technical architecture – Data acquisition, Data storage, and Information delivery.

Module 3:

Business Requirements and Data warehouse: Dimensional nature of Business data and Dimensional Analysis, Dimension hierarchies and categories, Key Business. Metrics (Facts), Requirement Gathering methods and Requirements Definition Document (contents). Distinction between architecture and infrastructure, understanding of how data warehouse infrastructure supports its architecture Components of physical infrastructure, Hardware and Operating systems for data warehouse, Database Software, Collection of Tools, Data warehouse Appliances – evolution and benefits. Business Requirements and Data Design – Structure for Business Dimensions and Key Measurements, Levels of detail. Business Requirements and the Architecture plan, Business Requirements and Data Storage Specifications, Business Requirements and Information Delivery Strategy.

Module 4:

Understanding the importance of Metadata, Metadata types by functional areas – Data acquisition, Data storage, and Information delivery, Business Metadata – overview of content and examples, Technical Metadata – overview of content and examples, Metadata Requirements, Sources of Metadata, Metadata management – challenges, Metadata Repository, Metadata, integration and standards.

Module 5:

Concepts of Data warehouse architecture – Definition and architecture in the areas of Data acquisition, Data storage, and Information delivery, Distinguishing characteristics – Different objectives and scope, Data content, Complex analysis for faster response, Flexible and Dynamic, Metadata-driven etc Architectural Framework – supporting flow of data, and the Management and Control module. Technical architecture – Data acquisition, Data storage, and Information delivery. Design decisions, Basics of Dimensional modeling, E-R modeling versus Dimensional modeling, The STAR schema – illustration, Dimension Table, Fact Table, Factless Fact Table, Data granularity, STAR schema keys – Primary, Surrogate, and Foreign, Advantages of the STAR schema, STAR schema examples. Overview of ETL, Requirements of ETL and steps Data extraction – identification of sources and techniques Data transformation – Basic tasks, Transformation types, Data integration and consolidation, Transformation for dimension attributes, Data loading – Techniques and processes, Data refresh versus update, Procedures for Dimension tables, Fact tables : History and incremental loads ETL Tool options.

Module 6:

Distinction between architecture and infrastructure, Understanding of how data warehouse infrastructure supports its architecture Components of physical infrastructure, Hardware and Operating systems for data warehouse, Database Software, Collection of Tools,Overall concept of Online Analytical Processing (OLAP), OLAP definitions and rules, OLAP characteristics Major features and functions of OLAP – General features, Dimensional analysis, Hypercubes, Drill Down and Roll Up, Slice and Dice, Rotation, Uses and Benefits Familiarity with OLAP models – Overview of variations, MOLAP, ROLAP, HOLAP, DOLAP, Database OLAP, Web OLAP. Web-enabled Data Warehouse – adapting data warehouse for the web Web-based information delivery – Browser technology for data warehouse and Security issues

OLAP and Web – Enterprise OLAP, Web-OLAP approaches, OLAP Engine design. Data warehouse Appliances – evolution and benefits

Module 7:

Overview of Data mining – Definition, Knowledge Discovery Process (Relationships, Patterns, Phases of the process), OLAP versus Data mining, Some aspects of Data mining – Association rules, Outlier analysis, Predictive analytics etc), Concepts of Data mining in a Data warehouse environment, Major Data Mining techniques – Cluster Detection using R Language, Decision Trees, Memory-based Reasoning, Link Analysis, Neural, Networks, Genetic Algorithms etc, Data Mining Applications in industry – Benefits of Data mining using R Language, Discussion on applications in Customer Relationship, Management (CRM), Retail, Telecommunication, Biotechnology, Banking and Finance etc.

Textbooks:
1. Data Mining Technology, Third Edition by Arun K Pujari, Universities Press, India
2. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India
3. Alex Berson, Stephen J. Smith, "Data Warehousing Data Mining & OLAP", Tata McGrow- Hill References

References:
1. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill
2. Data warehouse Toolkit by Ralph Kimball, Wiley India
3. Gajendra Sharma,"Data Mining Data Warehousing and OLAP", S.K.KATARIA & SONS

TITLE OF COURSE: FUNDAMENTAL OF DATA ANALYSIS
COURSE CODE: DS502
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: This course requires that you are familiar with high-school level linear algebra, and calculus. Knowledge of probability theory, statistics, and programming is desirable.
Introduction:
This course will expose you to the data analytics practices executed in the business world. We will explore such key areas as the analytical process, how data is created, stored, accessed, and how the organization works with data and creates the environment in which analytics can flourish.
Course Outcomes (CO):
After Completion of this course student able to understand:
CO1: Strong foundation in all the areas that support analytics
CO2: Basis for going deeper into advanced investigative and computational methods
CO3: Use a simple but powerful language called SQL to extract analytical data sets
CO4: Machine learning utilization in Data Analysis.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓

CO3	✓				✓			✓	✓
CO4	✓	✓	✓		✓			✓	✓

Course Contents:

Module 1: Introduction to Data & Analysis in Real World, Thinking about Analytical Problems, Conceptual Business Models, The Information-Action Value Chain, Real World Events and Characteristics, Data Capture by Source Systems.

Module 2: Introduction - Analytical Technologies, Data Storage and Databases, Big Data & the Cloud, Virtualization, Federation, and In-Memory Computing, The Relational Database, Data Tools Landscape, The Tools of the Data Analyst.

Module 3: 1. Introduction to SQL, Aggregating and Sorting Data in SQL, Extracting Data from Multiple Tables, Stacking Data with UNION Command, Extending SQL Queries Using Operators, Using SQL Subqueries.

Module 4: Introduction to Real World Analytical Orgs, Analytical Organizations – Roles, Analytical Organizations – Structures, Data Governance ,Data Privacy, Data Quality.

Module 5: Descriptive Statistics, Inferential Statistics through hypothesis tests Permutation & Randomization Test, Regression & ANOVA, Machine Learning: Introduction and Concepts, Supervised and Unsupervised Learning Technique.

Textbooks:
1. Montgomery, Douglas C., and George C. Runger., Applied statistics and probability for engineers. John Wiley & Sons, 2010

TITLE OF COURSE: DATA SCIENCE WITH PYTHON
COURSE CODE: DS503
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: This course is intended for learners who have a basic knowledge of programming in any language (Java, C, C++, Pascal, Fortran, Javascript, PHP, python, etc.).

Introduction:
This course will introduce the learner to the basics of the python programming environment, including fundamental python programming techniques such as lambdas, reading and manipulating csv files, and the numpy library. The course will introduce data manipulation and cleaning techniques using the popular python pandas data science library and introduce the abstraction of the Series and DataFrame as the central data structures for data analysis, along with tutorials on how to use functions such as groupby, merge, and pivot tables effectively. By the end of this course, students will be able to take tabular data, clean it, manipulate it, and run basic inferential statistical analyses.

Course Outcomes (CO):
After Completion of this course student able to understand:
CO1: Basic process of data science
CO2: Python and Jupyter notebooks
CO3: An applied understanding of how to manipulate and analyze unsaturated datasets
CO4: Basic statistical analysis and machine learning methods

CO5: How to effectively visualize results

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓				✓
CO2	✓			✓	✓				✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓			✓				✓	✓

Course Contents:
Module 1: Data Science, Jupyter Notebook System, Python Functions, Python Types and Sequences, Python More on Strings
Module 2: Python Demonstration: Reading and Writing CSV files, Python Dates and Times, Advanced Python Objects, map (), Advanced Python Lambda and List Comprehensions, Advanced Python Demonstration: The Numerical Python Library (NumPy).
Module 3: The Series Data Structure, querying a Series, The Data Frame Data Structure, Data Frame Indexing and Loading, querying a Data Frame, Indexing Data frames, Missing Values.
Module 4: Merging Data frames, Pandas Idioms, Group by, Scales, Pivot Tables, Date Functionality.
Module 5: introduced to a variety of statistical techniques such a distributions, sampling and t-tests, Distributions, More Distributions, Hypothesis Testing in Python.

Text Books
1. Learning Python, 5th Edition by Mark Lutz, O'Reilly Media, 2013. ISBN 978-1-4493-5573-9
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython by Wes McKinny, O'Reilly Media, 2012. ISBN 978-1-4493-1979-3

Reference:
1. Clean Code: A Handbook of Agile Software Craftsmanship by Robert C. Martin, Prentice Hall, 2008. ISBN 000-0-1323-5088-2
2. The Linux Command Line: A Complete Introduction by William E. Shotts, Jr., No Starch Press, 2012. ISBN 978-1-5932-7389-7

TITLE OF COURSE: DATA VISUALIZATION
COURSE CODE: DS504
L-T-P: 3-0-0
CREDITS: 3

Prerequisites
Students should have taken a course in algorithms and data structures. While the computer graphics is not required, it is useful background. Familiarity with Web technologies and JavaScript is also useful.

Introduction:

Visualization is increasingly important in this era where the use of data is growing in many different fields. Data visualization techniques allow people to use their perception to better understand this data. The goal

of this course is to introduce students to data visualization including both the principles and techniques. Students will learn the value of visualization, specific techniques in information visualization and scientific visualization, and how understand how to best leverage visualization methods.

Course Outcome:
CO1: Students will be able to prepare data for visualization.
CO2: Students will be able to design visualizations.
CO3: Students will be able to use web technology to create visualizations.
CO4: Understand the type of data impacts the type of visualization.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓								✓
CO2	✓		✓						✓
CO3	✓	✓	✓					✓	✓
CO4	✓			✓					✓

Course Content:
Module 1: The Computer and the Human: Overview of Visualization, 2-D Graphics, SVG-example, 2-D Drawing, 3-D Graphics, Photorealism, Non-Photorealism, The Human, Memory, Reasoning, The Human Retina, Perceiving Two Dimensions, Perceiving Perspective.
Module 2: Visualization of Numerical Data Introduction, Data, Mapping, Charts, Glyphs, Parallel Coordinates, Stacked Graphs ,Tufte's Design Rules, Using Color.
Module 3: Visualization of Non-Numerical Data Introduction, Graphs and Networks, Embedding Planar Graphs, Graph Visualization, Tree Maps, Principal Component Analysis, Multidimensional Scaling, Packing.
Module 4: Introduction to Visualization Systems, The Information Visualization Mantra, Database Visualization Part, Visualization System Design

Textbooks:
1. Data Visualization: A Practical Introduction By Kieran Healy
2. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures By Claus O. Wilke

Reference:
1. Data Visualization: A Handbook for Data Driven Design, By Andy Kirk
2. Effective Data Visualization: The Right Chart for the Right Data, Book by Stephanie Evergreen

TITLE OF COURSE: DATA SCIENTIST'S TOOL BOX
COURSE CODE: DS605
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Data Science and Data Visualization Basic Knowledge.
Introduction:
In this course you will get an introduction to the main tools and ideas in the data scientist's toolbox. The course gives an overview of the data, questions, and tools that data analysts and data scientists work with. There are two components to this course. The first is a conceptual introduction to the ideas behind turning

data into actionable knowledge. The second is a practical introduction to the tools that will be used in the program like version control, markdown, git, GitHub, R, and RStudio.

Course Outcome:

CO1: Set up R, R-Studio, Github and other useful tools

CO2: Understand the data, problems, and tools that data analysts use

CO3: Explain essential study design concepts

CO4: Create a Github repository

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓				✓
CO2	✓	✓		✓					✓
CO3	✓		✓						✓
CO4	✓				✓			✓	✓

Course Content:

Module 1: Data Science Fundamentals: Why Automated Videos?, What is Data Science?, What is Data?, Getting Help, The Data Science Process.

Module 2: R and RStudio, Installing R, Installing R Studio, RStudio Tour, R Packages, Projects in R.

Module 3: Version Control and GitHub, Version Control, Github and Git, Linking Github and R Studio, Projects under Version Control.

Module 4: R Markdown, Scientific Thinking, and Big Data, R Markdown, Types of Data Science Questions, Experimental Design, Big Data.

Text Books:
1. Data Science Mindset, Methodologies, and Misconceptions By Zacharias Voulgaris
2. Domain-Specific Languages in R, Advanced Statistical Programming By Thomas Mailund

Reference Books:
1. R programming for data science by *roger d. Peng*
2. The analytics lifecycle toolkit a practical guide for an effective analytics capability, by greg nelson

Specialization Elective Course:
Cloud Computing

TITLE OF COURSE: INTRODUCTION TO CLOUD COMPUTING
COURSE CODE: CC401
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of Virtualization utilization in big data handling.

Introduction:
The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services.

Course Outcomes (CO):
The students will be able to know the basics of virtualization technology, hypervisors and cloud computing concepts

CO1: Understand what Cloud Computing is.
CO2: Understand what Virtualization is.
CO3: Understand Cloud Types and Cloud Service Deployment Models (IaaS*, PaaS*, SaaS*).
CO4: Learn How to Create Virtual Machines (VM) using Hypervisors (type-2).
CO5: Understand Computer Networks and IP Addressing.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓	✓				✓
CO3	✓	✓	✓		✓				✓
CO4	✓	✓	✓		✓				✓
CO5			✓					✓	✓

Course Contents:

Module-1: Overview: introduction to cloud computing, OS and Virtualization, VM, advantage of Virtualization, Virtualization and cloud and its overlapping, service driven model, advantage of cloud computing: marketing point of view, types of services, business value, business impact of cloud, technological value of cloud, end user benefits, change for provider and administrator, pros and cons of cloud model, anatomy of cloud, solution component, service catalog, user self-service portal, service request management, provisioning, optimized infrastructure, chargeback, benefit of cloud, delivery and deployment model, different cloud architecture: public, private and hybrid and its pros and cons, delivery

models. Cloud transformation roadmap, history of cloud, Clint-server, cluster, grid models, cloud vs grid and their relationship, cluster and cloud, utility computing and evolution of cloud computing, cloud computing.

Module-2: Introduction to Virtualization. Overview of Virtualization: Need of Virtualization, traditional IT Infrastructure, shortcoming of physical infrastructure, benefit of Virtualization, comparison of traditional IT infrastructure with virtualized infrastructure.

Module-3: Virtualization: Implementing Virtualization, typical hardware / software server stack and its logical equivalence, pre/post virtualization server stack ,types of virtualization, area and technology based classification, history of virtualization, time sharing system, IBM mainframe and Power virtualization, Extending Virtualization to x86 and its hardware support, impact of Virtualization: cost and manageability impact.

Module-4: Server and Storage Virtualization. Types of Server Virtualization, simulation, Hardware Assisted Virtualization, Hypervisors, Ring levels on x86 processors, types of Hypervisors, IBM PowerVM Hypervisors, common consideration in server Virtualization, Desktop Virtualization: Benefits Constraints and Types. Anatomy of server Virtualization, three major layers in Xen server, storage Virtualization overview: benefit and types, features of logical layers, Host level storage Virtualization, host based mirroring, storage level Virtualization, network based storage Virtualization.

Module-5: Network and Application Virtualization. Network Virtualization overview: VPN, VLAN, challenges in using application in traditional install, use and update model, solution for challenges, Architecture, benefits of Application Virtualization.

Module-6: Cloud Implementation, Deployment and Delivery Models. Cloud Deployment models: Public, Private, Hybrid, pros and cons of each architecture, cloud deployment decision factors, Business IT Control, Business critical application, data and transaction security, compliance and audit, balance of CAPEX and OPEX, workload characteristics, workload lifespan preferences, Industry segment- SME and Large enterprises, Data Freedom, software characteristics, time to deploy, Public Cloud: factor matrix, advantage, disadvantage, Public Cloud: Factor Matrix, advantage and disadvantage, Hybrid Cloud: factor matrix, advantage, disadvantage, Overview of Cloud delivery models, infrastructure, IT Layers, IaaS Overview, features, cloud bursting, multi tenancy, resource pooling, PaaS: overview, component, example, SaaS: advantage, example.

Module-7: Case Study on Virtualization and Cloud workloads. Case study overview, customer IT landscape, function of data center, trigger for virtualization, preparation for virtualization, server selection, server sizing, server criticality, provisioning, proximity and locality, transition tool for virtualization, cost savings, cloud workload overview, workload characterization, factor s, suitable workload for cloud, private cloud solution, types of workload, advantage, mission. critical workload, mixed workload, production only workload for hybrid cloud, industry specific workload, non-suitable workload: public, private cloud, possible workload by cloud.

Text Books:
1. Introduction to Virtualization and Cloud Computing (IBM ICE Publication).

Reference Books:
1. " Distributed and Cloud Computing " By Kai Hawang , GeofreyC.Fox, Jack J. Dongarra Pub: Elservier
2. Cloud Computing, Principal and Paradigms, Edited By RajkumarBuyya, JemesBroberg, A. Goscinski, Pub.- Wiley
3. Kumar Saurabh, "Cloud Computing", Wiley Pub
4. Krutz , Vines, "Cloud Security " , Wiley Pub
5. Velte, "Cloud Computing- A Practical Approach", TMH Pub

TITLE OF COURSE: INTRODUCTION TO CLOUD SECURITY
COURSE CODE: CC502
L-T-P: 3-0-0

CREDITS: 3

Pre requisites:
1. Knowledge of a programming language such as Python, Java or C/C++
2. Students are expected to have broad understanding of different aspects of how computer systems work.
3. It is strongly recommended that the student have a working knowledge of computer networks.
4. The students should also feel comfortable with algorithmic concepts and modular arithmetic.

Introduction:
Information is an important strategic and operational corporate asset. These days computers and computer networks, are increasingly being used for storing and retrieving information. Some of these information may be of a sensitive nature. Consequently they need to have adequate security measures that can safeguard sensitive information. In this course, we will begin by investigating some of the security measures that can be employed to safeguard information. For the most part we will look into the theory that goes into designing these measures rather than studying security tools and techniques. This is because there are too many of those tools out there and they are changing frequently. The course examines how system designs, network protocols, and software engineering practices can result in vulnerabilities. The course explores how to better design and implement future systems in order to mitigate vulnerabilities. In addition, the course explores how to detect and mitigate vulnerabilities in existing systems

Course Outcomes (CO):
CO1: Understand the fundamental principles of access control models and techniques, authentication, and secure system design
CO2: Have a strong understanding of different cryptographic protocols and techniques and be able to use them
CO3: Apply methods for authentication, access control, intrusion detection and prevention
CO4: Identify and mitigate software security vulnerabilities in existing systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓			✓	✓

Course Contents:
Module-1: Introduction to Cloud Security. Introduction- Architectural and Technological Influences of Cloud Computing -the Cloud deployment models security concepts- Cloud Computing Roles- threats-risk modeling and security services-Proactive activity monitoring, Incident Response -Monitoring for unauthorized access, malicious traffic, abuse of system privileges, intrusion detection, events and alerts - Auditing – Record generation, Reporting and Management- Tamper-proofing audit logs - Quality of Services - Secure Management -Identity management - Security Information and Event Management.
Module-2: Access control models: Policy, Compliance and Risk Management in Cloud Computing-Discretionary and mandatory access control- Covert channels and Chinese Wall-Clark-Wilson, RBAC, ABAC.
Module-3: Introduction to cryptography, Secret key cryptosystems- Key escrow-Modular Arithmetic and Public key cryptosystems-Public key cryptosystems- Diffie-Hellman, RSA, El-Gammal- Pairing based cryptosystems, IBE and attribute-based encryption.

Detailed Syllabus for Bachelor of Computer Application

Module-4: Message digests, Merkle hashes, digital signatures-Identification and authentication, Passwords, Biometrics- One-time passwords and challenge response schemes, Kerberos- SSL, SSH

Module-5: Wireless Security. Wireless Security- Privacy- Cloud Compliance Assessment and Reporting - Case Study- PCI DSS 3.0 Compliant Cloud Tenant- Protecting PHI in Cloud.

Text Books:
1. Charles P. Pfleeger, "Security in Computing", Prentice Hall.
2. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall.

Reference Books:
1. William R. Cheswick and Steven M. Bellovin, "Firewalls and Internet Security: Repelling the Wily Hacker", Addison-Wesley.
2. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network Security: Private Communication in a Public World", Prentice Hall.
3. Marshall D. Adams, Sushil Jajodia and Harold J. Podell, eds., "Information Security: An Integrated Collection of Essays". IEEE Computer Society Press.
4. Edward Amoroso, "Fundamentals of Computer Security Technology", Prentice-Hall.

TITLE OF COURSE: CLOUD ADAPTATION AND MIGRATION
COURSE CODE: CC503
L-T-P SCHEME: 3-0-2
COURSE CREDITS: 4

Pre requisites: For this course it's assumed that you have a working knowledge of Cloud Computing and Cloud principles

Introduction:
In this course we will study the important terminology and familiar with cloud adaptation, cloud migrations, some of the constraints that cloud avoid cloud migration, legacy hardware and software architecture.

Course Outcomes (CO):
From this course students will be able to learn about intra cloud data adaptation and inter cloud data migration. Students will also get some sense to implement data migration techniques from this course.
CO1: Have a greater visibility of some of the key points of a Cloud Migration.
CO2: Be able to confidently assess the requirements for your migration.
CO3: Get Knowledge about data migration techniques
CO4: Understand about Intra cloud data adaptation.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓					✓	✓

Course Contents:
Module-1(Cloud computing definition and use cases): Introduction – Component of CC – Comparing CC with Virtualization, Grids, Utility Computing, client- server model, P-to-P Computing - Key Drivers for Cloud Computing - Cloud computing Service delivery model, Cloud Types – Private, Public and Hybrid. Introduction to cloud computing &it's application. Goal of cloud adaptation and migration. Various use cases of cloud computing.

Module-2 (Adopting the cloud): Instantaneous provisioning of computing resources, tapping into an infinite storage capacity, cost-effective pay-as-you-use billing models. Handling sensitive data, aspects of cloud security, assessing governance solutions. Adoption of Public cloud by SMBs- Public Cloud Adoption phase for SMBs- Vendor liability and Management Adoption process of Public clouds by Enterprises – Managed Private clouds Migrating Application to the cloud – Impact of Shared Resources and Multi-Tenancy on cloud Applications – Phases during Migration an Application to An IaaS Cloud

Module-3: Introduction, definition, cloud adaptation architecture, adaptation techniques, decision engine architecture, adaptation in cloud resource configuration, VM- adaptation

Module-4 (Migration Framework): Re-architecting applications for the cloud, integrating the cloud with existing applications, avoiding vendor lock-in, planning the migration and selecting a vendor.

Module-5 (Migration Planning & Discovery): Identifying and mitigating risk, The 6 R's of cloud migration, asset and application discovery, licensing, data sovereignty, and governance.

Module-6 (Mobile Cloud computing): Introduction, Definition, Architecture, Benefits, challenges in mobile and at cloud shield.

Text Books
1. Cloud Migration from on-premise data center to AWS by Charista Keiko
2. Cloud Computing: Concepts, Technology & Architecture by RichardoPuttini, Thomas Erl, and Zaigham Mahmood

TITLE OF COURSE: CLOUD ARCHITECTURE & DEVELOPMENT MODEL
COURSE CODE: CC504
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of grid computing and cloud computing introduction.

Introduction:
The objective is to study the architecture and deployment models to develop a private cloud using the open standards tools such as open stack. Cloud is the future of computing. It is about outsourcing of IT services and infrastructure to make them accessible remotely via the Internet. Utilizing cloud-computing models boosts not only productivity but also provide a competitive edge to organizations. The growing popularity of cloud computing has given rise to different types of cloud service deployment models and strategies. Therefore, today there exists a variety of enterprise cloud solutions depending on the degree of desired outsourcing needs.

Course Outcomes (CO):
After successful completion of this course, the students will be able to:
CO1: Understand the architecture and deployment model of cloud computing.
CO2: Understand the architecture and components related to open stack.
CO3: Understand other open standards tools for deploying a private cloud such as Eucalyptus.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓		✓						✓

Course Contents:
Module-1: Definition of cloud computing, Delivery Models, Conceptual reference model, Cloud Computing solution components.
Module-2: Cloud computing Architecture:The conceptual reference model, Service Deployment, Cloud service management, cloud taxonomy, IBM CC RA, Common cloud management platform. Case Study:IBM Smart Cloud Entry, VMware vClouddirector.
Module-3: Cloud vendor selection:SLA, Security and privacy, periodic update and maintenance, data location and Jurisdiction, Measurability, Pricing, Interoperability and lock in, Exit process, track record.
Module-4: Open Stack:Definition, Advantages, Releases, Architectural overview, Different components of Open Stack, Open stack- Hypervisors, Network Services, Storage- Block Storage, Object Storage, Choosing Storage Backends , Commodity Storage Backend Technologies: swift, Ceph, Gluster, LVM, ZFS.
Module-5: Advance concepts in Openstack: MultiserverOpenstack, Tenant model architecture, Cloud orchestration using OpenStack using OpenStack Heat and Ubuntu Juju. Eucalyptus: Introduction, Features and Functionality, Architecture, Basic and Advanced Components. Eucalyptus vs Openstack. OpenNebula: Introduction, Features and Functionality, Architecture, Basic and Advanced Components. OpenNebula vs Open stack

Text Books:
1. Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski (2011), Cloud Computing: Principles and paradigms.
2. Rittinghouse, John, W, Cloud computing: Implementation, management and security

Reference Book:
1. Barrie Sosinsky (2011), Cloud Computing Bible, Wiley.
2. Bumgardner, V. C. (2016). OpenStack in action. Manning Publications Company.

TITLE OF COURSE: AWS FUNDAMENTAL
COURSE CODE: CC605
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of how the AWS cloud infrastructure is built, walk you through Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Lightsail compute services.

Introduction:
This course gives current or aspiring IT professionals an overview of the features, benefits, and capabilities of Amazon Web Services (AWS). As you proceed through these Module interconnected courses, you will gain a more vivid understanding of core AWS services, key AWS security concepts, strategies for migrating from on-premises to AWS, and basics of building serverless applications with AWS.
Course Outcomes (CO):
After successful completion of this course, the students will be able to:
CO1: Understand the core AWS services

CO2: Understand the key AWS security concepts
CO3: Understand the strategies for migrating from on-premises to AWS.
CO4: Understand basics building serverless applications with AWS.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓				✓
CO2	✓	✓		✓					✓
CO3	✓	✓							✓
CO4	✓	✓	✓					✓	✓

Course Contents:

Module-1: Aws Fundamentals: Going Cloud-Native, Introduced To The Course And Learn About Aws Services, Infrastructure, And Compute Services, Networking And Storage On Aws, Databases On Aws, Monitoring And Scaling.

Module-2: AWS Fundamentals: Addressing Security Risk, basic concepts such as "least privilege" and the "Shared Responsibility Model, network isolation and endpoint security, Detective controls such as Amazon Cloud Trail as well as AWS Security Hub, Amazon Guard Duty and AWS Config, encryption of data at rest, in motion, store data within and between various AWS services, Amazon EC2 and AWS Lambda, AWS Well-Architected Framework.

Module-3: AWS Fundamentals: Migrating to the Cloud, Defining what we mean by Migration, Migration Preparation and Business Planning, Portfolio Discovery and Planning ,Design, Migration and Application Validation ,Operate, Cloud Adoption Framework - Hybrid Environments, Scaling Considerations, High Availability, Considerations with Migrating DB vs Applications, AWS Server Migration Services, VM Import and VM on AWS (Server Migration Service),Introduce AWS Migration Hub, AWS Application Discovery Service, Amazon EFS, Amazon EBS, & Amazon S3,

Module-4: Storage - AWS Snowball & AWS Snowmobile, AWS Storage Gateway Now with AWS DataSync, Storage - AWS DMS Overview, Storage - AWS DMS Core Features, Storage Schema Conversion ,Storage - Amazon Aurora (Serverless), AWS Direct Connect & Amazon Route 53, Automation - AWS API Centricity, AWS System Manager & AWS Cloud Formation, Overview and TSO Logic, Migration Tools - Cloud Endure.

Module-5: AWS Fundamentals: Building Serverless Applications, Amazon Lex, Amazon Lex Walkthrough, Introduction to Amazon Cloud Front, AWS Identity Access Management (IAM), Introduction to Serverless Computing with AWS Lambda

Text Books:
1. Amazon web services in action, written by andreas witting and michael wittig
2. Mastering AWS Development, written by Uchit Vyas

Reference Books:
1. Implementing cloud design patterns for aws, written by marcus young.
2. Aws administration – the definitive guide, written by yohan wadia.

Specialization Elective Course
<mark>Block Chain</mark>

TITLE OF COURSE: BLOCKCHAIN TECHNOLOGY
COURSE CODE: BC401
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in networking.
Introduction:
This course describe basic blockchain technology in networking system. The Topics to be covered (tentatively) include: an introduction to blockchain, Crypto asset or Digital asset, Ethereum Blockchain, Bitcoin & Blockchain, Decentralized Systems and Ethereum Blockchain.

Course Outcomes (CO):
In this course we will study the basic components of blockchain. Students are expected to be capable of understanding the cryptocurrency, their advantages and drawbacks, how to implement them in blockchain, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to design & implement any blockchain properly.
CO2: Students would be able to implement any problem by writing their own algorithm in blockchain.
CO3: By analyzing, students would be able to implement public private key combination in security.
CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓				✓	✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Basic introduction about blockchain in digital world, Crypto asset or Digital asset, Self Sovereign Identity, Smart Contract, Decentralized Business Model, Device to device communication in blockchain
Module-2: Network Security, Different type of network attack, Warm hole attack, byzantine attack, network based attack etc, Trust based Secure routing schemes.

Detailed Syllabus for Bachelor of Computer Application

Module-3: Bitcoin & Blockchain : Blockchain Structure, Basic Operations, Beyond Bitcoin, Gas , minor's role in blockchain.

Module-4: Ethereum Blockchain : Smart Contracts, Ethereum Structure, Ethereum Operations, Incentive Model in blockchain.

Module-5: Cryptography and crypto currency: Algorithms & Techniques Public-Key Cryptography, Public key and private key combinations in Blockchain security, Hashing, Transaction Integrity, Securing Blockchain.

Module-6: Decentralized Systems: Consensus Protocol, Practitioner's Perspective Decentralized Governance, Robustness, Forks.

Text Books

1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, by Elad Elrom, ISBN-13: 978-1484248461, ISBN-10: 1484248465

References

1. Blockchain Technology Explained: The Ultimate Beginner's Guide about Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts, by Alan T. Norman

TITLE OF COURSE: BLOCKCHAIN COMPONENT & ARCHITECTURE
COURSE CODE: BC502
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in blockchain and networking.

Introduction:

This course described implementation and architecture of blockchain. The Topics to be covered (tentatively) include: an introduction to Blockchain history, Digital Money, Hash, Signature, Blockchains design goals, Blockchain for Government: Digital identity and records.

Course Outcomes (CO):

In this course we will study the basic components of blockchain in digital asset. Students are expected to be capable of understanding the blockchain architecture, their advantages and drawbacks, how to implement them in network, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to design & implement blockchain as a digital asset properly.

CO2: Students would be able to implement different security algorithm in blockchain.

CO3: By analyzing the logic of any algorithm, students would be able to implement Blockchain in Financial Software and Systems.

CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓					✓	✓

	CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Introduction to Blockchain history: Digital Money to Distributed Ledgers Design Primitives: Protocols, Security, Consensus, Permissions, Privacy
Module-2: Blockchain Architecture and Design. Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms
Module-3: Consensus, Requirements for the consensus protocols, Proof of Work (PoW) Scalability aspects of Blockchain consensus protocols
Module-4: Permissioned Blockchains, Design goals, Consensus protocols for Permissioned Blockchains Hyperledger, Decomposing the consensus process Hyperledger fabric components Chaincode Design and Implementation Hyperledger Fabric beyond Chain code fabric SDK and Front End, Hyperledger composer tool
Module-5: Blockchain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance
Use case II: Blockchain in trade supply chain: Provenance of goods, visibility, tradesupply chain finance, invoice management discounting, etc
Module-6: Blockchain for Government: Digital identity, and records and other kinds of record keeping between government entities, public distribution system social welfare systems
Module-7: Blockchain Cryptography Privacy and Security on Blockchain, Blockchain consensus protocols, Various recent works on scalability
Module-8: Secure cryptographic protocols on Blockchain Secured, Multi-party Computation, Blockchain, for science: making better use of the data-mining network, Case Studies:
Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more

Text Books
1. Blockchain Technology Explained, by Alan T. Norman

References
1. Blockchain: Ultimate guide to understanding blockchain, bitcoin, cryptocurrencies, smart contracts and the future of money.
2. The Bitcoin Standard: The Decentralized Alternative to Central Banking by Saifedean Ammous

TITLE OF COURSE: TRANSACTION ON BLOCK CHAIN
COURSE CODE: BC503
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Basic concepts in blockchain technology.
Introduction:
This course examines basic block chain. The Topics to be covered (tentatively) include: an introduction to Cryptoassets, Smart Contracts, Digital Signatures, Financial Services etc.

Course Outcomes (CO):
In this course we will study the basic components of cryptoasset and transaction of blockchain. Students are expected to be capable of understanding the smart contract, their advantages and drawbacks, how to implement them in blockchain, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any transaction at blockchain properly.

CO2: Students would be able to implement any problem by writing their own business idea.
CO3: By analyzing the logic of transaction, students would be able to write efficient business proposal in blockchain.
CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Cryptoassets, Cryptocurrencies, Protocol Tokens, Utility Tokens (App Coins),Security Tokens, Natural Asset & Commodity Tokens, Crypto-collectibles, Crypto-fiat Currencies and Stable coins, Practitioner Perspective – Tokenomics, Practitioner Perspective - Cristina Dolan: Cryptoassets, Initial Coin Offerings: A New Breed of Meta-Asset, Practitioner Perspective - Rolf Hoefer: ICOs, Recap of Cryptoassets Protocol Tokens, Utility Tokens (App Coins), Security Tokens, Natural Asset & Commodity Tokens.
Module-2: Smart Contracts, Practitioner Perspective - Rolf Hoefer: Smart Contracts, Smart Contract Phases, Smart vs. Traditional Contracts, Smart Contracts and Law, Practitioner Perspective - Smart Contracts, Smart Contract Application Areas, Practitioner Perspective - Rob Carter: Smart Contracts, Smart Contract Strategies & Best Practices for the Organization, Smart vs. Traditional Contracts, Smart Contract Application Areas
Module-3: Identity, Introduction to Identity and Identifiers, Five Problems With Identifiers, Distributed, Self-sovereign Identity Systems, Practitioner Perspective - Carlos Augier: Identity,
Blockchain Identity Applications, Practitioner Perspective - Stephen Tse & Li Jiang: Personal Data, Managing Health Data on a Blockchain, Polyalphabetic Ciphers, Symmetric Digital Signatures, RSA, ECC, ECDS
Module-4: Rethinking Finance, Six Inefficiencies in Financial Services, The Golden Eight Part, The Golden Eight Part, Problems With Modern Accounting, The World Wide Ledger, Rethinking Financial Services, The Golden Eight, New Frameworks for Accounting, The Golden Eight

Text Books
1. A Practical Guide to Blockchain and its applications by Parikshit Jain, Publisher: Bloomsbury India

References
1. Blockchain Enabled Applications: Understand the Blockchain Ecosystem and How to Make it Work for You, by Vikram Dhillon & David Metcalf & Max Hooper

TITLE OF COURSE: BLOCK CHAIN OPPORTUNITY ANALYSIS
COURSE CODE: BC504
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in blockchain.

Introduction:
This course examines Blockchain Transformations for Every Industry. The Topics to be covered (tentatively) include: Industry Transformations, Introduction to the Blockchain Case Commons, Problem Solving with Blockchain, Decision Matrix, and Statement of Benefit.

Course Outcomes (CO):
In this course we will study the business are of blockchain. Students are expected to be capable of understanding the implementation blockchain in industry, their advantages and drawbacks, how to implement them in network, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to analyses opportModuley in blockchain properly.
CO2: Students would be able to implement any problem by writing their own business idea.
CO3: By analyzing the logic of transaction, students would be able to write efficient business proposal in blockchain.
CO4: To become an efficient blockchain administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Blockchain Transformations for Every Industry, Practitioner Perspective: Rob Carter, CIO at FedEx, How to Use the Blockchain Case Commons, Decentralizing the Enterprise, Blockchain & ConsenSys, Transaction Costs and the Structure of the Firm, OpportModuley Search, OpportModuley Contracting, OpportModuley Coordination, OpportModuley, Building Trust, Determining Corporate Boundaries, Hacking Your Future: Boundary Decisions, Decentralizing the Enterprise, Transaction Costs and the Structure of the Firm
Module-2: Industry Transformations, Introduction to the Blockchain Case Commons, Exploratory Market Research, Conducting Preliminary Market Research, How to Perform a Competitive Analysis, Intellectual Property, Payments, Attribution, and Licensing, Distributed Ownership
Module-3: APAC Business Development & Strategic Relations, Use a Decision Matrix, Problems That Blockchain Can and Cannot Solve, Blockchain OpportModuley Brainstorm, Problem Solving With Blockchain, Decision Matrix, Statement of Benefit,
Module-4: Keyless Technologies, Strategic Positioning of Your Organization, Regulatory Principles, Regulation, Regulation vs. Governance, Regulation & Governance, The Blockchain Stack, Multiple Layers of Blockchain Governance, A New Framework for Blockchain Governance, Practitioner Perspective - Rob Carter: Governance, Profile of a Blockchain Hotbed

Text Books
1. Blockchain: Blueprint for a New Economy Kindle Edition, by Melanie Swan

References
1. The Internet of Money Kindle Edition, by Andreas M. Antonopoulos
2. Bitcoin Billionaires: A True Story of Genius, Betrayal, and Redemption, by Ben Mezrich

TITLE OF COURSE: BIT COIN AND CRYPTO CURRENCY
COURSE CODE: BC605
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in blockchain architecture.
Introduction: This course examines bit coin as a crypto currency. The Topics to be covered (tentatively) include: an introduction to crypto currency, Hash Functions, Hash Pointers, Bitcoin Transactions, Bitcoin Scripts, Applications, payment service in bit coin.

Course Outcomes (CO):
In this course we will study the bit coin as a crypto currency. Students are expected to be capable of understanding the crypto currency, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement bit coin as a crypto currency properly.
CO2: Students would be able to implement Ethereum under the hood.
CO3: By analyzing the logic of any hash function, students would be able to implement crypto asset.
CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency, Transacting in Bitcoin, Why Cryptocurrency.
Module-2: Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity, the Block Chain, Incentives and Proof of Work, Putting It All Together, The Digital Signature, A Tamper Proof Ledger, Examples, Distributed Consensus, Proof of Work, Mining and Currency Supply.
Module-3: Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations & Improvements, Cryptocurrency as an Asset Class, Risk and Return to Cryptocurrency, Review of Portfolio Theory, Asset Allocation with Cryptocurrency, Mining, Crypto Classifications, The Crypto Vision, Ethereum Overview, Ethereum Under the Hood, The DAO, Private Blockchains.
Module-4: How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets, Building the Blockchain, Crypto Finance, Business Use Cases, Blockchain in Gaming, Investing in Blockchain, Government and Regulation, Media and Advocacy1m, Creating the New Frontier of FinTech.

Text Books
1. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten
References
1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, by Elad Elrom, ISBN-13: 978-1484248461, ISBN-10: 1484248465

Specialization Elective Course:
Artificial Intelligence & Machine Learning

Title of Course: INTRODUCTION TO ARTIFICIAL INTELLIGENCE
Course Code: AIML401
L-T-P: 2-0-2
Credits: 3

Pre-requisite: Knowledge is also assumed of basic concepts on Mathematics, Strong experience of programming languages, writing algorithm for finding patterns and learning.

Introduction:
In this course we will study the basic components of an intelligent system, their functions, mechanisms, policies and techniques used in their implementation and examples.

Course Outcomes (CO):
The students will have a detailed knowledge of
CO1: The concepts of artificial intelligence,
CO2: Various applications of AI in different fields,
CO3: Aware of a variety of approaches to AI techniques

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						✓
CO2	✓			✓					✓
CO3	✓	✓							✓
CO4	✓	✓							✓

Course Contents:
Module-1 (Introduction to AI): Definitions, Goals of AI, AI Approaches, AI Techniques, Branches of AI, Applications of AI. Introduction of Intelligent Systems: Agents and Environments, Good Behavior: the concept of Rationality, The Nature of Environments, The structure of Agents, How the components of agent programs work.
Module-2 (Problems Solving, Search and Control Strategies)
Solving Problems by Searching, Study and analysis of various searching algorithms. Implementation of Depth-first search, Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening

depth-first search, Bi-directional search Informed (Heuristic) Search Strategies: Greedy best-first search A* search: Minimizing the total estimated solution cost, Conditions for optimality: Admissibility and consistency, Optimality of A*, Memory-bounded heuristic search, Heuristic Functions, Generating admissible heuristics from sub problems: Pattern databases, Learning heuristics from experience. Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hillclimbing search Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Non-deterministic Actions: AND-OR search trees, Searching with Partial Observations. Adversarial Search and Constraint Satisfaction Problems, Study of min-max algorithm Adversarial Search: Games, Optimal Decisions in Games, The mini-max algorithm, Optimal decisions in multiplayer games, Alpha--Beta Pruning, Move ordering , Imperfect Real-Time Decisions, Evaluation functions, Cutting off search, Forward pruning, Search versus lookup, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, Alpha-beta pruning and CSP, Implementation aspects of minimax algorithm and CSP.

Module- 3 (Knowledge Representations Issues, Predicate Logic, Rules)
Knowledge representation, KR using predicate logic, KR using rules. Reasoning System - Symbolic, Statistical: Reasoning, Symbolic reasoning, Statistical reasoning.

Module-4 (Quantifying Uncertainty, Learning Systems)
Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees. Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples.

Module-5 (Expert Systems)
Introduction, Knowledge acquisition, Knowledge base, working memory, Inference engine, Expert system shells, Explanation, Application of expert systems. Fundamentals of Neural Networks: Introduction and research history, Model of artificial neuron, Characteristics of neural networks, learning methods in neural networks, Singlelayer neural network system, Applications of neural networks. Fundamentals of Genetic Algorithms: Introduction, Encoding, Operators of genetic algorithm, Basic genetic algorithm.

Text Books
1. Rich, Elaine Knight, Kevin, Artificial Intelligence, Tata McGraw Hill.
2. Luger, George F, Artificial Intelligence: Structures and Strategies for Complex
Problem Solving, Pearson Education.

References
1. Nilsson, Nils J, Artificial Intelligence, Morgan Kaufmann.
2. Russell, Stuart J. Norvig, Peter, AI: A Modern Approach, Pearson Education.

TITLE OF COURSE: MACHINE LEARNING TECHNIQUES
COURSE CODE: AIML502
L-T-P: 2-0-2
CREDITS: 3

Pre-Requisites: Fundamental knowledge of computer science principles and skills, probability and statistics theory, and the theory and application of linear algebra are required.

Introduction:
Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention.

Course Outcomes (CO):
By the end of the course, students should be able to
CO1: Differentiate various Learning Approaches, and to interpret the Concepts of Supervised Learning.
CO2: Compare the different dimensionality reduction techniques.
CO3: Apply theoretical foundations of Decision Trees to identify best split and Bayesian Classifier to Label data points.
CO4: Illustrate the working of classifier models Like SVM, Neural Networks and Deep Neural Networks Classifier Model for typical Machine Learning Applications.
CO5: Illustrate and apply clustering algorithms and identify Its applicability in real life problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓	✓		✓			✓
CO4	✓	✓	✓	✓					✓
CO5	✓	✓	✓	✓					

Course Contents:
Module-1: Introductions, Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation
Module-2: Linear regression, Decision trees, overfitting
Module-3: Instance based learning, Feature reduction, Collaborative filtering based recommendation, Probability and Bayes learning
Module-4: Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM
Module-5: Neural network, Perceptron, multilayer network, backpropagation, introduction to deep neural network
Module-6: Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning

Text Books
1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin
References
1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.

TITLE OF COURSE: COMPUTER VISION
COURSE CODE: AIML503
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of data structure and algorithm, image processing, programming concepts and linear algebra.

Introduction:
This course examines development of algorithms and techniques to analyze and interpret the visible world around us. The Topics to be covered (tentatively) include:
- Digital Image Formation and low-level processing
- Depth estimation and Multi-camera views
- Feature Extraction
- Image Segmentation
- Pattern Analysis
- Motion Analysis
- Shape from X

Course Outcomes (CO):
CO1: Understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.
CO2: Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision.
CO3: Applications range from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓					✓
CO2	✓	✓	✓	✓	✓				✓
CO3	✓		✓		✓	✓			✓

Course Contents:
Module 1: Introduction: Introduction to Computer Vision, Case study: Face Recognition.
Module 2: Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.
Module 3: Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel
Module 4: Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis-Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.
Module 5: Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.
Module 6: Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.
Module 7: Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Module 8: Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Text Books
1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003

References
1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

TITLE OF COURSE: APPLICATION OF MACHINE LEARNING IN INDUSTRIES
COURSE CODE: AIML504
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concept of Artificial Intelligence, Machine Learning
Introduction:
Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task
Course Outcomes (CO):
CO1: This incredible form of artificial intelligence is already being used in various industries and professions. For Example, Image and Speech Recognition, Medical Diagnosis, Prediction, Classification, Learning Associations, Statistical Arbitrage, Extraction, Regression.
CO2: After completion of the course student can understand how all these Machine Learning Applications are useful in today's modern world.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							✓
CO2	✓								✓

Course Contents:
Module-1(Overview of Machine Learning): Process and Techniques, Demonstration of ML concepts with Deep Playground, Data Input and Preprocessing with Tensorflow, Machine Learning Model Building, Prediction with Tensorflow, Monitoring and evaluating models using Tensorboard
Module-2 (Education and training): tutoring systems and personalized learning, how they works
Module-3 (Health and medicine): learning treatment policies in the medical sciences, optimal treatment policies, usage of medical equipment, medication dosing, and two-stage clinical trials
Module-4 (Text, speech, and dialog systems): Different procedure of text, speech processing, how chatbot works etc.
Module-5 (Finance): Machine Learning Examples in Finance for Fraud Detection
Module-6 (Retail): Machine Learning Examples in Retail for Product Recommendations, Improved Customer Service; practically how it is done

Module-7 (Image Classification): How Image Recognition and Classification Works, Different procedure, practical example.
Module-8 (miscellaneous): More applications of Machine Learning (like Travel for Dynamic Pricing)

Text Books
1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

References
1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.

TITLE OF COURSE: RECOMMENDED SYSTEM
COURSE CODE: AIML605
L-T-P: 2-0-2
CREDITS: 3

Pre-requisite: Basics of Data Structures and Algorithm, Design and Analysis of Algorithm

Introduction:
Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Course Outcomes (CO):
To develop state-of-the-art recommender systems that
CO1: automate a variety of choice-making strategies
CO2: goal of providing affordable, personal, and high-quality recommendations

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓	✓					✓

Course Contents:
Module 1:
Neighborhood-Based Collaborative Filtering - Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood-Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, A Regression Modeling View of Neighborhood Methods, Graph Models for Neighborhood-Based Methods.
Model-Based Collaborative Filtering - Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box, Latent Factor Models, Integrating Factorization and Neighborhood Models.
Module 2:
Content-Based Recommender Systems - Basic Components, Preprocessing and Feature Extraction, Feature Representation and Cleaning, Collecting User Likes and Dislikes, Supervised Feature Selection

and Weighting, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations. Knowledge-Based Recommender Systems - Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems.

Module 3:
Ensemble-Based and Hybrid Recommender Systems - Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrids, Feature Combination Hybrids, Mixed hybrids. Evaluating Recommender Systems - Evaluation Paradigms, General Goals, Design Issues, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures. Context-Sensitive Recommender Systems - The Multidimensional Approach, Contextual Pre-filtering: A Reduction-Based Approach, Post-Filtering Methods, Contextual Modelling.

Module 4:
Time- and Location-Sensitive Recommender Systems-Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, Structural Recommendations in Networks - Ranking Algorithms, Recommendations by Collective Classification, Recommending Friends: Link Prediction, Social Influence Analysis and Viral Marketing. Social and Trust-Centric Recommender Systems - Multidimensional Models for Social Context, Network-Centric and Trust-Centric Methods, User Interaction in Social Recommenders.

Module 5:
Attack-Resistant Recommender Systems - Understanding the Trade-Offs in Attack Models, Types of Attacks, Detecting Attacks on Recommender Systems, Strategies for Robust Recommender Design.Learning to Rank, Multi-Armed Bandit Algorithms, Group Recommender Systems, Multi-Criteria Recommender Systems, Active Learning in Recommender Systems, Privacy in Recommender Systems, Some Interesting Application Domains

Text Books
1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.

References
1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

TITLE OF COURSE: HUMAN COMPUTER INTERACTION
COURSE CODE: AIML606
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic subjects of CSE like Basic Data structures, Algorithms, FLAT, Software Engg, Operating Systems, Databases, OS, Computer Architecture

Introduction:
Human-computer interaction is an emerging field of study at present, due to the proliferation of large number of consumer electronic products. The key issue in this field is to make the products usable to lay-persons. In order to do that, we need to take care of the (creative) design aspects (the look-and-feel of the interface) and also the system design aspect (both software and hardware). The field is interdisciplinary with inputs required from various other fields. However, the computer science and engineering plays the central role in the design of such systems

Course Outcomes (CO):

After completion of the course, student will

CO1: understand the engineering life cycles for design of interactive systems,

CO2: understand the computational design framework (as part of the life cycle),

CO3: understand the components of the framework including the computational models of users and systems, and evaluation of such systems (with or without users)

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						✓
CO2	✓	✓		✓					✓
CO3	✓		✓						✓

Course Contents:

Module 1: Introduction to user-centric design, historical evolution, issues and challenges and current trend, Components of HCI Types of interfaces Design process

Module 2: Engineering user-centric systems – relation with software engineering, iterative life-cycle, prototyping, guidelines, Contextual inquiry Importance of users / talking to users Task analysis

Module 3: Sketching Low & hi fidelity prototyping, mental models, Usability evaluation think aloud, observing users Modelling users, expert evaluations

Module 4: Information visualization, Empirical research – research question formulation, experiment design, data analysis, statistical significance test

Module 5: HCI & mobility New faces of HCI, Refresher for all modules seen in the course, User-centric design evaluation – overview of evaluation techniques, expert evaluation, user evaluation, model-based evaluation with case studies

Text Books

2. Samit Bhattacharya (July, 2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw-Hill India, Print Edition: ISBN-13: 978-93-5316-804-9; ISBN-10: 93-5316-804-X, E-book Edition: ISBN-13: 978-93-5316-805-6; ISBN-10: 93-5316-805-8

3. Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russel Beale. (2003). Human-Computer Interaction (3rd Edition), Pearson.

References

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen and Steven Jacobs. (2009). Designing the User Interfaces: Strategies for Effective Human-Computer Interaction (5th Edison), Pearson

Specialization Elective Course:
Cyber Forensics & Internet Security

TITLE OF COURSE: INTRODUCTION TO CRYPTOGRAPHY
COURSE CODE: IS401
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Networking and security.

Introduction:
This course examines data security in networking. The Topics to be covered (tentatively) include: an introduction to networking by cryptography, Basic symmetric-key encryption, Message integrity, Public key cryptography, Public key cryptography, Protocols.

Course Outcomes (CO):
In this course we will study the basic components of cryptography. Students are expected to be capable of understanding the cryptography, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement basic concept of cryptography properly.
CO2: Students would be able to implement any problem by writing their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to implement crypto-data set.
CO4: To become an efficient crypto-data programmer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Basics overview of cryptography, Data security in networking, using cryptography in real world.
Module-2: Basic symmetric-key encryption, One time pad and stream ciphers, perfect secrecy and the one time pad, semantic security and stream ciphers, Block ciphers: Feistel networks and iterated Even-Mansour ciphers

Module-3: Message integrity: definition and applications, Collision resistant hashing, Merkle-Damgard and Davies-Meyer. MACs from collision resistance. Authenticated encryption: security against active attacks.

Module-4: Public key cryptography: Arithmetic modulo primes, Cryptography using arithmetic modulo primes, vanilla key exchange (Diffie-Hellman); the CDH and discrete-log assumptions, Public key encryption, semantically secure ElGamal encryption, CCA security, RSA and Rabin functions. Encrypt with trapdoor permutations.

Module-5: Digital signatures: definitions and applications. How to sign using RSA. Hash based signatures, certificates, certificate transparency, certificate revocation.

Module-6: Protocols: Identification protocols, Password protocols, salts; one time passwords (S/Key and SecurID), challenge response authentication, Authenticated key exchange and SSL/TLS session setup, Zero knowledge protocols, Cryptography in the age of quantum computers, Grover's algorithm and symmetric crypto, Shor's algorithm and public key crypto, post-quantum crypto: signatures and key exchange

Text Books
1. "Cryptography Kindle Edition" by WAGmob WAGmob; 1.0 edition (2 August 2013)
2. "Serious Cryptography: A Practical Introduction to Modern Encryption" Kindle Edition Jean-Philippe Aumasson

References
1. "The Handbook of Applied Cryptography" by Menezes, van Oorschot, and Vanstone

TITLE OF COURSE: INTRODUCTION TO CYBER SECURITY
COURSE CODE: IS502
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Information and Network Security.
Introduction:
This course examines cyber security. The Topics to be covered (tentatively) include: an introduction to cyber security, type of attack in network, Public Key infrastructure, Password Cracking, E-commerce Security, Server Management and Firewalls.

Course Outcomes (CO):
In this course we will study the basic idea about cyber security. Students are expected to be capable of understanding the cyber-attack, their advantages and drawbacks, how to prevent them, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to know cyber security properly.
CO2: Students would be able to implement digital signature in digital world.
CO3: By analyzing the logic of any networking algorithm, students would be able to implement algo.
CO4: To become an efficient in network security administrator.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓

CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Module-1: Basics of Communication Systems, Transmission Media, Topology and Types of Networks, TCP/IP Protocol Stacks, Wireless Networks, Information Security Overview: Background and Current Scenario, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography

Module-2: Security Threats and Vulnerabilities, Overview of Security threats, Weak / Strong Passwords and Password Cracking, Insecure Network connections, Malicious Code, Programming Bugs, Cybercrime and Cyber terrorism, Information Warfare and Surveillance.

Module-3: Introduction to Cryptography or Encryption, Digital Signatures, Public Key infrastructure, Applications of Cryptography, Tools and techniques of Cryptography.

Module-4: Security Management, Overview of Security Management, Information Classification Process, Security Policy, Risk Management, Security Procedures and Guidelines, Business Continuity and Disaster Recovery, Ethics and Best Practices.

Module-5: Web Application Tools: Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra.

Module-6: Security Laws and Standards, Security Assurance, Security Laws, IPR, International Standards, Security Audit, SSE-CMM / COBIT etc

Module-7: Introduction to Cyber Crime and law: Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Comp. as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.

Module-8: Server Management and Firewalls, User Management, Overview of Firewalls, Types of Firewalls, DMZ and firewall features, Security for VPN and Next Generation Technologies
VPN Security, Security in Multimedia Networks, Various Computing Platforms: HPC, Cluster and Computing Grids, Virtualization and Cloud Technology and Security

Module-9: System and Application Security, Security Architectures and Models, Designing Secure Operating Systems, Controls to enforce security services, Information Security Models, System Security, Desktop Security, email security: PGP and SMIME, Web Security: web authentication, SSL and SET, Database Security, OS Security Vulnerabilities, updates and patches, OS integrity checks, Anti-virus software, Configuring the OS for security, OS Security Vulnerabilities, updates and patches, Wireless Networks and Security, Components of wireless networks, Security issues in wireless

Text Books
1. Applied Cryptography, Bruce Schneier, 2nd Edition, Wiley & Sons, 1996
2. Firewalls and Internet Security, Repelling the Wily Hacker, William R. Cheswick, and Steven M. Bellovin, Addison-Wesley, 1994

References
1. Handbook of Digital Forensics and Investigations, Eoghan Casey ed., Elsevier Academic Press, ISBN 13: 978-0-12-374267-4
2. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
3. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SModule Belpure, Publication Wiley.

TITLE OF COURSE: DIGITAL FORENSICS
COURSE CODE: IS503
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in network security.

Introduction:
This course examines Computer Forensics. The Topics to be covered (tentatively) include: an introduction to Computer Forensics with basic concepts such as Network Investigations, Malware, Windows Artifacts, Forensic ToolKit, WinHex etc, hidden data, Encryption/Decryption, Steganography.

Course Outcomes (CO):
In this course we will study the basic components of Computer Forensics. Students are expected to be capable of understanding the digital footprint, their advantages and drawbacks, how to implement them in proper security, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to understand hidden data, Encryption/Decryption, Steganography.
CO2: Students would be able to investigative situations and digital crime scene.
CO3: By analyzing the logic use Computer Forensics Tools.
CO4: To become an efficient network admistrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Introduction to Computer Forensics: computer crimes, evidence, extraction, preservation, etc.
Module-2: Overview of hardware and operating systems: structure of storage media/devices; windows/Macintosh/Linux -- registry, boot process, file systems, file metadata.
Module-3: Data recovery: identifying hidden data, Encryption/Decryption, Steganography, recovering deleted files.
Module-4: Digital evidence controls: uncovering attacks that evade detection by Event Viewer, Task Manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary &cache files,
Module-5: forensic, audit/investigative situations and digital crime scene, Criminal Law and Forensics, Network Investigations, Malware, Windows Artifacts, Various (in the past: cell phone forensics; how spinning platter magnetic hard drives work; how flash storage works; how to be an expert witness) investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.
Module-6: Computer Forensic tools: Evaluating Computer Forensics Tool Needs, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Tool Comparisons, Other Considerations

for Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools, Computer Forensics Hardware Tools,
Forensic Workstations, Using a Write-Blocker. Encase, Helix, FTK, Autopsy, Sleuth kit Forensic Browser, FIRE, Found stone Forensic ToolKit, WinHex, Linux dd and other open source tools.
Module-7: Network Forensic: Collecting and analyzing network-based evidence, reconstructing web browsing, email activity, and windows registry changes, intrusion detection, tracking offenders, etc. Mobile Network Forensic: Introduction, Mobile Network Technology, Investigations, Collecting Evidence, Where to seek Digital Data for further Investigations, Interpretation of Digital Evidence on Mobile Network.
Module-8: Software Reverse Engineering: defend against software targets for viruses, worms and other malware, improving third-party software library, identifying hostile codes-buffer overflow, provision of unexpected inputs, Data Representation, Carving Data etc.
Module-9: Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for extraction, preservation, and deposition of legal evidence in a court of law.

Text Books
1. "DIGITAL FORENSICS", by Dr.Jeetendra Pande and Dr. Ajay Prasad, Published by: Uttarakhand Open University, Haldwani.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Fourth Edition, Course Technology. 3. Angus M.Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008.

References
1. Digital Forensics by André Årnes, JOHN WILEY publisher JOHN WILEY, July 2017
2. Computer Forensics: Investigating Network Intrusions and Cyber Crime, EC-Council | Press
3. Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, Syngress imprint of Elsevier.

TITLE OF COURSE: CYBER LAWS & IPR
COURSE CODE: IS504
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Cyber law.

Introduction:
This course examines cyber law & IPR. The Topics to be covered (tentatively) include: an introduction to cyber law, Copyright Protection, Reproducing, Defenses, Ownership and Enforcement of Intellectual Property, Digital Contracts, Digital signature.

Course Outcomes (CO):
In this course we will study the basic components of cyber law & IPR. Students are expected to be capable of understanding the cyber law, their advantages and drawbacks, how to implement them in digital world, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to know cyber law.
CO2: Students would be able to implement copyright protection.
CO3: By analyzing the logic of any law, students would be able to use that.
CO4: To become an efficient network administrator and cyber law expert.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Intellectual Property: Introduction, Protection of Intellectual Property — Copyright, Related Rights, Patents, Industrial Designs, Trademark, Unfair Competition
Module-2: Information Technology Related Intellectual Property Rights Computer Software and Intellectual Property — Objective, Copyright Protection, Reproducing, Defenses, Patent Protection. Database and Data Protection-Objective, Need for Protection, UK Data Protection Act, 1998, US Safe Harbor Principle, Enforcement. Protection of Semiconductor Chips, Objectives Justification of Protection, Criteria, Subject Matter of Protection, WIPO Treaty, TRIPs, SCPA. Domain Name Protection-Objectives, Domain Name and Intellectual Property, Registration of Domain Names, Disputes under Intellectual Property Rights, Jurisdictional Issues, and International Perspective.
Module-3: Patents (Ownership and Enforcement of Intellectual Property) Patents Objectives, Rights, Assignments, Defences in Case of Infringement Copyright-Objectives, Rights, Transfer of Copyright, Work of Employment Infringement, Defenses for Infringement, Trademarks Objectives, Rights, Protection of good will, Infringement, Passing off, Defenses. Designs Objectives, Rights, Assignments, Infringements, Defenses of Design Infringement.
Module-4: Enforcement of Intellectual Property Rights Civil Remedies, Criminal Remedies, Border Security Measures. Practical Aspects of Licensing Benefits, Determinative Factors, Important Clauses, Licensing Clauses.
Module-5: Cyber Law: Basic Concepts of Technology and Law: Understanding the Technology of Internet, Scope of Cyber Laws, Cyber Jurisprudence Law of Digital Contracts: The Essence of Digital Contracts, The System of Digital Signatures, The Role and Function of Certifying Authorities, The Science of Cryptography Intellectual Property Issues in Cyber Space: Domain Names and Related Issues, Copyright in the Digital Media, Patents in the Cyber World. Rights of Netizens and e-Governance: Privacy and Freedom Issues in the Cyber World, e-Governance, Cyber Crimes and Cyber Laws.
Module-6: Information Technology Act, 2000: Information Technology Act, 2000-1 (Sec. 1 to 13), Information Technology Act, 2000-2 (Sec. 14 to 42 and Certifying authority Rules), Information Technology Act, 2000-3 (Sec. 43 to 45 and Sec. 65 to 78), Information Technology Act, 2000 4 (Sec. 46 to Sec. 64 and CRAT Rules), Information Technology Act, 2000-5 (Sec 79 to 90), Information Technology Act, 2000-6 (Sec. 91-94) Amendments in 2008.

Text Books
1. "IPR and CYBER LAWS" by Adv. (Prof.) Sunil N. Shah,   Himalaya publishing house.
2. IPR & Cyber Laws (April – 2017) Kindle Edition

References
1. CYBER LAW LAW OF INFORMATION TECHNOLOGY AND INTERNET 1st Edition (English, Paperback, Anirudh Rastogi)

TITLE OF COURSE: INTRUSION DETECTION AND PREVENTION SYSTEM
COURSE CODE: IS605

L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Computer Network

Introduction:
This course examines basics Intrusion Detection and Prevention System. The Topics to be covered (tentatively) include: an introduction to History of Intrusion detection, Audit, Network IDs protocol, Snort Installation Scenarios.

Course Outcomes (CO):
In this course we will study the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets. Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.
CO1: Students would be able to know Intrusion Detection and Prevention System.
CO2: Students would be able to implement any Network IDs protocol by their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to write efficient program.
CO4: To become an efficient network administrator.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: History of Intrusion detection, Audit, Concept and definition , Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.
Module-2: Intrusion Prevention Systems, Network IDs protocol based IDs ,Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis , techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis
Module-3: Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and
Install Snort Location of Snort Files, Snort Modes Snort Alert Modes.
Module-4: Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL
Module-5: Using ACID and Snort Snarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs.

Text Books
1. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003.

References

1. Christopher Kruegel,Fredrik Valeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005.
2. Carl Endorf, Eugene Schultz and Jim Mellander " Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
3. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002.
4. T. Fahringer, R. Prodan, "A Text book on Grid Application Development and Computing Environment". 6th Edition, KhannaPublihsers, 2012.

TITLE OF COURSE: ETHICAL HACKING
COURSE CODE: IS606
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts of Networking.

Introduction:
This course examines Ethical Hacking and security basics. The Topics to be covered (tentatively) include: an introduction to Ethical Hacking, importance of security, Foot-printing & Port Scanning, Hacking Web Services & Session Hijacking, Hacking Wireless Networks.

Course Outcomes (CO):
In this course we will study the basic components of Ethical Hacking. Students are expected to be capable of understanding the digital foot-print, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any digital security properly.
CO2: Students would be able to implement System Hacking their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to Hacking Web Services & Session Hijacking.
CO4: To become an efficient network administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: The importance of security, Concept of ethical hacking and essential Terminologies Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking
Module-2: Foot printing & Port Scanning: Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS
Module-3: System Hacking : Aspect of remote password guessing, Role of eavesdropping ,Various

methods of password cracking, Keystroke Loggers, Understanding Sniffers ,Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.

Module-4: Hacking Web Services & Session Hijacking: Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools

Module-5: Hacking Wireless Networks: Introduction to 802.11,Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks.

Text Books
1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010

References
1. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.). Packt Publishing, 2011
2. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003
3. Rajat Khare, "Network Seuciryt and Ethical Hacking", Luniver Press, 2006