Department of Computer Science
D.D.U. Gorakhpur University, Gorakhpur

Year wise Structure of B.A. / B.Sc. Computer Application Subject

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
1	I	COA101F	Basics of Computer Application	Theory	2
	I	COA102F	Introducing to Computer and PC Software	Theory	4
	I	COA103F	PC Software Lab	Practical	2
	II	COA104F	Problem Solving using Computer	Theory	4
	II	COA105F	Software Lab	Practical	2
2	III	COA201F	Object Oriented Programming and C++	Theory	4
	III	COA202F	OOPs Lab	Practical	2
	IV	COA203F	Database Management System	Theory	4
	IV	COA204F	DBMS Lab	Practical	2
3	V	COA301F	Data Communication and Computer Networks	Theory	4
	V	COA302F	Internet and Web Technologies	Theory	4
	V	COA303F	Lab on Web Technologies and Computer Networks	Practical	2
	VI	COA304F	Software Engineering and Project Management	Theory	4
	VI	COA305F	Algorithms and Data Structures	Theory	4
	VI	COA306F	Lab on Algorithms and Data Structures	Practical	2

4	VII	COA 401F	Computer Organization and Architecture	Theory	4
	VII	COA 402F	Operating System	Theory	4
	VII	COA 403F	Cyber Security & Cyber Laws	Theory	4
	VII	COA 404F	Programming Using Python	Theory	4
	VII	COA 405F	COA, OS and Python Lab	Practical	4
	VIII	COA 406F	Software Engineering	Theory	4
	VIII	COA 407F	Advance Database Management System	Theory	4
	VIII	COA 408F	Linux and Shell Programming	Theory	4
	VIII	COA 409F	Artificial Intelligence	Theory	4
	VIII	COA 410F	DBMS, Linux and AI Lab	Practical	4

OR For Students who secured 75% Marks in First Six Semesters

4	VII	COA 401F	Computer Organization and Architecture	Theory	4
	VII	COA 402F	Operating System	Theory	4
	VII	COA 403F	Cyber Security	Theory	4
	VII	COA 404F	Programming Using Python	Theory	4
	VII	COA 405F	COA, OS and Python Lab	Practical	4
	VIII	COA 406F	Software Engineering	Theory	4
	VIII	COA 407F	Advance Database Management System	Theory	4
	VIII	COA411F	Research Project	Practical	12

Programme outcomes(POs): Students taking admission to B.A. / B.Sc. program are expected to get prepared with following outcomes:	
PO1	Explaining the basic scientific principles and methods.
PO2	Inculcating scientific thinking and awareness among the student.
Programme Specific outcomes(PSOs)	
PSO1	To prepare students for career in Computer Application and its applications in professional Career.
PSO2	To develop the student to cope up with the advancements in respective fields.
PSO3	The student will determine the appropriate level of technology for use in: a) Experimental design and implementation, b) Analysis of experimental data, and c) Numerical and mathematical methods in problem solutions.
PSO4	Investigate and apply mathematical problems and solutions in a variety of contexts related to science, technology, business and industry, and illustrate these solutions using symbolic, numeric, or graphical methods.

Syllabus for B.A. / B.Sc.
Subject: Computer Application

Programme/Class: **B.A. / B.Sc.**	Year: **First**	Semester: **First**
Subject: **Computer Application**		
Course Code: COA101F	Course Title: Basics of Computer Application	

Course outcomes:
After the completion of the course the students will be able to:

1: History and evolution of Computer System, understand hardware components of computer system such as memory system organization, input/output devices, aware of software components of computer system, and windows operating system concepts.
2: Develops basic understanding of computers, the concept of flow chart, algorithm and algorithmic thinking.
3: Develops the ability to analyze a problem, develop an algorithm to solve it.
4: Develops the ability to use office application software through word processing software.
5: To get employment opportunity in the basic of computer area.

Credits: 2

Unit	Topic
I	**KNOWING COMPUTER:** What is Computer, Basic Applications of Computer, Components of Computer System, Concept of Hardware and Software (Application Software Systems software), Concept of computing, data and information.
II	**OPERATING COMPUTER USING GUI BASED OPERATING SYSTEM:** Basics of Operating System, The User Interface (Task Bar, Icons, Menu, running an application), File and Directory Management (Creating and renaming of files and directories), Operating System Simple Setting (Changing System Date and Time, Changing Display Properties, To Add or Remove a Windows Component, Changing Mouse Properties).
III	**UNDERSTANDING WORD PROCESSING AND SPREAD SHEET:** Word Processing Basics, Opening and closing Documents, Text Creation and manipulation, Formatting the Text, Elements of Electronic Spread Sheet, Manipulation of Cells
IV	**WWW and Web Browser –** Internet, world wide web, popular web browsing software, search engines, understanding url.

Suggested Readings:

1. P.K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications, 2007.
2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.

Suggestive digital platforms web-links-

https://www.pearsoned.co.in/prc/book/anita-goel-computer-fundamentals-1e-1/9788131733097

Programme/Class: **B.A. / B.Sc.**	Year: **First**	Semester: **First**
Subject: **Computer Application**		
Course Code:COA102F	Course Title: Introducing to Computer and PC software	

Course outcomes:

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

1: Understand hardware components of computer system such as memory system organization, input/output devices, aware of software components of computer system, and windows operating system concepts.

2: Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.

3: Develops the ability to analyze a problem, develop an algorithm to solve it.

4: To get employment opportunity in the area of computer software.

Credits: 4

Unit	Topic
I	**Introduction to computers** – Definition, Characteristics, Generation, Applications, Classifications, Hardware, Software, Computer Arithmetic & Number System, Decimal, Binary, Octal & Hexadecimal System. Arithmetic Operations on Binary Numbers. ASCII, EBCDIC, BCD codes, Fixed point & floating point representation of numbers. **Computer Organization & Architecture** – Memory hierarchy, Primary Memory - memory unit, SRAM, DRAM, SDRAM, RDRAM, Flash memory. Secondary storage devices- Magnetic Disk, Floppy Disk, Optical Disk, Magnetic Drum , Input Devices, Output Devices.
II	**Software** – Introductory ideas of System Software, Application Software, Operating System, Translators, Interpreters, Compilers, Assemblers, Generation of Languages. **Operating System**: Definition, Introductory ideas of single user and multi-uer operating system, Time sharing, multitasking, multiprogramming, Batch Processing, on-line processing, spooling.
III	**Microsoft Office: Word Processing Software**–file menu, edit menu, view menu, insert menu, format menu, tools menu table menu, alignment of text, applying fonts, working with wizards, size of text, font of the text, color of the text.
IV	**Microsoft Excel for windows**– understanding spreadsheets, file menu, edit menu, view menu, insert menu, format menu, tools menu, data menu, creating a Worksheet in Excel for windows, copying formula, formulas that make decisions, functions in Excel, sum function, average function, function wizard, functions in Excel, Date and time functions, logical functions, creating charts in Excel, creating graphs, modifying chart, adding data to a chart,
V	**PowerPoint for windows**– file menu, edit menu, view menu, insert menu, format menu, tools menu, slide show menu, creating presentation by AutoContent Wizard, creating a new presentation entering the text, moving the text, reordering slides, duplicating slides, deleting slides, making slide shows, adding effects, adding animation, creating your own animation,

Suggested Readings:

1. P.K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications,2007.
2. V. Rajaraman, "Fundamentals of Computers", PHI publications, 2015.
3. Dr. Anita Goel, Computer Fundamentals, Pearson Education,2010.

Suggestive digital platforms web-links-

https://www.pearsoned.co.in/prc/book/anita-goel-computer-fundamentals-1e-1/9788131733097

Programme/Class: **B.A. / B.Sc.**	Year: **First**	Semester: **First**
Subject: Computer Application		
Course Code: COA103F	**Course Title: PC Software Lab**	

Course outcomes:

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

1: Understand hardware components of computer system such as memory system organization, input/output devices, aware of software components of computer system, andwindows operating system concepts.

2: Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.

3: Develops the ability to analyze a problem, develop an algorithm to solve it.

4: To get employment opportunity in the area of computer software.

Credits**:2**

Lab exercises on PC Software lab –

Working with MS-Word: Prepare a word document with various formatting tools and tables,

Working with MS-Excel: Prepare worksheets, use of formulae, Prepare Tables and Charts (Pi-chart, Bar-chart), Insert pictures in a worksheet,

Working with Power Point: Prepare Power Point presentation with various features of animations and sounds etc.

Various assignments can be given to students related to these packages.

Programme/Class: **B.A. / B.Sc.**	Year: **First**	Semester: **Second**
Subject: **Computer Application**		
Course Code:COA104F	Course Title: Problem Solving using Computer	

Course outcomes:

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

1: Understand hardware components of computer system such as memory system organization, input/output devices, aware of software components of computer system, and windows operating system concepts.

2: Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.

3: Develops the ability to analyze a problem, develop an algorithm to solve it.

4: To get employment opportunity in the field of programming.

Credits:**4**

Unit	Topic
I	Overview of Programming – Introduction to Computer Based problem Solving, requirements of Problem Solving by the Computer, Programs & Algorithms & Flow Charts. An Overview of C, Structure of C Program, Storage class specifier & data types, Construct and variable declaration, operator & expression.
II	Program Control Statements – True and false in C, C statements, Conditional Statements, if, switch, for, while, do/while, break, exit (), continue, goto. Basic I/O : Formatted and unformatted input/output, Functions Return statement, local & global variables, Scope rule of functions, function arguments, parameters passing – call-by-value, call-by- reference, function prototypes, function call with array, recursion, implementation issue.
III	Arrays, declaration, one- & two-dimensional array, multidimensional arrays. Advanced Features in C – Pointers, pointers variables, pointers operators, pointer expression, dynamic allocation function – malloc (), free (), calloc(), Initialising pointers, pointers to function, pointers and arrays.
IV	Structures, Unions and user defined variables - Basics of structure, declaration of structure, Array of structure, passing structure to function, structure pointers, and nested structure. File Management – Stream and files, Console I/O, file pointer, file management functions.
V	Data Structures – Basic concept of data representation, algorithm design and data structure. Overview of arrays, linked list, stack and queue.

Suggested Readings:

1. Herbert Schildt, “C: The Complete Reference”, McGraw Hill Education India.
2. Kanetkar Yashavant, “Let Us C”, BPB Publications.
3. E. Balagurusamy, “Programming in ANSI C”, McGraw Hill Education India.

Programme/Class: **B.A. / B.Sc.**	Year: **First**	Semester: **Second**
Subject: Computer Application		
Course Code: COA105F	**Course Title: Software Lab**	

Course outcomes:

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

1: Understand hardware components of computer system such as memory system organization, input/output devices, aware of software components of computer system, and windows operating system concepts.

2: Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.

3: Develops the ability to analyze a problem, develop an algorithm to solve it.

4: To get employment opportunity in the field of programming.

Credits**:2**

Sample Programs

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria:

   Grade A: Percentage>=80
   Grade B: Percentage>=70 and <80
   Grade C: Percentage>=60 and <70
   Grade D: Percentage>=40 and <60
   Grade E: Percentage<40
3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. WAP to display the first n terms of Fibonacci series.
5. WAP to find factorial of the given number.

   Similar programming exercises based on the syllabus.

Programme/Class: **B.A. / B.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Computer Application**		
CourseCode:COA201F	Course Title: Object Oriented Programming and C++	

Course outcomes:

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

1. Understands the basic concepts of OOPs.
2. Design class & object diagrams for real world applications.
3. Formulate OOPs concepts like encapsulation, inheritance, polymorphism and dynamic binding to implement C++ programs.
4. To get employment opportunity in the field of real world programming.

Credits:**4**

Unit	Topic
I	Introduction to Object Oriented Concept : Overview of object oriented system, Abstract data Types, Inheritance, Polymorphism, Object Identity, Object Modeling Concepts, Object Oriented Design, Object Oriented Programming Languages, Object Oriented Database.
II	C++ Programming Language: Overview of C++, Programming Paradigm, Support For Data Abstraction, Support for Object Oriented Programming, Declaration and Constants, Expression and Statement, Function and Files: Linkages, How to Make a Library, Functions.
III	Classes and Objects : Definition of Class, Class Declaration, Class Function Definition, Member Function definition inside and outside the class declaration, Scope resolution operator(: :),Private and Public member function, Nesting member function, Creating Objects, Accessing Class data members, Accessing member functions, Arrays of Objects, Objects as function arguments.
IV	Operator Overloading: Operator Function, User Defined Type Conversion, Litreral, large objects, Assignments and Initialisation, subscripting, function call, dereferencing, increment and decrement, A string Class, Friends and members. Inheritance through Extending Classes: Concept of Inheritance, Base Class, Derived Class, Defining derived classes, Visibility modes, single inheritance.
V	Streams, Templates and Design of Libraries: Output, Input, Formatting, Files and Streams, C-I/O, Design of Libraries.

Suggested Readings:

1. Grady Booch, "Object-Oriented Analysis and Design with Applications (3rd Edition)", PERSON publication.
2. Herbert Schildt, "C++: The Complete Reference", McGraw Hill Education India.
3. E. Balagurusamy, "Object Oriented Programming in C++", McGraw Hill Education India.

Programme/Class: **B.A. / B.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Computer Application**		
Course Code: COA202F	**Course Title: OOPs Lab**	
Course outcomes: 1. To learn and understand C++ programming basics. 2. To learn and understand C++ functionalities. 3. To learn and know the concepts of encapsulation, inheritance, polymorphism, and dynamic binding, etc. 4. To get employment opportunity in the field of real world programming.		
Credits**:2**		

OOPs Lab

Write program in 'C++' language.

1. Using input and output statements.
2. Using control statements.
3. Using functions.
4. Using array.
5. Using Classes and implementation of Constructor and Destructor.
6. Using files.
7. Using OOPS Concept Inheritance.
8. Using OOPS Concept Polymorphism
9. Using OOPS Concept Encapsulation
10. Using OOPS Concepts Friend and Static Functions.

Note: Program should be fully documented with simple 1/0 data. Flow charts should be developed wherever necessary.

Programme/Class: **B.A. / B.Sc.**	Year: **Second**	Semester: **Fourth**
Subject: **Computer Application**		
CourseCode:COA203F	Course Title: **Database Management System**	

Course outcomes:

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

1. Understands the basic concepts of database management systems.
2. To get employment opportunity in the area of DBMS.
3. Formulate relational algebraic expressions using relational data models and languages.
4. Apply normalization transaction properties and concurrency control to design database.

Credits:**4**

Unit	Topic
I	Overview of Database Management – File oriented approach versus database oriented approach to data management, Disadvantage of file oriented approach Data Independence, DBA and its role, DBMS architecture, Different types of DBMS users, Data dictionary and its contents, Types of Database Languages, Different Type of Data Models
II	Relational Model - Definition of relational model, concept of keys, candidate key, Primary key, Foreign key, Fundamentals integrity rules, Relational Algebra. Database Design – E – R model as a tool for conceptual design, entities, attributes and relationship E R diagram, strong and weak entities,
III	Normalization concept in relational model, Functional dependencies, Normal Forms (1 N F, 2 N F, 3 N F, B C N F, 4 N F). SQL – SQL Construct, (SELECT - - - FROM - - - WHERE - - - GROUP BY - - - HAVING - - - ORDER BY), INSERT, DELETE, UPDATE, VIEW, definition & use, Nested Queries.
IV	FoxPro – Introduction to FoxPro, Database Construction, searching, sorting, indexing, Updation, Reports, Screen Designing, Programming Concepts, Managing numbers & date. Case Studies - Inventory control system, Payroll Processing etc.

Suggested Readings:

1. Paul Du Bois, "MySQL Cookbook: Solutions for Database Developers and Administrators," Third Edition, O' Reilly Media, 2014.
2. FrankM.Kromann,"BeginningPHPandMySQL:FromNovicetoProfessional,"FifthEdition,Apress, 2018.
3. JoelMurachandRayHarris,"Murach'sPHPandMySQL,"FirstEdition,MikeMurach&Associates,2010.
4. Luke Welling, Laura Thomson, "PHP and MySQL Web Development," Fourth Edition, Addison-Wesley, 2008.

Programme/Class: **B.A. / B.Sc.**	Year: **Second**	Semester: **Fourth**
Subject: Computer Application		
Course Code: COA204F	Course Title: DBMS Lab	

Course outcomes:

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

1. Understands the basic concepts of database management systems.
2. To get employment opportunity in the area of DBMS.
3. Formulate relational algebraic expressions using relational data models and languages.
4. Apply normalization transaction properties and concurrency control to design database

Credits**:2**

Software Lab based on Database Management Systems

Note: PHP/MySQL may be used

List of Experiments

1. Creation of databases and execution of SQL queries.
2. Creation of Tables using MySQL: Data types, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables.
3. Practicing DML commands- Insert, Select, Update, Delete.
4. Practicing Queries using ANY, ALL, IN, EXISTS, NOT, EXISTS, UNION, INTERSECT, and CONSTRAINTS, etc.
5. Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUPBY, HAVING, VIEWS Creation and Dropping.
6. Use of COMMIT, ROLLBACK and SAVEPOINT.

Programme/Class: **B.A. / B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Computer Application**		
CourseCode:COA301F	Course Title: **Data Communication and Computer Networks**	

Course outcomes:

After the completion of the course the students will be able:

1. To develop understanding of computer networks and communication basics.
2. To understand design issues and services at different layers of reference models.
3. To learn various error detection/correction techniques, routing protocols, congestion control algorithms, and connection establishment/release.
4. To get employment opportunity in the field of Networking and Communication.

Credits: **4**

Unit	Topic
I	**Computer Communication & Network:** Data Communication, Data Transmission : Serial and Parallel, Modes of Data Transmission : Asynchronous and synchronous, Time and Frequency Domain, Composite Signals
II	**Types of Transmission :** Analog and Digital, Types of Transmission System : Simplex, Half – Duplex and Full – duplex, Communication Media, Modems, Data Multiplexers, Computers Networks, Server, Transmission Technology, Local Area Network, Topologies : Star, Ring, Bus, Wide Area Networks, MAN, OSI Models of ISO, Network Protocols : SPX/IPX TCP/IP.
III	**Telnet :** Remote Login, Telnet Protocols, Basic Concepts, Telnet Clients : Windows 98/95 Telnet Program, Hyper terminal, Unix for Telnetting , Terminal Emulation.
IV	**Management of a LAN**: – LAN, Definition and usage, Major components, architecture, initiation to Novell Netware, IPX command, Changing Drives, Logging in , Giving passwords, changing password, Logging out, Login Restriction, LAN Community, Regular user, User group, operator & Supervisor, Storing of files, Network drives, Map command, Network rights, File management, Netware Rescue, Filter utility, Access method, Login scripts.

Suggested Readings:

1. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks, "5th Edition, Pearson, 2014.
2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson, 2013.
3. Behrouz A. Forouzan, "Data Communications and Networking," 4th Edition, McGraw-Hill Higher Education, 2007

Programme/Class: **B.A. / B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Computer Application**		
CourseCode:COA302F	Course Title : **Internet and web Technologies**	

Course outcomes:

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

1. Understand the Internet.
2. Understanding the World Wide Web.
3. Understanding the Internet Security
4. To get employment in the field of emerging area of Internet & web technologies.

Credits: **4**

Unit	Topic
I	**Internet –** evolution, Applications, Technologies, Working, Clients & Servers, Internet Services, Online Services, TCP/IP, Getting Connected, Different type of connections, ISP, Address in internet, intranets.
II	**E – mail –** E-mail basics, E – mail networks, Protocols, working, Format of an E-mail message, Basic E – mail functions, E-mail clients – Netscape messenger, outlook express, E-mail security, FTP – The file transfer protocol introduction and basic procedure, Types of FTP Servers, FTP Software, Command Driven clients and GUI – driven Clients, FTP with web Browsers.
III	**World Wide Web (WWW) –** Evolution, Basic features. Clients & servers, URL, HTTP, HTML, XML, multimedia, WWW Browsers, WWW Servers, using a Web Browser eg. Internet Explorer.
IV	**Web Publishing –** Website planning, Publishing Tools, The Front Page Solution, HTML – Designing and decoration of web pages using HTML's basic features in different style & Looks.
V	**Internet Security –** Need, Web Search engine, web meta searcher, web search Agents, E-mail Threats, Firewall, Firewall Architecture, Choosing a suitable Firewall.

Suggested Readings:

1. Reeta Sahoo, **"Web Technologies",** New Sarswati House Publication.
2. Uttam Kumar Roy "**Web Technologies**", Oxford University Press.

Programme/Class: **B.A. / B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: Computer Application		
Course Code: COA303F	Course Title: Lab on Web Technologies and Computer Network	

Course outcomes:

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

1. To develop understanding of computer networks and communication basics.
2. Understanding the World Wide Web and Internet Security.
3. To get employment opportunity in the field of Networking and Internet.

Credits**:2**

Lab based on Computer Networks:

1. Simulate Checksum Algorithm.
2. Simulate CRC Algorithm
3. Simulate Stop& Wait Protocol.
4. Simulate Go-Back-N Protocol.
5. Simulate Selective Repeat Protocol.

Lab based on Internet and Web technologies:

6. Programming exercises on HTML programming: Page designing, Text formatting, table creation, Form designing.
7. Understanding email creation and uses.
8. Understanding Web Publishing
9. Establishing Internet connection

Programme/Class: **B.A. / B.Sc.**	Year: **Third**	Semester: **Six**
Subject: **Computer Application**		
Course Code: COA304F	Course Title: Software Engineering and Project Management	

Course outcomes:

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

1. Upon the completion of this course the student will have the knowledge of software design and development concepts.
2. He would be able to choose and design suitable software development for real world problems.
3. He can appropriately use software development tools to develop application software.
4. To get employment opportunity in the field of software engineering and project management.

Credits: **4**

Unit	Topic
I	**Introduction:** Characteristics, Components. Applications, Software Development Lifecycle Models: Waterfall, Iterative Waterfall, Spiral. Prototyping, incremental development, Fourth Generation Techniques, Concepts of Project Management, Role of Metrics & Measurements.
II	**Software Analysis:** Principles of Structured & Object Oriented Analysis, Requirement analysis, DFD, Entity Relationship diagram, Data dictionary, **Software Design:** Objectives, Principles; Concepts, Design methodologies: Data design, Architectural Design, procedural design, Object -oriented concepts.
III	**Software Project Planning:** Objectives, Decomposition techniques: S/W Sizing, Problem-based estimation, Process based estimation. Cost Estimation Models: COCOMO Model, the S/W Equation, and System, Budgeting, Capital Budgeting, Net present value (NPV). ROI (Rate Of Interest), Payback Models.
IV	**Software Configuration Management:** Baseline, Software Configuration Items (SCI). Software Configuration Management Process. Identification of Objects in the Software Configuration. Version Control, Change Control, Configuration Audit, Status Reporting, Goals of SCM.
V	**Project Closure and Software Quality Assurance:** Goals of SQA, FTR (Formal Technical Review), Standards and Procedures, SQA activities, Software Qualities – Reliability, Maintainability, Transportability, Interoperability, Efficiency, Creating a SQA plan. Project Closure Analysis, Role of Closure Analysis, Closure Analysis Report.

Suggested Readings:

1. Roger S. Pressman, Bruce R. Maxim, “Software Engineering: A Practitioner's Approach”, McGraw-Hill Education, 2014.
2. Ronald J. Leach, “Introduction to Software Engineering”, CRC Press, 2018.
3. B. B. Agarwal, S. P. Tayal, Mahesh Gupta, “Software Engineering and Testing”, Jones & Bartlett Learning, 2010

Programme/Class: **B.A. / B.Sc.**	Year: **Third**	Semester: **Sixth**
Subject: **Computer Application**		
Course Code: COA305F	Course Title: **Algorithm and Data Structures**	

Course outcomes:

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

1: Understand that various problem solving categories exist such as; iterative technique, divide and conquer, dynamic programming, greedy algorithms, and understand various searching and sorting algorithms.

2: Employ a deep knowledge of various data structures when constructing program.

3: Design and construct simple object-oriented software with an appreciation for data abstraction and information hiding.

4: To get employment opportunity in the field of software development tools including libraries, compilers, editors, linkers and debuggers to write and troubleshoot programs.

Credits: **4**

Unit	Topic
I	**Introduction**: Basic Design and Analysis techniques of Algorithms, time and space complexity, Correctness of Algorithm, Algorithm Design Techniques: Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms.
II	**Searching Techniques & Sorting Techniques**: Linear and Binary search, Elementary sorting techniques: Bubble Sort, Insertion Sort, Merge Sort, Heap Sort, Quick Sort.
III	**Stacks and Queues:** Implementing stack using array and linked list, Array and Linked representation of Queue.
IV	**Linked Lists:** Singly, Doubly and Circular Lists, representation of Stack and Queue as Linked Lists.
V	**Trees and Graph**: Introduction to Tree and Graph as a data structure, Binary Trees, Binary Search Tree,(Creation, and Traversals Trees), Type of Graph, Spanning tree of Graph.

Suggested Readings:

1. Cormen T. H., Leiserson Charles E., Rivest Ronald L., Stein Clifford, Introduction to Algorithms, PHI Learning Pvt. Ltd., 2009, 3rd Edition.
2. Basse Sara & A.V. Gelder, Computer Algorithm: Introduction to Design and Analysis, Pearson, 2000, 3rd Edition.
3. Tenenbaum Aaron M., Augenstein Moshe J., Langsam Yedidyah, "Data Structures Using C and C++, PHI, 2009, Second edition.
4. Kruse Robert L., "Data Structures and Program Design in C++", Pearson.
5. **Suggestive digital platforms web links or online course-**

   https://www.oercommons.org/authoring/14873-data-structure/view

   https://www.oercommons.org/courses/data-structure-and-algorithms

Programme/Class: **B.A. / B.Sc.**	Year: **Third**	Semester: **Sixth**
Subject: **Computer Application**		
Course Code: COA306F	Course Title: **Lab on Algorithm and Data Structures**	

Course outcomes:

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

1: Understand that various problem solving categories exist such as; iterative technique, divide and conquer, dynamic programming, greedy algorithms, and understand various searching and sorting algorithms.

2: Employ a deep knowledge of various data structures when constructing program.

3: Design and construct simple object-oriented software with an appreciation for data abstraction and information hiding.

4: To get employment opportunity in the field of software development tools including libraries, compilers, editors, linkers and debuggers to write and troubleshoot programs

Credits:**2**

Practical List on Analysis of Algorithms and Data Structures:

1. Write a program that uses functions to perform the following:
   a) Create a singly linked list of integers.
   b) Delete a given integer from the above linked list.

2. Write a program that uses functions to perform the following:
   a) Create a doubly linked list of integers.
   b) Delete a given integer from the above doubly linked list.

3. Write program to implement a double ended queue using
   i) Array.
   ii) Linked list.

4. Write a program that uses functions to perform the following:
   a) Create a binary search tree of characters.
   b) Traverse the above Binary search tree recursively in different orders.

5. Write program for implementing the searching methods.

6. Write program to implement Sorting.

Programme/Class: **B.A. / B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Application**		
Course Code: COA401F	Course Title: **Computer Organization and Architecture**	

Course outcomes:

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

- Understand the basic fundamentals of computer organization
- Understand the major components of a computer including CPU, memory, I/O and storage as well as cache memory.
- Understand memory technologies both internal and external.

Knowledge about the basic components of the CPU including the ALU and control unit.

Credits: **4**

Unit	Topic
I	**Digital Components:** overview of computer organization, logic gates, adders, flip-flops, encoders, decoders, multiplexers, registers, and shift registers, counters, RAM, ROM.
II	**Digital Components:** overview of computer organization, logic gates, adders, flip-flops, encoders, decoders, multiplexers, registers, and shift registers, counters, RAM, ROM.
III	**Register transfer and Micro operations:** Bus and memory transfers, three state bus buffers, Binary adder, Binary incremented, Arithmetic Circuit, Logic and shift micro operations, ALU.
IV	**Basic computer Organization:** Instruction Codes, Addressing modes, timing and control signal, instruction cycle, memory reference instruction, input output instruction, general register organization of CPU, memory stack, one address and two address instruction, software and hardware interrupts.
V	**I/O and Memory organization:** input devices, synchronous and asynchronous communications, modes of data transfer from I/O to Memory, DMA, memory hierarchy, Main memory, Memory management, Cache memory, virtual memory.

Suggested Readings:

1) Computer Architecture: A Qualitative Approach, John L. Hennessy and David A. Morgan Kaufmann, Pearson.
2) Modern Processor Design: Fundamentals of Superscalar Processors, John Paul Shen and Mikko H. Lipas, Tata McGraw-Hill.
3) Computer Architecture: Pipelined and Parallel Processor Design, M. J. Flynn, Narosa Publishing

House.

1. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, McGraw-HillKruse Robert L., "Data Structures and Program Design in C++", Pearson.

2. Suggestive digital platforms web links or online course-

https://www.oercommons.org/authoring/14873-data-structure/view

https://www.oercommons.org/courses/data-structure-and-algorithms

Programme/Class: **B.A. / B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Application**		
Course Code: COA402F	Course Title: **Operating System**	

Course outcomes:

After the completion of the course the students will be able:

1. Understand role, responsibilities, features, and design of operating system.
2. Analyze memory management schemes and process scheduling algorithms.
3. Apply process synchronization techniques to formulate solution for critical section problems.
4. Develops the ability to get employment in System Development field.
5. Evaluate process deadlock handling techniques.

Credits: **4**

Unit	Topic
I	**Introduction** Operating system and functions, Classification of Operating systems: Batch,Interactive,Timesharing,RealTimeSystem,MultiprocessorSystems,Multiuser Systems, Multithreaded Systems, Operating System Structure,SystemComponents,OperatingSystemServices,Kernels,MonolithicandMicrokernelSystems.
II	**Process Management** Process Concept, Process States, Process Synchronization, Critical Section, Mutual Exclusion, Classical Synchronization Problems, Process Scheduling, Process States, Process Transitions, Scheduling Algorithms Inter-process Communication, Threads and their management, Security Issues.
III	**CPU Scheduling** Scheduling Concepts, Techniques of Scheduling, Preemptive and Non-Preemptive Scheduling: First-Come-First-Serve, Shortest Request Next, Highest Response Ration Next, Round Robin, Least Complete Next, Shortest Time to Go, Long, Medium, Short Scheduling, Priority Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.

IV	**Memory Management and Disk Scheduling** Memory allocation, Relocation, Protection, Sharing, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing, Disk storage and disk scheduling, RAID.
V	**File System:** File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.

Suggested Readings:

1. Andrew S. Tanenbaum and Herbert Bos, "Modern Operating Systems, "Fourth Edition, Pearson, 2014.
2. Abraham Silberschatz, Greg Gagne, and Peter B. Galvin, "Operating System Concepts, "Tenth Edition, Wiley, 2018.
3. William Stallings, "Operating Systems: Internals and Design Principles," 7th Edition, Prentice Hall, 2011.
4. Dhanjay Dhamdhere, "Operating Systems, "First Edition, McGraw-Hill, 2008

Programme/Class: **B.A. / B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Application**		
Course Code: COA403F	Course Title: **Cyber Security & Cyber Laws**	

Course outcomes:

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

1. Understand types of information, cyber threats, and national / international cyber security standards.
2. Do mathematical modeling and development of security techniques and information system.
3. Develop understanding of legal issues related to cyber security.
4. To get opportunity of employment in the field of Cyber Security and Law.

Credits: **4**

Unit	Topic
I	**Introduction:** Introduction to Information System, Type of information system, Development of information system, CIA model of Information Characteristics, Introduction to Information Security, Need of Information Security, Cyber Security, Business need, Ethical and Professional issues of Security.
II	Information Security Techniques, Introduction to Cryptography: Terminology, Cryptanalysis, Security of Algorithms, Substitution Cipher and Transposition Cipher, Single XOR, One-way Pad**.**

III	Cryptographic Protocols: Arbitrated and Adjudicated Protocol, One-Way Hash function, Public key cryptography, Digital Signature, Digital Watermarking Technique: Characteristics and Types.
IV	Security Policies, Why Policies should be developed, WWW policies, Email Security policies and Policy Review Process-Corporate policies - Sample Security Policies.
V	Cyber Laws**:** Information Security Standards, IT Act 2000 Provisions, Introduction to digital laws, cyber laws, intellectual property rights, copyright laws, patent laws, software license.

Suggested Readings:

1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security, "6th Edition, Cengage Learning, 2017.
2. Douglas J. Landoll, "Information Security Policies, Procedure, and Standards: A Practitioner's Reference," CRC Press, 2016.
3. Harold F. Tipton and Micki Krause, "Hand book of information security management, "6thArchtech Publication, 2007.
4. William Stallings, "Cryptography and Network Security: Principles and Practice," 6th Edition, Pearson, 2014.

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Application**		
Course Code: CSC404F	Course Title: **Programming Using Python**	

Course outcomes:

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

1.Create your first program in Python IDLE
2.Implement OOPs concepts in your programming
3.Use Arrays, and Data structures
Create an application with the 4.support of graphics in Python
5.Implement error handling

Credits: **4**

Unit	**Topic**

I	**Paradigms and Principles:** Overview of different programming paradigms e.g. imperative, object oriented, functional, logic and concurrent programming. Syntax and semantics- overview of syntax specification and semiformal semantic, specification using attribute grammar, Formal Semantics (languages with higher order constructs and types, recursive type and subtype).
II	**Programming Concepts in Python:** OOP, Keyword and Default Arguments, Scope Rules, Expressions, Conditionals, Loops, Functions etc; The Programming Cycle for Python, Python IDE, Strings-indexing and slicing of strings; Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries.
III	Higher Order Functions: Lambda Expressions; File I/O: File input and output operations in Python Programming Exceptions and Assertions Modules; Abstract Data Types: ADT interface; ***Classes:*** Class definition and other operations in the classes; Special Methods (such as _init_, _str_, comparison & Arithmetic methods); Modules and Packages.
IV	**Python in Web Development and Database Connection:** CGI in Python, Git tool, Django Framework, Styling with CSS, Django Forms, Sessions, SQL and Django models to Store and Access Data, Event-Driven Programming, APIs- JavaScript Objects, Applications with User Interfaces, Scalability-Hosting on the Cloud, Security-HTTPS; Database Connectivity.
V	**Python in Data Science:** Charting & Data Representation in Python, Usage of Numpy & Pandas, Applied Text Mining, Applied Social Network Analysis in Python, iPython for Interactive Computing, Data Wrangling:- Clean, Transform, Merge, Reshape; Usage of SciKit for Machine learning.

Suggested Readings:

1) A Formal Semantics of Programming Languages: An Introduction, Glynn Winskel, MIT Press.
2) Programming Languages: Concepts and Constructs, Ravi Sethi, Addison-Wesley.
3) Python for Data Analysis: Data Wrangling with Pandas, W. McKinney, NumPy and iPython, 2 nd Ed., O'Reilly, 2017.
4) Introduction to Data Mining, P. Tan, M. Steinbach, A Karpatne, and V. Kumar, 2nd Ed., Pearson Education, 2018.
5) Python Programming, Michael Urban and Joel Murach, Shroff/Murach,

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Application**		
Course Code: COA405F	Course Title: **COA, OS and Python Lab**	**Credit - 4**

1. Use of Linux operating system and able to write shell programs.
2. Simulate and demonstrate the concepts of operating systems.
3. Develops the ability to get employment in System Development field.
4. Illustrate by writing script that will print, message "Hello World, in Bold and Blink effect, and in different colors like red, brown etc using echo commands?
5. Write a shell script that accepts a file name, starting and ending line numbers as arguments and displays all the lines between the given line numbers.
6. Illustrate by writing script using for loop to print the pyramid patterns.

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Application**		
Course Code: COA 406F	Course Title: **Software Engineering**	

Course outcomes:

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

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively with a range of audiences.

Credits: **4**

Unit	Topic
I	**Fundamental Concepts:** Software life-cycle models, requirements specification, UML, design patterns, user interface design, coding and unit testing, integration and systems testing, debugging techniques, software quality - SEI CMM and ISO-9001. Reliability and fault-tolerance, planning, monitoring, control, and maintenance, Computer-Aided Software Engineering (CASE).
II	**Requirements Analysis and Specification:** Formal requirements specification, Development of requirements specification, SRS Building Process, Specification Languages, Validation of SRS, metrics, monitoring and control, Object Oriented analysis.
III	**Software Project Planning and Architecture:** Software Cost Estimation Techniques, Project Scheduling & Tracking, Project Team Standards, software configuration management. Role of Software Architecture, Architecture Views, Component and Connector View, Architecture Styles for C&C View, Architecture Evaluation.

IV	**Fundamental Issues in Software Design:** Goodness of design, cohesion, and coupling. Unified Modeling Language (UML), Unified design process. User interface design, Function oriented design using SA/SD, object-oriented design using UML, test case design, Design Strategies, Design specification and verification, Metrics, Design Translation Process.
V	**Software Testing and Reliability:** Strategies & Techniques, Debugging, Software Maintenance, Software Reliability and Availability Models, Software Reengineering, Cleanroom Approach, Software Reuse. Introduction to IEEE Standards, Case Studies.

Suggested Readings:

1) An Integrated Approach to Software Engineering, IIIrd Edition, Pankaj Jalote, Narosa Publishing House.
2) Software Engineering: Principles and Practices Waman S. Jawadekar, Tata McGraw-Hill.
3) Software Engineering: A Practitioner's approach, Roger S. Pressman, McGraw-Hill.
4) Software Engineering, Ian Sommerville, Pearson Education.
5) Fundamentals of Software Engineering, Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, PHI.
6) Fundamentals of Software Engineering, Rajib Mall, Prentice Hall India.

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Application**		
Course Code: COA407F	Course Title: Advance Database Management System	

Course outcomes:

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

1. Explain and evaluate the fundamental theories for advanced database architectures and query operators.

2. Design and implement parallel database systems with evaluating different methods of storing, managing of parallel database.

3. Assess and apply database functions of distributed database.

4. Evaluate different database designs and architecture.

5. Administer and analyze database with query optimization techniques and developWeb interface with database.

6. Understand advanced querying and decision support system.

Credits: **4**

Unit	Topic
I	**Basic Concepts:** Object-oriented and object relational databases, logical databases, web databases, distributed databases, data warehousing and data mining.
II	**Database System Architecture and Selected Issues:** Data Abstraction, Data Independence, Data Definition and Data Manipulation Languages, Data Security, Transaction Management, Introduction to Query Processing and Query Optimization, Concurrency Control, Recovery Techniques.
III	**Distributed DBMS:** Features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design – fragmentation, allocation criteria. Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled.
IV	**Partitioned Networks and Storage Mechanisms in Distributed DBMS**: Checkpoints & Cold Starts. Distributed Transactions Management, 2 Phase Protocols. Architectural Aspects. Node & Link Failure Recoveries. Translation of Global Queries. Global Query Optimization, Query Execution & Access, Concurrency Control, 2 Phases Locks. Distributed Deadlocks. Time based & quorum-based Protocols.
V	**Alternative Architecture in Distributed DBMS:** Development Tasks, Operation, Global task management. Client Server

	Databases, SQL Server, ODBC, Constructing an application.

Suggested Readings:

1) An Introduction to Database Systems, Vol I & II, C. J. Date, Addison Wesley.
2) Data Base System Concepts, Korth Silberschatz, McGraw Hill.
3) Principles of Database Systems, J. D. Ullman, Galgotia.
4) Database Design, Wiederhold, McGraw Hill.
5) Fundamentals of Database Systems, R. Elmasri and S. B. Navathe, Pearson Education Asia.
6) Database Management Systems, Raghu Ramakrishnan, McGraw-Hill Education.
7) Distributed Databases Principles & Systems, Tata McGraw-Hill Education.

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Application**		
Course Code: COA408F	Course Title: Linux and Shell Programming	

Course outcomes:

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

1. List the basic commands of unix operating system and use them in Linux environment (ubuntu, fedora etc.)
2. Understand commands related to process control and apply them to manage processes.
3. Understand the concepts of control structure, loops, case and functions in shell programming and apply them to create shell scripts.
4. Associate the concepts of arrays with Linux and apply them to create, compile and execute C programs in Linux terminal
5. Compare different editors (vi, gedit, nano) and use them to create shell script and C program for given problem.

Credits: **4**

Unit	**Topic**

I	Linux Utilities: File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities, Backup utilities Sed - Scripts, Operations, Addresses, Commands,,awk - Execution, Fields and Records, Scripts, Operations, Actions, Assocoative Array, Strings and Mathematical functions, System commands in awk, Applications. Shell programming with Bourne Again Shell (bash): Introduction, Shell responsibilities, Pipes and redirection, here documents, Running a shell script, Shell as a programming language, Shell meta characters, File-name substitution, Shell variables, Command substitution, Shell commands, The environment, Quoting, test command, Control structures, Arithmetic in shell, Shell script examples, Interrupt processing functions, Debugging shell scripts
II	Files and Directories: File concepts, File types File system structure,file metadata - Inodes, kernel support for files, System calls for the file I/O operations-open,create,read,wrirte,close,lseek,dup2,file status information-stat family, file and record locking-fcntl function, file permissions- chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links- symlink, link, unlink.
III	Process: Process concept, Layout of a C program image in main memory, Process environment – environment list, environment variables, getenv, setenv, Kernel support for process, Process identification, Process control - Process creation, replacing a process image, waiting for process, Process termination, Zombie process, Orphan process, ,system call interface for process management – fork, vfork, exit, wait, waitpid, exec family, process groups, sessions and controlling Terminal, differences between threads and processes.
IV	Inter process Communication: Introduction to IPC,IPC between processes on a single computer system, IPC between processes on different systems, Pipes-creationIPC between related processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions.
V	Sockets: Introduction to Berkley Sockets, IPC over a network, client – server model, Socket address structures (Unix domain and internet domain) , Socket system calls for connection oriented protocol and connectionless protocol, example- client/server programs- single server- client connection, multiple simultaneous clients, socket options setsockopt and fcntl system calls, comparison of IPC mechanisms.

Suggested Readings:

1. Begining Linux Programming, 4th Edition, N. Matthew, R.Stones, Wrox, Wiley India Edition.
2. Unix for Programmers 3rd Ed, Graham Glass & King Ables, Pearson Education.
3. System Programming with C and Unix, A.Hoover, Pearson.
4. Unix System Programming, communication, concurrency and Threads, K.A. Robbins and S.Robbins, Pearson Education.
5. Unix Shell Programming, S.G. Kochan and P.Wood, 3rd edition, Pearson Education.

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Application**		
Course Code: COA409F	Course Title: Web Application Development	

Course outcomes:

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

- Knowledge about scripting languages such as HTML, CSS, XML, JavaScript, PHP.
- Build dynamic web pages using JavaScript and VB Script (client side programming).
- Learn to build interactive web applications.
- Design web pages using PHP
- Create XML documents and understand XML Schema.
  Provides employment opportunity ine the emerging area of web development

Credits: **4**

Unit	Topic
I	Introduction to web technology : Introduction to web, Protocols governing the web, web development strategies, web application, web project, web team.
II	Web Page Designing : Introduction to HTML, Basic Structure of HTML, Markup Tags, Heading, Line Break, HTML tag, HTML list, tables and Frames, Hyperlinks, images and multimedia.
III	CSS : CSS, CSS properties, CSS styling, list properties, Box model, CSS Advanced, CSS color.
IV	Scripting : Introduction to JAVA script, JAVA script types, variables in JS, Operator in JS, Condition Statement, Loops, Events, Arrays, Objects, Functions, Validation of Forms using JS, Introduction to AJAX.

Suggested Readings:

1. Eloquent JavaScript Marijn Haverbeke
2. Secrets of the JavaScript Ninja John Resig
3. Bear Bibeault Josip Maras
4. Web Design with HTML, CSS, JavaScript, and jQuery Set Jon Duckett
5. Learn JavaScript With Interactive Exercises Visually Ivelin Demirov
6. JavaScript: The Definitive Guide David Flanagan
7. Fullstack Vue: The Complete Guide to Vue.js Hassan Djirdeh Nate Murray Ari Lerner

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Application**		
Course Code: COA410F	Course Title: **DBMS, Linux and AI Lab**	**Credit - 4**

1. Installation of Linux operating system using virtualization technique
2. Understanding and practice of various Linux commands
3. Creation/usage of various types of files supported by Linux
4. Practice of Computer networking commands
5. Write a shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. Whenever the argument is a file, the number of lines on it is also reported
6. Complete any at any 10 experiments as per the direction given by the instructor.
7. Designing and Implementation of some of the uninformed search algorithms.
8. Designing and Implementation of some of the informed search algorithms.
9. Designing and Implementation of A* search algorithms.
10. Designing and Implementation of A* search algorithms with different heuristic functions.
11. Designing and Implementation of some types of intelligent agents.
12. A simple linear regression attempts to draw a straight line that will best minimize the residual sum of squares between the observations and the predictions in python program language.

Programme/ Class: BA/**B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Application**		
Course Code: COA411F	Course Title: Research Project	**Credit - 12**

The candidate can formulate and complete Research Project in the emerging areas of Computer Application and allied discipline. The candidate has to complete Research Project related to his/her subject major. This course can be completed in the form of Research project work etc. It can be of interdisciplinary/ multi-disciplinary nature. This Research Project will be completed under the supervision of a faculty member of the concerned subject. A co-supervisor can be taken from research organization if needed**.**