Course Title with Credit Load
M.Sc. (Ag) in Computer Application

Course Code	Course Title	Credit Hours	Semester
*MCA 513	Mathematics for Applied Sciences	2+0	I
*MCA 514	Statistical Computing	1+1	III
*MCA 551	Mathematical Foundations in Computer Science	3+0	I
*MCA 552	Object Oriented Programming	2+1	I
*MCA 553	Design And Analysis of Algorithms	2+1	I
*MCA 561	Data Structures	2+1	II
*MCA 562	System Software and Programming	2+1	II
*MCA 563	Internet Technologies	1+1	II
*MCA 571	Database Management Systems	2+1	III
*MCA 572	Software Engineering	2+0	III
MCA 591	Master's Seminar	0+1	I/II/III
MCA 599	Master's Research	0+30	II-IV
MCA 554	Information Security	2+0	I
MCA 555	Web Technologies and Applications	1+1	I
MCA 556	Computer Networks	2+0	I
MCA 564	Bioinformatics Computing	1+1	II
MCA 565	Soft Computing Techniques	1+1	II
MCA 573	Operating System	2+1	III
MCA 574	Compiler Construction	2+1	III
MCA 575	Data Warehousing and Data Mining	2+1	III
	Supporting Courses		
MCA 501	Computers Fundamentals and Programming	2+1	I
MCA 502	Computer Organization Andarchitecture	2+0	I
MCA 511	Introduction Tocommunication Technologies, Computer Networking and Internet	1+1	II
MCA 512	Information Technology in Agriculture	2+0	II

*Core Courses

Course Contents
M.Sc. (Ag) in Computer Application

I. Course Title : **Computer Fundamentals and Programming**
II. Course Code : **MCA 501**
III. Credit Hours : **2+1**

IV. Aim of the course

This is a course on Computer Fundamentals and Programming that aims at exposing the students to understand how computer works, analytical skills to solve problems using computers. andto write computer programs using C.

V. Theory

Unit I

Functional units of computer, I/O devices, primary and secondary memories. Number systems: decimal, octal, binary and hexadecimal; Representation of integers, fixed and floating point numbers, Operator precedence, character representation; ASCII, Unicode.

Unit II

Programming Fundamentals with C - Algorithm, techniques of problem solving, flowcharting, stepwise refinement; Constants and variables; Data types: integer, character, real, data types; Arithmetic expressions, assignment statements, logical expressions. Control flow

Unit III

Arrays and structures. Pointers, dynamic memory allocations

Unit IV

Program Structures – functions, subroutines

Unit V

I/O operations, Program correctness; Debugging and testing of programs.

VI. Practical

- Conversion of different number types;
- Creation of flow chart, conversion of algorithm/flowchart to program;
- Mathematical operators, operator precedence;
- Sequence, control and iteration;
- Arrays and string processing;
- Matrix operations, Sorting, Pointers and File processing – Reading and writing text files.

VII. Suggested Reading

- Balaguruswamy E. 2019. *Programming with ANSI C*. Tata McGraw Hill.
- Gottfried B. 2017. *Programming with C, Schaum Outline Series*. Tata McGraw Hill.
- Kanetkar Y. 1999. *Let Us C*. BPB Publ.

- Malvino A.P. and Brown J.A.. 2017. *Digital Computer Electronics*. Tata McGrawHill.
- Mano M.M. 1999. *Digital Logic and Computer Design*. Prentice Hall of India.

I. Course Title : Computer Organization and Architecture

II. Course Code : MCA 502

III. Credit Hours : 2+0

IV. Aim of the course

This is a course on Computer Organization and Architecture that aims at exposing the students to understand basic knowledge of how computer works.

V. Theory

Unit I

Number systems; Boolean algebra - minimization of Boolean function using KarnaughMap.

Unit II

Logic Gates, Combinational circuits – multiplexer, de-multiplexer, encoder, decoder; Sequential circuits: Flip-flops, Half and Full adder, Shift register, Counters.

Unit III

Organization of CPU, Control Unit- Instruction and Execution cycle in CPU, Register Organization, The Instruction Cycle, Instruction Pipelining.

Unit IV

Memory organization - Internal memory: Semiconductor Main Memory (RAM, ROM, EPROM), Cache Memory, Advanced DRAM Organization; External Memory - Magnetic Disks, RAID, Optical Memory, Magnetic Tape.

Unit V

Basic structure of computer hardware and system software - Addressing methods and machine programme sequencing; Input-output organizations - accessing I/O devices - direct memory access (DMA) – interrupts.

Unit VI

Introduction to microprocessors – CISC and RISC Architecture, Study of functional units of microprocessors.

VI. Suggested Reading

- Gear C.W. 1974. *Computer Organization and Programming*. McGraw Hill.
- Hayes J.P. 1988. *Computer Architecture and Organisation*. McGraw Hill.
- Malvino A.P and Brown J.A. 1999. *Digital Computer Electronics*. Tata McGraw Hill.
- Mano M.M. 1999. *Digital Logic and Computer Design*. Prentice Hall of India.
- Mano M.M. 2007. *Computer System Architecture*. Prentice Hall of India.
- Stallings W. 2016. *Computer Organization and Architecture: Designing for Performance*. Pearson Edu.

I. Course Title : Introduction to Networking and Internet Applications

II. Course Code : MCA 511

III. Credit Hours : 1+1

IV. Aim of the course

This is a course on Introduction to Networking and Internet Applications that aims

at exposing the students to understand Computer networking and web applications development.

V. Theory

Unit I

Networking fundamentals, types of networking, network topology; Introduction to File Transfer Protocol (FTP), Telnet, Simple Mail Transfer Protocol (SMTP), Internet Protocol v4 & v6. Network infrastructure and Security-switches, routers, firewall, intranet, internet, Virtual Private Network

Unit II

World Wide Web (www), working with Internet; Web pages, web sites, web servers; Web Applications.

Unit III

Hyper Text Markup Language (HTML), DHTML, web based application development. Static websites, dynamic websites. Client Side processing – scripting languages, Jquery. Server Side processing ASP.NET/JSP

VI. Practical

- Network and mail configuration;
- Using Network Services;
- Browsing of Internet;
- Creation of web pages;
- Creation of websites using HTML and scripting languages.

VII. Suggested Reading

- Cox V, Wermers L and Reding E.E. 2006. *HTML Illustrated Complete*. 3rd Ed. Course Technology.
- Niederst J. 2001. *Web Design in a Nutshell*. O'Reilly Media.
- Tanenbaum A.S. 2003. Computer Networks. *Prentice* Hall of India.

I. Course Title : Information Technology in Agriculture

II. Course Code : MCA 512

III. Credit Hours : 2+0

IV. Aim of the course

This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office. Also to understand Internet and WWW, use of IT application and different IT tools in Agriculture

V. Theory

Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions,

Unit II

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web

(WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

Unit III

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

Unit IV

Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.

VI. Suggested Reading

- Vanitha G. 2011. *Agro-informatics*
- http://www.*agrimoon*.com
- http://www.agriinfo.in
- http://www.eagri.org
- http://www.agriglance.com
- http://agritech.tnau.ac.in

I. Course Title : Mathematics for Applied Sciences

II. Course Code : MCA 513

III. Credit Hours : 2+0

IV. Aim of the course

This course is meant for students who do not have sufficient background of Mathematics. The students would be exposed to elementary mathematics that would prepare them to study their main courses that involve knowledge of Mathematics. The students would get an exposure to Linear Algebra, differentiation, integration and differential equations etc.

V. Theory

Unit I

Set theory-set operations, finite and infinite sets, operations of set, function.

Unit II

Vectors and vector spaces, Matrices notations and operations, laws of matrix algebra; transpose and inverse of matrix, Eigen values and Eigen vectors. Determinants - evaluation and properties of determinants, Solutions of Linear Equations.

Unit III

Variables and functions, limits and continuity of specific functions. Differentiation: theorems of differentiation, differentiation of logarithmic, trigonometric, exponential and inverse functions, Differentiation of function of a function, derivatives of higher order, partial derivatives. Application of derivatives, determination of points of inflexion, maxima and minima.

Unit IV

Integration, methods of integration, reduction formulae, definite and indefinite integral, Applications of integration in Agriculture, Differential Equations.

VI. Suggested Reading

- Hohn FE. 2013. *Elementary Matrix Algebra*, 3rdEd., Kindle Edition
- Harville DA. 1997. *Matrix Algebra from a Statistician's Perspective*. Springer.
- Searle SR. 1982. *Matrix Algebra Useful for Statistics*. John Wiley.
- Stewart J. 2007. *Calculus*. Thompson.
- Thomas GB. Jr. and Finney RL. 1996. *Calculus*. 9th Ed. Pearson Edu

I. Course Title : Statistical Computing
II. Course Code : MCA 514
III. Credit Hours : 1+1

IV. Aim of the course

This course is meant for exposing the students in the concepts of computational techniques. Various statistical packages would be used for teaching the concepts of computational techniques.

V. Theory

Unit I

Introduction to statistical packages and computing: data types and structures, Use of Software packages like, SAS, SPSS or "R: The R Project for Statistical Computing". Data analysis principles and practice, Summarization and tabulation of data, Exploratory data analysis; Graphical representation of data.Statistical Distributions: Fitting and testing the goodness of fit of discrete and continuous probability distributions;

Unit II

ANOVA, regression and categorical data methods; model formulation, fitting, diagnostics and validation; Matrix computations in linear models. Analysis of discrete data. Multiple comparisons, Contrast analysis

Unit III

Numerical linear algebra, numerical optimization, graphical techniques, numerical approximations, Time Series Analysis

Unit IV

Analysis of mixed models; Estimation of variance components, Analysis of Covariance, Fitting of non-linear model, Discriminant function; Principal component analysis. techniques in the analysis of survival data and longitudinal studies, Approaches to handling missing data, and meta-analysis

VI. Practical

- Data management, Graphical representation of data, Descriptive statistics
- General linear models ~ fitting and analysis of residuals, outlier detection
- Fitting and testing the goodness of fit of probability distributions
- Testing the hypothesis for one sample *t*-test, two sample *t*-test, paired *t*-test, test for large samples - Chi-squares test, F test
- One way analysis of variance, contrast and its testing, pairwise comparisons

- Mixed effect models, estimation of variance components
- Categorical data analysis, dissimilarity measures, similarity measures
- Analysis of discrete data, analysis of binary data
- Numerical algorithms
- Spatial modeling, cohort studies
- Clinical trials, analysis of survival data
- Handling missing data
- Analysis of time series data - fitting of ARIMA models.

VII. Suggested Reading

- Agresti A. 2013. *Categorical Data Analysis*. 3rd Ed. John Wiley.
- Everitt B.S. and Dunn G. 1991. *Advanced Multivariate Data Analysis*. 2nd Ed. Arnold.
- Geisser S. 1993. *Predictive Inference: An Introduction*. Chapman & Hall.
- Gelman A and Hill J. 2006. *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge Univ. Press.
- Gentle J.E., Härdle W and Mori Y. 2012. *Handbook of Computational Statistics - Concepts and Methods*. 2nd Ed. Springer.
- Han J and Kamber M. 2000. *Data Mining: Concepts and Techniques*. Morgan.
- Hastie T, Tibshirani R and Friedman R. 2001. *The Elements of Statistical Learning: Data Mining, Inference and Prediction*. Springer.
- Kennedy W.J. and Gentle J.E. 1980. *Statistical Computing*. Marcel Dekker.
- Miller RG Jr. 1986. Beyond ANOVA, *Basics of Applied Statistics*. John Wiley.
- Rajaraman V. 1993. *Computer Oriented Numerical Methods*. Prentice-Hall.
- Ross S. 2000. *Introduction to Probability Models*. Academic Press.
- Ryan B.F. and Joiner B.L. 1994. *Minitab Handbook*. 3rd Ed. Duxbury Press.
- Simonoff J.S. 1996. *Smoothing Methods in Statistics*. Springer.
- Singh, AK. 2016. *Practical R-Book by Examples for Agricultural Statistics*. Deptt. of Ag. Statistics, IGKV. Raipur
- Snell E.J. 1987. Applied Statistics: A Handbook of BMDP Analyses. Chapman & Hall.
- Thisted R.A. 1988. Elements of Statistical Computing. Chapman & Hall.
- Venables W.N. and Ripley B.D. 1999. Modern Applied Statistics With S-Plus. 3rd Ed. Springer.
- http://www.r-project.org/
- http://www.stat.sc.edu/~grego/courses/stat706/.
- Design Resources Server: www.drs.icar.gov.in.

I. Course Title : Mathematical Foundations in Computer Science

II. Course Code : MCA 551

III. Credit Hours : 3+0

IV. Aim of the course

This is a course on Mathematical Foundations in Computer Science that aims at exposing the students to provide basic foundations in Mathematics for problem solving.

V. Theory

Unit I

Mathematical Logic: Propositions – Simple and complex; Validity of Proposition-Truth Tables; Use of Propositions in computer programming.

Unit II

Mathematical data types: Sets, Functions, Bijective functions, pigeon-hole principle,

Boolean functions, permutation functions, Boolean algebra, recursion relations.

Unit III

Number Theory: Binary arithmetic, exponentiation, induction, sequences, big-oh notation, GCD, Euclidean algorithm, partially ordered sets, congruence and equivalence relation, encryption scheme, Fibonacci sequence, linear homogenous recurrence relations with constant coefficients.

Unit IV

Matrix Algebra Basic operations on matrices, Rank and inverse of matrices. System of linear equations, Characteristic roots and equations, Eigen values and eigen vectors;

Unit V

Graph Theory: Graphs, trees, LAN, Eulerian cycles, Hamiltonian cycles, graph coloring, graph algorithms.

VI. Suggested Reading

- Abertson M.O. and Hutchinson J.P. 1988. *Discrete Mathematics with Algorithms*. John Wiley.
- Deo N. 1984. *Graph Theory with Application to Engineering and Computer Science*. Prentice Hall of India.
- Knuth D.E. 2011. *Art of Computer Programming*. Vol. I. *Fundamental Algorithms*. Addison Wesley.
- Tremblay J.P. and Manohar R.P. 2017. *Discrete Mathematical Structures with Applications to Computer Science*. McGraw Hill.

I. Course Title : Object Oriented Programming

II. Course Code : MCA 552

III. Credit Hours : 2+1

IV. Aim of the course

This is a course on Java that aims at exposing the students to understand basic concepts of object oriented design and to write computer programs for problem solving using object oriented.

V. Theory

Unit I

Introduction to Objected Oriented Programming(OOP), Introduction to C++, data types in C++, Compilation and execution of C++; data types, control flow, input/output operations, interaction with file systems – reading, writing and appending.

Unit II

Strings, string manipulations, Arrays, functions, scope of variables, structures in C++.

Unit III

Classes, data members, member functions, this Pointer, Friends, Friend Functions, Friend Classes, Constructors, destructors.

Unit IV

Operator Overloading, dynamic binding, parametric polymorphism. Inheritance, inheritance and dynamic binding, multiple inheritance.

Unit V

New Approaches to programming – Model-View-Controller (MVC) architecture, Single page applications.

VI. Practical

- Case studies using object oriented analysis and design (OOAD);
- Creation of classes with features - overloading, inheritance, data abstraction, polymorphism and Implementation of a case study.

VII. Suggested Reading

- Arnold K and Gosling J. 1996. *The Java Programming Language. The Java Series.* Addison Wesley.
- Bergin J. 1994. *Data Abstraction: The Object-Oriented Approach Using C++.* McGraw Hill.
- Holzner S. 1997. *The Visual C++ Programming Language.* Prentice Hall of India.
- Johnsonbaugh R and Kalin M. 1995. *Object Oriented Programming in C++.* Prentice Hall.
- Khoshafian S and Abnous R. 1995. *Object Orientation Concepts, Languages, Databases, User Interfaces.* JohnWiley.
- Sengupta S and Korobkin C.P. 1994. *C++ Object Oriented Data Structures.*Springer.
- Stroustrup B. 1997. *The C++ Programming Language.* Addison Wesley.
- Troelsen A. 2005. *Pro C# 2005 and the .NET 2.0 Platform.* 3rd Ed. Apress.
- Kothari D.P. 2013. *Object Oriented Approach using C++*

I. Course Title : Design and Analysis of Algorithms

II. Course Code : MCA 553

III. Credit Hours : 2+1

IV. Aim of the course

This course provides a theoretical foundation in designing algorithms. The focus is on the advanced analysis of algorithms and on how the selections of different data structures affect the performanceof algorithms.

V. Theory

Unit I

Algorithm Analysis – Time Space Tradeoff – Asymptotic Notations – Conditional asymptotic notation – Removing condition from the conditional asymptotic notation - Properties of big-Oh notation – Recurrence equations – Solving recurrence equations – Analysis of linear search.

Unit II

Divide and Conquer: General Method – Binary Search – Finding Maximum and Minimum –Merge Sort – Greedy Algorithms: General Method – Container Loading – Knapsack Problem.

Unit III

Dynamic Programming: General Method – Multistage Graphs – All-Pair shortest paths – Optimal binary search trees – 0/1 Knapsack – Travelling salesperson problem.

Unit IV

Backtracking: General Method – 8 Queens problem – sum of subsets – graph coloring – Hamiltonian problem – knapsack problem.

Unit V

Graph Traversals – Connected Components – Spanning Trees – Biconnected components – Branch and Bound: General Methods (FIFO & LC) – 0/1 Knapsack problem – Introduction to NP-Hard and NP-Completeness.

VI. Practical

- Solving recurrence equations, Analysis of linear search,
- Programming Divide and Conquer Algorithms and their analysis,
- Programming Greedy Algorithms and their analysis,
- Implementing Dynamic Programming and their analysis,
- Implementing Backtracking examples,
- Implementing Graph Traversals,
- Implementing Spanning Trees.

VII. Suggested Reading

- Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman. 1999. *The Design and Analysis of Computer Algorithms*. Pearson Education.
- Cormen, T.H., C.E. Leiserson, R.L. Rivest, and C. Stein. 2003. *Introduction to Algorithms*. Prentice Hall of India, New Delhi.
- Horowitz E, Sahni S and Rajasekaran S. 2007. *Computer Algorithms/ C++*. Universities Press.

I. Course Title : Information Security
II. Course Code : MCA 554
III. Credit Hours : 2+0

IV. Aim of the course

This course provides exposure to challenges and techniques for securing the information in servers and Web enabled systems. The course deals with theoretical as well as practical issues of Information Security.

V. Theory

Unit I

General introduction to security, Cryptographic techniques: classical cryptography, conventional cryptography (DES), public-key cryptography (RSA), and digital signatures (DSA), steganography.

Unit II

Security services: message integrity, confidentiality and authentication, certification and key management (PKI).

Unit III

Network security applications: IP security (IPsec), Web security (SSL, TLS, SET), Electronic mail security (PGP, S/MIME), and SNMP security.

Unit IV

Access control in computer networks: authentication protocols and services (Kerberos), firewalls and Virtual Private Networks (VPNs).

Unit V

System security: intrusion detection, viruses. E-commerce securities: e-payment systems, fair data exchange.

VI. Suggested Reading

- Amoroso E. 1994. *Fundamentals of Computer Security Technology*. Prentice-Hall.
- Bhushan M. 2017. *Fundamentals of Cyber Security* Prentice Hall
- Chapman B and Zwicky E.D. 2000. *Building Internet Firewalls*. O'Reilly.
- Ford W. 1994. *Computer Communications Security*. Prentice Hall. Pfleeger CP. 2006. *Security in Computing*. Prentice Hall.
- Stallings W. 2003. *Cryptography and Network Security: Principles and* Practice. Prentice-Hall.

I. Course Title : Web Technologies and Applications

II. Course Code : MCA555

III. Credit Hours : 1+1

IV. Aim of the course

The main objective of the course is to introduce the whole range of web technologies. Through the various examples, the course will describe how to design a specific page, dynamic web pages, forms and frames and interaction with adatabase.

V. Theory

Unit I

Survey of contemporary Internet Technologies - Role, use and implementation of currenttools.

Unit II

Application Layer Services and protocols - Domain name services, network management protocol, electronic mail and file transfer protocol.

Unit III

World Wide Web – Web pages, Web Sites, Web Servers; Intranet andxtranet Concepts; Web Application Architectures.

Unit IV

Hyper Text Markup Language (HTML); Building static and dynamic web pages.

Unit V

Scripting Languages - Client side and server side scripting; Interaction with database.

Unit VI

Latest trends in programming on the emerging technologies relating to web based software development.

VI. Practical

- Designing static website with features like tables, hyperlink among pages, pictures, frames and layers;
- Client side scripting for user interface validation;
- Server side scripting for database interaction;
- Designing of a information system.

VII. Suggested Reading

- Ayers D, Bergsten H, Bogovich M, Diamond J, Ferris M, Fleury M, Halberstadt A, Houle P, Mohseni P, Patzer A, Philips R, Li S, Vedati K, Wilcox M and Zeiger S. 1999. *Professional Java Server Programming*. Wrox Press Ltd.

- Boudreaux 2005. PHP 5: *Your Visual Blueprint for Creating Open Source, Server-side Content.* (Visual Blueprint). Visual.
- Ellis M.D. 2007. *ASP.NET AJAX Programming Tricks.* Magma Interactive.
- Esposito D 2007. *Introducing Microsoft ASP. NET AJAX (Pro Developer).* Microsoft Press.
- Evjen B, Hanselman S and Rader D. 2008. *Professional ASP.NET 3.5: In C# and VB (Programmer to Programmer).* Wrox Press Ltd.
- Haefel-Monson R. 2003. *Enterprise JavaBeans.* O'Reilly & Associates.
- Naughton P and Schildt H. 2001.*The Complete Reference, Java 2.* TataMcGraw Hill.
- Neimke D. 2006. *ASP.NET 2.0 Web Parts in Action: Building Dynamic Web Portals (In Action).* Manning Publ.
- Walther S. 2008. ASP.NET 3.5 Unleashed. Sams.

I. Course Title : Computer Networks

II. Course Code : MCA 556

III. Credit Hours : 2+0

IV. Aim of the course

This course addresses the principles, architectures and protocols that have gone into the development of the Internet and modern networked applications. The course examines network design principles, underlying protocols, technologies and architectures such as naming, data transport, routing and algorithms for networked applications including messaging, encryption and authentication.

V. Theory

Unit I

The importance of Networking, Types of Networking, Network Topology, Transmission Media, Data communication: Concepts of data, signal, channel, bandwidth, bit-rate and baud-rate; Maximum data-rate of channel; Analog and digital communications, asynchronous and synchronous transmission.

Unit II

Network adapters card, Multiplexer (FDM, TDM, STDM), Hub, Repeater. Network References Models: Layered architecture, protocol hierarchies, interface and services.

Unit III

ISO-OSI references model, TCP/IP reference model; Data link layer function and protocols: Framing, error-control, flow control; sliding window protocol; HDLC, SLIP and PPP protocol.

Unit IV

Network layer - routing algorithms, congestion control algorithms; Internetworking: bridges and gateway; Transport layer - connection management, addressing; Flow control and buffering, multiplexing.

Unit V

Session layer – RPC; Presentation layer - abstract syntax notation.

Unit VI

Application layer - File Transfer Protocol (FTP), Telnet, Simple Mail Transfer Protocol (SMTP); World Wide Web(WWW) - Wide Area Indexed Servers (WAIS), WAP; Network Security; Data compression and cryptography.

VI. Suggested Reading

- Arick MR. 1994. *The TCP/IP Companion - A Guide for Common User*. Shroff Publ.
- Freer J. 1990. *Computer Communication and Networks*. Affiliated East West Press.
- Hayes J. 2001. *Modelling and Analysis of Computer Communication Networks*. KhannaPubl.
- Tanenbaum AS. 2003. *Computer Networks*. Prentice Hall of India.

I. Course Title : Data Structures

II. Course Code : MCA 561

III. Credit Hours : 2+1

IV. Aim of the course

This is a course on Data Structures that aims at exposing the students tounderstand data structures and their use in problem solving and to analyze different algorithms

V. Theory

Unit I

Algorithms and analysis of Algorithms, Big Oh notation. Arrays, Linked Lists, Elementary List Processing. Memory Allocation for Lists. Strings. Compound Data Structures.

Unit II

Recursive algorithms, Divide and conquer, Dynamic programming, Trees, different tree traversal algorithms, graph traversal.

Unit III

Sorting, Selection Sort. Insertion Sort. Bubble Sort. Performance Characteristics of Elementary Sorts. Shellsort. Sorting Other Types of Data. Index and Pointer Sorting. algorithms.

Unit IV

Quick sort, merging, merge sort, Heap structure, algorithm on heap structure, Queues, priority queues, Search Algorithms

VI. Practical

Implementation of various types of structures - linked lists, doubly linked lists, circular linked lists, queue, dequeue, stack and tree; String processing; Searching and sorting techniques; Graph and geometric algorithms and Casestudies

VII. Suggested Reading

- Aho A.V., Hopcroft J.E. and Ullman J.D. 1983. *Data Structures and Algorithms*. Addison Wesley.
- Cormen T.H., Leiserson CE, Rivest R.L. and Stein C. 2006. *Introduction toAlgorithms*. Prentice Hall of India.
- Goodrich M.T., Tamassia R and Mount D. 2004. *Data Structures and Algorithms in C++*. John Wiley.
- Horowitz E and Sahani S. 1983. *Fundamentals of Data Structures*. Galgotia Publ.
- Jain H. 2018. *Problem Solving in Data Structures and Algorithms Using Java*.
- Kleinberg J and Tardos E. 2006. *Algorithm Design*. Pearson Edu.
- Knuth D.E. 1968. *Art of Computer Programming*. Vol. I. *Fundamental Algorithms*. Addison Wesley.
- Knuth D.E. 1973. *Art of Computer Programming*. Vol. III. *Sorting and Searching*. Addison Wesley.

- Kruse R.L. and Ryba A.J. 1998. *Data Structures and Program Design in C++*. Prentice-Hall.
- Langsam Y, Augenstein M.J. and Tanenbum A.S. 1999. *Data Structures Using C and C++*. Prentice Hall of India.
- Tremblay J.P. and Sorenson P.G. 2017. *An Introduction to Data Structures with Applications*. McGrawHill.
- Weiss M.A. 1994. *Data Structures and Algorithm Analysis in C++*. Benjamin/Cummings.

I. Course Title : System Software and Programming

II. Course Code : MCA 562

III. Credit Hours : 2+1

IV. Aim of the course

This is a course on System Software and Programming that aims at exposing the students to understand operating systems and its functions and to design and write simple low level programming.

V. Theory

Unit I

Systems software-introduction, system specific features; Operating Systems and its functions – device management, process management, memory management, file system management, security.

Unit II

Users, directory, files, file access rights; Terminal Controls and signals; Modularization and program assembly – Interfaces, APIs, header files, libraries, shared objects, dynamic and static links.

Unit III

Input/output at System Level – sequential and random access; indexes.

Unit IV

Memory Management –Allocating and deallocating memory; Threads, spawning processes, network access, sleep, Inter Process communications – pipes, shared memory, sockets, secured sockets, Certificates.

Unit V

Object oriented software design; Generic and reusable classes, Debugging and testing of programs

VI. Practical

- Low Level programming for input/output interface, memory, threads, listening and responding,
- Programming constructs, control statements: branching and looping, file operations,
- Creation of classes with features - overloading, inheritance, data abstraction, polymorphism and a case study using and Object oriented language.

VII. Suggested Reading

- Ken A and Gosling, J. 1996. *The Java Programming Language*. The Java Series. Addison Wesley.
- Balaguruswamy, E. 2019. *Programming with ANSI C*. Tata McGraw Hill, New Delhi.
- Balaguruswamy, E. 2017. *Programming with Object Oriented Programming using C++*. Tata McGraw Hill, New Delhi.

- Bergin, J. 1994. *Data Abstraction: The Object-Oriented Approach Using C++*. McGraw Hill.
- Sethi, R. 1996. *Programming Language Concepts*. Addison Wesley.
- Stroustrup, B. 1997. *The C++ Programming Language*. Addison Wesley.

I. Course Title : Internet Technologies

II. Course Code : MCA 563

III. Credit Hours : 1+1

IV. Aim of the course

The main objective of the course is to introduce the whole range of web technologies. Through the various examples, the course will describe how to design a specific page, dynamic web pages, forms and frames and interaction with adatabase.

V. Theory

Unit I

World Wide Web – Web pages, Web Sites, Web Servers; Intranet and Extranet Concepts; Hyper Text Markup Language (HTML); Building static dynamic web pages.

Unit II

Web application architecture – (ASP.NET/Java) – Web Forms, Server Side Controls, handling events, Validation, JQuery

Unit III

Database Connectivity, read, write, update databases using web forms; data bound controls, sessions, session handling

Unit IV

Authentication of users, Personalization, Roles, role based access

Unit V

Using external libraries/ controls; Ajax, Jquery; Data Exchange – XML, JSON; Creating web services

VI. Practical

- Designing static website with features like tables, hyperlink among pages, pictures, frames and layers;
- Client side scripting for user interface validation;
- Server side scripting for database interaction;
- Designing of information system.

VII. Suggested Reading

- Ayers D, Bergsten H, Bogovich M, Diamond J, Ferris M, Fleury M, Halberstadt A, Houle P, Mohseni P, Patzer A, Philips R, Li S, Vedati K, Wilcox M and Zeiger S. 1999. *Professional Java Server Programming*. Wrox Press Ltd.
- Buest C and Allamaraju S. 2007. *Professional Java Server Programming*: J2EE 3rd Ed.
- Boudreaux 2005. PHP 5: *Your Visual Blueprint for Creating Open Source, Server-side Content*. (Visual Blueprint). Visual.
- Ellis M.D. 2007. *ASP.NET AJAX Programming Tricks*. Magma Interactive.
- Esposito D. 2007. *Introducing Microsoft ASP.NET AJAX (Pro-Developer)*. Microsoft Press.
- Evjen B, Hanselman S and Rader D. 2008. *Professional ASP.NET 3.5: In C# and VB (Programmer to Programmer)*. Wrox Press Ltd.
- Haefel-Monson R. 2003. *Enterprise Java Beans*. O'Reilly & Associates.

- Naughton P and Schildt H. 2001. *The Complete Reference, Java 2.* Tata McGraw Hill.
- Neimke D. 2006. *ASP.NET 2.0 Web Parts in Action: Building Dynamic Web Portals (In Action).* Manning Publ.
- Walther S. 2008. *ASP.NET 3.5 Unleashed.* Sams.

I. Course Title : Bioinformatics Computing

II. Course Code : MCA 564

III. Credit Hours : 1+1

IV. Aim of the course

The aim of the course is to introduce modern computational practices in bioinformatics at the algorithmic level that will train the students to complement researchers with biological background.

V. Theory

Unit I

The Central Dogma, Review and Utilization of Biological Databases.

Unit II

Overview of Algorithms: Pattern Matching, Biological Motivation Naïve Algorithm.

Unit III

Pre-processing: Suffix trees Time and Space Considerations. Approximate Pattern Matching: Sequence Comparisons, Dot Plots. Sequence Alignment: Dynamic Programming, Global and Local Alignments Scoring Matrices, BLAST, FASTA Parameters.

Unit IV

Similarity and Distance: PAM & BLOSUM matrices, Heuristic Approaches.

Unit V

Exhaustive Search Fragment Assembly: DNA Sequencing, Greedy Algorithms, Sequencing by Hybridization Fragment Assembly.

Unit VI

Graph Algorithms, Overlap Graphs, and Hamiltonian Path Wrap-up.

VI. Practical

- Suffix trees: Time and Space Considerations;
- Approximate Pattern Matching: Sequence Comparisons, Dot Plots;
- Sequence Alignment: Dynamic Programming, Global and Local Alignments Scoring Matrices, BLAST, FASTA Parameters;
- Similarity and Distance: PAM & BLOSUM matrices,
- Heuristic Approaches and Exhaustive Search Fragment Assembly: DNA Sequencing, Greedy Algorithms, Sequencing by Hybridization Fragment Assembly,
- Graph Algorithms, Overlap Graphs, and Hamiltonian PathWrap-up.

VII. Suggested Reading

- Bryan B. 2002. *Bioinformatics Computing.* Prentice Hall.
- Duda R.O., Hart P.E. and Stork D.G. 1999. *Pattern Classification.* John Wiley.
- Ewens W.J. and Grant G.R. 2001. *Statistical Methods in Bioinformatics.* Springer.
- Jones N.C. and Pavel A.P. 2004. *Introduction to Bioinformatics Algorithms.* MIT Press.
- Koskinen T. 2001. *Hidden Markov Models for Bioinformatics.* Kluwer.

- Krane D.E. & Raymer M.L. 2002. *Fundamental Concepts of Bioinformatics*. Benjamin / Cummings.
- Krawetz S.A. and Womble D.D. 2003. *Introduction to Bioinformatics: A Theoretical and Practical Approach*. Humana Press.
- Lesk A.M. 2002. *Introduction to Bioinformatics*. Oxford Univ. Press.
- Shortliffe E.H. and Cimino J.J. 2006. *Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)*. Springer.
- Wang J.T.L., Zaki M.J., Toivonen H.T.T. and Shasha D. 2004. *Data Mining in Bioinformatics*. Springer.

I. Course Title : Soft Computing Techniques

II. Course Code : MCA 565

III. Credit Hours : 1+1

IV. Aim of the course

This course introduces the soft computing techniques and their applications in solving real world problems. The course is dealt with the perspective of using soft computing techniques in machine learning.

V. Theory

Unit I

Introduction to soft-computing tools – Fuzzy Logic, Genetic Algorithm, Neural Networks and Probabilistic Reasoning, Rough Sets.

Unit II

Applications of Fuzzy Logic concepts in Knowledge Management.

Unit III

Optimization problem solving using genetic algorithm.

Unit IV

Neuron as a simple computing element, the perceptron, multilayer neural networks, Neural network approaches in data analysis, design and diagnostics problems; Applications of probabilistic reasoning approaches.

VI. Practical

Classification using Fuzzy Logic, Genetic Algorithm, Neural Networks

VII. Suggested Reading

- Goldberg D.E. 2008. *Genetic Algorithms in Search, Optimization, and Machine Learning*. Addison Wesley.
- Haykin S. 1998. *Neural Networks: A Comprehensive Foundation*. Prentice Hall.
- Jang J.R., Sun C and Mizutani E. 1996. *Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*. Prentice Hall.
- Kecman V and Kecman V. 2001. *Learning and Soft Computing: Support Vector Machines, Neural Networks, and Fuzzy Logic Models*. MIT Press.
- Lee K.H. 2005. *First Course on Fuzzy Theory and Applications*. Springer.
- Mitra S and Acharya T. 2003. *Data Mining: Multimedia, Soft Computing, and Bioinformatics*. John Wiley.

I. Course Title : Database Management System

II. Course Code : MCA 571

III. Credit Hours : 2+1

IV. Aim of the course

Database systems are backbone of any information system, enterprise resource planning, research activities and other activity that require permanence of data storage. This course provides the basic introduction to database system technologies; design, concurrency, security and backup/recovery issues of database management systems. The major focus in this course is the Relational database model.

V. Theory

Unit I

Database system - Operational Data, Characteristics of database approach, architecture.

Unit II

Overview of DBMS; Data associations - Entities, Attributes and Associations, Relationship among Entities, Representation of Associations and Relationship, Data Model classification.

Unit III

Entity Relationship model; Relational Data Structure- Relations, Domains and Attributes, Relational Algebra and Operations, Retrieval Operations.

Unit IV

Relational Database Design - Anomalies in a Database, Normalization Theory, and Normal forms; Query processing.

Unit V

Distributed Databases- concepts, architecture, design; Structured Query Language (SQL) - Data Definition Language (DDL), Data Manipulation Language (DML).

Unit VI

PL/SQL - Stored procedure, Database triggers; Relational Data Base Management Package.

VI. Practical

E-R diagram construction; SQL - Command Syntax, Data types, DDL Statements, DML Statements, integrity constraints; Triggers, creating stored procedures/ functions; Normalization of database and Case study on a database design andimplementation.

VII. Suggested Reading

- Date C.J. 2000. *Introduction to Database System*. Addison Wesley.
- Desai B.C. 2000. *Introduction to Database Systems*. Galgotia Publ.
- Elmasri and Navathe. 2006. *Fundamentals of Database Systems*. 4th Ed. Addison Wesley.
- Garcia-Molina H., Ullman J.D. and Widom J. 2013. *Database Systems: The Complete Book*. Prentice Hall.
- Rob P. and Coronel C. 2006. *Database Systems: Design, Implementation and Management*. 7th Ed. Thomson Learning.
- Silberschartz A, Korth H.F. and Sudarshan S. 1997. *Database Systems Concepts*. Tata McGraw Hill.

I. Course Title : **Software Engineering**
II. Course Code : **MCA 572**
III. Credit Hours : **2+0**

IV. Aim of the course

The objective of the course is to make the learner efficiently work as software engineer so as to acquaint them with all the phases of Software Development Life Cycle.

V. Theory

Unit I

Software engineering definition; Software Development: Phases, Process models, Project structure, Project team structure, Role of metrics, Measurement, Software quality factors.

Unit II

Planning and Software Project: Requirement analysis, Cost estimation, Project Scheduling, Quality Assurance Plan, and Project Monitoring Plans, Gantt charts, PERT and CPM.

Unit III

System Design: Design Objectives, Design Principles, Design Tools, and Techniques, Prototyping.

Unit IV

Structured Programming Coding: Programming Practices, Verification, Monitoring and Control.

Unit V

Testing: Testing Fundamentals, Functional Testing, Structural Testing, Test Plan activities, Unit testing, IntegrationTesting.

Unit VI

Reliability: Concept of Software Reliability, Reliability Models, Limitations of Reliability Models, Software Maintenance. CASE tools.

VI. Suggested Reading

- Aggarwal K.K. and Singh Y. 2006. *Software Engineering*. 2nd Ed. New Age.
- Awad E.M. 1993. *System Analysis and Design*. Galgotia Publ.
- Fairley R. 2017. *Software Engineering Concepts*. Tata McGraw Hill.
- Jalote P. 2005. *An Integrated Approach to Software Engineering*. 3rd Ed. Narosa.
- Kerzner H. 1998. *Project Management: A System Approach to Planning, Scheduling and Controlling*. CBS.
- Mall R. 2006. *Fundamentals of Software Engineering*. 2nd Ed. Prentice- Hall ofIndia.
- Pressman R.S. 2017. *Software Engineering: A Practitioner's Approach*. 6th Ed. McGraw Hill.
- Sommerville I. 2004. *Software Engineering*. 6thEd. Pearson Edu.

I. Course Title : **Operating System**
II. Course Code : **MCA 573**
III. Credit Hours : **2+1**

IV. Aim of the course

The main objective of this course is to provide core knowledge of Operating Systems features,functions and techniques.

V. Theory

Unit I

Operating system overview: operating system as an extended machine and resource manager; Operating system classifications; Operating system modes and system calls.

Unit II

Operating system architecture; Process model, Process synchronization, Concurrent processes,Process scheduling criterion and algorithms.

Unit III

Problem of mutual exclusion; Deadlock and prevention; Race conditions; Semaphores; Monitors; Process allocation.

Unit IV

Memory management; Multi-programming with fixed and variable number of tasks; Continuousallocation; Paging, Demand paging, Page fault; Virtual memory; Fragmentation; Segmentedmemory management, shared segments; Segmented and demand paged management, Overlaysand swapping, Thrashing.

Unit V

Multi-processor system, Master slave scheduling; Homogeneous scheduling; Device managementsystem; Dedicated share and virtual devices.

Unit VI

File Management System- Input-Output file protection; Remote Procedure Call; Distributedoperating system (Course to be taught in accordance to the Unix Operating System).

VI. Practical

- Problems using system calls for process management, signaling, file management, directorymanagement, protection;
- Critical section problem; Solution to mutual exclusion by Peterson method;
- Producer consumer problem with fatal race conditions;
- Comparison of various CPU scheduling algorithms and Paging, segmentation and demand paging.

VII. Suggested Reading

- Bach, M.J. 2015. *Design of the UNIX Operating System*. Pearson Education.
- Deitel, H.M. 1990. *An Introduction to Operating System*. Addison Wesley.
- Dhamdhere, D.M. 2007. *Operating Systems: A Concept Based Approach*. Tata McGraw Hill, NewDelhi.
- Kernighan, B.W. and Pike, R. 1996. *The UNIX Programming Environment*. Prentice Hall of India,New Delhi.
- Peterson, J. and Silberschatz, A. 1991. *Operating System*. Addison Wesley.
- Stallings, W. 2006. *Operating Systems: Internals and Design Principals*. Prentice Hall of India, New Delhi.
- Silberchatz, A., Galvin, P.B. and Gagne, G. 2006. *Operating System Principals*. Wiley India.
- Tanenbaum, A.S. 2001. *Modern Operating Systems*. Prentice Hall of India, New Delhi.

I. Course Title : Compiler Construction

II. Course Code : MCA 574

III. Credit Hours : 2+1

IV. Aim of the course

The purpose of the course is to acquaint various phases of compiler writing which will help anapplication/system programmer working on other projects besides compilers.

V. Theory

Unit I

Introduction to Compiler, Compilation Process, Compiler Structure.

Unit II

Programming Language Grammars, Elements of a Formal Language Grammar, Derivation,Reduction and Syntax Trees, Ambiguity Regular Grammar & Regular Expression – Context FreeGrammar.

Unit III

Introduction to Finite Automata, Deterministic Finite Automata.

Unit IV

Non-deterministic Finite Automata; Scanning & Parsing Techniques – The Scanner, RegularGrammar and FSA, Top Down Parsing, Parsing Algorithm, Top Down Parsing WithoutBacktracking, Predictive Parsers, Bottom Up Parsing, Parsing, LR Parsers, Shift Reduce Parsing; Symbol Table.

Unit V

Organization, Memory Allocation – Static & Dynamic Memory Allocation, Compilation Control Transfer, Procedure Calls, Conditional Execution, Iteration Control Construct; Lexical Syntax Errors, Semantic, Major Issues in Optimization, Optimizing.

Unit VI

Transformations, Local Optimization, Program Flow Analysis, Global Optimization.

VI. Practical

- Design of a lexical analyser for regular expression;
- Design of a finite state machine;
- Program for - magic squares, context free grammar, shift reduce parsing, operator precedence parsing, recursive decent parsing, predictive parser, simple LR parser and Post fix form for intermediate code.

VII. Suggested Reading

- Aho, A.V. and Ullman, J.D. 1993. *Principles of Compiler Design Theory*. NarosaPublishing House,New Delhi.
- Galles, G. 2007. *Modern Compiler Design*. Pearson Education.
- Holab, A. 2006. *Compiler Design in C*. Prentice-Hall of India, New Delhi.
- Lewis, P.M., Rosenkrantz, D.J. and Stearns, R.E. 1978. *Compiler Design Theory*. Addison Wesley.
- Tremblay, J.P. and Sorenson, P.G. 1985. *The Theory and Practice of Compiler Writing*. McGraw Hill.
- Raghavan V. 2017. *Principles of Compiler Design*. Addison Wesley

I. Course Title : Data Warehousing and Data Mining

II. Course Code : MCA 575

III. Credit Hours : 2+1

IV. Aim of the course

The basic objective of this course is to familiarize students about this state of art of setting datawarehouse for business intelligence in relation to agricultural research, development and planning.

V. Theory

Unit I

Concepts and principles of data warehousing; Project management and requirements. Introduction to Data Mining and its Tasks, Data Pre-processing, Data Discretization

Unit II

Dimensional modelling; Data warehousing architecture; System process and process architecture. Classification and Prediction, Decision Tree, Naive Bayes' Classifier.

Unit III

Data warehousing design; Database schema; Data staging. Output and Knowledge Representation, Evaluation and Credibility, Association Rule Mining.

Unit IV

Partitioning strategy; Aggregations; Data marts; Meta data management; OLAP Modelling, Querymanagement. Clustering: Similarity measures, Hierarchical Clustering, k-Means Clustering.

Unit V

Data warehouse security; Backup and recovery; Building end-user Applications; Capacity planning; Testing the warehouse.

Unit VI

Implementation and maintenance of data warehouse; Case study.

V. Practical

- Data warehouse design, selection of schema;
- Normalization and renormalization;
- Query planstrategy;
- Performance tuning, backup and recovery of data warehouse;
- Dynamic reports and OLAP Reports.
- Introduction to Data Mining software,
- Data Pre-processing, Discretization, Decision Tree: D3,Naïve Bayes' Classifier,
- Association Rule Mining: Apriori Algorithm,
- Clustering: Hierarchical Clustering, K-Means.

VI. Suggested Reading

- Gupta, G.K. 2014. *Introduction to Data Mining with Case Studies*. Prentice Hall of India, New Delhi.
- Han, J and Kamber, M. 2006. *Data Mining: Concepts and Techniques*. Morgan Kaufman.
- Inmon, B. 2005. *Building the Data Warehouse*. John Wiley.
- Kelly, S. 1997. *Data Warehousing in Action*. John Wiley.
- Kimball, R. 2000. *The Data Webhouse Toolkit: Building the Web-Enabled Data Warehouse*. John Wiley.

- Kimball, R. 2002. *The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling.* John Wiley.
- Kimball, R. 2004. *The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data.* John Wiley.
- Kimball, R. 2005. *The Microsoft Data Warehouse Toolkit: With SQL Server 2005 and the Microsoft Business Intelligence Toolset.* John Wiley.
- Kimball, R. 2008. *The Data Warehouse Lifecycle Toolkit: Practical Techniques for Building Data Warehouse and Business Intelligence Systems.* John Wiley.
- Kimball, R and Ross M. 2013. *The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling*, John Wiley
- Lee, K.H. 2005. First Course on Fuzzy *Theory and Applications.* Springer.