Academic Syllabus for

M. Sc. In Computer Science

Binod Bihari Mahto Koyalanchal University, Dhanbad

www.bbmku.ac.in,

Govt. Polytechnic Road

Dhanbad-828130

Email: registrarbbmku@gmail.com

Course Structure of M.Sc. in Computer Science (wef 2018)

	ODD SEMESTER Semester-1		EVEN SEMESTER Semester-2		
Paper Code	Paper Code	Credits	Paper Code	Paper	Credits
MCS-C11	Programming Techniques	5	MCS-C21	Computer Networks	5
MCS-C12	Computer Organization & Architecture	5	MCS-C22	Database Management Systems	5
MCS-E1X	Elective 1 (Theory of Computation /Design & Analysis of Algorithms /Computer Graphics/ Web Technology)	5	MCS-E2X	Elective-2 (Multimedia Systems / Parallel Algorithms /Compiler Design /Operating Systems)	5
MCS-P11	Computing Laboratory-1	5	MCS-P21	Computing Laboratory-2	5

	ODD SEMESTER Semester-3		EVEN SEMESTER Semester-4		
Paper Code	Paper Code	Credits	Paper Code	Paper	Credits
MCS-C31	Image Processing and Pattern Recognition	5	MCS-C41	Artificial Intelligence	5
MCS-C32	Software Engineering	5	MCS-E41X	Elective-4 (Cloud Computing/ Software Testing and Reliability /Cryptography and Network Security	5
MCS-E3X	Elective 3 (Advanced Database Management Systems / Algorithmic Graph Theory/ Wireless Networks	5	MCS-E42X	Elective-5 (Bioinformatics/Quantum Computing / Big Data and Analytics	5
MCS-P31	Computing Laboratory-3	5	MCS-D41	Dissertation	5

Total Credit = 80 [Each Paper in Each Semester is of 5 (Five) Credits]

Each Paper (Theory & Practical) carries a full marks of 100, out of which Internal Exam. will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Internal Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory (short answer type each to be answered in about 50

words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

List of Elective Subjects

Elective -1	**E11**	Theory of Computation
	E12	Design & Analysis of Algorithms
	E13	Computer Graphics
	E14	**Web Technology**

Elective -2	**E21**	Multimedia Systems
	E22	Parallel Algorithms
	E23	Compiler Design
	E24	Operating Systems

Elective -3	E31	Advanced Database Management Systems
	E32	Algorithmic Graph Theory
	E33	Wireless Networks

Elective -4	E411	Cloud Computing
	E412	**Software Testing and Reliability**
	E413	Cryptography and Network Security

Elective -5	E421	Bioinformatics
	E422	Quantum Computing
	E423	**Big Data and Analytics**

Eligibility for Admission in M.Sc. in Computer Science

- The candidate should have any of the following degree from a recognized University with a minimum of 55% marks for General /OBC candidates and 50% marks for SC/ST candidates:
  - Bachelor's Degree in Science/Engineering (Computer Science/Information Technology/Electronics or equivalent)
  - Bachelor's Degree in Science with Honours in Mathematics / Physics (with Mathematics as generic/sub.)
  - BCA having Mathematics as a subject at 10+2 level.

- Roster will be followed as per rules of government of Jharkhand

- Admission will be strictly on merit basis

- Total intake : 32

- Other rules and regulations will be same as that of other regular PG courses of Binod Bihari Mahto Koyalanchal University, Dhanbad

- Any change in rules and regulations may be made as per decision/approval/permission of the concerned bodies/committees of Binod Bihari Mahto Koyalanchal University, Dhanbad and/or directives of government of Jharkhand

SEMESTER – 1

MCS-C11 (Programming Techniques)

Concepts of programming languages, Programming domains, Language Evaluation Criteria, influences on Language design, Language categories, Programming Paradigms – Imperative, Object Oriented, functional Programming , Logic Programming. Programming Language Implementation – Compilation and Virtual Machines, programming environments.

Syntax and Semantics: general Problem of describing Syntax and Semantics, formal methods of describing syntax - BNF, EBNF for common programming languages features, parse trees, ambiguous grammars, attribute grammars, denotational semantics and axiomatic semantics for common programming language features.
Data types: Introduction, primitive, character, user defined, array, union, pointer and reference types, structure, design and implementation uses related to these types.
Names, Variable, concept of binding, type checking, strong typing, type compatibility, named constants, variable initialization.

Expressions and Statements: Arithmetic relational and Boolean expressions, Short circuit evaluation mixed mode assignment, Assignment Statements, Control Structures – Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, guarded commands.
Subprograms and Blocks: Fundamentals of sub-programs, Scope and lifetime of variable, static and dynamic scope, Design issues of subprograms and operations, local referencing environments, parameter passing methods, overloaded sub-programs, generic sub-programs, parameters that are sub-program names, design issues for functions user defined overloaded operators, co routines.

Introduction and overview of logic programming, basic elements of prolog, application of logic programming, Introduction, fundamentals of FPL, LISP.

Text Books:

1. Programming Languages –Louden, Second Edition, Thomson
2. LISP Patrick Henry Winston and Paul Horn Pearson Education.
3. Programming in PROLOG Clocksin, Springer
4. Programming With C, Gottfried, TMH
5. C Programming Essentials – Kashi Nath Dey and Samir K Bandyopadhyay, Pearson Education

MCS-C12 (Computer Organisation & Architecture)

Basic structure of Computer, Overview of von Neumann architecture, Number systems, Boolean postulates and laws, De-Morgan's Theorem, Boolean function, Minimization of Boolean expressions, SOP, POS, Karnaugh map, Logic Gates, Combinational and Sequential circuits.Overview on Arithmetic Unit, Processing Unit.

Memory Devices – RAM, ROM, Cache memory, Virtual memory, Secondary Storage
IO Organization - Accessing I/O devices, Interrupts, Direct Memory Access, Buses, Interface circuits, Standard I/O Interfaces - PCI, SCSI, USB

Basic Parallel Processing Architecture, Taxonomy- SISD. MISD, SIMD, MIMD structures, Serial, Parallel & Concurrent Computation, CISC Vs RISC
Concepts of pipelining, Hierarchical Memory Technology: Inclusion, Coherence and locality properties
Concepts of instruction-level parallelism (ILP), Superscalar, superpipelined and VLIW processor architectures; Vector and symbolic processors

Multiprocessor Architecture, Taxonomy of parallel architectures; Centralized shared-memory architecture, synchronization, memory consistency, interconnection networks, Distributed shared-memory architecture, Cluster computers.
Non von Neumann Architectures, Data flow Computers, Reduction computer architectures, Systolic Architectures.

Basic Features of Current Architectural Trends. DSP Processor, Dual core Technology

Text Books:
1. Digital Design, 3.edition by M. Morris Mano, PHI publication
2. Computer Organization and Architecture – Designing for Performance, 6th Edition by William Stallings
3. Advanced Computer Architecture: Parallelism, Scalability and Programmability by Kai Hwang

MCS-E11: Theory of Computation

Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees,ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

Turing machines, The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recllrsive) languages and their closure properties, variants ofTuring machines, nondeterministicTMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

General Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.

Text Books :

1. K.L.P Mishra & N. Chandrasekharan- "Theory of Computer Science", PHI

2. Hopcroft JE. and Ullman JD., "Introduction to Automata Theory, Languages & Computation", Narosa.
3. Ash & Ash- "Discrete Mathematics",TMH
4. Lewis H. R. and Papadimitrou C. H., "Elements of the theory of Computation", P.H.I.
5. Kain, "Theory of Automata & Formal Language", McGraw Hill.
6. Henne, “Theory of Computation”
7. Linz Peter, "An Introduction to Formal Languages and Automata", Narosa

MCS-E12: Design and Analysis of Algorithms

Introduction to Data structure and algorithms. The running times of a program, Use of the Big-Oh, small o, Big-omega and small omega notation, Efficiency of algorithms, Analysis of recursive programs, Solving recurrence equation, Divide and conquer algorithms, Dynamic programming, Greedy algorithm.

Implementation of Abstact data Types (ADT), list, stack, queue hashing, Tree structures: binary trees, AVL trees, Red-Black trees, priority queues, Tree traversal algorithms, Graphs and algorithms: Prim’s algorithm, Kruskal’s algorithm, Dijkstra’s method, Backtracking minimum spanning trees, Sorting & Searching algorithms.

Introduction to NP Problem, Polynomial-time, Abstract Problems, Encoding, NP-Completeness and Reducibility, NP-Completeness, Circuit Satisfiability, NP-Complete Problems, The Vertex-cover Problem, The Subset-sum Problem, The Hamiltonian-cycle Problem, The Traveling-salesman Problem.

Text Books:

1. Data Structure using C and C++ - 2nd edition by Tanenbaum
2. Fundamentals Of Data Structures In C++ by Ellis Horowitz, Sahni, Dinesh Mehta
3. Introduction to Algorithm by Thomas H. Cormen, Charies E. Leiserson and Ronald. L. Riveit,
4. The Design and Analysis of Computer Algorithms by Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman.

MCS-E13 : Computer Graphics

Introduction: Transformation, Translation, Rotation, Scaling. Reflection, Shear and Projection.

Clipping; Three Dimensional Clipping, 3D Midpoint Subdivision algorithm, 3D Cyrus-Beck algorithm, 3D Liang-Barsky algorithm, Polygon Clipping.

Curves; Plane Curve, Space Curve, Cubic Splines, Hermite Spline, Cubic Bezier Curve, Cubic B-Spline.

Visible Lines and Visible Surfaces: Introduction, Floating Horizon Algo. , Upper & Lower Horizon, Roberts algorithm, Warnock algorithm, Scan-line Z-buffer algorithm, Ray-Tracing algorithm.

Rendering; Introduction, Illumination, Gouraud Shading, Phong Shading, Transparency, Shadows, Texture, Radiosity.

Text Books:

1. Procedural Elements for Computer Graphics, David F. Rogers, Tata Mc-Graw Hill.
2. Mathematical Elements for Computer Graphics, David F. Rogers, J. Alan Adams, TMH.
3. Computer Graphics, Hearn & Baker, PHI.
4. Computer Graphics, Plastock, Schaum Outline Series, TMH.
5. Introduction to Computer Graphics and Multimedia, Anirban Mukhopadhyay, Arup Chattopadhyay, Vikas.

MCS-E14: Web Technologies

The Internet Client server software models, world wide web & web browsers, HTML building blocks, search engines. Advanced web page construction: Image file, JAVA scripts, applets, query and query refinements, software on internet, internet relay chat etc. Java language introduction, object references, instance variables, dot operator constructors, Methods overloading, Inheritance, Exception handling Threads and Synchronization, utilities, I/O, Networking in Java, server socket, URLK, URL connection, Abstract Window, JDK.

Web servers – IIS (XAMPP, LAMPP) and Tomcat Servers. Java Web Technologies- Servlets, JavaServer Pages, Java Server Faces, Web Technologies in Netbeans, Building a Web Application in Netbeans, JSF Components, Session Tracking, Cookies

PHP- Basics, String Processing and Regular Expressions, Form Processing and Business Logic, Using Cookies, Dynamic Content, Operator Precedence Chart

Database Connectivity with MySQL - Servlets, JSP, PHP. Case Studies- Student information system, Health Management System

Text Books:

1. Elizabeth Castro, “HTML for the World Wide Web”, Peachpit Press Pearson Education.
2. Lehnert Wendy, “Web 101, Making the network for you”, Pearson Education, Asia.
3. Naughton Patrick, “The JAVA Hanbook”, TataMcgraw Hill 1996.
4. Winston PH & Narsimhan, “On to JAVA 1.2”, Addison Wesley.

5. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet & World Wide Web How to Program”, Deitel series, 5th edition, 2012

6.Jason Gilmore, “Beginning PHP and MySQL From Novice to Professional”, 4th Edition, Apress Publications, 2010

7. Robert W. Sebesta, “Programming with World Wide Web”, Pearson, 4th edition, 2008

8. David William Barron, “The World of Scripting Languages”, Wiley Publications, 2000

SEMESTER -2

MCS-C21(Computer Networks)

Fundamentals of data transmission, wired and wireless media, digital and analog transmission, data coding techniques, multiplexing, overview on OSI layers and TCP/IP model
Local Area Networks and data link protocols, point-to-point links and sliding window flow control, CSMA/CD, Ethernet, wireless LAN, cellular networks, and advanced multi-user communication (CDMA, SDMA/MIMO), mobility
Internetworking using TCP/IP: network programming using socket API, network client/server design
Packet/circuit switching and wide-area networks: store-and-forward networks, source routing, virtual/permanent, circuits and call set-up, LAN/WAN addressing, hop-by-hop vs. end-to-end control

Routing techniques - intra-domain routing (OSPF, RIP), inter-domain policy routing (BGP) and network connectivity
Transport protocols - TCP and UDP, Congestion control, TCP window control, multimedia streaming
High-level network services - DNS, HTTP, SMTP, network management (SNMP), network Security

Text Books:
1. Computer Networks by AS Tanenbaum, Fourth Edition, 2002, Pearson Education
2. Data Communication and Networking by B. Forouzan
3. Data and Communication by W. Stallings,

MCS-C22(Database Management Systems)

What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management.

The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction.

Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML

Relational database model: Logical view of data, keys, integrity rules.

Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).

Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison.

Calculus: Tuple relational calculus, Domain relational Calculus, calculus Vs algebra, computational capabilities.

What is constraints, types of constrains, Integrity constraints,

Views: Introduction to views, data independence, security, updates on views, comparison between tables and views

SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.

Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks),Time stamping methods, optimistic methods, database recovery management.

Text Books :

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts",fifth EditionMcGraw-Hill ,
2. Rob, Coronel, "Database Systems",Seventh Edition, Cengage Learning.
3. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
4. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
5. Ramakrishnan: Database Management System , McGraw-Hill

MCS-E21 : Multimedia Systems

Overview of digitization and compression techniques: Characteristics of image, audio and video stream, sampling and quantization, PCM, ADPCM and DM techniques, Lossless and lossy compression mechanisms.
Encoding and file structure of media streams: JPEG, giff images, flac, mp3 audio, H.261 and H.263 video compression schemes, MPEG 1/2/4 video encoding standards, audio-video synchronization.
Transportation of multimedia streams over internet; Application requirements, QoS parameters, RTP/RTCP protocol basics.
VoIP fundamentals: Network protocols (H.323, SIP), QoS requirements.

Text Books :

1. Networked Multimedia Systems: Concepts, Architecture and Design, S V Raghavan and S K Tripathi, Prentice-Hall.
2. Multimedia Communications: Applications Networks, Protocols and Standards; Fred Halsall; Pearson.
3. Fundamentals of Multimedia, Z-N. Li, M.S. Drew, Pearson Prentice Hall.
4. Multimedia Systems, John F. Koegel Buford.
5. Multimedia Systems, Ralf Steinmetz, Klara Nahrstedt.

MCS-E22 : Parallel Algorithms

Introduction; Sequential Algorithms, Sequential Algorithm Vs. Parallel Algorithms, Nature of Parallel Algorithms. Parallel Algorithms with Parallel Computers, Need for Parallel Algorithms, Analyzing an Algorithm; Running time: Counting Steps, Bounds (Lower and Upper), Speedup Ratio, Numbers of Processors, Amdhal's Law, Cost, Other measures, Area, Length, Period, Flynn's Classification of Computer, SISD, SIMD, MISD, MIMD models.

Parallel Selection; Introduction, Lower bound, rank, Linear Order, Selection, Complexity. Sequential Algorithm, Desirable Properties of Parallel Algorithms, Broadcasting a Datum and Example of Parallel selection algorithm.

Parallel Merging: Introduction to Parallel Merging, A Network for parallel Merging, Merging on CREW Model: parallel merging and Sequential Merging, Merging on EREW model.

Parallel Sorting; Introduction, A Network for Sorting, Sorting on a Linear Array, Sorting on the CRCW Model, Sorting CREW Model, Sorting on EREW Model. Case study.

Parallel Searching: Introduction, Searching a Sorted Sequence, EREW Searching. CREW Searching, CRCW Searching, Searching a random Sequence, searching on SM SIMD Computers, EREW, ERCW, CREW, CRCW. Searching on a Tree, Searching on a Mesh.

Parallel Matrix Operations: Introduction, Transposition, Matrix-by-Matrix Multiplication, Mesh Network, Cube Network, CRCW, Matrix by Vector Multiplication.

Parallel Algorithms for Graph Theory: Introduction, Definitions, Computing the Connectivity Matrix, Finding Connected Components, All-pairs of shortest paths, Computing the minimum Spanning Tree.

Text Books :

1, Parallel Algorithms, Salim G Aid, PHI.
2, Introduction to Parallel Algorithms, S,Quinn, Addison Wesley.
3, Parallel Algorithms, Joseph Jaja.

MCS-E23 : Compiler Design

Introduction; Compilers and Translators, Structure of a Compiler, Compiler writing tools, Lexical and syntactic structure of a language.
Lexical analysis: Finite automata, Regular expression, Lexical analyzer, Lexical analyzer generator.
Syntax Analysis: Notion of top-down and bottom-up parsing, LL parsing, Operatorprecedence parsing, LR parsing (SLR, LALR, and Canonical LR parsing), Syntax Directed Translation, Parser generator.
Semantic Analysis: Declaration processing, Type checking, Symbol tables.
Intermediate Code Generation: Run-time environments, translation of language constructs.
Code Generation: Flow-graphs, Register allocation, Code-generation algorithms.
Error handling and recovery.
Code optimization; An introduction to the techniques.

Text Books :

1. Principles of Compiler Design – Alfred V. Aho, Jeffrey D, Ullman, Sethi.
2. Compiler Design in C – Allen I. Holub, Prentice Hall of India, 1993.
3. Compiler Construction; Principles & Practice, Kenneth C. Louden, Thomson Learning 2003.
4. The Theory and Practice of Compiler Writing, Jean-Paul Tremblay and Paul G, Sorrenson, McGraw Hill .

MCS-E24 : Operating System

OS services and components, multitasking, multiprogramming, time sharing, buffering, spooling

Process & thread management, context switching, multithreading
Concurrency control, mutual exclusion requirements, semaphores, monitors, Dead locks – detection, recovery, avoidance and prevention

Memory management, partitioning, swapping, paging, segmentation, virtual memory, Demand paging, page replacement and allocation algorithm

I/O Systems, interrupt handlers, device drivers, and device independent I/O software
Secondary-storage structure, file system management

Protection & security, Implementation of access matrix, Encryption
Case studies on Linux & Windows 2000

Introduction to Distributed Systems, Architectures of Distributed Systems, communication networks, Mutual Exclusion in Distributed Systems, RMI, concept of Replication, Distributed File Systems (NFS, AFS, coda) overview, security in Distributed Systems

Multiprocessor operating systems, basic multiprocessor system architectures, overview

on Database Operating systems

Real Time Operating System and Overview on Embedded System

Text Books:

1. Advanced Concepts In Operating Systems by Mukesh Singhal and Niranjan Shivaratri
2. Distributed Operating systems by Andrew s.Tanenbanm
3. Operating System Concepts, 5th ed. By Silberschatz and Galvin

SEMESTER – 3

MCS-C31(Image Processing & Pattern Recognition)

Introduction:
Definition, Origins of Digital Image Processing, Applications, Fundamental Steps, Components, Mathematical Preliminaries
Digital Image Fundamentals:
Image sensing and Acquisition, Image sampling and Quantization, Some basic relationships between pixels, Linear and Nonlinear Operations
Image Enhancement in Spatial Domain:
Basic Gray Level Transformation, Histogram Processing, Enhancement using Basic Arithmetic Operations, Smoothing Spatial Filters,
Sharpening Spatial Filters

Image Enhancement in Frequency Domain:
Introduction to Fourier Transform and and the Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering, Implementation
Image Restoration:
Restoration Process, Noise Models, Restoration in the Process of Noise Only- Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering,
Linear Position Invariant Degradations, Estimating Degradations, Inverse Filtering, Wiener Filtering, Constrained Least Square Filtering, Geometric Mean Filtering, Geometric Transformations

Colour Image Processing:
Introduction, Colour Models, Pseudo Colour Image, Processing, Basics of Full-Colour Image Processing, Colour Transformations, Smoothing and Sharpening, Colour Segmentation, Noise, Compression
Image Compression:
Introduction, Compression Models, Elements of Information Theory, Error Free Compression, Lossy Compression, Image Compression Standards
Image Segmentation:
Detection of Discontinuity , Edge Linking and Boundary Detection, Threshholding, Region Based Segmentation, Use of Motion in segmentation

Implementation of Image Processing Operations Using MATLAB/ImageJ/SciLab:
Introduction to Image Processing Functions, Implementation of different Image Processing Operations, Implementation of general HP and LP filters, Implementation of Special Filters like Inverse, CLS, Weiner etc. Colour Image Processing

The nature of statistical pattern recognition; Three learning paradigms; The sub-problems of pattern recognition; The basic structure of a pattern recognition system; Comparing classifiers. Basic statistical issues; Sources of classification error; Bias and variance; Three approaches to classification: density estimation, regression and discriminant analysis; Bayes' decision theory - General framework; Optimal decisions; Classification; Simple performance bounds, Empirical error criteria; Optimization methods; Failure of MLE; Linear and quadratic discriminants; Shrinkage; Logistic classification; Generalized linear classifiers; Perceptrons; Maximum Margin; Error Correcting Codes; Sample error and true error; Error rate estimation; Confidence intervals; Resampling methods; Regularization; Model selection; Minimum description length; Comparing classifiers, Histograms rules; Nearest neighbor methods; Kernel approaches; Local polynomial

fitting; Flexible metrics; Automatic kernels methods, Optimal features; Optimal linear transformations; Linear and nonlinear principal components; Feature subset selection; Feature Extraction and classification stages, Unsupervised learning and clustering, Syntactic pattern recognition, Fuzzy set Theoretic approach to PR, Speech and speaker recognition, Character recognition, Scene analysis.

Text Books:

1. Gonzalez and Woods, Digital Image Processing, Pearson
2. Soloman, Fundamentals of Digital Image Processing, Wiley
3. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
4. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
5. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

MCS-C32 (Software Engineering)

The Product : Software, Software Myths,
The process : Software engineering : A Layered Technology, Software Process Models, The linear sequential Model, The prototyping Model,The RAD Model, Evolutionary Software Process Models.
Software project planning : Project planning objectives, Software scope, Decomposition Techniques, Estimation models, The Make/Buy Decision.
Risk analysis and Management : Reactive versus proactive risk strategies, Software risks, Risk identification, Risk projection, Risk refinement, Risk mitigation, monitoring, and management, Safety risks and hazards,
Project scheduling and technique : Basic concept, Defining a task set for the software project, Defining a task Network, Scheduling, Earned value analysis.
Software Quality Assurance : Quality Concepts, The Quality Movement, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Formal Approaches to SQA, Statistical Software Quality Assurance, Software Reliability, Mistake Proofing for Software, Introduction to ISO standard.
Software Testing Technique : Software testing fundamentals, Test case design, White-box Testing, Basis path testing, Control structure testing, Black-box testing, Testing for specialized environments, architectures and application.
Object-Oriented Analysis :
Introduction to UML Diagrams, Use Case Diagrams, Class Diagrams, Collaboration Diagrams, Implementation Diagrams.

Text Books :

1. R. G. Pressman – Practitioners Approach to Software Engineering, TMH
2. Rajib Mall - Software Engineering Fundamentals
3. Ghezzi, Software Engineering, PHI
4.Pankaj Jalote - An Integrated Approach to Software Engineering, NAROSA.
5.Object Oriented & Classical Software Engineering(Fifth Edition), SCHACH,TMH
6.Vans Vlet, Software Engineering, SPD
7.Uma, Essentials of Software Engineering, Jaico
8.Sommerville, Ian - Software Engineering, Pearson Education
9.Benmenachen, Software Quality, Vikas
10. G. Booch, “Object oriented Analysis and Design with Applications”, Second Edition, Benjamin Cummings, 1994.

MCS-E31 : Advanced Database Management System

Introduction : Concept & Overview of DBMS, Concepts of Different Database Models, Database Languages, Functions of Database Administrator, Database Users, Three Schema architecture of DBMS.
Relational Databases: Integrity Constraints revisited: Functional, Multi-valued and Join Dependency, Template Algebraic, Inclusion and Generalized Functional Dependency, Chase Algorithms and Synthesis of Relational Schemes.

Query Processing and Optimization: Evaluation of Relational Operations, Transformation of Relational Expressions, Indexing and Query Optimization, Limitations of Relational Data Model, Null Values and Partial Information.

Parallel and Distributed Databases: Distributed Data Storage: Fragmentation and Replication, Location and Fragment Transparency, Distributed Query Processing and Optimization, Distributed Transaction Modeling and Concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation.

Advanced Transaction Processing: Nested and Multilevel Transactions, Compensating Transactions and Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, Transaction Processing Monitors. Active Databases: Triggers in SQL, Event Constraint and Action: ECA Rules, Query Processing and Concurrency Control, Compensation and Databases Recovery.

Deductive Databases: Datalog and Recursion, Evaluation of Datalog program, Recursive queries with negation. Objected Oriented and Object Relational Databases: Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases. Case Studies: Gemstone, O2, Object Store, SQL3, Oracle xxi, DB2.

Text Books :

1. Abraham Silberschatz, Henry Korth, and S. Sudarshan, Database System Concepts, McGraw-Hill.
2. Raghu Ramakrishnan, Database Management Systems, WCB/McGraw-Hill.
3. Bipin Desai, An Introduction to Database Systems, Galgotia.
4. J. D. Ullman, Principles of Database Systems, Galgotia.
5. R. Elmasri and S. Navathe, Fundamentals of Database Systems8, Addison-Wesley.
6. Serge Abiteboul, Richard Hull and Victor Vianu, Foundations of Databases. Addison-Wesley.

MCS-E32 : Algorithmic Graph Theory

Cut-sets and Cut-vertices, Connectivity and Separability, 1-Isomorphism and 2-Isomorphism. Planarity, Planarity - Testing Algorithms, Coloring, Partitioning, Independent set, Vertex Cover, Matching, Algorithms for Bipartite Matching and Genera) Matching, Graph Enumeration.

Different Types of Graphs: Intersection Graphs, Circular-arc Graphs, Interval Graphs, Line Graphs of Bipartite Graphs, Perfect Graphs, Permutation graphs, Chordal Graphs, p-Critical Graphs, Comparability Graphs, F-Graphs, Recognizing Triangulated Graphs, MCS Algorithm, PEG Testing Algorithm, Minimum Fill-In Computation, Optimization Algorithms on Triangulated Graphs - Chromatic Number Calculation, Algorithm to Construct G-decomposition, TRO Algorithm.

Text Books :

1. Perfect Graph Algorithms, Columbia,
2. Introduction to Graph Theory, Douglas B.West, Pearson Education.

3. Graph Theory with Applications_ to Engineering and Computer Science, Narsingh Deo, Prentice-Hall, India.

MCS-E33 : Wireless Networks

Cellular Mobile Wireless Networks: Description of Cellular System, Evolution of cellular networks, Overview of Layer-1 functionalities.
GSM Architecture and Protocols: Network Architecture, air interface, multiple access scheme, channel organization, NAS procedures.
GPRS: Network Architecture, Classes of Operation, TBF procedure for channel assignment, NAS protocols for Session Management, PS-domain Mobility procedures.
UMTS: Concept of WCDMA, network architecture, channel structure, enhancement of NAS procedures over GSM/GPRS, RJBS and Mobility related RRM procedures.
HSPA over UMTS: HSDPA and HSUPA architecture, HARQ operations, realization of variable data rates over shared channels.
CS and PS services over cellular networks: Voice call, SMS, Packet call, supplementary services, introduction to AT commands set.
WLAN: IEEE 802.11x standards, architecture, air interface, authentication, Wi-Fi.
Ad-Hoc Network Concepts: Mobility and routing issues, MANET, VANET.

Text Books :
1. Wireless Network Evolution (2G to 3G), Garg, Pearson Education.
2. Mobile Communications, Jochen Schiller, Pearson.

SEMESTER – 4

MCS-C41(Artificial Intelligence)

Overview: foundations, scope, problems, and approaches of AI

Problem-solving through Search; forward and backward, state-space models, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Knowledge Representation and Reasoning: ontology, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

Variable-based models: Constraints; constraint satisfaction problems, factor graphs, independence, variable elimination, Markov networks, Gibbs sampling, particle filtering, Generative; Markov models, Bayesian networks, HMMs.

Machine learning; supervised learning, linear models, loss minimization, maximum likelihood, unsupervised learning, reinforcement learning.

Logic: propositional logic, first-order logic.

Applications: Language, vision, Robotics.

Text Books :

1.Artificial Intelligence; A Modern Approach, Stuart Russell & Peter Norvig, Prentice-Hall.
2. Artificial Intelligence, Third Edition, Patrick Henry Winston, Addison-Wesley Professional, 1992.
3. Introduction to Artificial Intelligence & Expert Systems, D. W. Patterson, PHI
4. Nils J. Nilsson, “Artificial Intelligence: A New Sythesis”, Morgan-Kaufmann.

MCS-E411: Cloud Computing

Introduction to Cloud Computing : Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing

Introduction to Cloud Technologies : Study of Hypervisors, Compare SOAP and REST, Webservices, AJAX and mashups-Web services: SOAP and REST, SOAP versus REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services

Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization

Multitenant software: Multi-entity support, Multi-schema approach, Multi tenance using cloud data stores, Data access control for enterprise applications

Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo.

Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of MapReduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Mapreduce, Features and comparisons among GFS,HDFS etc, Map-Reduce model

Cloud security : security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud, Cloud computing security architecture: Architectural Considerations-General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control Identity management, Access control, Autonomic Security
Cloud computing security challenges: Virtualization security management virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.

Issues in cloud computing: Implementing real time application over cloud platform Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud

Cloud computing platforms: Installing cloud platforms and performance evaluation Features and functions of cloud platforms: Xen Cloud Platform, Eucalyptus, Open Nebula, Nimbus, T Platform, Apache Virtual Computing Lab (VCL), Enomaly Elastic Computing Platform.

Text Books :

1. Mastering Cloud Computing, Rajkumar Buyya,Christian Vecchiola, Selvi
2.Cloud Computing Bible by Barrie Sosinsky, Wiley India
3. Enterprise Cloud Computing by Gautam Shroff,Cambridge
4. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
5. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif (SPD,O'REILLY)
6. Cloud Computing : A Practical Approach, Antohy T Velte, et.al McGraw Hill

MCS-E412 : Software Testing and Reliability

Brief introduction to software systems and SDLC

Evolving Role of Software, Software Characteristics, Software Applications.

Software Engineering, Definitions of Software Engineering, The Serial or Linear Sequential Development Model, Iterative Development Model, The incremental Development Model, The Parallel or Concurrent Development Model, Hacking.

Software Reliability: Introduction to Software Reliability, Software reliability metrics, Programming for Reliability- Fault avoidance, Fault tolerance; Software Reuse

Introduction to Software Design, System Models-data -flow model, Semantic data models, Object models; Data Dictionaries, Software Design- The design process, Design Methods, Design description, Design strategies, Design quality; Architectural Design- System structuring, Control models, Modular decomposition, Domain-specific architectures.

Software Testing: Basic Testing Vocabulary, Quality Assurance versus Quality Control, The Cost of Quality, Software Quality Factors, How Quality is Defined, Why Do We Test Software? What is a Defect? The Multiple Roles of the Software Tester(People Relationships), Scope of Testing, When Should Testing Occur? Testing Constraints, Life Cycle Testing, Independent Testing, What is a QA Process? Levels of Testing, The "V" Concept of Testing

Software Testing Techniques: Software Testing Fundamental, Testing Principles, White Box Testing, Control Structure Testing, Black Box Testing, Boundary Value Analysis, Testing GUIs, Testing Documentation and Help Facilities.

Software Testing Assurance: Verification and Validation- Validation Testing, Validation Test Criteria; Test Plan- Test Documentation; Test Strategies- Top-Down Testing, Bottom-Up Testing, Thread testing, Stress testing , Back-to-back testing; Principles of Testing, Testing methods and tools- Testing through reviews, Black-box testing (Functional testing), White box testing (glass-box testing), Testing software changes; Additional requirements in testing OO Systems, System Testing, Acceptance Testing, Regression testing , Metrics Collection, Computation, and Evaluation, Test and QA plan, Managing Testing Functions.

Software Testing Strategies: Introduction to Software Testing Strategies, Organizing for software testing, Software Testing Strategy, Unit Testing- Unit Test Considerations; Top-down Integration, Bottom-up Integration

Managing Change: Software Configuration Management, Change Management

Risks – Risk Analysis and Management with examples
Case Study: How to test web, stand alone and database applications – with examples.
Basics of automation testing – why, when and how to perform automation testing, Factors for choosing a particular tool, An overview for the major functional testing tools, Overview of Test management and bug tracking tools

Text Books :

1. R.S. Pressman, "Software Engineering", Tata McGraw Hill Pub. Co., Delhi, 2000.

2. Ian Sommerville, "Software Engineering", Pearson Education, Delhi, 2000.

3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Narosa Publishing House, Delhi, 2000

4. J.D. McGregor and D.A. Sykes, A Practical Guide to Testing, Addison-Wesley, 2001.

5. Glenford J. Myers, The Art of Software Testing (2nd ed.), John Wiley, 2004.

6. D. Graham, E.V. Veenendaal, I. Evans and R. Black, Foundations of Software Testing, Thomson Learning, 2007.

7. N.S. Godbole, Software Quality Assurance: Principles and Practice, Narosa Publishing House, 2006

8. Daniel Galin, Quality Assurance: From theory to implementation, Pearson Education Ltd., 2004.

9. S.H. Kan, Metrics and Models in Software Quality Engineering (2nd ed.), Pearson Education Inc., 2003.

10. Behforooz, Software Engineering Fundamentals, OUP

11. Peters and Pedrycz, "Software Engineering: an Engineering Approach", Wiley

12. Benmenachen, Software Quality, Vikas

13 Ghezzi, Software Engineering, PHI

MCS-E413 : Cryptography & Network Security
Concepts and Terminology:
Threats, Attacks, Services and Mechanisms, Security Attacks, Security Services, Integrity check, digital Signature, authentication, Spoofing, Sniffing, Firewall.
Cryptography:
Techniques, Mathematical foundation, Stream Ciphers, Block Ciphers, Cryptanalysis, Hash Algorithms.
Secret Key Cryptography: Block Encryption, DES rounds, S-Boxes IDEA: Overview, comparison with DES, Key
expansion, IDEA rounds, Uses of Secret key Cryptography; ECB, CBC, OFB, CFB, Multiple encryptions DES.
Hash Functions and Message Digests:
Length of hash, uses, algorithms (MD2, MD4, MD5, SHS) MD2: Algorithm (Padding, checksum, passes.) MD4 and 5: algorithm (padding, stages, digest computation.) SHS: Overview, padding, stages.

Public key Cryptography:
Algorithms, examples, Modular arithmetic (addition, multiplication, inverse, and exponentiation) RSA: generating keys, encryption and decryption. Other Algorithms: PKCS, Diffie-Hellman, El-Gamal signatures, DSS, Zero-knowledge signatures.

Authentication:
Password Based, Address Based, Cryptographic Authentication. Passwords in distributed systems, on-line vs offline guessing, storing. Cryptographic Authentication: passwords as keys, protocols, KDC's Certification Revocation, Inter-domain, groups, delegation. Authentication of People: Verification techniques, passwords, length of passwords, password distribution, smart cards, biometrics.
Security Policies and Security Handshake Pitfalls:
What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication.

Network Security:
Electronic mail security, IP security, Network management security.
Security for electronic commerce: E-commerce security analysis, protocol, SSL, SET
System Security: Intruders and Viruses, Firewalls, Intrusion Detection.
Case Studies
Web threats, E-mail threats, Domain controller threats, Extranet and VPN threats.
Assignment and Project work.

Text Books:
1. Atul Kahate, Cryptography and Network Security, McGraw Hill
2. Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002
3. Stallings, W.,.Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003
4. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000
5. Cryptography and Network Security; McGraw Hill; Behrouz A Forouzan
6. Information Security Intelligence Cryptographic Principles andApp. Calabrese Thomson
7. D. P. Nagpal, Information Security, S. Chand Complany Limited
8. 7. Securing A Wireless Network Chris Hurley SPD.

MCS-E421 : Bioinformatics

Introduction, branches, aim, scope, research areas.
The genetic material: nucleotides, orientation, base pairing, central dogma.
Gene structure: promoter sequence, genetic code, introns and exons.
Pairwise Alignment: gaps, dynamic programming, Needleman and Wunsch Algorithm, Smith-Waterman algorithm.
Databases in Bioinformatics: Structures - sequence and molecular file formats, conversion tods, databases, classification schema, retrieval systems.
Sequence databases; nucleotide sequence databases, secondary nucleotide, protein sequence databases, secondary and specialized protein sequence databases.
Data Analysis Tools: Introduction to BLAST, PSI-BLAST.
Data visualization in proteins using RasMol / Chime.

Text Books :

1. Bioinformatics -Databases, Tools and Algorithms by O Basu and S K Thukral
2. Bioinformatics - Principle and Applications by Z Ghosh and B Ballick
3. Fundamental Concepts of Bioinformatics by D E Krane and M L Raymer
4. Bioinformatics - A Modern Approach by V R Srinivas
5.Introduction to Bioinformatics – Arthur M. Lesk, 2002, Oxford University Press

MCS-E422 : Quantum Computing

Quantum Computing, history of quantum computation and quantum information, Single Qubit, Multiple Qubit, Quantum Gates, Multiple Quantum Gates, Quantum Circuit, Quantum Entanglement, N-colning theorem,Bell states, Quantum algorithm, Quantum Fourier Transform and its applications, Shor's factoring algorithm, Deutsch Algorithm, Grover's data search algorithm. Quantum Cryptography, Quantum Teleportation, Quantum game.

Text Books :

1. Quantum Computation and Quantum Information, MA Nelson & I L Chang, Cambridge University Press.

MCS-E423 : Big Data and Analytics

Introduction to big data: Introduction, distributed file system, Big Data and its importance, Drivers, Big data analytics, Big data applications. Algorithms, Matrix-Vector, Multiplication by Map Reduce.

Introduction to HADOOP: Big Data, Apache Hadoop & Hadoop Ecosystem, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization.

HADOOP Architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce Paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

HADOOP ecosystem and yarn: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Introduction to Python History, Features, Setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator, Conditional Statements & Looping If, If- else, Nested if-else For, While, Nested loops Break, Continue, Pass, String Manipulation Accessing Strings Basic Operations String slices Function and Methods

Lists, Tuple and Dictionaries Lists – Introduction, Accessing list, Operations, Working with lists, Function and Methods Tuple – Introduction, Accessing tuples, Operations, Working, Functions and Methods Dictionaries - Introduction, Accessing values in dictionaries, working with dictionaries, Properties, Functions, Defining a function calling a function Types of functions Function Arguments Anonymous functions Global and local variables, Modules Importing module Math module Random module Packages Composition

Input-Output Printing on screen Reading data from keyboard Opening and closing file Reading and writing files Functions

Regular expressions Match function Search function Matching VS Searching Modifiers Patterns

CGI Introduction Architecture CGI environment variable GET and POST methods, Cookies File upload Database Introduction Connections Executing queries Transactions Handling error

Text Books:

1. Boris Lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al. “Understanding Big data ”, McGraw Hill, 2012.
3. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
4. MapReduce Design Patterns (Building Effective Algorithms & Analytics for Hadoop) by Donald Miner & Adam Shook
5. Dive into Python by Mark Pilgrim
6. Programming Python by Mark Lutz, O’Reilly Media
7. Python Programming: An Introduction to Computer Science” by John Zelle