DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

COURSE STRUCTURE & SYLLABUS M.Tech CSE for COMPUTER SCIENCE PROGRAMME

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

M. Tech. (CS) I SEMESTER							
S.No	**Course Code**	**Courses**	**Category**	**L**	**T**	**P**	**C**
1	MTCS1101	**Program Core-1** Mathematical Foundations of Computer Science	PC	3	0	0	3
2	MTCS1102	**Program Core-2** Advanced Data Structures	PC	3	0	0	3
3	MTCS1103	**Program Elective-1** 1. Advanced Operating Systems 2. Advanced Computer Architecture 3. Parallel Computing	PE	3	0	0	3
4	MTCS1104	**Program Elective-2** 1. Advanced Data Bases 2. Advanced Computer Networks 3. Object Oriented Software Engineering	PE	3	0	0	3
5	MTCS1105	**Research Methodology and IPR**	CC			0	2
6	MTCS1106	**Laboratory-1** Advanced Data Structures Lab	LB	0	0	4	2
7	MTCS1107	**Laboartory-2** Advanced Computing Lab-1	LB	0	0	4	2
8	MTCS1108	**Audit Course-1***	AC	2	0	0	0
Total Credits							18

**Student has to choose any one audit course listed below.*

II SEMESTER

S.No	**Course Code**	**Courses**	**Cate Gory**	**L**	**T**	**P**	**C**
1	MTCS1201	**Program Core-3** Advance Algorithms	PC	3	0	0	3
2	MTCS1202	**Program Core-4** Data Science through Python Programming	PC	3	0	0	3
3	MTCS1203	**Program Elective-3** 1. Machine Learning 2. Ad hoc and Sensor Networks 3. Internet of Things	PE	3	0	0	3
4	MTCS1204	**Program Elective-4** 1. Cryptography and network Security 2. Cloud Computing 3. Web Technologies	PE	3	0	0	3
5	MTCS1205	**Laboratory-3** Advance Algorithms Lab	LB	0	0	4	2
6	MTCS1206	**Laboartory-4** Advanced Computing Lab-2	LB	0	0	4	2
7	MTCS1207	**Mini Project with Seminar**	MP	2	0	0	2
8	MTCS1208	**Audit Course-2***	AC	2	0	0	0
Total Credits							18

**Student has to choose any one audit course listed below.*

Audit Course 1 & 2:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

III SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTCS2101	**Program Elective-5** 1. Mobile Applications and Development 2. Big Data Analytics 3. MOOCs-1 through NPTEL/ SWAYAM- 12 Week Program related to the programme which is not listed in the course structure	PE	3	0	0	3
2	MTCS2102	**Open Elective** 1. MOOCs-2 Through NPTEL /SWAYAM - Any 12 week course on Engineering/ Management/ Mathematics offered by other than parent department 2. Course offered by other departments in the college	OE	3	0	0	3
3	MTCS2103	**Dissertation-I/Industrial Project #**	PJ	0	0	20	10
Total Credits							16

#Students going for Industrial Project/Thesis will complete these courses through MOOCs

IV SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTCS2201	**Dissertation-II**	PJ	0	0	32	16
Total Credits							16

Open Electives offered by the Department of Computer Science and Engineering for other Departments students

1. Python Programming
2. Data Science
3. Bioinformatics
4. Digital Forensics
5. Web Security
6. Machine Learning

I Year - I Semester		L	T	P	C
		3	0	0	3

Mathematical Foundations of Computer Science (MTCSE1101)

Course Objectives:

- To understand the mathematical fundamentals that are vital many courses in the field of Computer Science.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

Course Outcomes: After completion of course, students would be able to

- Demonstrate skills in solving mathematical problems.
- Comprehend mathematical principles and logic.
- Demonstrate knowledge of mathematical modeling and proficiency in using mathematical software
- Manipulate and analyze data numerically and/or graphically using appropriate Software.
- Communicate effectively mathematical ideas/results verbally or in writing.

UNIT I: Mathematical Logic-Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof. Predicate Calculus: Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

UNIT II: Set Theory-Introduction, Operations on Binary Sets, Principle of Inclusion and Exclusion, *Relations:* Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations, Hasse Diagrams, *Functions:* Bijective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions, Lattice and its Properties.

UNIT III: Algebraic Structures and Number Theory- *Algebraic Structures:* Algebraic Systems, Examples, General Properties, Semi Groups and Monoids, Homomorphism of Semi Groups and Monoids, Group, Subgroup, Abelian Group, Homomorphism, Isomorphism, *Number Theory:* Properties of Integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic (Fermat's Theorem and Euler's Theorem)

UNIT IV: Combinatorics- Basic of Counting, Permutations, Permutations with Repetitions, Circular Permutations, Restricted Permutations, Combinations, Restricted Combinations, Generating Functions of Permutations and Combinations, Binomial and Multinomial Coefficients, Binomial and Multinomial Theorems, The Principles of Inclusion–Exclusion, Pigeonhole Principle and its Application.

UNIT V: Recurrence Relations-Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations, **Graph Theory:** Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Planar Graphs, Euler's Formula, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Algorithms for Spanning Trees (Problems Only and Theorems without Proofs).

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill.
2. Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rd Edition, Tata McGraw Hill.
3. Discrete Mathematics and its Applications with Combinatorics and Graph

Theory, K. H. Rosen, 7th Edition, Tata McGraw Hill.

Reference Books:

1. Discrete Mathematics for Computer Scientists and Mathematicians, J. L. Mott, A. Kandel, T. P. Baker, 2nd Edition, Prentice Hall of India.
2. Discrete Mathematical Structures, Bernand Kolman, Robert C. Busby, Sharon Cutler Ross, PHI.
3. Discrete Mathematics, S. K. Chakraborthy and B.K. Sarkar, Oxford, 2011.

I Year - I Semester		L	T	P	C
		3	0	0	3

Advanced Data Structures (MTCS1102)

Course objectives:

- To be familiar with basic techniques of object oriented principles and exception handling using C++
- To be familiar with the concepts like Inheritance, Polymorphism
- Solve problems using data structures such as linear lists, stacks, queues, hash tables
- Be familiar with advanced data structures such as balanced search trees, AVL Trees, and B Trees.

Course outcomes:

- Select appropriate data structures as applied to specified problem definition.
- Apply advanced data structure strategies for exploring complex data structures.
- Implement all data structures like stacks, queues, trees, lists and graphs and compare their Performance and trade offs
- Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
- Incorporate data structures into the applications such as binary search trees, AVL, Red Black, splay and B Trees
- Determine and analyze the complexity of given Algorithms

UNIT I: Arrays Abstract Data Types and the C++ Class, The Array as an Abstract Data Type, The Polynomial Abstract Data type, Spares Matrices, Introduction- Sparse Matrix Representation- Transposing a Matrix- Matrix Multiplication, Representation of Arrays. **Stacks And Queues-** Templates in C++, The Stack Abstract Data Type, The Queue Abstract Data Type, Subtyping and Inheritance in C++, Evaluation of Expressions, Expression- Postfix Notation- Infix to Postfix.

UNIT II: Linked Lists Single Linked List and Chains, Representing Chains in C++, The Template Class Chain, Circular Lists, Available Space Lists, Linked Stacks and Queues, Polynomials, Equivalence Classes, Sparse Matrices, Doubly Linked Lists, Generalized Lists, Representation of Generalized Lists, **Trees** Introduction, Binary Trees, Binary Tree Traversal and Tree Iterators-Introduction, Inorder, Preorder, Postorder Traversal, Thread Binary Trees, Heaps, Binary Search Trees.

UNIT III: Graphs The Graph Abstract Data Type, Elementary Graph Operation, Minimum Cost Spanning Trees, Shortest Paths and Transitive Closure, **Hashing-** Introduction, Static Hashing, Dynamic Hashing

UNIT IV: Priority Queues Binomial heaps, Fibonacci Heaps, Symmetric Min-Max Heaps, **Efficient Binary Search Trees** Optimal Binary Search Trees, AVL trees, Red-Black Trees, Splay Trees.

UNIT V: Multyway Search Trees m-way Search Trees, B- Trees, B+- Trees **Digital Search Trees** Digital Search Trees, Binary Tries and Patricia, Multiway Tries

Text Books:

1. Data structures, Algorithms and Applications in C++, S.Sahni, 2nd edition, Universities Press, Pvt. Ltd.
2. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.
3. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and Mount, Wiley student edition, John Wiley and Sons.

Reference Books:

1. Data structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson
2. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
3. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.

I Year - I Semester		L	T	P	C
		3	0	0	3

Advanced Operating Systems (MTCS11XX)

Course Objectives:

This course is aimed at enabling the students to

- provide comprehensive and up-to-date coverage of the major developments in distributed Operating System, Multi-processor Operating System and Database Operating System and to cover important theoretical foundations including Process Synchronization, Concurrency, Event ordering, Mutual Exclusion, Deadlock, Agreement Protocol, Security, Recovery and fault tolerance.

Course Outcomes:

After the completion of the course, student will be able to

- Illustrate on the fundamental concepts of distributed operating systems, its architecture and distributed mutual exclusion.
- Analyze on deadlock detection algorithms and agreement protocols.
- Make use of algorithms for implementing DSM and its scheduling.
- Apply protection and security in distributed operating systems.
- Elaborate concurrency control mechanisms in distributed database systems.

UNIT I: Introduction- Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks - communication primitives. Theoretical Foundations - inherent limitations of a distributed system - lamp ports logical clocks - vector clocks - casual ordering of messages - global state - cuts of a distributed computation - termination detection. Distributed Mutual Exclusion - introduction - the classification of mutual exclusion and associated algorithms - a comparative performance analysis.

UNIT II: Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems - issues in deadlock detection and resolution - control organizations for distributed deadlock detection - centralized and distributed deadlock detection algorithms -hierarchical deadlock detection algorithms. Agreement protocols - introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture - mechanism for building distributed file systems - design issues - log structured file systems.

UNIT III: Distributed shared memory-Architecture- algorithms for implementing DSM - memory coherence and protocols - design issues. Distributed Scheduling - introduction - issues in load distributing - components of a load distributing algorithm - stability - load distributing algorithm - performance comparison - selecting a suitable load sharing algorithm - requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction- basic concepts - classification of failures - backward and forward error recovery, backward error recovery- recovery in concurrent systems - consistent set of check points - synchronous and asynchronous check pointing and recovery - check pointing for distributed database systems- recovery in replicated distributed databases.

UNIT IV: Protection and security -preliminaries, the access matrix model and its implementations.-safety in matrix model- advanced models of protection. Data security - cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard-public key cryptography - multiple encryption - authentication in distributed systems.

UNIT V: Multiprocessor operating systems - basic multiprocessor system architectures - inter connection networks for multiprocessor systems - caching - hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling. Database Operating systems :Introduction- requirements of a database operating system Concurrency control : theoretical aspects - introduction, database systems - a concurrency control model of database systems- the problem of concurrency control - serializability theory- distributed database systems, concurrency control algorithms - introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms - concurrency control algorithms, data replication.

Text Books:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Distributed principles, Algorithms and Systems Computing Reissue Edition, Kindle Edition by Ajay D. Kshemkalyani , Mukesh Singhal

Reference Books:

1. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003.
2. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
3. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003

I Year - I Semester		L	T	P	C
		3	0	0	3

Advanced Computer Architecture

Course Objective:

- Understand the Concept of Parallel Processing and its applications.
- Implement the Hardware for Arithmetic Operations.
- Analyze the performance of different scalar Computers.
- Develop the Pipelining Concept for a given set of Instructions.
- Distinguish the performance of pipelining and non pipelining environment in a processor.

Course Outcomes:

After the completion of the course, student will be able to

- know the types of computers, and new trends and developments in computer architecture.
- Understand pipelining, instruction set architectures, memory addressing.
- Understand exploiting ILP using dynamic scheduling, multiple issue, and speculation.
- Understand the various techniques to enhance a processors ability to exploit Instruction-level parallelism (ILP), and its challenges.
- Understand multithreading by using ILP and supporting thread-level parallelism (TLP).

UNIT I: Fundamentals of Computer Design-Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, Measuring and reporting performance, Quantitative principles of computer design, Amdahl's law, Instruction set principles and examples- Introduction, Classifying instruction set- Memory addressing- type and size of operands, Operations in the instruction set.

UNIT II: Pipelines- Introduction, Basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties, **Memory Hierarchy Design-** Introduction, Review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

UNIT III: Instruction Level Parallelism the Hardware Approach: Instruction- Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation.

UNIT IV: ILP Software

Approach Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.

UNIT V: Multi Processors and Thread Level Parallelism:

Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization, **Inter Connection and Networks-** Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters, **Intel Architecture-** Intel IA-64 ILP in embedded and mobile markets Fallacies and pit falls.

Text Books:

1. John L. Hennessy, David A. Patterson – Computer Architecture: A Quantitative Approach, 3rd Edition, An Imprint of Elsevier.

References:

1. John P. Shen and Miikko H. Lipasti – Modern Processor Design : Fundamentals of Super Scalar Processors
2. Computer Architecture and Parallel Processing – Kai Hwang, Faye A.Brigs., MC Graw Hill.
3. Advanced Computer Architecture – A Design Space Approach – Dezso Sima, Terence Fountain,

Peter Kacsuk , Pearson Ed

I Year - I Semester		L	T	P	C
		3	0	0	3

Parallel Computing (MTCS11XX)

Course Objective: Students will demonstrate an understanding of concepts, algorithms, and design principles underlying parallel computing, develop algorithm design and implementation skills, and gain practical experience in programming large scale parallel machines.

Course Outcomes:

After the completion of the course, student will be able to

- Describe different parallel architectures; inter-connect networks, programming models, and algorithms for common operations such as matrix-vector multiplication.
- Develop an efficient parallel algorithm to solve it.
- Analyze a parallel algorithm time complexity as a function of the problem size and number of processors.
- Analyze parallel code performance, determine computational bottlenecks, and optimize the performance of the code.
- Implement parallel algorithm using MPI, OpenMP, pthreads, or a combination of MPI and OpenMP.

UNIT I: History- Introduction, Modern Scientific Method, Evolution of Supercomputing , Modem Parallel Computers, Seeking Concurrency, Data Clustering, Programming Parallel Computers. **Parallel Architectures:** Introduction, Interconnection Networks, Processor Arrays, Multiprocessors, Multi computers, Flynn's Taxonomy

UNIT II: Parallel Algorithm Design- Introduction, The Task/Channel Model, Foster's Design Methodology, Boundary Value Problem ,Finding the Maximum, The n-Body Problem, Adding Data Input, **Message-Passing Programming-** Introduction, The Message-Passing Model, The Message-Passing Interface , Circuit Satisfiability, Introducing Collective Communication, Benchmarking Parallel Performance.

UNIT III: The Sieve of Eratosthenes-Introduction, Sequential Algorithm, Sources of Parallelism, Data Decomposition options, Developing the Parallel Algorithm, Analysis of Parallel Sieve Algorithm, Documenting the Parallel Program, Benchmarking, Improvements, **Performance Analysis-** Introduction, Speedup and Efficiency, Amdahl's Law, Gustafson-Barsis's Law, The Karp-Flatt Metric, The Iso-efficiency Metric.

UNIT IV: Matrix Multiplication, Introduction, Sequential Matrix Multiplication, Row wise Block-Striped Parallel Algorithm, Cannon's Algorithm, Solving Linear Systems, Back Substitution, Gaussian Elimination, Iterative Methods, **Sorting** Introduction, Quick sort, A Parallel Quick sort Algorithm, Hyper quick sort Algorithm, Parallel Sorting by Regular Sampling.

UNIT V: Shared-Memory Programming – Introduction, The Shared-Memory Model, Parallel for Loops, Declaring Private Variables, Critical section, Reductions, Performance Improvements, More General Data Parallelism, Functional Parallelism, **Combining MPI and OpenMP** -Introduction, Conjugate Gradient Method, Jacobi Method.

Text Books:

1. Parallel Programming in C with MPI and OpenMP Michael J, Quinn Oregon State University.

Reference books:

1. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things 1st Edition, Kai Hwang , Jack Dongarra, Geoffrey C. Fox

I Year - I Semester		L	T	P	C
		3	0	0	3

ADVANCED DATABASES (MTCS11XX)

Course Objectives:

- Design and implement advanced queries using Structured Query Language
- To study the usage and applications of Object Oriented database
- To acquire knowledge on variety of NoSQL databases
- To attain inquisitive attitude towards research topics in NoSQL databases

Course Outcomes:

- Understand Distributed Database Process, Architecture, and Design Principles.
- Apply Distributed Query Optimization Techniques and Algorithms.
- Analyze and apply Concurrency Control and Reliability Techniques,
- Analyze Need of Complex Data type like ORDBMS and OODBMS
- Identify Emerging Database Models.

UNIT I: Database Analysis and Design Techniques: Review of basic Database Concepts, Database Design Methodologies. ER Modeling: Specialization, Generalization, Aggregation, Normalization Theory. Database Implementation using UML: Introduction to UML, Structure diagrams, behavioral diagrams, object oriented analysis, class diagram, Advanced Transaction Processing and Concurrency Control: Transaction Concepts, Concurrency Control: Locking Methods, Time stamping Methods, Optimistic Methods for Concurrency Control, Concurrency Control in Distributed Systems.

UNIT II: Query Compiler: Introduction, parsing, generating logical query plan from parse tree. Query Processing: Physical-Query-plan Operators. Operations: selection, sorting, join, project, set. Query Evaluation: Introduction, Approaches to QE, Transformation of relational expressions in Query optimization, heuristic optimization, cost estimation for various operations, transformation rule.

UNIT III: Distributed Database Centralized DBMS and Distributed DBMS, functions and architecture of a DDBMS, Distributed Data Storage, Transparency issues in DDBMS, Query Processing DDBMS, Distributed transaction Management and Protocols, Distributed Concurrency Control and Deadlock Management.

UNIT IV: Object Oriented Database Limitations of RDBMS, Need of Complex Datatype, Data Definition, ODBMS Fundamentals, issues in OODBMS, Object-oriented database design. Comparison of ORDBMS and OODBMS.

UNIT V: Emerging Database Models, Technologies and Applications Multimedia database-Emergence, difference from other data types, structure, deductive databases, GIS and spatial databases, Knowledge database, Information Visualization, Wireless Networks and databases, Personal database, Digital libraries, web databases, case studies.

Text Books:

1. Advanced database management system by RiniChkrabarti and Shibhadra Dasgupta, Dreamtech.
2. Distributed Databases by Ozsu and Valduriez ,Pearson Education.

Reference Books:

1. Fundamentals of Database Systems by Ramez Elmasri, Shamkant Navathe, Pearson Education
2. Database System Concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Tata McGraw-Hill.

I Year - I Semester		L	T	P	C
		3	0	0	3

Advanced Computer Networks (MTCS11XX)

Course Objectives:

- The course is aimed at providing basic understanding of Protocols at Network layers with special emphasis on IP, TCP & UDP and Routing algorithms.
- Implementation Routing and Addressing.
- Provide the mathematical background of routing protocols.
- Aim of this course is to develop some familiarity with current research problems and research methods in advance computer networks.

Course Outcomes:

- Understand the functionality and services provided by the network layer, analyze and apply routing algorithms.
- Analyze how to assign the IP addresses for the given network.
- Select the transport protocol appropriate for a given application
- Select appropriate quality of service mechanisms for a give computer network
- Analyze emerging trends and security issues

UNIT I: **Network layer-**Network Layer design issues: store-and forward packet switching, services provided transport layers, implementation connection less services, implementation connection oriented services, comparison of virtual –circuit and datagram subnets. **Routing Algorithm** –shortest path routing, flooding, distance vector routing, link state routing, Hierarchical routing, Broadcast routing, Multicasting routing, routing for mobiles Hosts, routing in Adhoc networks, **Congestion control algorithms**-Load shedding, Congestion control in Data gram Subnet.

UNIT II: IPV4 Address address space, notations, classful addressing, classless addressing network addressing translation(NAT) , **IPV6 Address** structure address space, **Internetworking** need for network layer internet as a data gram, internet as connection less network. **IPV4** datagram, Fragmentation, checksum, options. **IPV6** Advantages, packet format, extension Headers, Transition form IPV4 to IPV6

UNIT III: Process to process delivery: client/server paradigm, multiplexing and demultiplexing, connectionless versus connection oriented services, reliable versus reliable. **UDP:** well known ports for UDP, user data gram, check sum, UDP operation, and uses of UDP **TCP:** TCP services, TCP features, segement, A TCP connection, Flow control, error control, congestion control. **SCTP:** SCTP services SCTP features, packet format, An SCTP association, flow control, error
control. **Congestion control**: open loop congestion control, closed loop congestion control, Congestion control in TCP, frame relay, **Quality Of Service**: flow characteristics, flow classes **Techniques To Improve QOS**: scheduling, traffic shaping, resource reservation, admission control.

UNIT IV: Multimedia- introduction digital a audio , Audio compression, streaming audio, internet radio, voice over IP, introduction to video, video compression, video on demand, the MBone-the multicast back bone

UNIT V: Emerging trends Computer Networks- Mobile Ad hoc networks: applications of Ad hoc networks, challenges and issues in MANETS,MAC layers issues, routing protocols in MANET, transport layer issues, Ad Hoc networks security. **Wireless sensors networks:** WSN functioning, operation system support in sensor devices, WSN Characteristics, sensor network operation, sensor Architecture: cluster management; **Wireless mesh networks** WMN design, Issues in WMNs;

Text Books:

1. Data communications and networking 4th edtion Behrouz A Fourzan, TMH
2. Computer networks 4th editon Andrew S Tanenbaum, Pearson
3. Computer networks, Mayank Dave, CENGAGE

Reference Books:

1. Computer Networks, A system Approach, 5th ed, Larry L Peterson and Bruce S Davie, Elsevier

I Year - I Semester		L	T	P	C
		3	0	0	3

Object Oriented Software Engineering (MTCS11XX)

Course Objectives:

- To elicit, analyze and specify software requirements through a productive working relationship with various stakeholders of the project.
- To understand the what software life cycle is, how software projects are planned and managed, types of resources involved in software development projects, risks are identified and assessed, predictions and assessments are made.
- To identify, formulate, and solve software engineering problems, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements

Course Outcomes:

After the completion of the course, student will be able to

- Apply the Object Oriented Software-Development Process to design software
- Analyze and Specify software requirements through a SRS documents.
- Design and Plan software solutions to problems using an object-oriented strategy.
- Model the object oriented software systems using Unified Modeling Language (UML)
- Estimate the cost of constructing object oriented software.

UNIT I: Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges. Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models- Process, use, applicability and Advantages/limitations.

UNIT II: Object oriented Paradigm, Object oriented Concepts, Classes, Objects, Attributes, Methods and services, Messages, Encapsulation, Inheritance, Polymorphism, Identifying the elements of object model, management of object oriented Software projects, Object Oriented Analysis, Domain Analysis, Generic Components of OOA model,, OOA Process, Object Relationship model, Object Behavior Model, Object Oriented Design: Design for Object- Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Design Patterns, Object Oriented Programming.

UNIT III: Object Oriented testing: Broadening the view of Testing, Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software, testing methods applicable at the class level, Interclass test case design

UNIT IV: Technical Metrics for Object Oriented Systems: The Intent of Object Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented metrics, Operation-Oriented Metrics, Metrics foe Object Oriented testing, Metrics for Object Oriented projects

UNIT V: Computer-Aided Software Engineering: What is CASE?, Building blocks for CASE, A taxonomy of CASE tools, Integrated CASE environments, The Integration Architecture, The CASE Repository

Text Books:

1. Object Oriented and Classical Software Engineering, 7/e, Stephen R. Schach, TMH.
2. Object oriented and Classical Software Engineering, Timothy Lethbridge, Robert Laganiere, TMH
3. Software Engineering by Roger S Pressman, Tata McGraw Hill.

Reference Books:

1. Component based Software Engineering: ivica Crnkovic, Springer.

I Year - I Semester		L	T	P	C
		2	0	0	2

RESEARCH METHODOLOGY AND IPR (MTCS1105)

UNIT 1:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2:
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 3:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 4:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 5:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

(1) Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
(2) Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
(3) Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
(4) Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
(5) Mayall, "Industrial Design", McGraw Hill, 1992.
(6) Niebel, "Product Design", McGraw Hill, 1974.
(7) Asimov, "Introduction to Design", Prentice Hall, 1962.
(8) (8) Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
(9) T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

I Year - I Semester		L	T	P	C
		0	0	4	2

Advanced Data Structures Lab (MTCS1106)

Course Objectives:
Students will try:

- Understand and remember algorithms and its analysis procedure.
- Introduce the concept of data structures through ADT including List, Stack, Queues.
- To design and implement various data structure algorithms.
- To introduce various techniques for representation of the data in the real world.
- To develop application using data structure algorithms.
- Compute the complexity of various algorithms.

Course Outcomes:

- Develop solutions for a range of problems using object oriented programming.
- Implement complex problems using advanced data structures (like arrays, stacks, queues, linked lists, graph and trees.).
- Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
- Incorporate data structures into the applications such as binary search trees, AVL and B Trees

List of Experiments

Experiment 1:
Write a program to implement Polynomial additions using Arrays.

Experiment 2:
Write a program to implement Polynomial additions using linked lists.

Experiment 3:
Write a program to implement Multi Stack ADT using Arrays with the basic operations as Create(), IsEmpty(), Push(), Pop(), IsFull() with appropriate prototype to a functions.

Experiment 4:
Write a program to implement Queue ADT using Linked list with the basic functions of Create(), IsEmpty(), Insert(), Delete() and IsFull() with suitable prototype to a functions.

Experiment 5:
Write a program to transfer data from stack to queue.

Experiment 6:
Write a program to implement the following ADT using Linked list with the basic functions of Create(), IsEmpty(), Insert(), Delete() and IsFull() with suitable prototype to a functions.

i) Double Ended Queue (Dequeues)
ii) Circular Queues

Experiment 7:
Write a program to generate the binary tree from the given inorder, preorder and postorder traversal.

Experiment 8:
Write a program to implement insertion, deletion and display operation in Min-Max Heap for the given data as integers.

Experiment 9:
Write a program for Binary Search Tree to implement following operations:

a) Insertion
b) Deletion
   i. Delete node with only child
   ii. Delete node with both children
c) Finding an element
d) Finding Min element
e) Finding Max element
f) Left child of the given node
g) Right child of the given node
h) Finding the number of nodes, leaves nodes, full nodes, ancestors, descendants

Experiment 10:
Write a program to implement BFS and DFS for a Graph.

Experiment 11:
Write a program to implement to generate a min-cost spanning tree

a) Krushkal's algorithm
b) Prims algorithm

Experiment 12:
Write a program to store k keys into an array of size n at the location computed using a hash function, loc = key % n, where k<=n and k takes values from [1 to m], m>n. To handle the collisions use the following collision resolution techniques,

a) Linear probing
b) Quadratic probing
c) Double hashing/rehashing

Experiment 13:
Write a program for AVL Tree to implement following operations:
(For nodes as integers)

a) Insertion: Test program for all cases (LL, RR, RL, LR rotation)
b) Deletion: Test Program for all cases (R0, R1, R-1, L0, L1, L-1)
c) Display: using set notation

Experiment 14:
Write a program to generate the B-tree of order 2-3 for a given list of integers.

Experiment 15:
Write a program to perform string matching using Boyer-Moore algorithm.

I Year - I Semester		L	T	P	C
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Advanced Computing Lab-1					

Note: Lab programs based on elective taken by student may be offered.

ADVANCED OPERATING SYSTEMS

Course Outcomes:

- Implement deadlock avoidance and detection algorithms in a distributed environment.
- Implement efficient clock synchronization and election algorithms.
- Describe Client server architecture.

Experiment 1:
Write a program to implement Deadlocks through Simulation.

Experiment 2:
Write Case Study of 3 tier client server architecture.

Experiment 3:
Write Case study on Client and RMI Server.

Experiment 4:
Write a program to implement any one Election algorithms.

Experiment 5:
Write a program to show the software simulation for Clock Synchronization in Distributed System using Lamport's Algorithm.

Experiment 6:
Write a program to implement Banker's Algorithm for avoiding Deadlock.

PARALLEL COMPUTING

Course Outcomes:

- Develop an efficient parallel algorithm to solve it.
- Implement parallel algorithm using MPI, OpenMP, pthreads, or a combination of MPI and OpenMP.

Experiment 1:
Write a parallel program that computes the sum 1+2+------+ in the following manner. Each process I assigns the value i+1 to an integer, and then the processes perform a sum reduction. As a way of double-checking the result, process 0 should also compute and print the value p(p+1)/2.

Experiment 2:
A print number is a positive integer evenly divisible by exactly two positive integers: itself and .The first five prime numbers are 2,3,5,7 and 11. Sometimes two consecutive odd numbers are both prime. For example, the odd integers following 3,5 and 11 are all prime numbers. However, the odd integer following 7 is not a prime number. Write a parallel program to determine, for all integers less then 1,000,000, the number of times that two consecutive odd integers are both prime.

Experiment 3:
Write a program implementing the parallel matrix multiplication algorithm.

Experiment 4:
Write a MPI program implementing consecutive gradient.

Experiment 5:
Write a MPI program to implementing Quick sort.

I Year - I Semester		L	T	P	C
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Advanced Computing Lab-1

ADVANCED COMPUTER NETWORKS

Course Outcomes:

- Implements various routing protocols
- Implement sub netting and addressing IP
- Implement emerging trends and security issues in computer Networks

Experiment 1:
Configuration of IP addressing for a given scenario for a given set of topologies.

Experiment 2:
Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.

Experiment 3:
Configure, implement and debug the following: Use open source tools for debugging and diagnostics.

a) ARP/RARP protocols
b) RIP routing protocols
c) BGP routing
d) OSPF routing protocols
e) Static routes (check using netstat)

OBJECT ORIENTED SOFTWARE ENGINEERING

Course Outcome:

- Design and Plan software solutions to problems using an object-oriented strategy.
- Able to Model the object oriented software systems using Unified Modeling Language (UML)

Experiments 1:
Do the following for the given project

a) Write the problem statement, Software Requirement Specification, entity relationship diagram,
b) dataflow diagrams for level 0 and level 1,
c) Draw use-case diagram
d) Draw the activity diagram of all use cases.
e) Draw sequence diagram of all use cases
f) Draw collaboration diagram of all use cases, and Assign objects in Sequence diagram to classes and make class diagrams

Project 1:

A payroll application is to be developed which is required to perform the following functions:

i) It must provide a user in employee mode with the details of an employee, which includes his name, department, date of joining and salary.

ii) It must validate an user to enter in administrator mode using password. It must provide a user to enter in administrator mode to view or modify an employee's details using his employee ID. It must also allow the user to add a new employee and generate the payroll.

Project 2:

Develop an automated banking system, which is required to perform the following functions:

i) The customer logs into the system using card number and pin number. The system checks for validation.

ii) The system queries the customer for the type of account either fixed deposit or credit account. After getting the type of account the system shows the balance left.

iii) The system queries the customer for the transaction type either withdrawal or deposit and the required amount. The user enters the amount and the transaction if carries out

I Year - II Semester		L	T	P	C
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Advanced Algorithms

COURSE OBJECTIVE

- Introduce students to the advanced methods of designing and analyzing algorithms.
- The student should be able to choose appropriate algorithms and use it for a specific problem.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Students should be able to understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design.

COURSE OUTCOMES

After completion of course, students would be able to:

- Analyze the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- Categorize the different problems in various classes according to their complexity.
- Students should have an insight of recent activities in the field of the advanced data structure.

Syllabus:

UNIT I: Sorting: Review of various sorting algorithms, topological sorting **Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT II: Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. **Graph Matching:** Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT III: Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT IV: Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.
Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

UNIT V:Linear Programming: Geometry of the feasibility region and Simplex algorithm. **NP-completeness:** Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method,Advanced Number Theoretic AlgorithmRecent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text Books:

1. "Introduction to Algorithms",3rd Edition, by Cormen, Leiserson, Rivest, Stein, PHP, 2017.
2. "The Design and Analysis of Computer Algorithms" 1st edition by Aho, Hopcroft, Ullman,pearson,1974.
3."Algorithms " Robert Sedgewick, Addison wisely publications,1983

Reference Books:

1."Algorithm Design"1st Edition by Kleinberg and Tardos, Pearson 2013.

I Year - II Semester		L	T	P	C
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Data Science through Python Programming

Course Objective:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Produce Python code to statistically analyze a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

Course Outcomes:

After the completion of the course, student will be able to

- Explain how data is collected, managed and stored for data science.
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
- Implement data collection and management scripts using Python Pandas.

Syllabus:

UNIT I: PYTHON Basics and Programming Concepts: Introducing Python, Types and Operations - Numbers, Strings, Lists, Tuples, Dictionaries, Files, Numeric Types, Dynamic Typing; Statements and Syntax - Assignments, Expressions, Statements, Loops, iterations, comprehensions; Functions - Function Basics, Scopes, Arguments, Advanced Functions; Modules - Module Coding Basics, Module Packages, Advanced Module Topics; Classes and OOP - Class, Operator Overloading, Class Designing; Exceptions and Tools - Exception Basics, Exception Coding Details, Exception Objects, Designing With Exceptions, Parallel System Tools

UNIT II: GUI Programming: Graphical User Interface - Python gui development options, Adding Widgets, GUI Coding Techniques, Customizing Widgets; Internet Programming - Network Scripting, Client-Side scripting, Pymailgui client, server-side scripting, Pymailcgi server; Tools and Techniques - databases and persistence, data structures, text and language, python/c integration

UNIT III: Pandas and NumPy: Numpy Basics - Fast Element wise array functions, Multidimensional Array, Data Processing using arrays, file i/o with arrays; Pandas - Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing

UNIT IV: Data Preprocessing: Data Loading, Storage, and FileFormats - Reading and Writing data in text format, binary data formats, interacting with html and web apis, interacting with databases; Data Wrangling: Clean, Transform, Merge, Reshape - Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation; Data Aggregation and Group Operations – Group by Mechanics, Data Aggregation, Groupby Operations and and Transformations, Pivot Tables and Cross-Tabulation

UNIT V: Data Visualization: A Brief matplotlib API Primer, Plotting Functions in pandas, Time Series, Financial and Economic Data Applications

Text Books:

1. Learning Python , OReilly, Mark Lutz
2. Programming Python, OReilly, Mark Lutz
3. Python For Data Analysis (O Reilly, Wes Mckinney)

Reference Text Books:

1. Python: The Complete Reference, Martin C. Brown, McGraw Hill Education
2. Head First Python, Paul Barry, O′Reilly

I Year - II Semester		L	T	P	C
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Machine Learning

Course Objectives:

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.
- Demonstrate how to perform evaluation of learning algorithms and model selection.

Course Outcomes:

After the completion of the course, student will be able to

- Domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- Demonstrate on Supervised and Computational Learning
- Analyze on Statistics in learning techniques and Logistic Regression
- Illustrate on Support Vector Machines and Perceptron Algorithm
- Design a Multilayer Perceptron Networks and classification of decision tree

UNIT-I: Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT-II: Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Overfitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification.

UNIT-III: Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT-IV: Support Vector Machines (SVM)- Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly seperable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines.

Learning with Neural Networks: Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

UNIT -V: Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. **Decision Tree Learning**: Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

Textbooks:

1. Applied Machine Learning,1e, M.Gopal, Mc Graw Hill Education, 2018

Reference Books

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

I Year - II Semester		L	T	P	C
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Ad Hoc & Sensor Networks

Course Objectives:

- Acquire the knowledge of various techniques in mobile networks/Adhoc networks and sensor based networks.
- The objective of this course is to facilitate the understanding of Infrastructure less networks and their importance in the future directions for wireless communications

Course Outcomes:

- Explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks
- Describe the MAC protocol issues of ad hoc networks
- Describe routing protocols for ad hoc wireless networks with respect to TCP design issues
- Explain the concepts of network architecture and MAC layer protocol for WSN
- Discuss the WSN routing issues by considering QoS measurements

UNIT I: Introduction : Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms ,Characteristics of the Wireless channel mobile ad hoc networks (MANETs), **Wireless Sensor Networks (WSNs):** concepts and architectures, Applications of Ad Hoc and Sensor Networks, Design Challenges in Ad hoc and Sensor Networks.

UNIT II: MAC Protocols For Ad Hoc Wireless Networks: Issues in designing a MAC Protocol, Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based protocols, Contention based protocols with Reservation Mechanisms, Contention based protocols with Scheduling Mechanisms, Multi channel MAC - IEEE 802.11.

UNIT III: Routing Protocols And Transport Layer In Ad Hoc Wireless Networks: Routing Protocol: Issues in designing a routing protocol for Ad hoc networks, Classification, proactive routing, reactive routing (on-demand), hybrid routing, Transport Layer protocol for Ad hoc networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer solutions-TCP over Ad hoc wireless, Network Security, Security in Ad Hoc Wireless Networks, Network Security Requirements.

UNIT IV: Wireless Sensor Networks (WSNS) And Mac Protocols: Single node architecture - hardware and software components of a sensor node, **WSN Network architecture:** typical network architectures, data relaying and aggregation strategies, **MAC layer protocols:** self-organizing, Hybrid TDMA/FDMA and CSMA based MAC -IEEE 802.15.4.

UNIT V: WSN Routing, Localization & Qos: Issues in WSN routing, OLSR, Localization, Indoor and Sensor Network Localization, absolute and relative localization, triangulation, QOS in WSN, Energy Efficient Design, Synchronization.

Text Books:

1. "Ad Hoc Wireless Networks: Architectures and Protocols ", C. Siva Ram Murthy, and B. S. Manoj, Pearson Education, 2008
2. “Wireless Adhoc and Sensor Networks”, Labiod. H, Wiley, 1st edition-2008
3. “Wireless ad -hoc and sensor Networks: theory and applications”, Li, X, Cambridge University Press, fifth edition-2008.

Reference Books:

4. “Ad Hoc & Sensor Networks: Theory and Applications”, 2nd edition, Carlos De MoraisCordeiro, Dharma Prakash Agrawal ,World Scientific Publishing Company, 2011
5. "Wireless Sensor Networks", Feng Zhao and LeonidesGuibas,Elsevier Publication 2nd edition-2004
6. “Protocols and Architectures for Wireless Sensor Networks”, Holger Karl and Andreas Willig,Wiley, 2005 (soft copy available)
7. “Wireless Sensor Networks Technology, Protocols, and Applications”, KazemSohraby, Daniel Minoli, &TaiebZnati, John Wiley, 2007. (soft copy available)

I Year - II Semester		L	T	P	C
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Internet of Things

Course Objectives:

- To Understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

Course Outcomes:

After the completion of the course, student will be able to

- Summarize on the term 'internet of things' in different contexts.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

UNIT I:

FUNDAMENTALS OF IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures,oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II:

IoT PROTOCOLS: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT. Bluetooth Smart Connectivity-Overview, Key Versions, BLE-Bluetooth Low Energy Protocol, Low Energy Architecture.

UNIT III:

DESIGN AND DEVELOPMENT: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT IV:

Arm Based Embedded System Design: ARM Cortex-A class processor, Embedded Devices-ARM Cortex-M Class processor, Networking-Bluetooth Smart Technology

Introduction to embedded systems: CPUs vs MCU's vs Embedded Systems, Examples, Options for Building Embedded Systems, Features of Embedded Systems, Building Embedded Systems, Building Embedded Systems using MCUs, Introduction to mbedTM Platform

UNIT V:

CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. The Definative Guide to ARM Cortex-MR3 and M4 Processor, 3rd Edition, Joseph Yiu

Reference Books:

1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015

2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011.
5. Cortex–A series Programmer's Guide for ARMv7-A by Arm http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.den0013d/index.htmlc

I Year - II Semester		L	T	P	C
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Cryptography and Network Security

Course Objectives:
From the course the student will learn

- To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes.
- To explore message digests, public key algorithms, design issues.
- To explore working principles of various authentication protocols.
- To explore various secure communication standards including Kerberos, IPsec, and SSL/TLS.

Course Outcomes (COs):

- Explain different security threats and countermeasures and foundation course of cryptography mathematics.
- Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography.
- Revise the basic principles of Public key algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more.
- Design applications of hash algorithms, digital signatures and key management techniques.
- Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL,TSL, and IPsec.

UNIT-I: Basic Principles- Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography- Integer Arithmetic, Modular Arithmetic, Matrices Linear Congruence, Algebraic Structures, GF(2^n) Fields, **Symmetric Encryption-** Mathematics of Symmetric Key Cryptography- Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation and Logarithm, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

UNIT-II: Asymmetric Encryption- Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography- Introduction, RSA Cryptosystem, RABIN Cryptosystem, ELGAMAL Cryptosystem, Elliptic Curve Cryptosystems.

UNIT-III: Data Integrity, Digital Signature Schemes & Key Management- Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

UNIT-IV: Network Security-I- Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, **Network Security-II-** Security at the Network Layer: IPSec, System Security, **Security at Transport Layer-** SSL and TLS.

UNIT-V: Abstract Models for BLOCKCHAIN, GARAY model, RLA Model, Proof of Work (PoW) as random oracle, formal treatment of consistency, liveness and fairness, Proof of Stake (PoS) based Chains, Hybrid models (PoW + PoS). Bitcoin, Wallet, Blocks, Merkley Tree, hardness of mining, transaction verifiability, anonymity, forks, double spending, mathematical analysis of properties of Bitcoin.

Text Books:

1. Cryptography and Network Security, 3rd Edition, Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill
2. Cryptography and Network Security,6th Edition, William Stallings, Pearson
3. Bitcoin and cryptocurrency technologies: A comprehensive introduction, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Princeton University Press, 2016
4. Everyday Cryptography, Keith M.Martin, Oxford

Reference Books:

1. Network Security and Cryptography, Bernard Meneges, Cengage Learning

I Year - II Semester		L	T	P	C
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Cloud Computing

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- Broadly educate to know the impact of engineering on legal and societal issues involved.

Course Outcomes: At the end of the course, student will be able to

- Interpret the key dimensions of the challenge of Cloud Computing
- Examine the economics, financial, and technological implications for selecting cloud computing for own organization.
- Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications
- Evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas.
- To Illustrate Virtualization for Data-Center Automation.

SYLLABUS:

UNIT I: Introduction: Network centric computing, Network centric content, peer-to –peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. **Parallel and Distributed Systems:** Introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, model concurrency with Petri Nets.

UNIT II: Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing, **Cloud Computing :** Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, The Map Reduce Program model, HPC on cloud, biological research.

UNIT III: Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, **Cloud Resource Management and Scheduling**: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT IV: Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2), **Cloud Security:** Cloud security risks, security – a top concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT V: Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Installing Simple Notification Service on Ubuntu 10.04, Installing Hadoop on Eclipse, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), **Google:** Google App Engine, Google Web Toolkit (Text Book 2), **Microsoft:** Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2).

Text Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH

Reference book:

1. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammarai selvi, TMH

I Year - II Semester		L	T	P	C
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Web Technologies

Course Objectives:

- The objective of this lab is to To develop an ability to design and implement static and dynamic website

Course Outcomes:

- Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's
- Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services
- Get introduced in the area of Online Game programming.

Syllabus:

UNIT-I: Java script- The Basic of Java script: Objects, Primitives Operations and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, Constructors, Patttern Matching using Regular Expressions

UNIT-II: XML- Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches, **AJAX A New Approach:** Introduction to AJAX, Integrating PHP and AJAX.

UNIT-III: PHP Programming- Introducing PHP: Creating PHP script, Running PHP script. **Working with variables and constants:** Using variables, Using constants, Data types, Operators. **Controlling program flow:** Conditional statements, Control statements, Arrays,functions.Working with forms and Databases such as MySQL.

UNIT-IV: PERL- Introduction to PERL, Operators and if statements, Program design and control structures, Arrays, Hashs and File handling, Regular expressions, Subroutines, Retrieving documents from the web with Perl.

UNIT-V: RUBY: Introduction to Ruby, Variables, types, simple I/O, Control, Arrays, Hashes, Methods, Classes, Iterators, Pattern Matching. Overview of Rails.

TEXT BOOKS:

1. Programming the World Wide Web, Robet W Sebesta, 7ed, Pearson.
2. Web Technologies, Uttam K Roy, Oxford

Reference Book:

1. The Web Warrior Guide to Web Programming, Bai, Ekedahl, Farrelll, Gosselin, Zak, Karparhi, Maclntyre, Morrissey, Cengage
2. Programming world wide web-Sebesta, Pearson Education ,2007.

Core SERVLETS ANDJAVASERVER PAGES VOLUME 1: CORE TECHNOLOGIES By Marty Hall and Larry Brown Pearson Internet and World Wide Web – How to program by Dietel and Nieto PHI/Pearson Education Asia.

I Year - II Semester		L	T	P	C
		0	0	4	2

Advanced algorithms Lab

Course Objectives:
From the course the student will learn
- Knowing about oops concepts for a specific problem.
- Various advanced data structures concepts like arrays, stacks, queues, linked lists, graphs and trees.

Course Outcomes:
- Identify classes, objects, members of a class and relationships among them needed for a specific problem.
- Examine algorithms performance using Prior analysis and asymptotic notations.
- Organize and apply to solve the complex problems using advanced data structures (like arrays, stacks, queues, linked lists, graphs and trees.)
- Apply and analyze functions of Dictionary

List of Experiments

Experiment 1:
Write a java program to implement Multi stacks.

Experiment 2:
Write a java program to implement Double Ended Queue (Dequeues) & Circular Queues.

Experiment 3:
Write a java program to implement various Recursive operations on Binary Search Tree.

Experiment 4:
Write a java program to implement various Non-Recursive operations on Binary Search Tree.

Experiment 5:
Write a java program to implement BFS for a Graph

Experiment 6:
Write a java program implement DFS for a Graph.

Experiment 7:
Write a java program to implement Merge & Heap Sort of given elements.

Experiment 8:
Write a java program to implement Quick Sort of given elements.

Experiment 9:
Write a java program to implement various operations on AVL trees.

Experiment 10:
Write a java program to implement B: Tree operations.

Experiment 11:
Write a java program to implementation of Binary trees and Traversals (DFT, BFT)

Write a java program to implement Krushkal's algorithm to generate a min-cost spanning tree.

Experiment 13:
Write a java program to implement Prim's algorithm to generate a min-cost spanning tree.

Experiment 14:
Write a java program to implement functions of Dictionary using Hashing.

I Year - II Semester		L	T	P	C
		0	0	4	2

Advanced Computing Lab-2

List of Experiments

Machine Learning Lab

Course Objectives:

- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).
- Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).
- Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

Course Outcomes:

After the completion of the course, student will be able to

- Explain the definition and usage of the term 'the internet of things' in different contexts.
- Demonstrate on various network protocols used in IoT.
- Analyze on various key wireless technologies used in IoT systems, such as WiFi, 6LoWPAN, Bluetooth and ZigBee.
- Illustrate on the role of big data, cloud computing and data analytics in IoT system.
- Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software.

Experiment 1:

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Experiment 2:

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Experiment 3:

Write a program to implement the naïve Bayesian classifier for Iris data set. Compute the accuracy of the classifier, considering few test data sets.

Experiment 4:

Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

Experiment 5:

Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

Web Technologies lab

Course Objectives:

- The objective of this lab is to To develop an ability to design and implement static and dynamic website

Course Outcomes:

- Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's

- Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services
- Get introduced in the area of Online Game programming.

Experiment 6:

Write a JavaScript programs on EventHandling

- Validation of registration form
- Open a window from the current window
- Change color of a back ground at each click of button or refresh of a page
- Display calendar for the month and year selected from combo box
- On Mouse over event

Experiment 7:

Write an XML file which will display the Book information which includes the following:

1) Title of the book 2) Author Name 3) ISBN number
4) Publisher name 5) Edition 6) Price

Write a Document Type Definition (DTD) to validate the above XML file.

Experiment 8:

Do the following Ruby programs:

- Write a Ruby program to read a number and calculates the factorial value of it and prints the same.
- Write a Ruby program which counts number of lines in a text file using its regular expressions facility.
- Write a Ruby program that uses iterator to find out the length of a string.
- Write Ruby program which uses Math module to find area of a triangle.

Experiment 9:

Do the following Perl programs

- Write a program which illustrates the use of associative arrays in perl.
- Write perl program takes a set names along the command line and prints whether they are regular files or special files

Experiment 10:

Example PHP program for registering users of a website and login.

Cloud Computing Lab

Course Objectives:

- To implement Virtualization
- Apply Map-Reduce concept to applications.
- Broadly educate to know the impact of engineering on legal and societal issues involved.

Course Outcomes: At the end of the course, student will be able to

- Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications
- Evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas.
- To Illustrate Virtualization for Data-Center Automation.

Experiment 11:

To study & Implement Web services in SOAP for JAVA Applications

Experiment 12:

Implementation of Para-Virtualization using VM Ware's Workstation/
Oracle's Virtual Box and Guest O.S.

Experiment 13:

Installation and Configuration of Hadoop

Experiment 14:

Create an application (Ex: Word Count) using Hadoop Map/Reduce

Experiment 15:

Case Study: PAAS (Face book, Google App Engine)

II Year - I Semester		L	T	P	C
		3	0	0	3
Mobile Applications And Development					

Course Objectives:

- To understand fundamentals of android operating systems.
- Illustrate the various components, layouts and views in creating android
- applications
- To understand fundamentals of android programming.

Course Outcomes:

- Create data sharing with different applications and sending and intercepting SMS.
- Develop applications using services and publishing android applications.
- To demonstrate their skills of using Android software development tools

Unit I: Introduction to Android: The Android 4.1 jelly Bean SDK, Understanding the Android Software Stack, installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text view Control, Using the Android Emulator, The Android Debug Bridge(ADB), Launching Android Applications on a Handset.

Unit II: Basic Widgets: Understanding the Role of Android Application Components, Understanding the Utility of Android API, Overview of the Android Project Files, Understanding Activities, Role of the Android Manifest File, Creating the User Interface, Commonly Used Layouts and Controls, Event Handling, Displaying Messages Through Toast, Creating and Starting an Activity, Using the Edit Text Control, Choosing Options with Checkbox, Choosing Mutually Exclusive Items Using Radio Buttons

Unit III: Building Blocks for Android Application Design: Introduction to Layouts, Linear Layout, Relative Layout, Absolute Layout, Using Image View, Frame Layout, Table Layout, Grid Layout, Adapting to Screen orientation. Utilizing Resources and Media Resources, Creating Values Resources, Using Drawable Resources, Switching States with Toggle Buttons, Creating an Images Switcher Application, Scrolling Through Scroll View, playing Audio, Playing Video, Displaying Progress with Progress Bar, Using Assets.

Unit IV: Using Selection widgets and Debugging: Using List View, Using the Spinner control, Using the GridView Control, Creating an Image Gallery Using the ViewPager Control, Using the Debugging Tool: Dalvik Debug Monitor Service(DDMS), Debugging Application, Using the Debug Perspective. Displaying And Fetching Information Using Dialogs and Fragments: What Are Dialogs?, Selecting the Date and Time in One Application, Fragments, Creating Fragments with java Code, Creating Special Fragments

Unit V: Building Menus and Storing Data: Creating Interface Menus and Action Bars, Menus and Their Types, Creating Menus Through XML, Creating Menus Through Coding, Applying a Context Menu to a List View, Using the Action Bar, Replacing a Menu with the Action Bar, Creating a Tabbed Action Bar, Creating a Drop-Down List Action Bar Using Databases: Using the SQLiteOpenHelperclasss, Accessing Databases with the ADB, Creating a Data Entry Form, Communicating with SMS and Emails: Understanding Broadcast Receivers, Using the Notification System, Sending SMS Messages with Java Code, Receiving SMS Messages, Sending Email, Working With Telephony Manager.

Text Books

1. Android Programming by B.M Harwani, Pearson Education, 2013.

References Text Books:

1. Android application Development for Java Programmers, James C Sheusi, Cengage Learning
2. Android In Action by w.Frank Ableson, Robi Sen, Chris King, C. Enrique Ortiz., Dreamtech.
3. Professional Android 4 applications development, Reto Meier, Wiley India, 2012.
4. Beginning Android 4 applications development, Wei- Meng Lee, Wiley India,2013

II Year - I Semester		L	T	P	C
		3	0	0	3
Big Data Analytics					

Course Objectives: This course is aimed at enabling the students to

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSQL, Map Reduce, HIVE, Cassandra, Spark.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To optimize business decisions and create competitive advantage with Big Data analytics

Course Outcomes:

After the completion of the course, student will be able to

- Illustrate on big data and its use cases from selected business domains.
- Interpret and summarize on No SQL, Cassandra
- Analyze the HADOOP and Map Reduce technologies associated with big data analytics and explore on Big Data applications Using Hive.
- Make use of Apache Spark, RDDs etc. to work with datasets.
- Assess real time processing with Spark Streaming.

Syllabus:

UNIT I: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT II: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer- peer replication, sharding and replication, consistency, relaxing consistency, version stamps, Working with Cassandra ,Table creation, loading and reading data.

UNIT III: Data formats, analyzing data with Hadoop, scaling out, Architecture of Hadoop distributed file system (HDFS), fault tolerance ,with data replication, High availability, Data locality , Map Reduce Architecture, Process flow, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization. Introduction to Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, Logical joins, Window functions, Optimization, Table partitioning, Bucketing, Indexing, Join strategies.

UNIT IV: Apache spark- Advantages over Hadoop, lazy evaluation, In memory processing, DAG, Spark context, Spark Session, RDD, Transformations- Narrow and Wide, Actions, Data frames ,RDD to Data frames, Catalyst optimizer, Data Frame Transformations, Working with Dates and Timestamps, Working with Nulls in Data, Working with Complex Types, Working with JSON, Grouping, Window Functions, Joins, Data Sources, Broadcast Variables, Accumulators, Deploying Spark- On-Premises Cluster Deployments, Cluster Managers- Standalone Mode, Spark on YARN , Spark Logs, The Spark UI- Spark UI History Server, Debugging and Spark First Aid

UNIT V: Spark-Performance Tuning, Stream Processing Fundamentals, Event-Time and State full Processing - Event Time, State full Processing, Windows on Event Time- Tumbling Windows, Handling Late Data with Watermarks, Dropping Duplicates in a Stream, Structured Streaming Basics - Core Concepts, Structured Streaming in Action, Transformations on Streams, Input and Output.

Text Books:

1. Big Data, Big Analytics: Emerging, Michael Minnelli, Michelle Chambers, and Ambiga Dhiraj
2. SPARK: The Definitive Guide, Bill Chambers & Matei Zaharia, O'Reilley, 2018 Edition
3. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World Polyglot Persistence", Addison-Wesley Professional, 2012
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012

Reference Books:

1. "Hadoop Operations", O'Reilley, Eric Sammer, 2012
2. "Programming Hive", O'Reilley, E. Capriolo, D. Wampler, and J. Rutherglen, 2012
3. "HBase: The Definitive Guide", O'Reilley, Lars George, 2011
4. "Cassandra: The Definitive Guide", O'Reilley, Eben Hewitt, 2010
5. "Programming Pig", O'Reilley, Alan Gates, 2011

II Year - I Semester		L	T	P	C
		3	0	0	3

Python Programming

ourse Objectives:

- To acquire programming skills in core Python.
- To acquire Object Oriented Skills in Python.
- To develop the skill of designing Graphical user Interfaces in Python.
- To develop the ability to write database applications in Python.

Course Outcomes(COs): At the end of the course, student will be able to

- Understand and comprehend the basics of python programming.
- Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
- Explain the use of the built-in data structures list, sets, tuples and dictionary.
- Make use of functions and its applications.
- Identify real-world applications using oops, files and exception handling provided by python.

UNIT – I:

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT – II:

Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass

UNIT – III:

Data Structures-Lists- Operations, Slicing, Methods, Tuples, Sets, Dictionaries, Sequences, Comprehensions.

UNIT – IV:

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables, **Modules**: Creating modules, import statement, from. Import statement, name spacing, **Python packages**, Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT – V:

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, **Error and Exceptions:** Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User defined Exceptions, **Brief Tour of the Standard Library** - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics, **Testing:** Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

Text Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson

Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press
2. Think Python, Allen Downey, Green Tea Press
3. Core Python Programming, W. Chun, Pearson

II Year - I Semester		L	T	P	C
		3	0	0	3

Data Science

Course Objective:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Produce Python code to statistically analyze a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

Course Outcomes: After the completion of the course, student will be able to

- Explain how data is collected, managed and stored for data science.
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
- Implement data collection and management scripts using MongoDB.

Syllabus:

Unit -I: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT -II: Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

UNIT -III: Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT -IV: Data visualization-Introduction, Types of data visualization, Data for Visualization- Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT -V: Applications of Data Science, Technologies for visualization, Bokeh (Python), Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

References:

1. Data science and analytics, 1st edition, V.K.Jain, Khanna Publlications,2018.

II Year - I Semester		L	T	P	C
		3	0	0	3

BIO INFORMATICS

Course Objectives:

- To understand Bio informatics from computing perspective.
- To comprehend bio informatics databases, file formats and its applications.
- To understand the applications of Bio informatics

UNIT I: History of bioinformatics-History of Bioinformatics-role of Bioinformatics in biological sciences- scope of bioinformatics -introduction to internet-WWW- network basics- LAN & WAN standards-network topologies and protocols- FTP- HTTP - division of Bioinformatics- Bioinformatics and internet-challenges in Bioinformatics.

UNIT II: Databases in bioinformatics-Databases in Bioinformatics- Genbank- NCBI- EMBL- DDBJ - UniGene- SGD- EMI Genomes- -protein databases-PIR- SWISSPROT-TrEMBL-Prosite- PRINTS - structural databases-PDB- SCOP- CATH- PDB_SELECT- PDBSUM- DSSP- FSSPDALI- PRODOM- protein families & pattern databases-Pfam- KEGG - sequence storage sequence accuracy-EST-STS- sequence retrieval systems- Entrez-SRS- sequence query refinement using Boolean operators- limits- preview- history and index.

UNIT III: Sequence submission-Sequence submission tools-BANKIT-SEQUIN-WEBIN-SAKURAliterature databases-PubMed and medline. Data mining and its techniques- data warehousing- Sequence annotation- principles of genome annotation- annotation tools & resources.

UNIT IV: Applications of bioinformatics-Applications of Bioinformatics-phylogenetic analysissteps in phylogenetic analysis-microarrays-DNA and protein microarrays- Bioinformatics in pharmaceutical industry- informatics & drug- discovery – pharma informatics resources drug discovery and designing-SNP.

UNIT V: File formats-File formats-raw/plain format-NCBI-Genbank flat file format-ASN.1-GCGFASTA- EMBL- NBRF- PIR-swissprot sequence formats- PDB format-Introduction to structure prediction methods.

References:

1. Attwood T.K, Parry-Smith, “Introduction to Bioinformatics”, Addison Wesley Longman, 1999.
2. David W Mount, “Bioinformatics: Sequence and Genome Analysis”, 2nd edition, CBS Publishers, 2004.
3. Arun Jagota, “Data Analysis and Classification for Bioinformatics”, Pine Press, 2001.
4. Des Higgins and Willie Taylor, “Bioinformatics Sequence, Structures and Databanks”, Oxford University Press, 2000.
5. Jason T.L.Wang, Mohammed J. Zaki, Hannu T.T. Toivonene and Dennis Shasha, “Data Mining in Bioinformatics”, Springer International Edition, 2005.
6. K. Erciyes, “Distributed and Sequential Algorithms for Bioinformatics”, Springer, 2015.

II Year - I Semester		L	T	P	C
		3	0	0	3

Digital Forensics

Course Objective:

- Provides an in-depth study of the rapidly changing and fascinating field of computer
- Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
- E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

Course Outcomes: After completion of course, students would be

- Understand relevant legislation and codes of ethics
- Computer forensics and digital detective and various processes, policies and procedures
- E-discovery, guidelines and standards, E-evidence, tools and environment.
- Email and web forensics and network forensics

UNIT -I: Digital Forensics Science: Forensics science, computer forensics, and digital forensics, **Computer Crime:** Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

UNIT -II: Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT -III: Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT -IV: Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT -V: Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008, Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

Text Book:

1. John Sammons, 2e, The Basics of Digital Forensics, Elsevier, 2014

Reference Books:

1. Digital Forensics: The Fascinating world of digital evidences, 1st Edition, Nilakshi Jain, Dhananjay R. kalbande, wiley- 2016

2.

II Year - I Semester		L	T	P	C
		3	0	0	3
Web Security					

Course Objectives:

- Underlying security principles of the web
- Overview of concrete threats against web applications
- Insights into common attacks and countermeasures
- Current best practices for secure web applications

Course Outcomes: At the end of the course, student will be able to

- Demonstrate security concepts, security professional roles, and security resources in the context of systems and security development life cycle
- Justify applicable laws, legal issues and ethical issues regarding computer crime
- Explain the business need for security, threats, attacks, top ten security vulnerabilities, and secure software development
- Apply information security policies, standards and practices, the information security blueprint
- Analyze and describe security requirements for typical web application scenario

Syllabus:

UNIT–I: Introduction-A web security forensic lesson, Web languages, Introduction to different web attacks. Overview of N-tier web applications, Web Servers-Apache, IIS.

UNIT-II: Securing the Communication Channel- Understanding the dangers of an insecure communication channel. Practical advice on deploying HTTPS, and dealing with the impact on your application. Insights into the latest evolutions for HTTPS deployments.

UNIT–III: Web Hacking Basics- HTTP & HTTPS URL, Web under the Cover Overview of Java security Reading the HTML source, Applet Security Servlets Security Symmetric and Asymmetric Encryptions, Network security Basics, Firewalls & IDS.

UNIT–IV: Securely Handling Untrusted Data-Investigation of injection attacks over time. Understanding the cause behind both server-side and client-side injection attacks. Execution of common injection attacks, and implementation of various defenses..

UNIT–V: Preventing Unauthorized Access-Understanding the interplay between authentication, authorization and session management. Practical ways to secure the authentication process, prevent authorization bypasses and harden session management mechanisms, Securing Large Applications, Cyber Graffiti.

Text Books:

1. McClure, Stuart, Saumil Shah, and Shreeraj Shah. Web Hacking: attacks and defense. Addison Wesley. 2003.
2. Garms, Jess and Daniel Somerfield. Professional Java Security. Wrox. 2001.

Web Reference Books::

1. Collection of Cryptography Web Sites, Publications, FAQs, and Reference Books::http://world.std.com/~franl/crypto.html
2. FAQ: What is TLS/SSL? http://www.mail.nih.gov/user/faq/tlsssl.htm
3. The Open SSL Project (SDKs for free download): http://www.openssl.org/
4. Windows & .NET security updates Web site: http://www.ntsecurity.net/
5. Preventing Unauthorized access Web site: https://www.edx.org/course/web-security-fundamentals

II Year - I Semester		L	T	P	C
		3	0	0	3

Machine Learning

Course Objectives:

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.
- Demonstrate how to perform evaluation of learning algorithms and model selection.

Course Outcomes:

After the completion of the course, student will be able to

- Domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- Demonstrate on Supervised and Computational Learning
- Analyze on Statistics in learning techniques and Logistic Regression
- Illustrate on Support Vector Machines and Perceptron Algorithm
- Design a Multilayer Perceptron Networks and classification of decision tree

UNIT-I: Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT-II: Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Overfitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification.

UNIT-III: Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT-IV: Support Vector Machines (SVM)- Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly seperable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines.

Learning with Neural Networks: Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

UNIT -V: Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. **Decision Tree Learning**: Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

Textbooks:

1. Applied Machine Learning, 1st edition M.Gopal, Mc Graw Hill Education,2018

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

Understand that how to improve your writing skills and level of readability
Learn about what to write in each section
Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus		
Units	**CONTENTS**	**Hours**
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

Unit	Content	Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	4
2	Order Introduction of roots Technical information about Sanskrit Literature	4
3	Technical concepts of Engineering-Electrical,	4
4	Technical concepts of Engineering - Mechanical.	4
5	Technical concepts of Engineering - Architecture.	4
6	Technical concepts of Engineering – Mathematics.	4

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements	4
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature ,Discipline	4
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking.	4
4	Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	4
5	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women.	4
6	All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	4

Suggested reading

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes

Students will be able to 1.Knowledge of self-development
2.Learn the importance of Human values 3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus		
Units	**Content**	**Hours**
1	**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	**Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4
4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4
5	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4

6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

Syllabus		
Units	**Content**	**Hours**
1	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	4
3	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	4
4	Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
5	Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
6	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	4

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga)	5
2	Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha	5
3	Yam and Niyam. Do`s and Don't's in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	5
4	Asan and Pranayam Various yog poses and their benefits for mind & body	5
5	Regularization of breathing techniques and its effects-Types of pranayam	4

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue)	4
2	Neetisatakam-Holistic development of personality Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's)	4
3	Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,	4
4	Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	4
5	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18	4
6	Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	4

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

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