COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY

B. Tech. (Information Technology)
Effective from A. Y. 2014-15

INDEX

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PSC	Professional Science Course
3	PCC	Program Core Course
4	LC	Laboratory Course
5	HSSC	Humanities and Social Science Course
6	MLC	Mandatory Learning Course
8	LLC	Liberal Learning Course
9	BSC	Basic Science Course

Program Educational Objectives (PEOs):

1. To create graduates with sound knowledge of fundamentals of computer science and technology, who can contribute towards advancing science and technology.
2. To create graduates with sufficient capabilities in computer science and scientific computing who can become researchers and developers to satisfy the needs of the core computer technology industry.
3. To develop among students ability to formulate, analyse and solve real life problems faced in software industry.
4. To provide opportunity to students to learn the latest trends in computer technology and make them ready for life-long learning process.
5. To make the students aware of professional ethics of the Software Industry, and prepare them with basic soft skills essential for working in community and professional teams.
6. To prepare the students for graduate studies through competitive examinations, enabling them to reach higher echelons of excellence.

Program Outcomes (POs):

a. Graduates will demonstrate basic knowledge in fundamentals of programming, algorithms and programming technologies and fundamentals of Computer Science.
b. Graduates will demonstrate knowledge of fundamentals of hardware technology relevant to understanding Computer Science basics.
c. Graduates will have knowledge of the best practices in software development in industry.
d. Graduates will demonstrate the ability to design creative solutions to real life problems faced by the industry.
e. Graduates will demonstrate capability to work in teams and in professional work environments
f. Graduates will be able to communicate technical topics in written and verbal forms.
g. Graduates will demonstrate an understanding of the problems most relevant in time to Computer Engineering.
h. Graduates will demonstrate their ability to use the state of the art technologies and tools including Free and Open Source Software (FOSS) tools in developing software.
i. Graduates will demonstrate good performance at the competitive examinations like GATE, GRE, CAT for higher education.
j. Graduates will demonstrate their qualities of learning and demonstrating latest technology
k. Graduates will have developed the capability for self-learning.

CURRICULUM STRUCTURE OF B.TECH (Information Technology)

Effective from A. Y. 2014-2015

VII Semester

Sr. No.	Course Type/ code	Course	Contact hours L	T	P	Credits
01	OEC /SEC/HSSC	Open Elective/Science Elective/ Humanities Course	3			3
02	PCC	Information Security	3			3
03	PCC	Software Testing and Quality Assurance	3			3
04	DEC	DE – 3	3			3
05	DEC	DE – 4	3			3
06	LC	Information Security Lab			3	2
07	LC	Software Testing and Quality Assurance Lab			3	2
08	LC	DE – 3 Lab			2	1
09	LC	DE – 4 Lab			2	1
10	PCC	Project Work			2	1
11	LLC	Liberal Learning Course			2	1
			15		**14**	**23**

Department Elective - 3
AUP: Advanced UNIX Programming
S&V: Storage and Virtualization
AI: Artificial Intelligence
ADBMS: Advanced Database Management Systems
IBA: Introduction to Business Analytics
Subjects in Association with Industries

Department Elective - 4
HPC: High Performance Computing
MAN: Mobile and Ad-hoc Networks
IR: Information Retrieval
FF: Foundation of Finance
GTA: Graph Theory and Applications
Subjects in Association with Industries

*** Open Elective:** Intermediate Programming Concepts And Tools

VIII Semester

Sr. No.	Course Type/ code	Course	Contact hours L	T	P	Credits
01	OEC	Open Elective	3			3
02	DEC	DE – 5	3			3
03	DEC	DE – 6	3			3
04	LC	DE – 5 Lab			2	1
05	LC	DE – 6 Lab			2	1
06	PCC	Project Work			18	9
07	MLC	Intellectual Property Rights	1			1
			10		22	**21**

Departmental Elective – 5:
CB: Computational Biology
EC: E-commerce
GIS: Geographical Information Systems
NLP: Natural Language Processing
CSFLP: Cyber Security, Forensics and Legal Perspective
Subjects in Association with Industries

Departmental Elective – 6:
MT: Multicore Technologies
WST: Web Systems and Technologies
SDP: Software Design Patterns
OR: Operations Research
SA: System Administration

PCC : INFORMATION SECURITY

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction

Need of security, attributes of security, Active vs. Passive attacks, OSI Security Architecture Worms, viruses, Trojans, one time passwords, A Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Steganography.

Unit 2 **(6 Hrs)**

Symmetric Key Encryption

Modular Arithmetic, Euclid's Algorithm, Block ciphers, Stream ciphers, Data Encryption Standard,AES, Triple DES, RC5, RC4 Stream cipher.

Unit 3 **(6 Hrs)**

Public Key Cryptography

Introduction to Number Theory, Fermat's and Euler's Theorem, The Chinease Remainder Theorem, RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message authentication and hash functions, Hash Algorithms: MD5 message digest algorithm, secure hash algorithm, RIPEMD-160, HMAC.

Unit 4 **(6 Hrs)**

Authentication and Email Security

Digital Signatures, Authentication Protocols, Digital Signature Standards, Kerberos, X.509 Authentication service, Pretty Good Privacy, S/MIME.

Unit 5 **(6 Hrs)**

IP and Web Security

Internetworking and Internet protocols: IPv4, IPv6, IP security Architecture, Authentication Header, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 6 **(6 Hrs)**

System Security

Intruders, Intrusion Detection, Password Management, Viruses, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

Text Books:

- William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, Third Edition.
- Charlie Kaufman, Radia Perlman and Mike speciner, "Network security, Private communication in a Public World"

Reference Books:

- Christopher M. King, "Security architecture, design deployment and operations", Curtis patton and RSA Press.
- Stephen Northcatt, Leny Zeltser, "INSIDE NETWORK Perimeter Security", Pearson Education Asia.

- Robert Bragge, Mark Rhodes, Heith straggberg, "Network Security the Complete Reference", Tata McGraw Hill Publication.

Outcomes:

This course aims at

- Understand the need of information security to the students
- Comprehend the history of computer security and how it evolved into information security
- Understand the threats posed to information security and the more common attacks associated with those threats
- Understand the concept of developing encryption and decryption algorithms
- Understand the various techniques of encryption, key management in security and its importance

DE : SOFTWARE TESTING AND QUALITY ASSURANCE

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Quality Assurance

QA vs QC, Basics in Statistics and their applications, Different types of probability distributions and their applications

Unit 2 **(6 Hrs)**

Measurements, Metrics and Benchmarking , Various Theories of Quality – Juran, Demming, Ishikawa, Taguchi, Shingo, Crosby, Tom Peters, Watts Humphrey leading to CMMi, Six Sigma, ISO 9000, Total Quality Management, ISO 9126 / 25000 models

Unit 3 **(8 Hrs)**

Project Management, Project Planning, Quality Management, Configuration Management, Process Improvement

Software Maintenance: Importance to business, Advantages to individuals, Maintenance lifecycle, Static and Dynamic Analysis tools

Unit 4 **(6 Hrs)**

Testing

Fundamentals of Testing ,What is Testing? Seven Testing Principles, Fundamental Test Process,Testing Throughout the Software Life Cycle

Unit 5 **(6 Hrs)**

Test Level, Test Types, Static Techniques, Test Design Techniques, Specification-based or Black-box Techniques, Structure based or White-box Techniques

Unit 6 **(6 Hrs)**

Test Management, Test Planning and Estimation, Test Progress Monitoring and Control, Configuration Management, Tool Support for Testing.

Text Books and Online References:

- Beizer B. (1990) Software Testing Techniques (2nd edition), Van Nostrand Reinhold:Boston.
- Black, R. (2001) Managing the Testing Process (3rd edition), John Wiley & Sons New York.
- Hetzel, W. (1988) Complete Guide to Software Testing QED: Wellesley, MA.
- Lecture Notes on Basics of Statistics, Jarkko Isotalo
- http://www.wiley.com/college/sc/reid/chap5.pdf
- Ian Sommerville, Software Engineering 9th Edition, Pearson, Boston, ISBN-13: 978-0-13-703515-1 (part 4) Pande, Peter S., Neuman, Robert P., and Cavanagh, Roland R, "The Six Sigma Way: How GE, Motorola, and Other Top Companies are Honing Their Performance", ISBN: 0071358064
- http://www.6sigmastudy.com/6sigmadoc/BlackBelt/1. Introduction/3. Quality Gurus 26 their contribution to Quality.pdf
- Thomas Pigoski,"SoftwareMaintnenance",uhcl.edu/helm/SWEBOK_IEEE/data/swebok_chapter_06.pdf
- Watts Humphrey, "Managing Software Processes" Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA ©1989, ISBN:0-201-18095-2
- Kaner, C., Bach, J. and Petttico B. (2002) Lessons Learned in Software Testing, John Willey & Sons: New York.
- Myers, Glenford J. (1979) The Art of Software Testing, John Wiley & Sons: New York Van Vee enendaal, E. (ed.) (2004) The Testing Practitioner, UTN Publishers: The Nether rlands .

Outcomes:

This course aims at

- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
- To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
- To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.
- To gain software testing experience by applying software testing knowledge and methods to practice-oriented software testing projects.
- To understand software test automation problems and solutions.
- To learn how to write software testing documents, and communicate with engineers in various forms.
- To gain the techniques and skills on how to use modern software testing tools to support software testing projects.

DE : ADVANCED UNIX PROGRAMMING

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction:
Architecture of Unix OS, overview of file system, internal representation of files, Inodes, structure of Regular Files, Directories, data structures used for file handling.
System Calls for File Handling: File Descriptors, open, creat, close, lseek, read, write, dup, fcntl, ioctl, stat, File Types, set-user-id, set-group-id, access permissions, access, umask, chmod, Sticky bit, chown, File Size, File truncation.

Unit 2 **(6 Hrs)**

Link and Directory Files:
File Systems, link, Symbolic Links, symlink, readlink, File Times, utime, mkdir, rmdir, Special Device Files.
System Data Files and Information:
Introduction, Password File, Shadow Passwords, Group Files, Supplementary Group IDs, Login Accounting, System Identification, Time and Date Routines.

Unit 3 **(6 Hrs)**

UNIX Processes:
Context of a process, process states and Transitions, Environment of a UNIX Process main Function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, setjmp, longjmp,.
Process Control:
Processes Identifiers, fork, vfork, exit, wait, waitpid, Race Conditions, exec, Changing User IDs and Group IDs, Interpreter Files, system, Processes Accounting.

Unit 4 **(8 Hrs)**

Process Relationships:
Introduction, Terminal Logins, Network Logins, Process Groups, Sessions, Controlling Terminal, tcgetpgrp, tcsetpgrp, tcgetsid, Job Control, Shell Execution of Programs, Orphaned Process Groups,.
Daemon Processes:
Introduction, Daemon Characteristics, Coding Rules.
Threads:
Concepts, Identification, Creation, Termination, Synchronization, Limits, Attributes.

Unit 5 **(8 Hrs)**

Signals:
Introduction, Signal Concepts, Signal Function, SIGCLD Semantics, kill, raise, alarm and pause Functions, Signal Set, sigprocmask, sigpending, sigaction, sigsetjmp, siglongjmp, sigsuspend, abort, system, sleep Functions.

Unit 6 **(6 Hrs)**

Interprocess Communication Pipe, popen, pclose, Coprocesses, FIFOs, System V IPC, Message Queues, Semaphores, Shared Memory, Sockets.

Text Books:

- W. Richard Stevens, Stephen A Rago, Advanced Programming in the UNIX Environment, Addison-Wesley / PHI, 2nd Edition, 2011.
- Maurice J. Bach, The Design of Unix Operating System, PHI. 2009.

Reference Books:

- Terrence Chan: UNIX System Programming Using C++, Prentice Hall India, 1999.
- Kay A Robbins and Steve Robbins, Unix Systems Programming, Pearson Education, 2004.
- Marc J. Rochkind: Advanced UNIX Programming, 2nd Edition, Pearson Education, 2005.

Outcomes:

This course aims at

- Understand the role of Unix system calls as in files and internal data structures used by Unix.
- Able to identify the central role of concurrency in systems programming and produce programs which generate and control a process, establish relationship and communication between multiple processes.
- Learn the fundamentals of reliable signal handling and the related system calls.
- Develop short system utilities and applications using system calls.

DE : STORAGE AND VIRTUALIZATION

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(8 Hrs)**

Basic concepts for Systems and Storage
Storage Challenges and Issues- Data sources, challenges of data growth, availability, performance and managability requirements, data virtualization.
OS and Device Driver Concepts- Kernel, device drivers, firmware, RDMA, boot sector, device partitioning, UNIX flavors File System Concepts- File system, virtual memory, namespace, metadata, buffer cache, defragmentation.

Unit 2 **(6 Hrs)**

Storage Hardware and SCSI Protocol,SAN, NAS, Fibre Channel and iSCSI
Storage Hardware Building Blocks - Device Types (Magnetic Disks, JBOD, SSD, Optical, WORM), HBA, switches, hubs, routers, GBIC . Introduction to various Storage Protocols- Serial, Parallel protocols. Overview of IDE, SAS, SATA, SCSI, FC, FCoE, iSCSI, Infiniband, FCP, FC-IP, iFCP, Fibre Channel Protocol Stack & Concepts- FC (Protocol stack, Exchange, Sequence, Frames,

Port types, Topologies, Login, FC-ID) Mapping Protocols - iSCSI, FCP- SCSI mapping to underlying transport, Connection Management, PDU, TOE.
SAN Concepts and Advanced Topics- DAS, SAN architecture, Concepts (zoning, name server, SCN, WWN, routing), FC-SAN, IP-SAN and Applications NAS Concepts and Appliances- NAS architecture, Protocols (CIFS, NFS), Performance, Scalability and Usability, Appliances.

Unit 3 **(6 Hrs)**

Storage Virtualization Concepts
Data Center End to End View- Overview of complete stack including Storage, Network, Host, Clustering, High Availability, Applications, Virtual Machines, Cloud Storage Storage Virtualization Basics- RAID levels, I/O stack, OS abstraction, Storage Pooling, Storage Provisioning, Online Grow/Shrink Storage Virtualization Advanced topics- Metadata management, Transaction consistency, I/O maps, I/O path considerations, Data consistency, Crash recovery, Application interfaces.

Unit 4 **(8 Hrs)**

Applications and Use Cases for Storage Virtualization
Data Replication- Off-host processing, RPO/RTO, Replication (sync, async, periodic, continuous), Snapshots Data Protection- Backup (full, incremental, differential, continuous), Restore, Archival, Compliance considerations.
Capacity Management- Storage provisioning, De-duplication, Thin provisioning, Storage Tiering, ILM, Data classification, Storage grid.

Unit 5 **(8 Hrs)**

Cloud Computing Basics
Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization cloud computing,Cloud Computing definition, basics, Cloud Architectures: basics, advanced, and specialized.Services and applications.

Unit 6 **(8 Hrs)**

Cloud Computing Advanced
Cloud Computing mechanisms, The MapReduce programming model, Benefits and challenges,Cloud resource management and scheduling:Transition management
Cloud migration, Service management and SLAs, security, and monitoring, Cloud Platforms in industry, cloud applications.

Text Books:

- Storage Networks: The complete Reference. Robert Spalding TMH.
- Designing Storage Area Networks: A Practical Reference for Implementing Fibre Channel and IP SANs, Second Edition Publisher: Addison-Wesley Author: Tom Clark.

Reference Books:

- Cloud Computing: Concepts, Technology & Architecture (The Prentice Hall Service Technology Series from Thomas Erl) by Thomas Erl, Prentice Hall, 2013.
- Cloud Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by RajkumarBuyya,James Broberg, Andrzej M. Goscinski, John Wiley and Sons, 2011.
- Cloud Computing: Theory and Practice, Dan C Marinescu, Elsevier, 2013.

- Cloud Computing Bible by Barrie Sosinsky, Wiley Publishing, 2011.
- Virtualization Essentials by Matthew Portnoy, John Wiley and Sons, 2012.
- Computer Systems – A Programmer's Perspective, Randall Bryant and David O'Hallaron. Pearson Education. 2003.
- The Design and Implementation of the 4.4 BSD Operating System, McKusick, Bostic, Karels, and Quaterman, 1996.

Outcomes:

This course aims at

- This course is designed to introduce Introduction To Storage System, the fundamentals of Network Storage technologies, focusing on Storage Area Networks (SAN) and Network Attached Storage (NAS),Storage Related Services And Storage Grid.
- Understand the common terms and definitions of virtualization and cloud computing and be able to give examples.
- Understand the technical capabilities and business benefits of virtualization and cloud computing and how to measure these benefits.
- Describe the landscape of different types of virtualization and understand the different types of clouds.
- Understand the similarities and difference between cloud computing and outsourcing.

DE : ARTIFICIAL INTELLIGENCE

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction:

What is AI, History, AI problems, Production Systems, Problem characteristics, Intelligent Agents, Agent Architecture, AI Application (E-Commerce, & Medicine), AI Representation, Properties of internal representation, Future scope of AI , Issues in design of search algorithms.

Unit 2 **(6 Hrs)**

Heuristic search techniques:

Heuristic search, Hill Climbing, Best first search, mean and end analysis, Constraint Satisfaction, A* and AO* Algorithm, Knowledge Representation: Basic concepts, Knowledge representation Paradigms, Propositional Logic, Inference Rules in Propositional Logic, Knowledge representation using Predicate logic, Predicate Calculus, Predicate and arguments, ISA hierarchy, Frame notation, Resolution, Natural Deduction .

Unit 3 **(6 Hrs)**

Logic Programming:

Introduction, Logic, Logic Programming, Forward and Backward reasoning, forward and Backward chaining rules.

Knowledge representation using non monotonic logic:
TMS (Truth maintenance system), statistical and probabilistic reasoning, fuzzy logic, structure knowledge representation, semantic net, Frames, Script, Conceptual dependency.

Unit 4 **(6 Hrs)**

Learning:
What is Learning, Types of Learning (Rote, Direct instruction Analogy, Induction, Deduction)
Planning:
Block world, strips, Implementation using goal stack, Non linear planning with goal stacks, Hierarchical planning, Least commitment strategy.

Unit 5 **(6 Hrs)**

Advance AI Topics
Game playing: Min-max search procedure, Alpha beta cutoffs, waiting for Quiescence, Secondary search, Natural Language Processing: Introduction, Steps in NLP, Syntactic Processing, ATN, RTN, Semantic analysis, Discourse & Pragmatic Processing.
Perception and Action: Perception, Action, Robot Architecture.

Unit 6 **(6 Hrs)**

Neural Networks and Expert system
Introduction to neural networks and perception-qualitative Analysis, Neural net architecture and applications, Utilization and functionality, architecture of expert system, knowledge representation, two case studies on expert systems.

Text Books:
- Elaine Rich and Kerin Knight: "Artificial Intelligence."
- Eugene, Charniak, Drew Mcdermott: "Introduction to artificial intelligence."
- Kishen Mehrotra, Sanjay Rawika, K Mohan; "Artificial Neural Network."

References:
- Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Prentice Hall, 2nd Edition.
- Ivan Bratko : "Prolog Programming For Artificial Intelligence" , 2nd Edition Addison Wesley, 1990.
- Herbert A. Simon, "The Sciences of the Artificial ", MIT Press, 3rd Edition (2nd Printing), 1998.
- Tim Jones "Artificial Intelligence Application Programming" M. Dreamtech Publication.
- George F Luger : "Artificial Intelligence : Structures and Strategies for Complex Problem Solving", Pearson Edu., 4th Edition.
- Rajendra Akerkar : "Introduction to Artificial Intelligence ",PHI Publication.

Outcomes:
This course aims at
- The student will learn the basics of the theory and practice of Artificial Intelligence as a discipline about intelligent agents capable of deciding what to do, and do it.
- The student will be introduced to Artificial Intelligence programming.
- The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.

- The student will design simple software to experiment with various AI concepts and analyse results.
- The student will build self-learning and research skills to be able to tackle a topic of interest on his/her own or as part of a team.

DE : ADVANCED DATABASE MANAGEMENT SYSTEMS

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Parallel Databases
Introduction, I/O Parallelism, Inter-query and Intra-query Parallelism, Inter-operational and Intra-operational Parallelism, Design of Parallel systems.

Unit 2 **(6 Hrs)**

Distributed Databases
Homogeneous and Heterogeneous databases, Storing data in distributed DBMS, Distributed catalog management.

Unit 3 **(6 Hrs)**

Distributed Transactions
Distributed Transactions and Query processing, Distributed Concurrency and recovery.

Unit 4 **(6 Hrs)**

Data Warehouse and OLAP
Introduction to Decision Support, Data Warehousing, Creating and maintaining a warehouse. OLAP: Multidimensional data Model, OLAP Queries, Database design for OLAP, Implementation Techniques for OLAP Bitmap Indexes, Join Indexes, Views and decision support, Top N Queries, Online Aggregation.

Unit 5 **(6 Hrs)**

XML
Introduction, Structure of XML Data, XML Document Schema, Querying and Transformation, API to XML, Storage of XML Data, XML Applications.

Unit 6 **(6 Hrs)**

Advanced Topics
Hadoop / Map Reduce, No SQL Databases

Text Books:

- Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database system concepts", 5th Edition , McGraw Hill International Edition.
- Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", Second Edition, McGraw Hill International Editions.

Reference Books:

- Rob Coronel, Database systems: "Design implementation and management", 4th Edition, Thomson Learning Press.
- J. D. Ullman, Principles of Database Systems, Galgotia Publication, 2nd Edition, 1999.
- R. Elmasri, and S. Navathe, Fundamentals of Database Systems, Benjamin Cummings, Pearson, 6th Edition, 2010.

Outcomes:

This course aims at

- Understand concept and working of parallel database system.
- Study different types of distributed databases.
- Analyze Distributed Transactions and Query processing.
- List and describe the key characteristics of a data warehouse.
- Identify other data models such as object-oriented model and XML model.
- Exploit Big Data platforms such as Hadoop and NoSQL databases.

DE : INTRODUCTION TO BUSINESS ANALYTICS

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(5 Hrs)**

Fundamental of Business Analytics

Learning Objectives; What Is Business Analytics?, Evolution of Business Analytics, Scope of Business Analytics, Data for Business Analytics, Decision Models, Problem Solving and Decision Making, Spreadsheet Modeling and Spreadsheet Engineering.

Unit 2 **(7 Hrs)**

Descriptive Analytics

Visualizing and Exploring Data: Data Visualization, Data Queries Using Sorting and Filtering, Statistical Methods for Summarizing Data, Descriptive Statistical Measures: Populations and Samples, Measures of Location, Measures of Dispersion, Measures of Shape, Measures of Association, Statistical Thinking in Business Decisions, Details of Data Modeling.

Unit 3 **(7 Hrs)**

Predictive Analytics

Predictive Modeling and Analysis: Logic-Driven Modeling, Data-Driven Modeling, Analyzing Uncertainty and Model Assumptions, Model Analysis Using Risk Solver Platform, Introduction to

Data Mining: The Scope of Data Mining, Data Exploration and Reduction, Classification, Classification Techniques, Association Rule Mining, Cause-and-Effect Modeling

Unit 4 **(7 Hrs)**

Prescriptive Analytics

Linear Optimization: Building Linear Optimization Models, Implementing Linear Optimization Models on Spreadsheets, Solving Linear Optimization Models, Graphical Interpretation of Linear Optimization, Using Optimization Models for Prediction and Insight, Applications of Linear Optimization: Types of Constraints in Optimization Models

Unit 5 **(6 Hrs)**

Making Decisions

Making Decisions with Uncertain Information, Decision Trees, The Value of Information, Utility and Decision Making, Case Study

Text Books:

- James R. Evans, "Business Analytics: Methods, Models, and Decisions", Pearson 2012

Reference Books:

- R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics" , Wiley.
- Thomas H. Davenport, Jeanne G. Harris and Robert Morison, "Analytics at Work: Smarter Decisions, Better Results", Harvard Business Press, 2010.
- Evan Stubbs, "Delivering Business Analytics: Practical Guidelines for Best Practice", Wiley 2013

Outcomes:

This course aims at

- Describe and interpret the basic concepts of Business Analytics (BA).
- Describe basic principles of data mining as a basic tool of Business Analytics.
- Evaluate business problems and determine suitable analytical methods.
- Evaluate the difficulties presented by massive, opportunistic data.
- Plan, organize and evaluate methods to prepare raw data for business analytics, including partitioning data and imputing missing values.
- Compare and contrast different BA techniques.
- Interpret, analyze and validate the results.
- Synthesis the types of questions Business Analytics using data mining can be answered.
- Evaluate different methods of data mining and how they compare.

DE : HIGH PERFORMANCE COMPUTING

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Overview of High Performance Parallel Processing Architectures

Necessity of high performance, Constraints of conventional architecture, Parallelism in uni-processor system, Evolution of parallel processors, Architectural Classification: Flynn's Taxonomy, Different models of parallel computers, Applications of parallel processing, Instruction Level Parallelism and Thread Level Parallelism and differences, Types of parallelism, Case studies: Intel Itanium Processor, Explicitly Parallel Instruction Computing (EPIC) Architecture. Principles of scalable performance: Moore's Law, Performance Metrics and Measures, Speedup Performance Laws.

Unit 2 **(6 Hrs)**

Pipeline and Superscalar Architectures

Principles and implementation of Pipelining, Classification of pipelining processors, General pipelining reservation table, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register, Software pipelining, Very Long Instruction Word (VLIW) processor, Case studies: Superscalar Architecture- Pentium, Ultra SPARC, Recent advances in pipelining.

Unit 3 **(6 Hrs)**

Vector and SIMD Architectures-Graphics Processing Units

Basic vector architecture, Issues in Vector Processing, Vector performance modeling, vectorizers and optimizers, Case study: Cray Arch. SIMD Computer Organization Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection networks.

Case Study: Heterogeneous computing, CPU/GPU architecture comparison, GPU architecture details, Data parallelism and SPMD programming model, High level overview of CUDA basics, Strength and limitation of GPU.

Unit 4 **(6 Hrs)**

Multiprocessor Architectures

Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques.

Cache coherency and bus snooping, Massively Parallel Processors (MPP), Case Study of IBM Power4 Processor, Inter Processor Communication and Synchronization.

Unit 5 **(6 Hrs)**

Multithreaded Architectures

Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions.

Parallel Programming Techniques: Shared Memory Programming, PThreads in shared memory systems, Data Parallel Programming, Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming.

Unit 6 **(6 Hrs)**

Parallel Programming Environments and related Issues

Classification of parallel algorithms, Parallel algorithms for multiprocessors, Performance of parallel algorithms, Message passing libraries for parallel programming interface, Parallel Virtual Machine (in distributed memory system), Message Passing Interfaces (MPI), OpenMp shared Memory programming, Parallel Algorithm examples: Matrix Multiplication, Sorting, Parallel Programming Languages; Occam, C-Linda.

Cluster: COW's and NOW's (Cluster and Network of Workstations), Different ways of building a cluster.

Text Books:

- John L Hennessy, David A Patterson, "Computer Architecture: A Quantitative Approach", Fifth Edition, Morgan Kaufmann, 2011.
- Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture", Second Edition, Tata McGrawhill Edition, 2010.

Reference Books:

- Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGrawhill International Edition, 1985.
- V. Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI, 2004.
- Michael J Quinn, "Parallel Programming in C with MPI and OpenMP", Tata McGraw-Hill Edition, 2011.
- Dezaso Sima, Terence Fountain, Peter Kascuk, "Advanced Computer Architectures: A Design Space Approach", Pearson Education, 2009.
- Peter S Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011.

Outcomes:

This course aims at

- Understanding the design issues in advanced computer architectures.
- Different Parallel Programming environments.
- Understanding the fundamentals of high performance computing and their need.
- Understanding and differences between different paradigms: Shared memory, message passing.
- Use of the programming environment like pthreads, openMp and MPI, CUDA.
- Use of parallel programming benchmarks and performance measurements.
- Understanding the basics of Cluster and cluster building steps.

DE : MOBILE AND AD-HOC NETWORKS

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction

Fundamentals of Wireless Communication Technology, Characteristics of the Wireless Channel, Multiple Access Techniques, IEEE 802 Networking Standard, Wireless LANs and PANs, IEEE 802.11 Standard, IEEE 802.16 Standard, Bluetooth, HomeRF.

Unit 2 **(6 Hrs)**

Cellular Wireless Networks And Wireless Internet

The Cellular Concept, Cellular Architecture, First-Generation Cellular Systems, Second-Generation Cellular Systems, Third-Generation Cellular Systems, Wireless in Local Loop, Wireless ATM,Wireless Internet, What is Wireless Internet, Mobile IP, TCP in Wireless Domain, WAP, Optimizing Web Over Wireless.

Unit 3 **(6 Hrs)**

Introduction To Ad-Hoc Networks

Introduction to Ad-hoc networks, characteristics, applications, Issues in Ad Hoc Wireless Networks Medium Access Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE Standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN

Unit 4 **(6 Hrs)**

Routing Protocols For Ad-Hoc Networks

Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing

Unit 5 **(6 Hrs)**

Other Features Of Ad-Hoc Networks

Issues in designing Transport layer Ad-Hoc Networks, TCP over Wireless Ad-Hoc Networks, . Security issues in Ad-hoc networks, secure routing protocols, Energy Management in Ad-Hoc Networks, Battery Management, Transmission Power Management, System Power Management.

Unit 6 **(6 Hrs)**

Wireless Sensor Networks

Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network.

Text Books:

- C.Siva Ram Murthy and B.S.Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education. 2007

Reference Books:

- F.Zhao, L. Guibas, Wireless Sensor Networks: An Information Processing Approach. Morgan Kaufmann, 2004.
- Stefano Basagni, Marco Conti, Silvia Giordano and Ivan sSojmenovic, Mobile Ad-hoc Networking, Wiley-IEEE Press, 2004.
- Mohammad Ilyas, The Handbook of Ad-hoc Wireless Networks, CRC press, 2002.

Outcomes:

This course aims at

- Have an understanding of the principles of mobile ad hoc networks and what distinguishes them from infrastructure-based networks.
- Have an understanding of the principles and characteristics of wireless sensor networks.
- Be able to understand how routing protocols function and their implications on data transmission delay and bandwidth consumption.
- Be familiar with the mechanisms for implementing security, transport layer and energy efficiency in MANETs.

DE : INFORMATION RETRIEVAL

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction

Data Retrieval Vs Information Retrieval, Goals and history of IR, The impact of the web on IR, The role of AI in IR, Applications of IR, Basic Models of IR: Boolean and vector-space retrieval models, ranked retrieval,weighting, cosine similarity.

Unit 2 **(6 Hrs)**

Automatic Text Analysis and Classification

How the text of a document is represented inside a computer, Automatic classification methods in general and then takes a deeper look at the use of these methods in information retrieval.

Unit 3 **(6 Hrs)**

File Structures and Search Strategies

File Structures from the point of view information retrieval, Search strategies when applied to document collections structured in different ways, Use of feedback.

Unit 4 **(6 Hrs)**

Probabilistic Retrieval and Evaluation

Formal model for enhancing retrieval effectiveness by using sample information about the frequency of occurrence and co-occurrence of index terms in the relevant and non-relevant documents, Traditional view of measurement of effectiveness, theory of evaluation.

Unit 5 **(6 Hrs)**

Multimedia IR and Digital Libraries

Models and languages, Including MULTOS and SQL3, Libraries and Bibliographical Systems, digital libraries, online systems and public access catalogs, Challenges for effective deployment of digital libraries.

Unit 6 **(6 Hrs)**

Parallel and distributed IR and Searching the Web

Algorithms and architectures ,Parallel computing, performance measure MIMD,SIMD Architectures ,Distributed IR Collection Partitioning, Source Selection, Query Processing searching the web, challenges, characterizing the web , Search Engines , Ranking , Web crawlers.

Text Books:

- Richardo Baeza –Yates, Berthier Ribiero-Neto "Modern Information Retrieval " Addison – Wesley.
- C J Van Rijsbergen "Information Retrieval", An online book by C J Van Rijsbergen, University of Glasgow.
- Christopher D. Manning "Introduction to Information Retrieval" Cambridge University Press. 2008.

Outcomes:

This course aims at

- Understand and discuss current issues and research in searching and information retrieval.
- Appreciate the capabilities and limitations of information retrieval systems.
- Identify search concepts in an information request.
- Identify and exploit characteristics of reference and source databases and search systems for effective searching.
- Identify and discuss problems, issues, and future developments in information retrieval.

DE : FOUNDATIONS OF COMPUTATIONAL FINANCE

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Basics of Finance: Money, Currency, Inflation, Financial Management: Overview, scope and objectives.
Financial Markets: Role and functioning of financial markets viz. Capital, Derivatives and Commodity.
Financial Institutions: Functioning of financial institutions such as investment banks, brokerage houses, commercial banks, Insurance companies and employee benefit companies.

Unit 2 **(4 Hrs)**

Valuation Concepts: Time Value of Money, Risk and Rates of Return, Interest Rates.

Unit 3 **(8 Hrs)**

Introduction to Stocks, Futures and Options; Trading strategies involving options.

Unit 4 **(6 Hrs)**

Capital Budgeting: Basics of Capital Budgeting, Cash Flow Estimation and Risk Analysis.

Unit 5 **(4 Hrs)**

Introduction to Portfolio Theory and Capital Asset Management.

Unit 6 **(8 Hrs)**

Introduction to Time Series Analysis and Stochastic Calculus

Text Books:

- Eugene F. Brigham, Fundamentals of Financial Management 12th Edition, South Western, ISBN-13 9788131518571
- Ruey S. Tsay, Analysis of Financial Time Series, Wiley India Pvt. Ltd., ISBN-13 9788126523696
- Steven E. Shreve, Stochastic Calculus for Finance l, New Age International, ISBN-13 9788184892727

Reference Books:

- Richard Brealey, Principles of Corporate Finance, McGraw Hill Education India Pvt Ltd, ISBN-13 9781259004650
- Sheldon M. Ross, Stochastic Processes, Wiley India, ISBN 13 9788126517572

Outcomes:

This course aims at

- Introducing basics of finance
- Introducing the financial markets and financial institutions
- Studying valuation concepts and capital budgeting
- Introducing portfolio theory
- Introducing basics of mathematics of finance – time series analysis and stochastic calculus
- This course will prepare students to
    - work in software companies in finance domain
    - explore 'finance' as career and/or higher study option

DE : GRAPH THEORY AND APPLICATIONS

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(2 Hrs)**

Definitions of terms such as graph, vertex set, edge set, connected graphs, bipartite graphs, trees, path, cycle, graphic sequences etc.

Unit 2 **(6 Hrs)**

Paths, Cycles, Trees: Definitions and fundamental theorems related to these concepts.

Unit 3 **(8 Hrs)**

Matchings: perfect matching, matching in bipartite graphs, Berge's theorem, Hall's theorem, Konig-Egervary theorem, general matchings.

Unit 4 **(8 Hrs)**

Cuts and Connectivity, Flows in Directed Graphs, Connectivity and Menger's Theorem, Edge-Connectivity, Blocks,K-connected Graphs and k-edge-connected Graphs, 2-connected Graphs, Applications of Menger's Theorem.

Unit 5 **(6 Hrs)**

Independence and coloring: Brooks' theorem, Coloring maps, Greedy coloring algorithm Coloring edges - Vizing's Theorem.

Unit 6 **(6 Hrs)**

Graph Algorithms: Discussion on implementation of algorithms related to matchings, network flows, connectivitiy, coloring etc.

Text Books:

- Douglas B. West, Introduction to Graph Theory, Prentice-Hall, ISBN-13 9788120321427
- Reinhard Diestel, Graph Theory, Springer (India) Pvt. Ltd., ISBN-13 9788184890853

Reference Books:

- Bela Bollobas, Modern Graph Theory, Springer, ISBN 139788181283092

Outcomes:

This course aims at

- Introducing terminology of graph theory
- Studying fundamentals theorems in graph theory related to matching, coloring, connectivity etc
- Studying design and implementation of graph algorithms
- This course will expose students to different aspects of graph theory which would be useful in higher studies, research and working in different domains

DE : INFORMATION SECURITY LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Write a program to find an IP address of a remote system.
2. Write a program to detect a Remote Firewall
3. Install a Proxy server and configure an application Gateway
4. Install, Configure and study a Intrusion detection system (IDS).
5. Implementation of MD5 hashing Technique.
6. Implementation of Rijndael algorithm using 64-bit key.
7. Implementation of DES.
8. Implementation of Diffie-hellman algorithm.
9. Implementation of email security using PGP(create yourself a 1024 bit PGP key. Use your name and email address for your key label. Use PGP to verify the signature on this assignment.)
10. Design an experiment to estimate the amount of time to
    Generate key pair (RSA)
    Encrypt n bit message (RSA)
    Decrypt n bit message (RSA)
    As function of key size, experiment with different n-bit messages. Summarize your conclusion.

Outcomes:

This course aims to

- Implementing the cryptographic algorithms using the language they have studied
- Demonstrate the practical importance of Information Security
- Analyze the implementations for time required to generate keys and encryption/decryption process also various possible attacks
- Installing and configuring the proxy server and IDS

DE : SOFTWARE TESTING AND QUALITY ASSURANCE LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

11. Perform Verification & Validation & associated umbrella activities related to testing .Write the test cases for User Authentication for any application.The requirement is username should not be less than or equal to 7 characters. Valid password should be considered as combination of special characters,numbers,capital & small letters.
12. Write Master Test Plan for the system with sufficient complexity.
13. Discuss different testing strategies.Apply two suitable white box testing techniques.
14. Write test cases for intended functionality first i.e. for valid conditions according to requirements. Then write test cases for invalid conditions. This will cover expected as well unexpected behavior of application under test(AUT).
15. Identify and group test cases to perform regression testing.
16. Perform Black box testing for all the units contained in the architectural segments.Apply two suitable black box testing techniques.Prove the functionality with proper justification.
17. Applications requiring critical response time should be thoroughly tested for performance.

Outcomes:

This course aims to

- Students have an ability to apply software testing knowledge and engineering methods.
- Have an ability to design and conduct a software test process for a software testing project.
- Have an ability to identify the needs of software test automation, and define and develop a test tool to support test automation.
- Have an ability understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
- Have an ability to use various communication methods and skills to communicate with their teammates to conduct their practice-oriented software testing projects.
- Have basic understanding and knowledge of contemporary issues in software testing, such as component-based software testing problems.
- Have an ability to use software testing methods and modern software testing tools for their testing projects.

DE : ADVANCED UNIX PROGRAMMING LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Exercise on using the system calls for regular files.
2. Exercises on using system calls on file attributes, symbolic links.
3. Exercises on using system calls on directory and device files.
4. Exercises on using system calls on process control.
5. Exercises on using system calls on exec and session.
6. Exercises on using system calls on signal.
7. Exercises on using system calls on sigaction, sigsetjmp.
8. Exercises on using system calls on IPC – pipe.
9. Exercises on using system calls on IPC – sockets.

Text Book:

- W. Richard Stevens, Stephen A Rago, Advanced Programming in the UNIX Environment, Addison-Wesley / PHI, 2nd Edition, 2011.
- Maurice J. Bach, The Design of Unix Operating System, PHI, 2009.

Outcomes:

This course aims to

- Have hands-on experience on developing utilities using system calls and testing with open-source operating system.

DE : STORAGE AND VIRTUALIZATION LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Setting Up an NFS Server.
2. Setting up an NFS Client.
3. Running IO over NFS share.
4. Create a Public Share on Samba.
5. Running IO over Samba share.
6. Implement FUSE.
7. Implement LoggedFS.
8. Implement TrueCrypt.
9. Implement EncFS.

Outcomes:

This course aims to

- This course is designed to introduce Introduction To Storage System, the fundamentals of Network Storage technologies, focusing on Storage Area Networks (SAN) and Network Attached Storage (NAS),Storage Related Services And Storage Grid.
- Understand the common terms and definitions of virtualization and cloud computing and be able to give examples.
- Understand the technical capabilities and business benefits of virtualization and cloud computing and how to measure these benefits.
- Describe the landscape of different types of virtualization and understand the different types of clouds.
- Understand the similarities and difference between cloud computing and outsourcing.

DE : ARTIFICIAL INTELLIGENCE LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Implement A* algorithm .
2. Implement AO* algorithm .
3. Implementation of Unification Algorithm.
4. Implementation of Truth maintenance system using prolog.
5. Implementation of Min/MAX search procedure for game Playing .
6. Parsing Method Implementation using Prolog.
7. Development of mini expert system using Prolog / Expert System Shell " Vidwan" .

Outcomes:

This course aims to

- The student will learn the basics of the Artificial Intelligence as a discipline about intelligent agents capable of deciding what to do, and do it.
- The student will be introduced to Artificial Intelligence programming.
- The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.
- The student will design simple software to experiment with various AI concepts and analyse results.
- The student will build self-learning and research skills to be able to tackle a topic of interest on his/her own or as part of a team.

DE : ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Assignment on implement fragmentation of database.
2. Assignment to implement Relational operation sort-merge join algorithm.
3. Design and Implement Web Based database using ASP/JSP/PHP.
4. Implementation of packages, procedures, functions, cursors and trigger in PL/SQL.
5. Exercises based on XML (Xml Schema, DTD, XSL Stylsheet).
6. Assignment using Hadoop/ Mapreduce.
7. Assignment on OLAP.
8. Design and Implement a small application for Android Tablet.

Outcomes:
This course aims to

- Understand creating and maintaining a data warehouse.
- Connect high level programming language with database through JDBC.
- Design client/server model for database application.
- Design object-oriented model and XML model.
- Implementation of Android based application.
- Analysis of Big Data.
- Implement parallel and distributed database concepts.

DE : INTRODUCTION TO BUSINESS ANALYTICS LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. List down various applications (min 5) of Analytics and give a case study from any domain in a group of two students.
2. Find out a problem definition and give a solution using any of the analytics technique which is relevant to that problem.
3. Prepare and give a presentation on the above assignments.

Outcomes:
This course aims to

- Describe and interpret the basic concepts of Business Analytics (BA).
- Describe basic principles of data mining as a basic tool of Business Analytics.
- Evaluate business problems and determine suitable analytical methods.
- Evaluate the difficulties presented by massive, opportunistic data.

- Plan, organize and evaluate methods to prepare raw data for business analytics, including partitioning data and imputing missing values.
- Compare and contrast different BA techniques.
- Interpret, analyze and validate the results.
- Synthesis the types of questions Business Analytics using data mining can be answered.
- Evaluate different methods of data mining and how they compare.

DE : HIGH PERFORMANCE COMPUTING LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Study of different benchmarks in High Performance Computing.
2. Study of Cluster building steps - MPI Cluster setup.
3. Program to execute gather and scatter operation using MPI routines.
4. Program to execute Sorting algorithm using MPI routines.
5. Program to execute Matrix Operations using MPI.
6. Case Study of GPU Architecture with CUDA.
7. Program to execute matrix multiplication using CUDA on GPU.
8. Program to understand shared memory paradigm using pthreads.
9. Program to execute matrix vector multiplication using pthreads.
10. Study of parallel programming languages Occam, C-Linda.

Outcomes:
This course aims to

- Understanding the different benchmarks used in HPC.
- Understanding the difference in Shared Memory and Message Passing programming.
- Use of data parallel architecture and programming using GPU.
- Understanding the building blocks of cluster setup.

DE : MOBILE AND AD-HOC NETWORKS LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Set up an infrastructure wireless network consisting of multiple nodes and an access point. observing IEEE 802.11 traffic
2. Configure an ad hoc network, measure the throughput.
3. Measuring delay, throughput, connectivity, and overhead in MANET routing protocols using a network simulator.
4. Configure Bluetooth piconets and analyse the interference with 802.11.
5. Configure the Mobile IP

Outcomes:
This course aims to

- Familiarize with the wireless devices
- Understand the configure and operation of infrastructure wireless networks, adhoc wireless networks, Bluetooth and Mobile IP
- Conduct simulations using network simulator

DE : INFORMATION RETRIEVAL LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. To implement Conflation Algorithm.
2. Assignments based on classification.
3. To implement a program for graphic theoretic method for Clustering.
4. To implement a program Retrieval of documents using Cluster based search strategies.
5. Assignments based on Multimedia IR.
6. Assignments based on Digital Libraries.
7. Assignment based on Web search Engine.

Outcomes:
This course aims to

- Understand and discuss current issues and research in searching and information retrieval.
- Appreciate the capabilities and limitations of information retrieval systems.
- Identify search concepts in an information request.
- Identify and exploit characteristics of reference and source databases and search systems for effective searching.
- Identify and discuss problems, issues, and future developments in information retrieval.

DE : FOUNDATIONS OF COMPUTATIONAL FINANCE LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Write a program for return calculations in R.
2. Write a program to compute optimized portfolios using R functions.
3. Analyze Time Series using R.

Tutorials:

1. Give a brief overview of R for financial computation.
2. Explain financial statement analysis with examples. Explore freely available tools for the same.

Outcomes:

This course aims to

- Introducing basics of finance
- Introducing the financial markets and financial institutions
- Studying valuation concepts and capital budgeting
- Introducing portfolio theory
- Introducing basics of mathematics of finance – time series analysis and stochastic calculus
- This course will prepare students to
    - Work in software companies in finance domain
    - Explore 'finance' as career and/or higher study option

PCC : GRAPH THEORY AND APPLICATIONS LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

(To be done in any higher level language such as Java/C++/C or a scripting language such as Python)

1. Decide whether a given degree sequence is graphical (that is, it corresponds to a simple graph)
2. Find out if the given graph is connected and also decide the number of connected components in the graph.
3. Find all directed circuits in a digraph.
4. Given a connected even graph G and a specified vertex u of G, find an Euler tour of G starting (and ending) at u using BFS (Breadth First Search) method
5. Find either a bipartition or an odd cycle in a given graph.
6. Find a maximal matching in a bipartite graph.

7. Color a graph using greedy method so that at most (Δ+1) colors are used (Δ represents maximum degree of the graph).
8. Implement Ford-Fulkerson algorithm to compute maximum flow in a flow network

Outcomes:
These assignments will enable the students to
- Understand the nitty-gritty of some basic algorithms in Graph Theory
- Understand the implementation issues (such as choosing appropriate data structures, writing modular code etc) related to implementation of complex algorithms
- Get more proficiency in the language used for implementation

OE : INTERMEDIATE PROGRAMMING CONCEPTS AND TOOLS

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(2 Hrs)**

Introduction:
Role of programming, need to study programming , applications of computer programming in industry.
Types of programming languages and paradigms.

Unit 2 **(8 Hrs)**

A review of fundamentals:
What is algorithm, flowchart, binary numbers. Straight line code,Expressions and their types, Decisions and conditional statements, Loops. Input-Output statements.
Procedures: Procedure call and return, recursive subprogram, Different parameter passing methods, Scope, lifetime and visibility, Storage management (static and Dynamic), Exceptions and exception handling.
Modularity and reusability using procedures. Use of libaries and header files. Complex data types and moving towards object-orientation.

Unit 3 **(6 Hrs)**

Object Oriented Programming: Design Principles: Objects, classes, Messages and methods, Basics of Implementation of Object – oriented Programming.

Unit 4 **(6 Hrs)**

Object oriented programming with Java/Python/C++: Program structure, Object and class declarations, constructors, inheritance, polymorphism, access specification, interfaces, packages, exception handling, I/O.

Unit 5 **(8 Hrs)**

Introduction to Program Design: Program design philosophies. Design patterns. Performance Analysis: Introduction to growth of functions and algorithm performance. Different aspects of code performance. Profiling.

Correctness: Pragmatic and theoretical tests for correctness. Good programming practices. Debugging.

Case studies.

Unit 6 **(6 Hrs)**

Introduction to concurrent programming: Basic concepts of Concurrent Programming: processes, synchronization primitives, safety and live ness properties, Parallelism in Hardware, streams, concurrency as interleaving, safe access to shared data.

Text Books:

- Cornell and Horstman, ``Core Java vol 1", Prentice Hall
- Herbert Schilt, "JAVA Complete Reference", 7thEdition, Tata McGraw Hill, ISBN: 9780070636774
- Mark Lutz, "Learning Python", 2ndEdition,O'reilly, ISBN:978-0-596-00281-7
- Stanley B. Lippman,Josée Lajoie, Barbara E. Moo, "C++ Primer", 3rdEdition,Addison Wesley Professional,ISBN-10: 0201824701

Reference Books:

- Stanley B. Lippman,Josée Lajoie, Barbara E. Moo, "C++ Primer", 3rdEdition,Addison Wesley Professional,ISBN-10: 0201824701
- Ghezzi C, Milano P., Jazayeri M., "Programming Languages Concepts", 3rd Edition, John Wiley and Sons Pvt. Ltd (WSE), ISBN-0195113063
- M. Ben Ari, "Principles of Concurrent Programming, 1989
- Eckel B., "Thinking in Java", 3rd Edition, Pearson Education
- Seirra, Freeman, Bates ``Head first design patterns". Oreilly
- Steve McConnell, ``Code Complete". Microsoft Programming Series.

Outcomes:

This course aims at

- Revision of the Fundamentals of Computer Programming, for students from non-computing branches.
- To understand the different programming paradigms with special focus on Object Oriented programming.
- To get a feel of learning a new computing language based on general principles.
- To understand and practice good programming practices.
- To become familiar with debugging and program performance.
- To become familiar with fundamentals of program and application design.

DE : COMPUTATIONAL BIOLOGY

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(5 Hrs)**

Computational Biology: Introduction, Scope, Objectives, Course Plan discussion
Biology Introduction: Cell, Nucleus, Genes, DNA, RNA, Proteins, Chemical Structure of DNA, RNA, Transcription and Translation Process.

Unit 2 **(5 Hrs)**

Introduction to Bioinformatics: Protein Structure and Functions, Nature of Chemical Bonds
Molecular Biology tools, Polymerase chain reaction, Genomic Information Content.

Unit 3 **(7 Hrs)**

Sequence Aligment: Simple alignments, Gaps, Scoring Matrices, Global and Local Alignments, Smith-Waterman Algorithm, Database Searches, BLAST and its relatives, FASTA and related Algorithms, Multiple sequence Alignments.

Unit 4 **(8 Hrs)**

Statistics & Probability: Random Variables, Distribution Function, Probability basics, Probability distribution function, Bay's Theorem, Conditional Probability, pmf and pdf, Expectation, Std. Deviation, Mean Estimation, Guassian Distribution, Statistics & Probability: Bernoulli Variable, Binomial Variable, Examples, Phylogentics : History of Molecular Phylogenetics, Phylogenetic Trees, Rooted and unrooted trees, Gene vs. Species trees, Distance Vector matrix Methods: UPGMA, Estimation of branch length, Transformed distance methods, General review.

Unit 5 **(7 Hrs)**

Phylogentics: Neighbor's relation method, Neighbor-joining method, Maximum likelihood Approaches, Multiple Sequence Methods
Structural Biology: Sequence, organisms, 3D structures, complexes, Assemblies, Cell structures
Protein Structure, Amino acids, Nucleotides, Cysteine and disulphides, Peptide Units, Primary, Secondary, Tertiary, Quaternary Amino Acids, RNA Structure prediction, Case Studies, examples.

Unit 6 **(6 Hrs)**

Next Gen Sequencing: Massively Parallel Signature Sequencing (MPSS)
Polony sequencing, SOLiD sequencing, DNA nanoball sequencing, Heliscope single molecule sequencing, Single molecule real time (SMRT) sequencing

Text Books:

- Fundamental Concepts of Bioinformatics, Dan E. Krane, Michael L. Raymer, Pearson Education, Inc. Fourth Edition, 2009.
- Bioinformatics Principles and Applications, Harshawardhan P. Bal, Tata McGraw-Hill, seventh reprint, 2009.

Reference Books:

- Introduction to Bioinformatics, Teresa Attwood, David Parry-Smith, Pearson Education Series (1999).
- Biological Sequence Analysis: Probabilistic Models of proteins and nucleic acids, R. Durbin, S. Eddy, A. Krogh, G. Mitchison, Cambridge University Press.

Outcomes:

This course aims at

- Describe how networks, algorithms, and models are employed in computational biology.
- Describe how DNA and proteins are manipulated to generate information from sequences and whole genomes.
- Describe how biological processes can be modeled using computer programming.
- Provide examples of the use of mathematics and statistics in evolution and behavior.
- Describe the current applications of computational biology.

DE : E-COMMERCE

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

E-Commerce: Meaning, advantages & disadvantages
Electronic Commerce Framework, Electronic Commerce and media Convergence, Types of E-Commerce: B2C, B2B, C2C, P2P, M Commerce.Architectural Framework for Electronic Commerce, World Wide Web as the Architecture, Web Background: Hypertext publishing, Security and the Web.

Unit 2 **(6 Hrs)**

Legal issues of E-commerce
Risks, Paper document verses electronic document, Technology for authenticating an electronic document.
Laws for E-commerce: EDI Interchange Agreement. E-commerce in India – Laws for E-commerce in India.

Unit 3 **(6 Hrs)**

Ethical and other public policy issues related to Electronic Commerce: Protecting privacy, protecting Intellectual property, Copyright, trademarks and patents, Taxation and encryption policies

Unit 4 **(6 Hrs)**

E-Commerce Business Models:
Key Element of a Business Model, Major B2C business Models Portal, e-tailer, Content Provider, Transaction Broker, Market creation, Service Provider, Community Provider, Major B2B Business Models, Market Place, E-Distributor, B2B Service Provider, Match-Maker, Infometiary. Business Models in emerging e-commerce areas- C2C business models, P2P Business Models,M Commerce Business Models.

Unit 5 **(6 Hrs)**

Types of Electronic Payment Systems, Digital Token Based Electronic Payment Systems, Digital Wallet, Digital Cash, Smart cards Electronic payment Systems, Credit Card Based Electronic Payment Systems, Risk in Electronic payment Systems, Secure Electronic Transaction Protocol.

Unit 6 **(6 Hrs)**

Electronic Data Interchange, EDI Applications in Business, EDI: Legal, Security and Privacy Issue, EDI and Electronic Commerce. Applications of Electronic Commerce- Application of E Commerce in Direct Marketing and Selling, Value Chain Integration, Supply Chain Management, Corporate Purchasing, Financial and Information Services, Obstacles in adopting E-Commerce Applications, Future of E Commerce

Text Books:

- Kenneth C Lauden, Carol G. Traver, "E-Commerce", Perason Education.
- Doing Business on the Internet E-COMMERCE (Electronic Commerce for Business):S. Jaiswal, Galgotia Publications.

Reference Books:

- Efraim Turban, Jae Lee, David King, Chung "Electronic Commerce- A managerial perspective" Prentice-Hall International. (5th reprint, 2004).
- Kamlesh K. Bajaj, Debjani Nag, "Electronic Commerce: The cutting edge of business", Tata McGraw-Hill Publishing Co. Ltd, 2000.
- Jeffrey F. Rayport, Bernard J. Jaworski, "e-Commerce", Tata McGraw Hill, 2002.David Whiteley, "e-Commerce", Tata McGraw Hill, 2002.
- Pete Loshin, Paul A. Murphy, "Electronic Commerce", Jaico Publishing House, 2000.Ravi Kalakota, Andrew B. Whinston, "Frontiers of Electronic Commerce", Addison Wesley,2002.
- E-Business, 1/e Parag Kulkarni, Sunita Jahirabadkar &Pradip Chande.

Outcomes:

This course aims at

- Comprehend the underlying economic mechanisms and driving forces of E-Commerce.
- Understand the critical building blocks of E-Commerce and different types of prevailing business models employed by leading industrial leaders.
- Appraise the opportunities and potential to apply and synthesize a variety of E-Commerce concepts and solutions to create business value for organizations, customers, and business partners.
- Formulate E-Commerce strategies that lever firms' core competencies, facilitate organizational transformation, and foster innovation.
- Undertake planning, organizing, and implementing of E-Commerce initiatives to effectively respond to of dynamic market environments.

DE : GEOGRAPHICAL INFORMATION SYSTEMS

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 (8 Hrs)

Introduction: Introduction to GIS and Digital Geographic Data & Maps.
Introduction to Digital Geographic Data: Introduction to Geographic Information Systems, Spatial Measurement, Spatial Location and Reference, Spatial Patterns, Geographic Data Collection.
Map Basics: Abstract Nature of Maps, Map Scale, More Map Characteristics, Map Projection, Grid Systems for Process , Map Symbolism GIS Data Models, Computer File Structure, Database Structure, Graphic Representation of Entities and Attributes, GIS data Models for Multiple MAPS,

Unit 2 (6 Hrs)

Input, Storage and Editing
The Input Subsystem : Primary Data, Input Devices, Vector Input, Raster Input, Remote Sensing Data Input, GPS Data Input, Metadata and Metadata Standards.
Data Storage and Editing : Storage of GIS Databases, Detecting and Editing Errors of Different Types, Dealing with Projection Changes, Edge Matching, Rubber Shitting.

Unit 3 (7 Hrs)

Analysis
Elementary Spatial Analysis : GIS Data Query, Defining Spatial Characteristics, Working with Higher–Level Objectives Measurement : Measuring Length of Linear Objectives, Polygons, Shape and Distance Classification: Classification Principal, Elements of Reclassification, Neighborhood Functions ,Roving Windows, Buffers Statistical Surfaces: Surface Mapping, Sampling the Statistical Surface, The DEM, Raster Surface, Interpolation, Terrain Reclassification, Slicing the Statistical Surface, Cut and Fill Spatial Arrangement Point, Line and Area Arrangement, Point Patterns, Thiessen Polygons, Area Patterns, Distance and Adjacency, Polygon Arrangement Measures, Linear Patterns, Directionality of Linear and Areal Objective, Connectivity of Linear Objects, Gravity Model, Routing and Allocation

Unit 4 (5 Hrs)

The Cartographic Overlay, Point-in-Polygon, Line-in-Polygon, Polygon Overlay, Automating the Overlay, Types of Vector Overlay, CAD-Type Overlay, Dasymetric Mapping
Cartographic Modeling:Model Components, The Cartographic Models, Types of Cartographic Models, Inductive and Deductive Modeling, Factor Selection, model Flowcharting, Model implementation, Model Verification

Unit 5 (5 Hrs)

GIS Output
The Output from Analysis:Output: The Display of Analysis, Cartographic Output,The Design Process,Map Design Controls,Non cartographic Output.

Unit 6 **(5 Hrs)**

Two Case Studies on GIS, GIS application areas Urban management, Land resources, Environment, Transportation, Facilities management , Commercial applications, Public services, e-Government

Text Books:

- Michael N DeMers, "Fundamentals of Geographic Information Systems", Wiley India Education.

Reference Books:

- Kang-tsung Chang, "Introduction to Geographic Information Systems", McGraw-Hill Publication.
- YEUNG, ALBERT K. W., LO, C. P., "Concepts and Techniques of Geographic Information Systems", PHI Learning

Outcomes:

This course aims at

- Have a basic, theoretical and practical understanding of GIS, and Be able to work independently with various types of geographical data in GIS.

DE : NATURAL LANGUAGE PROCESSING

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction

Basic text processing: Review of Regular Expressions and Automata, word tokenization, word normalization, word level morphology, stemming -Porters algorithm, sentence segmentation, edit distances.

Unit 2 **(6 Hrs)**

POS Tagging

Introduction to parts of speech and POS tagging, rule based and stochastic taggers, POS tagsets, Hidden Markov Model and Viterbi algorithm.

Unit 3 **(8 Hrs)**

Language Modeling

Introduction to N-gram, probability estimation for n-gram, evaluation and perplexity, smoothing techniques, Named-Entity recognition.

Unit 4 **(6 Hrs)**

Parsing

Syntactic structure, co-reference resolution, parsing, parsing algorithms, parsing in case of ambiguity; probabilistic parsing , the CKY algorithm, Issues in parsing.

Unit 5 **(6 Hrs)**

Semantics

Word Senses, word relations, word similarity and thesaurus methods, Word sense disambiguation, Knowledge base and supervised WSD , WordNet , Unsupervised based WSD.

Unit 6 **(4 Hrs)**

Applications

Information extraction, Question answering system, Summarization, Sentiment analysis.

Text Books and References:

- Daniel Jurafsky and James H. Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
- Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
- Chris Manning and Hinrich Schuetze, Foundations of Statistical Natural Language Processing, MIT Press.
- Journals : Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence .
- Conferences : Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics (COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Annual Meeting of the Special Interest Group in Information Retrieval (SIGIR), Human Language Technology (HLT).

Outcomes:

This course aims at

- To study fundamentals of Natural language processing.
- To make the students understand the necessity of natural language processing in building an intelligent system.
- To make the Students understand the ambiguities that arises in natural language processing.
- To make the student familiar with basic language processing operations like : Morphological analysis , Parts-of-Speech tagging, Lexical processing , Semantic processing, Knowledge representation .
- At the end of this course, the student should be able to do the following:
    - Design the processing steps required for a NLP task.
    - Implement the processing techniques.

DE : CYBER SECURITY, FORENSICS AND LEGAL PERSPECTIVE

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Concept of Cyberspace & Netizens, Objective & Scope of the Information Technology Act, Comparisons between traditional criminal techniques and Cyber Crime, Public and Private Societies face challenges in addressing cybercrime, Computer Hardware, Networks and Internet: An Introduction.

Unit 2 **(6 Hrs)**

Nature and scope of computer crime, Understanding how cyber criminals and hackers work, types of cyber crime: Financial crime, cyber pornography, Forgery, Web Defacement, Data Diddling, Email frauds, Hacking, Tempering, Spamming, Phishing, Spoofing, Pharming, DoS Attacks, Viruses, Trojan, Worm, Malware, Spyware, Botnet etc. Concept of Digital Signatures and Cryptography, Digital Signature Certificate and Public Key Infrastructure. Authorities under the IT Act., Impact of cyber crime on e-governance and e-commerce.

Unit 3 **(6 Hrs)**

Cyber crime & Computer-based electronic and Digital evidence : Indian law perspective, Procedure for search & Seizure, Best practices for cyber crime Investigations involving the Computer, Internet and Networks : E-mail, Websites, Chatrooms, file sharing, Network Intrusion/Denial of Services, Messages boards, password breaking, keyloggers, IP tracing, etc. Case studies.

Unit 4 **(6 Hrs)**

Introduction to cyber forensic, Forensic Examination of Computer-based electronic and digital evidence, Evidence- Assessment, Acquisition, Examination, Handling real world investigations: email account hacking, Profile hacking social Networking site, Credit card fraud, source code and confidential information theft, Piracy, pornography, virus attacks, etc. Detailed Procedures for Obtaining a Bitstream Backup of a Hard Drive, Evidence collection and analysis Tools and Case studies.

Unit 5 **(6 Hrs)**

IT Act.2000, Jurisdiction under the IT Act-Territorial and Extra-Territorial Jurisdiction of the IT Act 2000, Intellectual Property Right issues in Cyberspace, Concept of property in Cyberspace. Copyright and related issues, Issues relating to Trademarks and Domain names. Liability for Hyperlinking and Metatags, Domain Name Dispute Resolution Policy, Role of ICANN.

Unit 6 **(6 Hrs)**

Security Technologies : IDS, IPS, Firewall, Antivirus, Access Control, Encryption etc., Ethical Hacking

References:

- "CYBER FORENSICS: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes", Albert J. Marcella, Jr. Doug Menendez, Second Edition, Auerbach Publications, International Standard Book Number-13: 978-0-8493-8328-1.
- "Guide to Computer Forensics and Investigations", Bill Nelson Amelia Phillips Christopher Steuart, 4th Edition, Course Technology, Cengage Learning, ISBN-13: 978-1-435-49883.
- "Computer Forensics: Computer Crime Scene Investigation", John R. Vacca, 2nd Edition, Charles River Media Publication, ISBN-13: 978-1-58450-389-7.
- Rodney Ryder - Guide to Cyber Laws.
- Mr. Vakul Sharma - Handbook of Cyber Laws.
- Justice Yatindra Singh - Cyber Laws.
- Dr. Sundeep Oberoi - E-Security and you.

Legislative Texts:

- Information Technology Act-2000 IT Act.2000 url : http://eprocure.gov.in/cppp/sites/default/files/eproc/itact2000.pdf

Outcomes:

This course aims at

- Understand the investication process in cyber crimes
- Understand various cyber crimes.
- Understand laws available in IT Act.2000.

DE : MULTICORE TECHNOLOGY

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Introduction to Multi-Core Architecture

Single-Core Processor Architecture Fundamentals , Motivation for Concurrency in Software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-Core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms, Understanding Performance.

Unit 2 **(6 Hrs)**

System Overview of Threading

Defining Threads, System View of Threads, Threading above the Operating System,Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading.

Threading on Multi-Core Processors Hardware-based Threading, Threading from Intel, Hyper-Threading Technology, Difference between Multiprocessor and Hyper-Threading Technology, Hyper-Threading Technology Architecture, Multi-Core Processors, Architectural Details, Comparison between Multiprocessors and Multi-Core Processors, Multi-Core for Itanium Architecture

Unit 3 **(6 Hrs)**

Fundamental Concepts of Parallel Programming Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion.

Parallel Programming constructs and Threading

POSIX Threads, Creating Threads, Managing Threads,Thread Synchronization, Signaling, Compilation and Linking.

Unit 4 **(6 Hrs)**

OpenMP: A Portable Solution for Threading Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Partitioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No-wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, Performance.

Unit 5 **(6 Hrs)**

Parallel Programming Problems and solutions

Too Many Threads, Data Races, Deadlocks, and Live Locks, Multi-Core Programming, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency.

Unit 6 **(6 Hrs)**

Combining OpenMP and MPI

Steps for building a hybrid cluster, MPI routines, differences in OpenMP and MPI, Examples like Searching, Sorting, Linear System Equations.

Text Books:

- Shameem Akhter, Jason Roberts "Multi-Core Programming: Increasing Performance through Software Multi-threading, Intel Press, April 2006.

Reference Books:

- Michael J Quinn, "Parallel Programming in C with MPI and OpenMP", Tata McGraw-Hill Edition, 2011.
- Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, Elsevier Series, 2011.
- John L Hennessy, David A Patterson, "Computer Architecture: A Quantitative Approach", Fifth Edition, Morgan Kaufmann, 2011.

Outcomes:

This course aims at

- Understanding the design issues in Multicore Architectures.
- Parallel Programming environments using threads and alternative solutions.

- Understanding the fundamentals of Multicore Architectures.
- Understanding and differences between Uniprocessor, Multiprocessor and Multicore.
- Use of the programming environment like pthreads, OpenMP.
- Understanding the parallel programming problems and their solutions.

DE : WEB SYSTEMS AND TECHNOLOGIES

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(4 Hrs)**

Introduction

Web Essentials: Clients, Servers, Communication, Basic Internet Protocols, HTTP Request Message, HTTP Response Message, Web Clients, Generations of web applications.

Unit 2 **(6 Hrs)**

Markup languages

An Introduction to HTML, Fundamental HTML Elements head, body etc. Basic XHTML Syntax and Semantics. Document publishing

Style sheets

Introduction to Cascading Style Sheets, CSS features, CSS syntax, Style properties of text, box, layout, list, table, cursor etc. User defined classes, inheritance.

Unit 3 **(8 Hrs)**

Client-Side Programming

Introduction to JavaScript, Basic Syntax, Variables and Data Types, Statements, Operators, literals, functions. Javascript Objects – properties, references, methods, constructors. Arrays, other built-in objects. Debugging javascript.

Host Objects

Document Object Model (DOM), Document tree, DOM event handling, Browsers.

Unit 4 **(8 Hrs)**

Server-Side Programming

Java servlet - architecture, life cycle. The Client Request – form data, request headers. The Server Response - HTTP Status Codes, HTTP Response Headers. Sessions, Cookies, URL Rewriting, Concurrency in servlets

Separating Programming and Presentation

Java server pages, Basic JSP, JavaBeans Classes and JSP, JSF, Java Database Connectivity (JDBC)

Unit 5 **(4 Hrs)**

Representing Web Data

XML – Namespaces, AJAX – Overview, basics, toolkits, security, DOM based XML processing, XSL, X Path, XSLT

Unit 6 **(6 Hrs)**

Web Services
Web service concepts, creating, publishing, testing and describing a Web Service, WSDL, Representing Data Types: XML Schema, Communicating Object Data: SOAP, REST

Text Books:
- Jeffrey C.Jackson, "Web Technologies : A Computer Science Perspective", Pearson Education, 2nd edition, 2007.

Reference Books:
- Marty Hall, Larry Brown,"Core Web Programming", Pearson Education, 2nd Edition, 2001.
- Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 4th Edition, 2007.
- H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Pearson Education, 3rd Edition, 2006.

Outcomes:
This course aims at
- Learn the basic request and response between the web client and the web server.
- Understand the presentation techniques of a web application.
- Study the web client side programming.
- Study the web server side programming.
- Study the data handling in web systems.
- Study the web services.

DE : SOFTWARE DESIGN PATTERNS

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**
Introduction:
What is a design Pattern? Design patterns in smalltalk MVC, Describing Design patterns, the catalog of design patterns, organizing the catalog, How design patterns solve design problems, how to select a design pattern, how to use a design pattern.

Unit 2 **(6 Hrs)**
A case Study: Designing a document editor:
Design Problems, Document Structure, formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, supporting multiple window system, user operations, spelling checking and hyphenation.

Unit 3 **(6 Hrs)**

Creational Patterns:
Object creational: Abstract Factory, builder, factory Method, prototype, Singleton.

Unit 4 **(6 Hrs)**

Structural Patterns:
Object Structural: Adapter, bridge, composite, decorator, façade, flyweight, proxy.

Unit 5 **(6 Hrs)**

Behavioral Patterns:
Object Behavioral: Chain of Responsibility, command, interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor.

Unit 6 **(6 Hrs)**

Patterns and Software Architecture:
Architectural pattern, Difference between design patterns and architectural patterns,different architectural patterns ,relation between software architecture and patterns.

Text Books:

- Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Design Patterns: Elements of Reusable Object Oriented Software, ISBN-10: 0-201-63361-2, ISBN-13: 078-5342633610, Pearson 1st edition.
- Allan Shalloway, James Trott, Design Patterns Explained- A New Perspective on Object Oriented Design, Addison Wesley 2nd Edition, ISBN-10: 0321247140, ISBN-13: 978-0321247148
- F. Buschmann et al. Pattern-Oriented Software Architecture, Wiley Volume 1 1996.ISBN-10: 8126516119 , ISBN-13: 978-8126516117

Reference Books:

- Eric Freeman and Elisabeth Freeman, Head First Design Patterns, O'Reilly 1st Edition, ISBN-10: 8173664668, ISBN-13: 978-8173664663
- Stephen Stelting and Olav Maassen , Applied Java Patterns, Prentice Hall 1st Edition, ISBN-10: 0130935387, ISBN-13: 978-0130935380

Outcomes:

This course aims at

- Students will master common patterns in Software Design.
- Will be familiar with alternative development process.
- Will learn different software architectures and their relation with design patterns.

DE : OPERATIONS RESEARCH

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(6 Hrs)**

Operation Research Models, Solving the OR model, Queuing and Simulation Models, Linear Programming (LP) Applications, Modeling with Linear Programming: Two-Variable LP model, Simplex method and sensitivity analysis, Advanced Linear Programming, Graphical LP Solutions, Duality, Goal Programming.

Unit 2 **(6 Hrs)**

Review of basic probability, Random variables and Probabilitydistributions, Random Processes, Transition Probability and Transition Matrix, Variations in expected value criteria, Four Common distributions, Solutions of mixed strategy games. Decision making under certainty, Decision making under risk, Decision making under uncertainty, Marcov Process and Marcov chain, Game theory: Introduction and definitions, Characteristics of Game theory, Maxima-minima, Saddle point, Optimal Strategies and value of game, solution of game with saddle point, Continuous review models, Multi- period models.

Unit 3 **(7 Hrs)**

Queuing system, queuing problem, Transient and steady States, List of symbols, Utilization factor, Elements of Queuing models, Generalized poisson queuing model, Specialized Poisson Queues, M/G/1 formula, Role of exponential distribution in queuing systems, Birth and Death Models, Queuing decision models, Review of recent advances in the subject.

Unit 4 **(7 Hrs)**

Job sequencing: Introduction, Terminology and Notions, Principal Assumptions, Solution of sequencing problem, Project Management: Applications and basic steps in PERT/CPM techniques, Network diagrams with time estimates and analysis, resource allocation, Processing n jobs with 2 machines, processing 2 jobs with m machines, Processing n jobs with m machines, Problem of dimensionality, Inventory Models.

Unit 5 **(6 Hrs)**

Non-Linear Programming (NLP) Introduction, Practical solutions of NLP, General from of NLP, Canonical form of NLP, Introduction to Separable functions, Piece-wise linear approximation of NLP, Geometric programming problem, Constrained and unconstrained problems of Maxima and Minima, Lagrangian method, To derive necessary condition of optimality, —Normality‖ and —Orthogonality‖ conditions, Problems with inequality constrains. Computational procedures of Fractional Algorithms

Unit 6 **(6 Hrs)**

Concept of dynamic programming, Deterministic dynamic programming, Forward and Backward recursion, Minimum path problem, models of single additive constraint, Multiplicatively

Separable return, Applications of dynamic programming in 6 production, linear programming and reliability, Decision trees and Bellman's principal of optimality, Recursive nature of computations in dynamic programming, Equipment replacement problem, Investment models, Expectation of a random variable. Problem of dimensionality, Inventory Models.

Text Books:

- Operations Research: An Introduction by Hamdy A Taha, Eighth Edition, Pearson Publications.
- Operations Research by Dr. S.D. Sharma, Eleventh Edition, Kedar Nath Ram Nath Publication.

Reference Books:

- Linear Programming and Extensions, G Dantzig, Princeton University Press, 1963.
- Theory of Games and Economic Behavior, J. von Neumann, O. Morgenstern, John Wiley Pub. 1967.
- Goal Programming: Methodology and Applications, M. Schniederjans, Kluwer Academic Pub, 1995.

Outcomes:

This course aims at

- Be able to solve linear programming problems.
- Be able to build and solve Transportation Models and Assignment Models.
- Be able to design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems.
- Be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type

DE : SYSTEM ADMINISTRATION

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 **(8 Hrs)**

Basic System Administration

Partitioning, Installation of multiple operating systems on Desktops, Various Unix Shells, Bash Shell, Windows Shell, Shell Programing; Various operating system services: cron, cpu usage, system load management, user management, backup, log management, boot loader, process management, file system namespace, ; Initialisation scripts; Kernel upgrade.

Unit 2 **(8 Hrs)**

Network Administration

LAN setup, DHCP Server, Configuration of network switch, Cluster Setup, DNS Server, NFS, NIS, Router Setup, Serial Line IP, Point to Point Protocal configuration, Email Setup, Sendmail, IDA, Network News.

Unit 3 **(6 Hrs)**

Filesystem Administration

Formatting, Partitioning, Defragmentation, Quotas, Journal, Logical Volume Mangement, Disk layouts, File System Check, SAN, NAS; Case Studies: ext2, ext4, ntfs, samba, cifs, nfs, btrfs, lvm, fat32.

Unit 4 **(6 Hrs)**

Security Administration

GNU/Linux security architecture, SE Linux, Authentication Mechanisms, LDAP, Firewall, Firewall policies, Proxy Servers, SOCKS Proxy server.

Unit 5 **(4 Hrs)**

Devices Administration

Installing and configuring printers, scanners, PCI devices, LAN cards, Troubleshooting, Plug and Play devices

Unit 6 **(8 Hrs)**

Various Server Administration

Apache web server configuration, IIS web server configuration, Printers, Network printer setup, Mysql server, POSTGRES server

Text Books and References:

- "UNIX and Linux System Administration Handbook", Evi Nemeth, Garth Snyder, Ben Whaley, Trent R. Hein; ISBN-13: 978-8131761779; Publisher: Pearson Education; Fourth edition
- "Linux Command Line and Shell Scripting Bible", Richard Blum, Christine Bresnahan; ISBN-13: 978-8126533831; Wiley India Pvt. Ltd.; Second edition
- "Linux: The Complete Reference, Sixth Edition", Richard Petersen; ISBN-13: 978-0070222946; Mcgraw-Hill Education; Sixth edition
- "Classic Shell Scripting", Arnold Robbins, Nelson H. F. Beebe; ISBN-13: 978-8173668463; Shroff/O'Reilly; First edition
- "Linux Administration: A Beginner's Guide", Wale Soyinka; ISBN-13: 978-0071767583; McGraw-Hill Osborne Media Publication; Sixth Edition

Online References:

- Various HOWTOs available on http://linux265.rwc.uc.edu/
- Linux System Administrator's Guide http://linux265.rwc.uc.edu/sag/
- Linux Network Administrator's Guide http://linux265.rwc.uc.edu/nag/node1.html#SECTION001000000
- Linux File System's HOWTO http://linux265.rwc.uc.edu/HOWTO/Filesystems HOWTO.html
- Linux Firewall and Proxy Server HOWTO http://linux265.rwc.uc.edu/HOWTO/Firewall-HOWTO.html
- Linux Printing Usage HOWTO http://linux265.rwc.uc.edu/HOWTO/Printing-Usage-HOWTO.html
- Linux Security HOWTO http://linux265.rwc.uc.edu/HOWTO/Security-HOWTO/
- Linux Installation and getting Started http://linux265.rwc.uc.edu/igs-guide/index.html
- BASH Programming Introduction HOWTO http://linux265.rwc.uc.edu/igs-guide/index.html

- Linux Man pages http://linux265.rwc.uc.edu/htmlman.html
- DNS HOWTO http://linux265.rwc.uc.edu/igs-guide/index.html
- Official SAMBA HOW TO and Reference Guidehttp://www.samba.org/samba/docs/man/Samba-HOWTO-Collection/.
- Linux From Scratch http://www.linuxfromscratch.org/lfs/view/stable/

Outcomes:
This course aims at
- Students will be able to carry out following tasks, with special emphasis on GNU/Linux based systems.
- Install various Linux distributions and Windows based servers and desktop systems on commodity hardware, and carry out basic administration tasks of user, network, process, storage management.
- Set a LAN based laboratory using DHCP.
- Install and configure a web server, database server, DNS, NFS, NIS, LDAP based system secure a Desktop and a server system completely using existing tools.

DE : COMPUTATIONAL BIOLOGY LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:
1. Study any biological database freely available on Internet; prepare a detailed report of it. Upload the same here
2. Select any string matching algorithm from available ones. You can select the algorithm based on time & space complexity. Implement the same using preferably in perl language. Upload the code with description of your selected algorithm.
3. Design and implement Smith-Waterman pairwise sequence alignment algorithm using any language (C, C++, Java, python, etc.) and test it for some arbitary sequences of Protein.
4. Design and implement Needleman-Wunsch pairwise sequence alignment algorithm using any language (C, C++, Java, python, etc.) and test it for some arbitary sequences of Protein.
5. Sequence alignment tools:
6. Bioinformatics tools other than BLAST and FASTA Assignment
7. Assignment on Multiple sequence alignment tool ClustalW2
8. Data mining using Clementine

Outcomes:
By the end of this course, students should be able to perform the following tasks:
- Working with biological databases
- Working with sequence alignment tools
- Working with phylogenomics tools
- Apply statistical and computational methods for genomic data

DE : E-COMMERCE LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

18. Basics of HTML, DHTML, ASP and ASP data Connectivity.
19. Creation of the SQL server Database, Creation of the ODBC connectivity.
20. Insertion/ modification of data with ASP, Selection of data using Record sets.
21. Exercises using ASP/SQL , 8. Exercises using MS FrontPage.
22. Mini Project

Outcomes:

This course aims to

- Comprehend the underlying economic mechanisms and driving forces of E-Commerce.
- Understand the critical building blocks of E-Commerce and different types of prevailing business models employed by leading industrial leaders.
- Appraise the opportunities and potential to apply and synthesize a variety of E-Commerce concepts and solutions to create business value for organizations, customers, and business partners.
- Formulate E-Commerce strategies that lever firms' core competencies, facilitate organizational transformation, and foster innovation.
- Undertake planning, organizing, and implementing of E-Commerce initiatives to effectively respond to of dynamic market environments.

DE : GEOGRAPHICAL INFORMATION SYSTEMS LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

23. Study of Basics of any open source GIS Tool (eg. wxgis)
24. Coordinate Systems and Map Projections in GIS Tool.
25. Working with Tables, Queries, and Basic Geoprocessing Tools .
26. Creating and Editing new spatial data files in GIS Tool.
27. Study and Implementation of Interpolation and Surface Modeling.
28. Building a Geodatabase.
29. Implementation of Mini project.

Outcomes:

This course aims to

- Have a basic, theoretical and practical understanding of GIS, and Be able to work independently with various types of geographical data in GIS.

DE : NATURAL LANGUAGE PROCESSING LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

30. Basic Text Processing Assignment.
31. Parts of Speech Tagging: HMM / Viterbi algorithm.
32. Named Entity Recognition.
33. Designing an N-gram language model.
34. Designing the CYK parsing algorithm.
35. Finding word senses using WordNet.
36. Building an application.

Outcomes:

This course aims to

- To study fundamentals of Natural language processing.
- To make the students understand the necessity of natural language processing in building an intelligent system.
- To make the Students understand the ambiguities that arises in natural language processing.
- To make the student familiar with basic language processing operations like : Morphological analysis , Parts-of-Speech tagging, Lexical processing , Semantic processing, Knowledge representation
- At the end of this course, the student should be able to do the following:
    - Design the processing steps required for a NLP task
    - Implement the processing techniques.

PCC : CYBER SECURITY, FORENSICS AND LEGAL PERSPECTIVE LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Evolution of WWW(Browser level)
2. Linux Vs Windows OS (Technology, Security Management etc.)
3. Study of Storage Devices , e.g. HDD, CD, Flash drive, Any other Semiconductor devices, Write a detail technical report on all File systems used for storing files.
4. Assignments on following various tools such as

Name of available tools

Index.dat Analyser
dtSearch
winHex
Nmap
SATAN (Security Administrator Tool for Analyzing Networks)

EtherPeek
SuperScan
QualysGuard
WebInspect
LC4 (formerly called L0phtcrack)
John the Ripper, or pwdump
LANguard Network Security Scanner
Network Stumbler
ToneLoc
Internet Scanner
Ethereal
Whisker or WebInspect
Nessus
Nikto
Kismet
THC-Scan
Sniffer

Outcomes:
These assignments will enable the students to
- Understand the investigation process in cyber crimes
- Understand various cyber crimes.
- Understand laws available in IT Act.2000.

DE : MULTICORE TECHNOLOGY LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:
1. Program for matrix vector multiplication using pthreads on Multicore architecture.
2. Shared Memory Programming OpenMP – Study of OpenMP clauses.
3. Program to execute bubble sort using OpenMP.
4. Program to execute odd-even sort using OpenMP.
5. Program to perform matrix multiplication using OpenMP.
6. Installation of OpenMP-MPI cluster and performance considerations.
7. Understanding Intel Threading building blocks.
8. Understanding threading from Intel.

Outcomes:
This course aims to
- Understand the shared memory programming using pthreads and OpenMP.
- Program different problems using OpenMP.
- Setup OpenMP-MPI cluster.
- Intel Threading Model.

DE : WEB SYSTEMS AND TECHNOLOGIES LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Study and compare features of 3 open source web servers.
2. Create a web page and study different HTML tags.
3. Create a website with attractive UI using the CSS.
4. Create a website that accepts the form filled by user and check for syntax validity of every field.
5. Write a Java servlet to perform the server side processing. Connect to the database.
6. Create an interactive multiple-choice quiz using HTML, JavaScript and AJAX and servlet.
7. Create a website using JSP and java beans that tracks the session activities. Observe the request and response objects.
8. URL rewriting - Create a website where user can view some data but cannot view its true URL.
9. Create a web service using Apache axis / Netbeans.
10. Mini project. Make sure of browser compatibility.

Outcomes:

This course aims to

- Learn the basic request and response between the web client and the web server.
- Understand the presentation techniques of a web application.
- Study the web client side programming.
- Study the web server side programming.
- Study the data handling in web systems.
- Study the web services.

DE : SOFTWARE DESIGN PATTERNS LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Applications to be designed by using different software design pattern and architectures.

Links:

- http://www.tutorialspoint.com/design_pattern/index.htm
- http://gee.cs.oswego.edu/dl/cpj/ifc.html

Outcomes:
This course aims to
- Students will be able to design patterns in Software Design.
- Students will be able to implement software architectures.

PCC : OPERATIONS RESEARCH LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:
Implementation of following algorithms in any higher level language such as Java, C++, C or any scripting language such as Python:

9. Simplex method
10. Transportation algorithm using (a) Northwest-corner method and (b) Vogel approximation method
11. Hungarian method for solving assignment problem
12. Critical Path Method (CPM)
13. Goal programming algorithms (a) weights method (b) preemptive method
14. Integer programming algorithm using branch and bound method to solve TSP (traveling salesperson problem)

Outcomes:
These assignments will enable the students to
- Understand the nitty-gritty of some basic algorithms in Operations Research
- Understand the implementation issues (such as choosing appropriate data structures, writing modular code etc) related to implementation of complex algorithms
- Understand and appreciate how complex real life problems can be solved using computers
- Get more proficiency in the language used for implementation

DE : SYSTEM ADMINISTRATION LAB

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
Term Work – 50 marks
Practical –50 marks

List of Assignments:

1. Set a desktop with following software configuration options: triple boot with Windows, Ubuntu and Fedora operating systems; Grub timeout set to 5 seconds with default Fedora Linux; Each step of boot process secured with passwords; Software updates set to use COEP mirrors; One administrative and one normal user account in each operating system; Following software installed in each OS: office,internet browser,c compiler, terminal, ssh server, telnet server,web server, database server

2. Set up a LAN based computer laboratory with 5 computers - using DHCP first and then using static IPs; one of the machines should work as DHCP server; set up NIS+NFS and LDAP+NFS based authentication for managing single identity on all computers; setup quotas on NFS systems
3. Demonstrate use of three-tier architecture using LAMP and WAMP suite using same code base
4. Demonstrate file system corruption and recovery on Ubuntu systems
5. Setup a disk management system using LVM such that all options of LVM are demonstrated; setup quotas;
6. Setup a network based printer and demonstrate its use
7. Write a program to browse an ext4 file system and locate data of a deleted file
8. Setup a proxy server and firewall with set of policies to block video content in the network.
9. Setup apache web server to serve 3 websites, with 3 domain names at a time from a single machine; demonstrate the use of at least 5 configuration options of apache
10. Setup an email server and demonstrate use of at least 3 email clients to send email using it
11. Setup a Point to point protocol network between two computers
12. Setup SE Linux
13. Given a desktop system with some unknown problem in it's working, solve the problem completely and bring the system to completely running configuration
14. Write a initialization shell script on Ubuntu Linux to check to prepare a report of useful system statistics for the administrator

Outcomes:

This course aims to

- Students will be able to carry out following tasks, with special emphasis on GNU/Linux based systems.
- Install various Linux distributions and Windows based servers and desktop systems on commodity hardware, and carry out basic administration tasks of user, network, process, storage management.
- Set a LAN based laboratory using DHCP.
- Install and configure a web server, database server, DNS, NFS, NIS, LDAP based system secure a Desktop and a server system completely using existing tools.

Annexure I

List of Open Elective/Professional Science courses offered by ALL Departments

Sr. No	Department	Course
1	Civil	Finite Elements in Engineering
2	Mechanical	1. Unconventional Machining Processes 2. Modern Control Systems 3. Power Plant Engineering
3	Electrical	1. Industrial Drives 2. Control System Engineering
4	Electronics and Telecommunication	Electronic Communication Systems
5	Metallurgy and Material Science	Composite Materials
6	Instrumentation and Control	Industrial Automation
7	Production	Introduction to ERP & Operations Efficiency
8	Computer Engineering	Information Systems
9	Information Technology	Information Systems
10	Applied Science	1. Humanities Course 2. Constitution of India
11	Innovation Centre	Liberal Learning Course

Annexure II

List of Liberal Learning courses offered at Institute Level

- **Agricultural** – Animal Science, Forestry, Horticulture, Floriculture, Sustainable Agriculture, Veterinary
- **Arts** – Graphic Design, Interior Design, Fashion Design
- **Basic Sciences** – Astronomy, Astro- Physics, Biology, Genetics, Kinesiology, Microbiology, Neuro Sciences.
- **Business** – Administration, Communication, Entrepreneurial studies, Hostel Management, Marketing.
- **Defense Studies** - Military Studies, Naval Studies, Air Force Studies, War strategies.
- **Education** - Education policies, Engineering Education, Teacher Training.
- **Environmental Sciences** – Ecology, Meteorology
- **Linguistics** – Word Language
- **Medicine** – Health Studies Nutrition and dietetics
- **Performing Arts**- Music, Dance Theatre, Cinema
- **Philosophy**- Religious Studies
- **Sports and Athletics**