SEMESTER I

18NN01 OPTIMIZATION TECHNIQUES 2 2 0 3


CONSTRAINED NONLINEAR OPTIMIZATION: Characteristics of constrained problem – constrained optimization algorithms - Kuhn-Tucker conditions, direct search methods – complex search and random search, linearized search techniques – cutting plane method. (8+7)

DYNAMIC PROGRAMMING: Principle of optimality, backward and forward recursion, calculus method of solution, tabular method of solution, shortest-route problem, knapsack model. (8+7)


REFERENCES:

Total L: 32 + T:28 = 60

18NN02/18NB02 ADVANCED ALGORITHMS AND ANALYSIS 3 2 0 4


ADVANCED CONCEPTS: Randomized algorithms: Las Vegas and Monte carlo algorithms, Approximate algorithms: applications - Vertex cover problem, String matching algorithms: Rabin Karp algorithm - Knuth Morris Pratt algorithm. (13+7)

Total L: 45 + T: 30 = 75

REFERENCES:

18NN03 ADVANCED OPERATING SYSTEMS 3 2 0 4


REFERENCES:

18NN04 DATABASE TECHNOLOGIES

3 2 0 4


SYSTEM IMPLEMENTATION TECHNIQUES: Properties of Transaction, Serializability, Concurrency Control: Locking - Timestamp based – Validation , Deadlock, Recovery System. 

SYSTEM ARCHITECTURE: Parallel Databases, Distributed databases Object based databases, XML databases Mobile databases, Geographic Information Systems (GIS),JSON Database. 


REFERENCES:

18NN05 SOFTWARE ENGINEERING METHODOLOGIES

3 0 0 3


REFERENCES:
18NN51 SOFTWARE DEVELOPMENT LABORATORY

1. Apply Agile methodology for an E-Commerce application.
2. Construct UML diagrams for an E-Commerce application.
3. Estimate cost of the project for designing a banking application using function point technique.
4. Implement E-Commerce application using various platforms.
5. Perform Unit testing, Integration testing and System testing using Open Source testing for E-Commerce application.

Total P: 60

SEMESTER II

18NN06 DATA ANALYTICS


Total L: 45 + T: 30 = 75

REFERENCES:

18NN07 CLOUD TECHNOLOGIES


VIRTUALIZATION: Basics of Virtualization, Types of virtualization, Implementation Levels of virtualization: Application level, Server level, Storage level and Networking, Virtual machine provisioning, manageability and migration, Virtualized Data Center environments, Study on virtualization tool - KVM, VMWARE, Linux Container. (12)

CLOUD STORAGE: Introduction to Storage system architecture, Types of storage systems – File, block and object, hybrid storage networking technologies: NAS and SAN, File System: GFS, HDFS, Programming Model: Map reduce paradigm and its applications, Perspective on Big data computing, NoSQL database, Bigtable+GFS, Hbase+HDFS+HIVE, mongodb as Daas, Firebase cloud messaging. (11)

WEB SERVICES AND SERVICE MANAGEMENT: Role of Web Services and API’s, RESTful web services, SLA management, Identity management, billing and Accounting. Case study on open source and commercial clouds, API’s to interact with cloud. (11)

Total L: 45

REFERENCES:

18NN08 INTERNET OF THINGS


BIGDATA ANALYTICS FOR IOT: IOT Cloud Platform: Data retrieval and visualization, Fog/Computing, Security, Privacy and Trust, Case Study: Smart Cities, Smart Logistics and Retail, Agriculture, Pollution Control, Health and Lifestyle. (11)

Total L: 45

REFERENCES:

18NN09 SCRIPTING LANGUAGES

PYTHON BASICS: Introduction to Python, Indentation, if block structures, Relational & Logical operators, Looping structures, break, continue, pass statements, Functions, Object Oriented Features, File, Exception Handling, Data Structures: List, Set, Tuple, Dictionary. (7+7)

DATABASE AND NETWORK CONNECTIVITY: Database API modules - Database Connectivity, Supermarket Management System, DML Operations, DDL operations, ACID properties, DCL operation - Database Connection, Error handling, socket connectivity methods, Multi user chat, client and server socket connection methods. (8+8)

PERL INTRODUCTION: Numbers and Strings, Unary and Binary Operators, Control Statements, Regular Expression, Scalar Values, Context, Lists and Arrays, Files, Hashes, Functions, Pattern matching, Operators, Meta character and symbols, Character class, quantifiers, Sub routines. (7+7)

PERL OO & IPC: Packages, Modules, Objects, Overloading, Inter process Communication, Signals, Files, Pipes, Sockets, Security: Handling insecure data and code, Portable Perl (8+8)

Total L: 30 + T: 30=60

REFERENCES:

18NN52 CLOUD COMPUTING LABORATORY

1. Realize IaaS
2. Spark Distributed environment setup – single node
3. e-commerce application – Setting up using AWS resources (trial version)
4. Building application using Docker
5. Processing twitter data using map reduce paradigm in Openstack with spark
18NN61 INDUSTRY VISIT AND TECHNICAL SEMINAR

0 0 4 2

The student will make at least two technical presentations on current topics related to the specialization. The same will be assessed by a committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation together with the observation in industry visits.

SEMIESTER III

18NN53 APPLICATION DEVELOPMENT LABORATORY

0 0 4 2

2. Create any web application using MongoDB, Cassandra or HBase.
3. Build ERP software for any application using python, javascript, zope and mySQL.
5. Create any mobile application using iOS environment.

0 0 6 3

18NN71 PROJECT WORK - I

- Identification of a real-life problem in thrust areas
- Developing a mathematical model for solving the above problem
- Finalization of system requirements and specification
- Proposing different solutions for the problem based on literature survey
- Future trends in providing alternate solutions
- Report Preparation

SEMIESTER IV

18NN72 PROJECT WORK - II

0 0 2 8 1 4

The project involves the following:

Preparing a project – brief proposal including

- Problem Identification
- A statement of system/process specifications proposed to be developed (block Diagram / Concept tree)
- Cost benefit analysis
- Time Line of activities

A report highlighting the design finalization (based on functional requirements & standards (if any)

A presentation including the following:

- Implementation Phase (Hardware / Software / both)
- Testing & Validation of the developed system
- Learning in the project

Project Report

0 0 4 2 0

ELECTIVE THEORY COURSES

(Six to be opted out of which two may be an open elective from other M.E/M.Tech programmes)

18NN21 AGENT BASED INTELLIGENT SYSTEMS

3 0 0 3


PROBABILISTIC AND LEARNING AGENTS: Uncertainty and probabilistic reasoning, Communicative Agents, Probabilistic Agent, Learning from observations, Statistical learning methods, Instance based learning, Neural networks. (12)

REFERENCES:

18NN22 BIOINSPIRED COMPUTATION TECHNIQUES 3 0 0 3


EVOLUTIONARY ALGORITHMS: Evolutionary techniques: Genetic algorithms, Evolution strategies, Evolution programming, Genetic programming, Swarm intelligence techniques: Particle swarm optimization, Ant colony optimization, Bee colony optimization. (12)

MULTIOBJECTIVE OPTIMIZATION: Principles of multi objective optimization, Dominance and Pareto Optimality, Methods: Non-Elitist multi objective Algorithms, Elitist multi objective algorithms, Hybrid algorithms. (12)

APPLICATIONS: Knapsack problem, N-Queen problem, Minimum spanning tree, Travelling salesman problem, Scheduling, Shortest path. (10)

REFERENCES:

18NN23 CRYPTOGRAPHY AND NETWORK SECURITY 2 2 0 3

INTRODUCTION: Computer security concepts, OSI security architecture, Security attacks, Security services, Security mechanisms, Model for network security, Cryptography and modern cryptography, Setting of private key encryption, Historical ciphers and their cryptanalysis. (8+8)

SYMMETRIC AND ASYMMETRIC TECHNIQUES: Symmetric cipher model, Substitution techniques, Transposition techniques, Block cipher principles, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Multiple encryption, block cipher modes of operation, Use of random numbers, Pseudorandom number generators, Stream ciphers, RC5,Asymmetric techniques: Public key cryptosystems, RSA algorithm, Key management and distribution, Diffie Hellman key exchange, Elliptic Curve Cryptography. (8+8)

IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security associations and Key management. (7+7)

DATA INTEGRITY AND SECURITY: Message Digest algorithm MD5, Secure Hash Algorithm, Message Authentication Codes, Digital Signature Standard, Viruses and related threats – Worms – Intruders - Intrusion detection system, Firewalls: Firewall design principles - Firewall configurations. (7+7)

REFERENCES:

Total L: 30 + T: 30 = 60

**18NN24 ADHOC AND SENSOR NETWORKS**

3003

**MAC AND ROUTING IN ADHOC NETWORKS:** IEEE 802.11 a/b/g/n/ac standards and their features-MAC Protocols and issues-Addressing issues in ad hoc networks-Routing Protocols: Design issues, goals and classification, Proactive and Reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Power/ Energy aware routing. (12)

**END TO END DELIVERY AND SECURITY IN ADHOC NETWORKS:** Transport layer Issues in designing- Transport layer classification-adhoc transport protocols-Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols. (11)

**SENSOR NETWORKS AND ROUTING:** Sensor Network Architecture- Address and Name management-Assignment of MAC Address- Contention-Based protocols – Schedule-Based protocols – Zig bee - Topology Control -Data Dissemination-Data Gathering- Localization and Positioning. (11)


Total L: 45

**REFERENCES:**


**18NN25 DATA WAREHOUSING AND DATA MINING**

3003

**INTRODUCTION:** Data Warehouses- Design Issues, Guidelines for Data Warehouse Implementation, Data Warehouse Metadata, Online Analytical Processing (OLAP), Characteristics of OLAP systems, Multidimensional view and Data cube, Data Cube Implementations, Data Cube operations, Data Mining Tasks, Issues, Functionalities, Data Preprocessing: Data Cleaning - Data Integration - Data Reduction - Data Transformation and Discretization. (10)

**ASSOCIATION MINING AND CLASSIFICATION:** Frequent Item Set Mining Methods: Apriori Algorithm - Pattern Growth Approach - Pattern Evaluation Methods, Mining Multilevel and Multidimensional Association, Association and sequence rules. CLASSIFICATION: Decision Tree Induction, Bayes Classification, Rule Based Classification, Classification by Back Propagation, Support Vector Machines, Lazy Learners, Classifier Evaluation. (13)


**TEXT AND WEB MINING:** Analysis of Text Patterns, Statistical Learning methods, Text Classification, Web Crawlers, Web Search and Information Retrieval, Web spamming. (11)

Total L: 45

**REFERENCES:**

2. Jiawei Han, MichelineKamber and Jian Pei, "Data Mining: Concepts and Techniques", Elsevier, New Delhi, 2012.
4. G.K.Gupta, "Introduction to Data Mining with Case Studies", PHI Learning, New Delhi, 2011.
18NN26 / 18NB26 DEEP LEARNING


CONVOLUTIONAL NEURAL NETWORK: Architecture - Pooling - Convolution and its variants - CNN for Image Recognition. (9)

SEQUENCE MODELING: Recurrent Neural Networks (RNN) - Bi-directional RNN, Encoder Decoder Architecture - Recursive Nets - LSTM - Gated RNN - RNN for Sentiment Analysis. (11)


REFERENCES:

Total L: 45

18NN27 GRAPH THEORY AND ITS APPLICATIONS

INTRODUCTION: Directed and Undirected Graph, Graph Models. Representation of Graph, degree sequence, handshaking lemma, Havel-Hakimi theorem. Walk, trail and path, connected graph, distance, radius and diameter. Graph isomorphism. Connectivity: Vertex and Edge Connectivity- Vertex and edge cuts- relationship between vertex and edge connectivity-bounds for connectivity. (7/47)


VERTEX-COLORING AND NETWORK FLOW: Vertex-coloring - chromatic number of a graph, vertex coloring algorithms, sequential vertex coloring, largest degree first algorithm. Network Flows: Flows and cuts in networks, solving the maximum flow problem, characterization of maximum flow (Max-flow Min-cut Theorem) (8/8)

RANDOM GRAPHS: Different Models, Ramsey number, Erdos Theorem-existentially closed graphs. Expectation and the first moment method, variance and sound moment method, threshold function. Web Graph Models. (7/7)

Total L: 30 + T: 30 = 60

REFERENCES:

18NN28 INFORMATION RETRIEVAL AND WEB SEARCH

INTRODUCTION: Overview, History of IR- Components- Issues and Challenges- The impact of the web- The role of AI- IR versus web search- Components of search engine-Characterizing the web. (11)

MODELING: Boolean and vector-space retrieval models - Term weighting- TF-IDF weighting - cosine similarity- Preprocessing-InvertedIndex- efficient processing with sparse vectors-LanguageModel Based IR - Probabilistic IR- Latent Semantic Indexing. (11)


REFERENCES:

18NN29 MACHINE LEARNING

MATHMATICAL BASICS: Definition of learning systems, Goals and applications of machine learning, Probability theory, Computational decision theory, Learning versus design, Feasibility of learning, Training versus testing, Labeled versus unlabeled dataset, Error, Noise, Theory of generalization, Hypothesis class, Vapnik-Chervonenkis (VC) dimension, Bias, Variance, Learning curve, Data preprocessing, Model selection, Under-fitting and over-fitting, Cross validation, Concept representation, Function approximation.

SUPERVISED LEARNING: Learning a class from examples, Learning multiple classes, Dimensions of a supervised machine learning algorithm, Discriminant functions, Probabilistic generative models, Probabilistic discriminative models, Logistic regression, Linear regression.


REFERENCES:

18NN30 MULTICORE ARCHITECTURE

INTRODUCTION TO PARALLEL COMPUTERS: Overview of parallelism - Instruction Level Parallelism (ILP) vs Thread Level Parallelism (TLP) - Architecture: Multicore, GPU, Vector Machines - Performance issues - Brief introduction to cache hierarchy and communication latency.

SHARED MEMORY MULTIPROCESSORS: General architecture and the problem of cache coherence; synchronization primitives: atomic primitives; locks: TTS, tickets, array; barriers: central and tree; Models of Memory Consistency – Interconnection Networks – shared memory programming - performance implications in shared memory programs.

CHIP MULTIPROCESSORS: CMP (Moore’s law, wire delay); shared L2 vs. tiled CMP; core complexity; power/performance; snoopy coherence: invalidate vs. update, MSI, MESI, MOESI, MOST; memory consistency models: SC; chip multiprocessor case studies: Intel Montecito and dual core Pentium 4, IBM power4.

PARALLEL PROGRAMMING: Introduction to OpenMP; data flow analysis, pointer analysis, alias analysis, data dependence analysis, Handling data and functional parallelism, Handling loops- Loop optimizations -Performance considerations.

REFERENCES:
18NN31 NATURAL LANGUAGE PROCESSING


SYNTAX PARSING AND SEMANTIC ANALYSIS: Syntax Parsing, Grammar formalisms and treebanks, Parsing with Context Free Grammars, Features and Unification, Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs, Semantic Analysis, Lexical semantics, Word-sense disambiguation, Supervised and Unsupervised Approaches, Compositional semantics Semantic Role Labeling and Semantic Parsing, Discourse Analysis. (15)

APPLICATIONS: Named entity recognition and relation extraction- IE using sequence labeling-Machine Translation (MT), Basic issues in MT-Statistical translation-word alignment- phrase-based translation – Question Answering. (10)

TOTAL: 45

REFERENCES:
2. Ela Kumar, "Natural language processing", IK International Pvt Ltd, New Delhi, 2011.

18NN32 NETWORK ANALYSIS


MULTIPLEXING MODELS: Multiplexing of Traffic on a Communication Link, Queuing Models: Little's Theorem, M / M /1 Queuing System, Markov Systems, M/G/1 System, Networks of Queues-Jackson's Theorem. (8+8)


Total L: 30 + T: 30 = 60

REFERENCES:

18NN33 SERVICE ORIENTED ARCHITECTURE

INTRODUCTION: Common Characteristics and principles of SOA, Governance, Comparison of SOA with client server and Distributed architectures, Technical and business benefits of SOA, Web services protocol stack and Microservices, Applications using SOA. (11)


WEB SERVICES SECURITY: WS overarching concern, Core concepts, Challenges, Threats and remedies, Securing the communication layer, Message level security, WS security framework, WS security policy, WS trust, WS secure conversation, Data level security, XML encryption, XML signature. (11)

REFERENCES:

18NN34 SOFTWARE DEFINED NETWORKS

INTRODUCTION: Packet switching terminology, Modern Data Center, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, SDN: Evolution of Switches and Control Planes-Implications for Research and Innovation-Data Center Innovation and Needs. (11)

CONTROL AND DATA PLANES: Control Plane and Data Plane, Moving Information between Planes, Distributed Control Planes, Centralized Control Planes, Data Center Concepts and Constructs: Multitenant Data Center, SDN Solutions for Data Center Network. (11)


NETWORK FUNCTION VIRTUALIZATION: Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NFV at ETSI, Non-ETSI NFV work-Network Programmability-Modern Programmatic Interfaces, I2RS, Modern Orchestration, Building SDN Framework. (12)

REFERENCES:

18NN35 SYSTEM MODELLING AND SIMULATION

INTRODUCTION TO SIMULATION: Introduction: Advantages and disadvantages of simulation - Areas of application - System environment - Components of a system - Discrete and continuous system - Model of a system. Types of models - Steps in a simulation study, Simulation Examples: Simulation of Queueing Systems - Simulation of Inventory Systems. (11)


Total L : 45

Total L : 45
REFERENCES:

AUDIT COURSES

18NN81 ENGLISH FOR RESEARCH PAPER WRITING
vide Automotive Engineering 18AE81

18NN82 RESEARCH METHODOLOGY AND IPR
vide Automotive Engineering 18AE82