# School of Engineering and Technology

# Programme Structure & Syllabus

# M.Tech. (COMPUTER SCIENCE AND ENGINEERING)

# 2022-23

## K.K. University

## Bihar Sharif, Nalanda - 803115



Pro Vice Chancellor
KK University
Berauti, Nepura, Bihar Sharif
Nalanda - 803115 (Bihar)

## FIRST SEMESTER

| S. No | CODE | TITLE | CREDIT | L | T | P | HOURS PER WEEK | Internal Marks | External Marks |
|---|---|---|---|---|---|---|---|---|---|
| **1** | EMCS1101 | Advanced Data Structure and File System | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **2** | EMCS1102 | Advanced Computer Network | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **3** | EMCS1103 | Cryptography and Network Security | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **4** | EMCS1104 | Machine Learning | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **5** | EMCS1105 | Theory of Computation | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **6** | EMCS1106 | Data Warehousing and Mining | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **7** | EMCS1102P | Advance Computer Network Lab | 2 | 2 | 0 | 0 | 4 | 30 | 70 |
| **Total** | | | **20** | **20** | **0** | **0** | **22** | **210** | **490** |

## SECOND SEMESTER

| S. No | CODE | COURSE TITLE | CREDIT | L | T | P | HOURS PER WEEK | INTERNAL MARKS | EXTERNAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| **1** | EMCS1201 | Advance Database Management System | 3 | 3 | 0 | | 3 | 30 | 70 |
| **2** | EMCS1202 | Soft Computing | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **3** | EMCS1203 | Queuing Theory and data Networks | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **4** | EMCS1204 | Block Chain | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **5** | EMCS1205 | Data Science | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **6** | EMCS1201P | Advance Database Management System Lab | 2 | 3 | 0 | 4 | 4 | 30 | 70 |
| **7** | | **Elective - I** | 3 | 3 | 0 | 0 | | 30 | 70 |
| **8** | EMCS1216 | Computer Law and Ethics | | | | | | 30 | 70 |
| **9** | EMCS1226 | **Neural networks** | | | | | | | |
| **10** | EMCS1236 | Image Processing | | | | | | | |
| **TOTAL** | | | **20** | **21** | **0** | **4** | **31** | **240** | **560** |



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## THIRD SEMESTER

| S. No | CODE | COURSE TITLE | CREDIT | L | T | P | HOURS PER WEEK | INTERNAL MARKS | EXTERNAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| **1** | EMCS2101 | Artificial Intelligence and Intelligent System | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **2** | EMCS2102 | Semantic Web | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **3** | | **Elective-II** | 3 | 3 | | | 3 | 30 | 70 |
| **4** | EMCS2113 | Server and storage | | | | | | | |
| **5** | EMCS2123 | Expert system | | | | | | | |
| **6** | EMCS2133 | **Natural Language Processing** | | | 0 | 0 | | | |
| **7** | EMCS2104 | Mini Project | 6 | | 0 | 12 | 12 | 30 | 70 |
| **8** | | Seminar | 2 | | 0 | 3 | 2 | 30 | 70 |
| **9** | | Viva-Voice | | | | | | | |
| **TOTAL** | | | **20** | **9** | **0** | **15** | **23** | **150** | **350** |

## FOURTH SEMESTER

| S.No | CODE | COURSE TITLE | CREDIT | L | T | P | Hours Per Week | Internal Marks | External Marks |
|---|---|---|---|---|---|---|---|---|---|
| **1** | EMCS2201 | Major Project/Dissertation | 15 | 0 | 0 | 24 | 32 | 30 | 70 |
| **2** | EMCS2202 | Seminar & Viva-voce | 2 | 0 | 0 | | 10 | 30 | 70 |
| | | Dissertation Viva-Voce | 3 | | | | | | |
| **TOTAL** | | | **20** | **0** | **0** | **24** | **42** | **60** | **140** |



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# SEMESTER-I

## Advanced Data Structure and File Systems

**EMCS1101** **L-T-P (3-0-0)**
**Credit-3**

**Objectives:**
The course will try to provide an insight of data structures used for storing and how the data structure are managed and transform, how the data structures are used for different data types, concept of File , record and various file structure.

**UNIT I**
Search Trees: Height-Balanced Trees, Weight-Balance Trees, Red-Black Trees and Trees of Almost Optimal Height, Top-Down Rebalancing for Red-Black Trees, Trees with Constant Update Time at a Known Location, Finger Trees and Level Linking, Trees with Partial Rebuilding: Amortized Analysis, Splay Trees: Adaptive Data Structures, Skip Lists: Randomized Data Structures, Joining and Splitting Balanced Search Trees. Tree Structures for Sets of Intervals: Interval Trees, Segment Trees, Trees for Interval-Restricted Maximum Sum Queries, Orthogonal Range Trees, Higher-Dimensional Segment Trees.

**UNIT II**
Heaps: Balanced Search Trees as Heaps, Array-Based Heap, Heap-Ordered Tress and Half-Ordered Trees, Leftist Heaps, Skew Heap, Binomial Heaps, Changing Keys in Heaps, Fibonacci Heaps, Heaps of Optimal Complexity, Double-Ended Heap Structures and Multidimensional Heaps, Heap- Related Structures with Constant-Time Updates.

**UNIT III**
Data Structure Transformations: Making Structures Dynamic, Making Structures Persistent. Data Structures for Strings: Tries and Compresses Tries, Dictionaries Allowing Errors in Queries, Suffix Trees, Suffix Arrays.

**UNIT IV**
Hash Tables: Basic Hash Tables and Collision Resolution, Universal Families of Hash Functions, Perfect Hash Functions, Hash Trees, Extendible Hashing, Membership Testers and Bloom Filters.
File Structures: Concept of record, File Operations, File systems organization :Sequential, Relative, Indexed and Random access mode, Sequential organization and access, Relative file organization, Addressing techniques, Direct mapping techniques : Absolute, relative and indexed sequential files(ISAM), Concept of index, Levels of index, Overflow Handling, Random

files, Multi key files Organization, multikey access, inverted file organization, Alternate key ISAM, Comparison and trade-off, File design considerations.

**Suggested Reading:**

1. Data structures: A Pseudocode approach with C by R. F. Gilberg, and B. A. Forouzan, Thomson Learning.
2. Data Structures and Algorithm by A .V. Aho, J . E . Hopcroft, J . D . Ulman Pearson Education.
3. Introduction to data management and file design by R.Kennith Walter.
4. Data Structures by S. Sahni and E. Horowitz, Galgotia Publications.
5. Data Structures using C by Tanenbaum, Pearson/PHI.
6. Introduction to Algorithms by T .H . Cormen, C . E . Leiserson, R .L . Rivest, PHI/Pearson.
7. Introduction to Algorithms – A Creative Approach by V . Manber, Pearson Education.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL.

## Advanced Computer Networks

**EMCS1102** **L-T-P (3-0-2)**
**Credit-5**

**Objective:**
The course will provide an insight of the various Network layer Models, working and architectural details of network layer, network security and practical insights via commonly used simulator. At the end of the curriculum the student will be well versed with the various network standards, data transmission, protocols at each layer, the concept of cryptography and firewals and also will be well equipped to work with NS2 simulator.

**UNIT I**
Introduction: Introduction to Network models-ISO-OSI, SNA, Appletalk and TCP/IP models. Review of Physical layer and Data link layers, Review of LAN (IEEE 802.3, 802.5, 802.11b/a/g, FDDI) and WAN (Frame Relay, ATM, ISDN) standards.
Network layer: ARP, RARP, Internet architecture and addressing, internetworking, IPv4, overview of IPv6, ICMP, Routing Protocols- RIP, OSPF, BGP, IP over ATM.

**UNIT II**
Transport layer: Design issues, Connection management, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Finite state machine model.
Application layer: WWW, DNS, e-mail, SNMP, RMON

**UNIT III**
Network Security: Cryptography, Firewalls, Secure Socket Layer (SSL) and Virtual Private Networks (VPN).
Case study: Study of various network simulators, Network performance analysis using NS2

**Suggested Reading:**
1. TCP/IP Protocol Suit by Behrouz A. Forouzan TMH, 2000.
2. Computer Networks 3rd Ed. by Tananbaum A. S.PHI, 1999.
3. Computer Networks-Protocols, Standards and Interfaces by Black U, PHI, 1996.

4. Data and Computer Communications 6th Ed. by Stallings W., PHI, 2002.
5. SNMP, SNMPv2, SNMPv3, RMON 1 and 2", 3rd Ed. by Stallings W., Addison Wesley, 1999.
6. Introduction to Cisco Router Configuration by Laurra Chappell (Ed), Techmedia, 1999.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Cryptography and Network Security

**EMCS1103** **L-T-P(3-0-0)**
**Credit-3**

**UNIT I**
Introduction: Basic objectives of cryptography, secret-key and public-key cryptography, one-way and trapdoor one-way functions, cryptanalysis, attack models, classical cryptography.
Block ciphers: Modes of operation, DES and its variants, RCS, IDEA, SAFER, FEAL, Blowfish, AES, linear and differential cryptanalysis. Stream ciphers: Stream ciphers based on linear feedback shift registers, SEAL, unconditional security.

**UNIT II**
Message digest: Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions. Public-key parameters: Modular arithmetic, gcd, primarily testing, Chinese remainder theorem, modular square roots, finite fields Course Structure & Detailed Syllabus of MURP & M. Tech Program – 2015-16 138Intractable problems: Integer factorization problem, RSA problem, modular square root problem, discrete logarithm problem, Diffie-Hellman problem, known algorithms for solving the intractable problems.

**UNIT III**
Public-key encryption: RSA, Rabin and EIGamal schemes, side channel attacks. Key exchange: Diffie-Hellman and MQV algorithms. Digital signatures: RSA, DAS and NR signature schemes, blind and undeniable signatures. Entity authentication: Passwords, challenge-response algorithms, zero-knowledge protocols.

**UNIT IV**
Standards: IEEE, RSA and ISO standards Network issues: Certification, public-key infrastructure (PKI), secured socket layer (SSL), Kerberos. Advanced topics: Elliptic and hyper-elliptic curve cryptography, number field sieve, lattices and their applications in cryptography, hidden

monomial cryptosystems, cryptographically secure random number generators.

**Suggested Reading:**

1. Cryptography and Network Security by B. Forouzan, McGraw-Hill.
2. Cryptography and Network Security by Atul Kahate, TMH.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Machine Learning

**EMCS1104** **L-T-P(3-0-0)**
**Credit-3**

**Objectives:**
The objective of the course is to provide detail knowledge of machine learning process. Pre-requisite: Basic knowledge of artificial intelligence. Student should be able to realized systems which has capability to mimic human brain learning.

**UNIT I**
Rule Learning: Propositional and First-Order, Over-fitting, Cross-Validation. Experimental Evaluation of Learning Algorithms Instance-Based Learning: k-Nearest neighbor algorithm, Radial basis functions. Case-based learning.

**UNIT II**
Computational Learning Theory: probably approximately correct (PAC) learning. Sample complexity. Computational complexity of training. Vapnik-Chervonenkis dimension.
Artificial Neural Networks: Linear threshold units, Perceptron's, Multilayer networks and back-propagation, recurrent networks.

**UNIT III**
Probabilistic Machine Learning: Maximum Likelihood Estimation, MAP, Bayes Classifiers Naive Bayes. Bayes optimal classifiers. Minimum description length principle. Bayesian Networks, Inference in Bayesian Networks, Bayes Net Structure Learning.

**UNIT IV**
Unlabelled data: EM, preventing overfitting, cotraining Gaussian Mixture Models, K-means and

Hierarchical Clustering, Clustering and Unsupervised Learning, Hidden Markov Models, Reinforcement Learning Support Vector Machines Ensemble learning: boosting, bagging.

**Suggested Reading:**

1. Tom Mitchell, Machine Learning, McGraw-Hill.
2. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan- Kaufmann.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Theory of Computation

**EMCS1105** **L-T-P(3-0-0)**
**Credit-3**

**Objectives:**
The course will provide an insight of mathematical logic in computer science, regular Languaged Grammar , Turning machine and computational complexity of program. At the end of this course the student will have the knowledge of Boolean logic , proof by construction, contradiction, Finite automata, DFA, NFA, regular expression, pushdown automata, Context free grammar, time complexity, decidable and undecidable problems

**UNIT I**
Introduction: Mathematical notions and terminology of sets, sequences and tuples, functions and relations, graphs, strings and languages. Boolean logic properties and representation. Definition. Theorems and types of proofs formal proofs, deductive, reduction to definition, proof by construction, contradiction, induction, counter-examples.

**UNIT II**
Regular languages: Finite automata, DFA, NFA. Equivalence of DFA and NFA. An application, Regular expressions and languages, applications. Context-free languages: CFGs, Applications, Ambiguity removal, Pushdown automata and Equivalence with CFGs. Turing machine: Turing machines, variants of TMs, programming techniques for TMs, TMs and computers.

**UNIT III**

Decidability: Decidable languages, decidable problems concerning Context free languages. The halting problem – Diagonalization method, halting problem is undecidable. Reducibility: Undecidable problems from language theory. Regular expressions, Turing machines, Reduction, A simple undecidable problem (PCP), mapping reducibility and other undecidable problems.

**UNIT IV**

Computability: Primitive recursive functions, more examples, the recursion theorem. Computational complexity: Tractable and Interact able problems, Growth rates of functions, Time complexity of TM of TM, Tractable decision problems, Theory of Optimization.

**Suggested Reading:**


1. Introduction to Theory of Computation - Michael Spicer (Thomson Brools Cole )
2. Introduction to Automata Theory, Languages and Computation - J. E. Hoperoft, Rajeev Motawani and J.D. Ullman( Pearson Education Asia) 2nd Edition.
3. Discrete Mathematical structures with applications to computer science - J. P. Thembloy and R. Manohar.
4. Theory of Computer Science – E. V. Krishnamoorthy


**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Data Warehouse and Mining

**EMCS1106** **L-T-P(3-0-0)**
**Credit-3**

**Objective:**

Be familiar with mathematical foundations of data mining tools. Understand and implement classical models and algorithms in data warehouses and data mining. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

**UNIT - I**

Data Warehousing: Introduction to Data Warehousing: Evolution of Data Warehousing, Data Warehousing concepts, Benefits of Data Warehousing, Comparison of OLTP and Data Warehousing, Problems of Data Warehousing. Data Warehousing Architecture. Architecture : Operational Data and Data store, Load Manager, Warehouse Manager, Query Manager, Detailed Data, Lightly and Highly summarized Data, Archive/Backup Data, Meta-Data, architecture model, 2-tier, 3-tier and 4-tier data warehouse, End user Access tools.

**UNIT - II**

Data Warehousing Tools and Technology Tools and Technologies: Extraction, cleaning and

Transformation tools, Data Warehouse DBMS, Data Warehouse Meta-Data, Administration and management tools, operational vs. information Systems. OLAP & DSS support in data warehouse.

**UNIT-3**

Types of Data Warehouses & Data Warehouse Design Host based, single stage, LAN based, Multistage, stationary distributed & virtual data-warehouses. Data warehousing Design: Designing Data warehouse Database, Database Design Methodology for Data Warehouses, Data Warehousing design Using Oracle.

**UNIT-4**

Data Mining Basic Data Mining tasks, Knowledge discovery in databases, Issues, OLTP systems, Fuzzy sets and Fuzzy logic, Information Retrieval, Dimensional Modeling, OLAP, Web search engines, Data Mining Techniques

# SEMESTER-II

## Advanced Database Management System

**EMCS1201** **L-T-P(3-0-2)**

**Credit-5**

**Objectives:**

Course will try to cover the basic concepts of relation databases, how to process and optimize the query, new concepts such as distributed database processing, parallel databases, Databases for image and multimedia

**UNIT I**

Relational Databases: Integrity Constraints revisited, Extended ER diagram, Relational Algebra and Calculus, Functional, Multivalued and Join Dependency, Normal Forms, Rules about functional dependencies.

Query Processing and Optimization: Valuation of Relational Operations, Transformation of

Relational Expressions, Indexing and Query Optimization, Limitations of Relational Data Model, Null Values and Partial Information.

**UNIT II**

Objected Oriented and Object Relational Databases: Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases Parallel and Distributed Databases: Distributed Data Storage – Fragmentation and Replication, Location and Fragment Transparency Distributed Query Processing and Optimization, Distributed Transaction Modeling and concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation.

**UNIT III**

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

**UNIT IV**

Image and Multimedia Databases: Modeling and Storage of Image and Multimedia Data, Data Structures – R-tree, k-d tree, Quad trees, Content Based Retrieval: Color Histograms, Textures, etc., Image Features, Spatial and Topological Relationships, Multimedia Data Formats.

**Suggested Reading:**

1. Fundamentals of Database Systems 4th Edition by Elmarsi, Navathe, Somayajulu, Gupta, Pearson Education, 2007
2. Database Systems, The complete book by Garcia, Ullman, Widom Pearson Education
3. Database Management Systems by R. Ramakrishnan, McGraw Hill Int.Editions
4. An Introduction to Database Systems 8th Edition by Date, Kannan, Swaminathan Pearson Education
5. Database System Concepts, design and application by Singh S.K., Pearson Education

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## SOFT COMPUTING

**EMCS1202** **L-T-P (3-0-0)**
**Credit-3**

**Objectives:**
The objective of the course is to introduce different approach towards Soft Computing. Pre-requisite: Graduate course on Artificial Intelligence. By the end of the course, students should be able to apply Soft Computing techniques to get better outcomes in their research work.

**UNIT I**
Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. Neural Network : Structure

and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear separability, Widrow and Hoff;s learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN.

**UNIT II**

Introduction of MLP: Different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA, Counter propagation network, architecture, functioning and characteristics of counter Propagation network, Hopfield/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications. Hopfield v/s Boltzmann machine. Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory.

**UNIT III**

Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, crisp relation and fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction and features of membership functions. Fuzzy rule base system: fuzzy propositions, formation, decomposition and aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision-making and Applications of fuzzy logic.

**UNIT IV**

Genetic algorithm: Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion and deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications and advances in GA, Differences and similarities between GA and other traditional method

**Suggested Reading:**

1. Soft Computing, Sivanandan and Deepa, Wiley
2. S. Rajasekaran and G.A.Vijaylakshmi Pai.. Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India.
3. K.H.Lee. First Course on Fuzzy Theory and Applications, Springer-Verlag.
4. J. Yen and R. Langari.. Fuzzy Logic, Intelligence, Control and Information, Pearson Education.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Queuing Theory and Data Networks

**EMCS1203** **L-T-P(3-0-0)**

**Credit-3**

**Objectives:**

The objective of the course is to prepare base for queuing theory and data networks.

Outcome: Should be able to apply Queuing Theory to their problem domain and model it.

**UNIT I**

Networks, Queues and Performance Modeling: Introduction, Network types, Multiple- access protocols, Discrete-time queues, Performance measures: Probability, Random Variables and Distributions, Probability, Random variables.

**UNIT II**

Distributions and Conditional distributions: Stochastic Process and Markov Chains, Poisson process and its properties, Markov chains and Markov chain models. Discrete-Time Queues: Performance measures and Little's result, Discrete-time queuing conventions, Discrete-time M/M/1 queue, Discrete-time M/M/1/J queue, Discrete-time Man/M/1, Discrete-time Man/Mdm/\∞ queue, S-queues .

**UNIT III**

Discrete-Time Queuing Networks: Tandem S-queues, Network of S-queues, Discrete-time queuing network models for multiple access protocols, Equilibrium point analysis, Different customer classes.

**UNIT IV**

Satellite Networks: Time-division multiple access, Slotted Aloha, Code division multiple access, Buffered slotted Aloha Local Area Networks: Carrier sensing networks, Token passing networks, Slotted rings.

**Suggested Reading:**

1. Woodward, M. E., "Communication and Computer Networks: Modeling with discrete-time queues", Systems Wiley-IEEE Computer Society IT646 Queuing Theory and Data Networks

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

**EMCS1204** **L-T-P(3-0-0)** **Credit 3**

**Objective:**

The students should be able to understand a broad overview of the essential concepts of block chain technology. To familiarize students with Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming. Students should be able to learn about different types of block chain and consensus algorithms.

**UNIT I:**

Introduction: Overview of Block chain, Public Ledgers, Bit coin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain.

**UNIT II:**

Overview of Security aspects of Block chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

**UNIT III:**

Bit coin and Block chain: Creation of coins, Payments and double spending, Bit coin Scripts, Bitcoin P2P Network, Transaction in Bit coin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bit coin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hash cash PoW, Bit coin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty,
Mining Pool.

**UNIT IV:**

Understanding Block chain for Enterprises Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport- Shostak- ease BFT Algorithm, BFT over Asynchronous systems.

**UNIT V:**

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain.

**UNIT VI:**

Block chain application development: Hyper ledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, writing smart contract using Hyper ledger
Fabric, writing smart contract using Ethereum, Overview of Ripple and Corda.

## Data Science

**EMCS1205** **L-T-P(3-0-0)**
**Credit 3**

**Objective:**
To introduce the various mathematical concepts and models, and provide skills required to implement the models. To undertake a critical evaluation of a wide range of numerical and data. To develop designing skills for modeling non-deterministic problems.

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

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

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

**Unit IV:**
Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

**Unit V:**
Applications of Data Science: Applications of Data Science, Technologies for visualization, Bokeh (Python)

**Unit VI:**
Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

**References:**
1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1,

Cambridge University Press.
3. The Art of Data Science by Roger D. Peng and Elizabeth Matsui
4. Practical Statistics for Data Scientists — by Peter Bruce

**Elective-I**

**Computer Law and Ethics**

**EMCS1216** **L-T-P(3-0-0)**
**Credit-3**

**Objectives:**
The objective of the course is to introduce about the computer law and its Etics. By the end of the course, students should be able to understand and practice Computer Law and ethics of Computer World.

**UNIT I**
Intellectual property rights, computer software copyrights, copyright in databases and electronic publishing, law of confidence, patent laws, trademarks, product designs, international law .

**UNIT II**
Computer contracts, liability for defective hardware and software, software contracts, web and hardware contracts, electronic contracts and torts, liabilities.

**UNIT III**
Computer crime, computer fraud, hacking, unauthorized modification of information, piracy, computer pornography and harassment.

**UNIT IV**
Cyber laws in India, IT Act 2000, data subjects' rights, ethical issues in computer security, case studies.

**Suggested Reading:**
1. D. Bainbridge, Introduction to Computer Law, 5/e, Pearson Education, 2004.
2. P. Duggal, Cyber law: the Indian Perspective, 2005.
3. C. P. Fleeger and S. L. Fleeger, Security in Computing, 3/e, Pearson Education, 2003.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Neural Networks

**EMCS1226** **L-T-P(3-0-0)**
**Credit-3**

**Objective:**

Introduce fundamental concepts of neural networks and study several network models in detail. After taking this course, the student will be ready to understand the structure, design, and training of various types of neural networks and will be ready to apply them to the solution of problems in a variety of domains.

**UNIT I**

Introduction: Background, Knowledge Based Information Processing, Neural Information Processing, Hybrid Intelligence. Basic Neural Computational Models: Introduction, Basic Concepts of Neural Networks, Inference and Learning, Classification Models, Association Model, Optimization Models, Self- Organization Models, General Issues, Hardware Implementation.

**UNIT II**

Learning: Supervised and Unsupervised: Introduction, Supervised and Unsupervised Learning, AI Learning, Neural Network Learning, Genetic Algorithms Knowledge-Based Neural Networks: Introduction, Rule -Based Neural Networks, Radial Basics Function Networks (RBFN), Network Training, Network Revision, Issues, Example of Theory Revision, Decision of Theory Revision, Decision Tree-Based Neural Networks, Constraint-Based Neural Networks.

**UNIT III**

Incremental Learning: Introduction, Fundamental Principles, Symbolic Methods, Neural Network Approaches, The Incremental RBCN. Mathematical Modelling: Introduction, Mathematical Modelling in General, The Applications of Neural Networks, Neural Networks as Mathematical Models, Knowledge-Based Approaches.

**UNIT IV**

Discovery: Introduction, Symbolic Methods, And Neural Network Methods. Structures and Sequences: Introduction, Connectionist Representation, A Hybrid Network Approach. Learning Spatiotemporal Patterns: Introduction, Spatio-temporal Neural Networks, Learning Procedures, Knowledge Procedures

**Suggested Reading:**

1. Neural Networks by Simon Haykin, Pearson Education/PHI
2. Neural Networks Algorithms, Applications, and Programming Techniques by James A. Freeman, David M. Skapura, PHI
3. Neural Network using MATLAB 6.0 by Sivanandam, Tata McGraw Hill
4. Neural Network: A classroom Approach by Satish Kumar, Tata McGraw Hill

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

**Image Processing**

**EMCS1236** **L-T-P(3-0-0)**

**Credit-3**

**Objectives:**

The course gives an insight for fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images. Particular emphasis will be placed on covering methods used for image sampling and quantization, image transforms, image enhancement and restoration, image encoding, image analysis and pattern recognition. In addition, the students will learn how to apply the methods to solve real-world problems in several areas including medical, remote sensing and surveillance and develop the insight necessary to use the tools of digital image processing (DIP) to solve any new problem.

**UNIT I**

Introduction to Image Processing: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display. Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling and Quantization - Uniform and Non uniform.

**UNIT II**

Mathematical Preliminaries: Neighbor of pixels, Connectivity, Relations, Equivalence and Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Discrete Cosine and Sine Transform. Image Enhancement: Spatial Domain Method, Frequency Domain Method, Contrast Enhancement

-Linear and Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Holomorphic Filtering

**UNIT III**

Image Restoration: Degradation Model, Discrete Formulation, Algebraic Approach to Restoration

- Unconstrained and Constrained; Constrained Least Square Restoration, Restoration by Holomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.

**UNIT IV**

Image Segmentation: Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking and Boundary Detection - Local Processing, Global Processing via The Hough Transform; Threshold - Foundation, Simple Global Threshold, Optimal Threshold; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting and Merging.

**Suggested Reading:**

1. Digital Image Processing, Tao Gonzalez, Woods, Pearson
2. Digital Image Processing, Jahne, Springer India
3. Fundamentals of Digital Image Processing, Jain, PHI

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## SEMESTER-III

### Artificial Intelligence and Intelligent Systems

**EMCS2101** **L-T-P(3-0-0)**

**Credit-3**

**Objectives:**

The curriculum will focus on machine learning , knowledge representation, reasoning and inference, Language for problem solving and other subsets of Artificial intelligence .At the end of the curriculum the student will be well versed with Concept of AI, Intelligent System, Predicate Logic, Fuzzy Sets inference and types of inference, knowledge representation, expert System , rule based expert system, programming in LISP, Fuzziness, Ant Colony optimization .

**UNIT I**

Introduction: Intelligence, communication, learning, artificial intelligence, importance, definitions, programming methods, techniques, fundamental issues, Progress of artificial intelligence, growth of AI, Artificial intelligence and industry, AI and the world, current trends

in applied AI, Modeling, simulation and AI, Intelligence systems, role of IS, role of computer in IS, comparison with conventional programs, fundamentals of various IS, comparison of various IS.

Knowledge Representation: Introduction, propositional calculus, syntax, semantics, properties of statements, inference rules, predicate calculus, symbols, semantics, quantifiers, rule based knowledge representation, representation of knowledge using rules, predicate calculus using inference rules, forward and backward chaining, forward versus backward reasoning, resolution, symbolic reasoning under uncertainty, non-monotonic reasoning, probability and Baye's theorem, approaching uncertainty through fuzzy sets, basic knowledge representation issues, considerations in knowledge representation.

**UNIT II**

Heuristic Search: Introduction, search as a problem-solving technique, heuristic search, techniques for heuristic search, hill-climbing heuristic, best-first search, evaluation of heuristic functions, admissibility, monotonicity, and informed ness, heuristic classification, understanding heuristic classification, relating heuristics and conceptual graphs. State Space Search: Introduction, state space search, structures and strategies for search, graph theory, problem solving using state space representation, strategies for state space search, data driven and goal driven search, implementation of graph search, depth-first search, breadth first search, representation of reasoning with predicate calculus using state space, search based on recursion, pattern directed search.

**UNIT III**

Artificial Intelligence Problem-solving Languages: LISP, uniqueness among other programming languages, s-expressions: syntax and numeric functions, list manipulation functions, defining functions, program control in LISP predicates and conditionals, editing, compiling and loading LISP files, lists as recursive structures, iteration constructs, input, output and local variables, matching of pattern in LISP, steps for good programming and tools for debugging, LISP- a problem solving tool, depth first search and breadth-first search and hill climbing, the farmer, wolf, goat, and cabbage problem, the tower of Hanoi, Programming methods in LISP.

Expert Systems: Introduction, expert systems, development of expert system technology, architecture, goals, advantages, difference between expert systems and conventional methods, stages in the development of an expert system, building a rule based expert system, verification, validation, and design for expert systems, Monte Carlo simulation, probability-based models, uncertainty measures, uncertainty propagation, control structures with uncertainty.

**UNIT IV**

Fuzzy Systems: Introduction, foundation of fuzzy systems, representing fuzzy elements, basic terms and operations, properties of fuzzy sets, fuzzy measures, measures of fuzziness, fuzzification, fuzziness and probability theory, membership function shape analysis, the extension principle, alpha cut and the resolution principle, fuzzy relations, composition of fuzzy relations, arithmetic operations of fuzzy numbers, the alpha cut method, the extension principle method, linguistic descriptions and their analytical forms, fuzzy linguistic descriptions, fuzzy relation inference, fuzzy implication and fuzzy algorithms.

Swarm Intelligent Systems: Introduction, back ground of ant intelligence systems, importance of the ant colony paradigm, ant colony systems, biological ant colony systems, artificial ant colony systems, development of the ant colony system, static combinatorial optimizations problems, dynamic combinatorial optimization problems, the working of ant colony systems, probabilistic transition rule, particle swarm intelligent systems, the basic PSO method.

**Suggested Reading:**

1. Artificial Intelligence and Intelligent Systems by N.P. Padhy, Oxford Higher Education.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Semantic Web

**EMCS2102** **L-T-P(3-0-0)**
**Credit-3**

**Objectives:**
To learn Web Intelligence, To learn Knowledge Representation for the Semantic Web To learn Ontology Engineering, To learn Semantic Web Applications, Services and Technology To learn Social Network Analysis and semantic web

**UNIT –I**

Web Intelligence: Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

**UNIT -II**

Knowledge Representation for the Semantic Web:Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

**UNIT-III**

Ontology Engineering:Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

**UNIT-IV**

Semantic Web Applications, Services and Technology:Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

**UNIT-V**

Social Network Analysis and semantic web:What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

**TEXT BOOKS:**

1. Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

**REFERENCE BOOKS:**

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
3. Information sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.

**Elective-II**

**Servers and Storage**

**EMCS2113** **L-T-P(3-0-0)**

**Credit-3**

**Objectives:**

Learning the Storage Technology beyond the storage of data on individual storage devices. By the end of the course, students should be able to understand server and storage techniques that are being used in the Enterprise to store huge amount of data.

**UNIT I**

Introduction: History: computing, networking, storage ,Need for storage networking ,SAN, NAS, SAN/NAS Convergence, Distributed Storage Systems , Mainframe/proprietary vs. open storage

,Storage Industry Organizations and Major ,Vendors Market , Storage networking strategy (SAN/NAS or Distr storage) , Impact of Regulations: existing and new .

**UNIT II**

Technology :Storage components , Data organization: File vs. Block, Object; ,Data store; Searchable models Storage Devices (including fixed content storage devices) , File Systems , Volume Managers ,RAID systems , Caches, Prefetching

**UNIT III**

Network components Connectivity: switches, directors, highly available systems ,Fibre Channel 1GE/10GE, Metro-ethernet ,Aggregation, Infiniband ,Error Management: Disk Error Mgmt , RAID Error Mgmt ,Distr Systems Error Mgmt

**UNIT IV**

Layering and Interfaces in Storage Protocols: eg. SCSI 1/2/3SNIA model ,Highly available and Disaster-tolerant designs,Ordered writes, Soft updates and Transactions 2 phase, 3 phase, Paxos commit protocols ,Impossibility Results from Distributed Systems Choose 2 of 3: Availability, Consistency and Partition Tolerance SAN Components: Fibre Channel ,IP-based Storage (iSCSI, FCIP, etc.) Examples NAS, NFS, CIFS,DAFS

**UNIT V**

Large Storage Systems,Google FS/BigTable ,Cloud/Web-based systems (Amazon S3) FS+DB convergence ,Programming models: Hadoop Archival Systems: Content addressable storage Backup: server less, LAN free, LAN Replication issues ,Storage Security,Storage Management, Device Management ,NAS Management Virtualization ,Virtualization solutions ,SAN Management ,Storage Provisioning ,Storage Migration SRM.

**Suggested Reading:**

1. G. Somasundaram, Alok Shrivastava, " Information Storage and Management Storing, Managing, and Protecting Digital Information", EMC Education Services, Wiley India Edition, 2009.
2. Marc Farley, "Storage Networking Fundamentals", CISCO Systems, First edition, 2004.
3. Gupta Meena, "Storage Area Network Fundamentals", Pearson Ed.

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

## Expert System

**EMCS2123** **L-T-P(3-0-0)**
**Credit-3**

**Objectives:**
The study of AI & Expert system is very important for the students of Computer science. Therefore, IT Company and any research organization wants that the students should have proficiency in subject because without the judicious use of these techniques one cannot write efficient Algorithm for problem solving technique.

**UNIT I**
The nature of Expert Systems. Types of applications of Expert Systems; relationship of Expert Systems to Artificial Intelligence and to Knowledge-Based Systems. The nature of expertise. Distinguishing features of Expert Systems. Benefits of using an Expert System.

**UNIT II**
Theoretical Foundations. What an expert system is. how it works and how it is built. Basic forms of inference: abduction; deduction; induction. The representation and manipulation of knowledge in a computer. Rule-based representations (with backward and forward reasoning); logic-based representations (with resolution refutation).

**UNIT III**
Taxonomies; meronomies; frames (with inheritance and exceptions); semantic and partitioned nets (query handling). Basic components of an expert system. Generation of explanations. Handling of uncertainties. Truth Maintenance Systems.

**UNIT IV**
Expert System Architectures. An analysis of some classic expert systems. Limitations of first generation expert systems. Deep expert systems. Co-operating expert systems and the blackboard model. • Building Expert Systems. Methodologies for building expert systems: knowledge.
acquisition and elicitation; formalization. representation and evaluation. Knowledge Engineering tools **.**

**Text Books:**
P Jackson, Introduction to Expert Systems, Addison Wesley, 1990 (2nd Edition)

**Reference Book:**
Elaine Rich, Kevin Knight, Artificial Intelligence, McGraw-Hill, Inc, 1991 (2nd Edition). Jean-Louis Lauriere, Problem Solving and Artificial Intelligence, Prentice Hall, 1990

**Natural Language Processing**

**EMCS2133** **L-T-P(3-0-0)**

**Credit-3**

**Objectives:**

The objective of the course is to provide detailed knowledge of natural language processing. Basic knowledge of compiler and automata theory. By the end of the course, students should be able to get basic approaches towards NLP, challenges in the domain and strategies to get over them.

**UNIT I**

Introduction: Need for Processing Natural languages, Issues in NLP and Complexity of Processing NLP, Brief history of NLP application development. Language Modeling: Various types of Languages and its modeling, Grammar based language models, Government and Binding, Lexical Functional Grammar and Paninian Grammar for handling natural languages, Statistical modeling.

**UNIT II**

Word Level Analysis: Regular expressions, Finite State Automata, Morphological parsing, Spelling Error Detection and Correction, Words and word classes (Hindi and English), Part of speech tagging : Rule-based tagger, Stochastic tagger, Hybrid tagger, Unknown words Syntactic Analysis: Context Free Grammar, Phrase and sentence level Constructions, Parsing: Top-down Parsing, Bottom-up parsing, A Basic Top-down Parser, The Earley Parser, The CYK Parser, Probabilistic Parsing : Estimating Rule Probabilities, Parsing PCFGs, Problems with PCFG

**UNIT III**

Semantic Analysis: Meaning Representation, Characteristics of Meaning Representatio, Languages, Meaning structure of languages, Syntax-driven semantic analysis, Semantic Grammars, Lexical Semantics, Relationships, Internal structure of words, Ambiguity, Word Sense Disambiguation, Selectional Restriction in Word sense Disambiguation, Context-based Word Sense Disambiguation Approaches, Knowledge sources in WSD, Applications of WSD , WSD Evaluation.

Discourse Context and World Knowledge: Local discourse Context and Anaphora Resolution, World Knowledge, Discourse Structure, Discourse Analysis

**UNIT IV**

Language Generation: Architecture of language generators, Template-based, Phrase-based and Feature-based Natural language generation, Knowledge-based Approaches Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine

Translation Approaches: Direct Machine Translation, Rule-based Machine Translation: Transfer-based and Interlingua based Machine Translation, Corpus-based Machine Translation: Statistical and Example-based Machine Translation, Semantic or Knowledge- based MT systems , Applications: Question-Answering System, Text Summarizers, Applications of NLP.

**Suggested Reading:**

1. Natural language Processing and Information Retrieval: T. Siddiqui and U. S. Tiwary, Oxford Univ. Press.
2. Natural Language Understanding: Allen
3. Statistical Language Learning: E. Charniac, MIT Press .

**Additional Learning Sources:-**

1. Web links to e-learning NPTEL

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|---|---|---|
| **EMCS2104** | **Mini-Project** | **Credit-6** |
| | **Seminar Viva-voce** | **Credit-2** |

## SEMESTER-IV

**EMCS2201** **Dissertation**
**Credit-15**

**Seminar-Viva-Voce**
**Credit-2**

**Dissertation-Viva-Voce**
**Credit-3**