Department of Electronics and Communication

J.K. Institute of Applied Physics & Technology

University of Allahabad, Allahabad

M. Tech. (Computer Science and Engineering) Course Structure and Syllabus

M.Tech. 1st Semester (CSE)						
Paper	Course Code	L-T-P-C	Credits	Four theory Papers & Practical Lab	Sessional Marks	End Semester Marks
Paper – 1	MCT 511	3-0-0-3	3	Advanced Computer Algorithms	40	60
Paper – 2	MCT 512	3-0-0-3	3	Advanced Concepts in Image Processing	40	60
Paper – 3	MCT 513	3-0-0-3	3	Intelligent Techniques	40	60
Paper – 4	MCT 514	3-0-0-3	3	High Performance Computing	40	60
Practical	MCT 515	0-0-15-8	8	Computer Lab	40	40

M.Tech. 2nd Semester (CSE)						
Paper	Course Code	L-T-P-C	Credits	Four theory Papers & Practical Lab	Sessional Marks	End Semester Marks
Paper – 1	MCT 516	3-0-0-3	3	Cyber Security	40	60
Paper – 2	MCT 517	3-0-0-3	3	Ubiquitous Computing	40	60
Paper – 3	MCT 518	3-0-0-3	3	Computer Vision	40	60
Paper – 4	MCT 519	3-0-0-3	3	Natural Language Processing	40	60
Practical	MCT 520	0-0-15-8	8	Computer Lab	40	60

M.Tech. 3rd Semester (CSE)						
Paper	Course Code	L-T-P-C	Credits	One theory Paper & Project	Sessional Marks	End Semester Marks
Paper – 1	MCT 604	4-0-0-4	4	Elective Paper	40	60
Projects	MCT 605	0-0-32-16	4	Project – Phase I – Seminar	40	60
			6	Project – Phase I – Dissertation	40	60
			6	Project – Phase I – Viva Voce	40	60

M.Tech. 4th Semester (CSE)						
Paper	Course Code	L-T-P-C	Credits	Project & Paper Writing	Sessional Marks	End Semester Marks
Projects	MCT 606	0-0-40-20	6	Project – Phase II – Seminar	40	60
			6	Project – Phase II – Dissertation	40	60
			6	Project – Phase II – Viva Voce	40	60
			2	Paper Writing & Presentation	40	60

M. Tech. First Semester
(CSE)

PAPER –I: Advanced Computer Algorithms

Unit 1 **08 Lectures**

String Algorithms: Rabin-Karp Fingerprinting Algorithms, Tries, Suffix Trees.

Network Flow: Flow and cuts, Augmenting Paths, Minimum-cost Flows, Bipartite matching, Cycle Algorithms, Strongly Polynomial Time Analysis, Minimum cuts without flows.

Unit 2 **08 Lectures**

Approximation Algorithm: P and NP, NP completeness, NP-Hardness , Greedy Approximation Algorithm, Dynamic Programming and Weakly Polynomial-Time Algorithms, Linear Programming Relaxations, Randomized Rounding, Limits to approximability, Vertex Cover, Wiring and TSP, Semidefinite Programming, Euclidian TSP.

Unit 3 **08 Lectures**

Online Algorithm: Ski Rental, River Search Problem, the k-Server Problem, List Ordering and Movo-to-Font.

Fixed Parameter Algorithms: Another Way of Coping with NP-Hardness, Parameterized Complexity, Kemeliztion, Vertex Cover, Connections to Approximation

Unit 4 **08 Lectures**

Computational Geometry: Convex Hull, Line-segment Intersection, Sweep Lines, Voronoi Diagrams, Range Trees, Seidel's Low-dimensional LP Algorithm.

Unit 5 **08 Lectures**

External-Memory Algorithms: Accounting for the Cost of Accessing Data from Slow Memory, Sorting, B-trees, Butter Trees, Cache-oblivious Algorithm for Matrix Multiplication and Binary Search.

Streaming Algorithm: Sketching, Distinct and Frequent Elements.

References:

Michel T. Goodrich and R. Tamassia, Algorithm Design, john Wiley & sons

H. Dorit ed, Approximation Algorithm for NP-Hard Problems, H. Dorit, PWS Publishing Company, Boston.

Robert Tarjan, Data Structures and Network Algorithm, SIAM Philadelphia.

Allan Borodin and El-Yaniv Ran, Online Computation and Competitive Analysis, Cambridge University Press.

Motwani and Raghvan, Randomized Algorithm, Cambridge University Press

Cormen Leiseron, Rivest and Stein, Introduction to Algorithm, MIT Press.

M. Tech. First Semester
(CSE)

PAPER –II: Advanced Concepts in Image Processing

Unit 1: Introduction: **08 Lectures**

Image representation and modeling, 2-D linear system, Luminance, Contrast and Brightness, Color representation, Visibility functions, Monochrome and color vision model.

Unit 2: Image Enhancement: **08 Lectures**

Point operation, Histogram modeling, Filtering and spatial operations, Transform operations, Multispectral Image Enhancement

Unit 3: Image Restoration: **08 Lectures**

Image formation models, Noise models, Inverse and Wiener filtering, Least square filters, Recursive filters, Maximum entropy method, Blind deconvolution, Bayesian method of noise removal, Image reconstruction, Tomography, Radan transform, Back-projection, Algebraic method, Pan-beam reconstruction.

Unit 4: Image Analysis: **08 Lectures**

Feature extraction, Edge detection, Boundary and region representation, Moment representation, Scene matching and detection, Image segmentation and classification

Unit 5: Data Compression: **08 Lectures**

Data compression vs. Bandwidth, Pixel coding, Predictive coding, Transform coding, Coding of two-tone images.

References:

1. Fundamentals of Digital Image Processing: Anil K. Jain, PHI
2. Digital Image Processing: R. Chellappa, IEEE Press
3. Image Processing for Scientific Applications: Bernd Jahne, CRC Press
4. Digital Image Processing: R.C. Gonzalez & R.E. Woods
5. The Image Processing Handbook: J.C. Russ, CRC Press
6. Digital Image Processing: W.K. Pratt
7. Digital Image Restoration: Andrews & Hunt

M. Tech. First Semester
(CSE)

PAPER –III: Intelligent Techniques

Unit 1: Introduction to Intelligent Techniques & Knowledge Representation:

08 Lectures

Introduction to Intelligent System and Techniques, Knowledge Representation using predicate logic, first order inference, Planning, probability models, probabilistic inference, Network-based knowledge representation.

Unit 2: Problem solving using search: **08 Lectures**

Problem solving search, Heuristic search techniques, Game search, Constraint satisfaction search

Unit 3: Intelligent Agent: **08 Lectures**

Introduction, Philosophical background: Dennett, Bratman, Logical foundations of actions and agents: modal, temporal and dynamic logic, BDI logic, Reasoning about actions, Agent architectures, Multi-agent Systems, Ethics and Risks of Intelligent Systems; Future of Intelligent Systems.

Unit 4: Pattern Classification, Machine Learning **10 Lectures**

Basic Principles of Pattern Classification Algorithms- Linear Discriminate Functions, Support Vector Machines, k-Nearest Neighbour, Artificial Neural Network; Principles of Combining Different Pattern Classification Algorithms, Types of Learning problems, Decision tree learning, Concept learning algorithm, Learning using Neural Nets, Back-propagation, Associate memory.

Unit 5: Soft-Computing Techniques: **06 Lectures**

Introduction to Fuzzy Logic, Genetic Algorithms, Application of Genetic Algorithms, Evolutionary Algorithms.

Reference:

S. Russell and P. Norvig, Artificial Intelligence – A Modern Approach, Pearson Education Ltd.

A. konar, Artificial Intelligence and Soft Computing CRC Press
G.F. Luger, Artificial Intelligence, Pearson Education Ltd.
N.J.Nilson, Artificial Intelligence, Elsevier Press
J. Pearl, Causality, Cambridge University Press
M. Wooldridge, Reasoning about Rational Agent, MIT Press

M. Tech. First Semester
(CSE)

PAPER –IV: High Performance Computing

Unit 1: Introduction **08 Lectures**

Introduction to Supercomputing, Supercomputing architecture, Vector machine, Parallel processor, Pipelining, Vectorization, Parallelization, Comparison of Serial, Parallel and Vector architectures, Multi-threaded execution models, Parallelizing compilers, State of the art research & future direction.

Unit 2: Microprocessor & System architecture **08 Lectures**

Pipelining, Superscalar design, SIMD, Multi-threading, Asynchronous microprocessor for high performance processing and low power applications.

Unit 3: Multi-processor architecture **08 Lectures**

Classification, MIMD, Distributed memory system, Parallel architecture, Distributed memory systems, Clusters, Grids, Interconnection networks.

Unit 4: Tightly coupled systems **08 Lectures**

Cache coherence, Consistency, Synchronization, SMP, ccNUMA, COMA, Performance evaluation, Speed up limitations, Amdahl's Law and extensions, Scaled Speed up, Pipelined speed-up

Unit 5: Parallel Programming Paradigms **08 Lectures**

Program analysis, Parallelization of algorithm, Parallel linear algebra routines, Loop Optimization, Implementation, Principal of locality, Caches & buffers, Massively data parallel algorithms, Array notation, Parallel & Vector C Code.

Queuing Theory & Computer Performance Evaluation:

Operation Analysis-Little's theorem, Utilization Law, Forced flow law, Application of these results to computer system, Cyclic queues-models of a multi-programming environment and models of interactive systems, Queuing networks-analysis of complex computer system.

Reference:

D.A. Patterson & J. L. Hennessy, Computer architecture: A quantitative approach, Morgan Kaufman Pub.
D Kuck, The Structure of Computer & Computation, Wiley
J. M. Ortega, Introducti9on to Parallel & Vector solution of Linear system, Plenum
Quinn, Efficient algorithms for Parallel Computers, McGraw Hill
P.J. Hatcher & M J Quinn, Data Parallel Programming on MIMD Computer, MIT Press
K Chandy & C Sauer, Computer System Performance Modeling, Prentice Hall
L Kleinrock, Queuing System Vol I & II, Wiley
E Coffman & P Denning, Operating System theory Prentice Hall

M. Tech. Second Semester
(CSE)

PAPER –I: Cyber Security

Unit 1: Introduction: **08 Lectures**
Nature of Cyberspace, CIA triad, Technical aspects of threats and vulnerabilities, Vulnerability scanning, vulnerability probe, Open VAS, Networks vulnerability scanning, Network sniffers and injection tools, Types of cybercrimes, IT Act, 2000

Unit 2: Encryption & Decryption: **08 Lectures**
Terminology, Mono-alphabetic ciphers, Poly-alphabetic substitution ciphers, Transpositions, Stream & block ciphers, Secure encryption systems, Public key encryption systems, RSA encryption, EL Gamal & Digital Signature algorithms, Hash algorithms, Secure secret key systems, DES algorithm, Enhancing cryptographic security

Unit 3: Network Defence Tools: **08 Lectures**
Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Denial of service attacks, Snorts: Introduction Detection System

Unit 4: Web Security: **08 Lectures**
Basic web security model, Web application security, Session management and user authentication, HTTPS: goals and pitfalls, Content security policies, Web workers and extensions, Introduction to web application tools

Unit 5: Security in mobile platform: 08 Lectures

Mobile platform security models, Understanding Android security, Real time privacy monitoring on smartphones, Mobile threats and malware, Mobile web app security

Recommended Readings:

1. Dieter Gollmann, "Computer Security", Wiley
2. Ross Anderson, "Security Engineering", Wiley
3. Nina Godbole and SunitBelpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley

M. Tech. Second Semester
(CSE)

PAPER –II: Ubiquitous Computing

Introduction:

Real life example of ubiquitous computing, Major trends din computing (mainframe, desktop and ubiquitous computing), Wearable computing, Pervasive computing: Design Issues for Ubiquitous Computing, Integration and Processing of Sensor-Based Input; Wireless Infrastructures; Sensing and Context Awareness, Use of RFID, Some Computer Science Issues in Ubiquitous Computing.

Essential technologies for ubiquitous computing:

Operating environment, Networking, Sensors, Location sensing; Smart Environment, Smart Devices, Perceptual components, Multisensor perception, answering machine, Room ware, Wireless sensing environment.

Wireless standards & protocols:

Wireless network types and standards, Ad-hoc network, Sensor network, IrDA, Bluetooth, 1EEE 802.11, WLAN, Wireless link, 802.11 LAN architecture, Bluetooth architecture, Sensor and smart spaces, Sensor Networking and sensor protocol, Mobility and Mobile networking, Mobile IP.

Cellular networks:

Mobile radio communication, Cellular system architecture GSM and CDMA, WCDMA.

Performance & QoS issues in wireless networks:

Network performance measures, Quality of Service, Need of feedback control, Bandwidh sharing and faimess, TCP over link, Packet Loss, Single cell and multicell wireless networks, Saturation throughout analysis, Real-time examples.

Privacy & Security:

Issues, Challenges, Attacks in Privacy & Security, Security issues in sensor networks, Security issues in ad-hoc networks, Resurrecting Duckling model of security.

Mobile computing:
Mobile computing vs. Distributed computing, Characteristic of mobile network, Mobile computing models, Unaware client/server model, Thin client/server model, Disconnected operation, Dynamic client/server model, Mobile agents, Challenges in mobile computing, mobile computing and databases.

Context aware computing:
Context-aware systems, Context-aware architecture, Context-aware applications, Adaptive GSM Phone/PDA, Handling multiple context, Issues and challenges.

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M. Tech. Second Semester
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PAPER –III: Computer Vision

Unit 1 **08 Lectures**

The digitized image and its properties, Data structures for image analysis, Pixel brightness and Geometric transforms, Edge detectors, Zero-crossings, Canny edge detection, Edges in multispectral Images.

Unit 2 **08 Lectures**

Segmentation: Thresholding, Edge-based segmentation, region-based segmentation, Matching.

Shape Representation: Region identification, Contour-based shape representation and description, Region-based shape representation and description, Shape classes, Object recognition.

Unit 3 **08 Lectures**

Image Understanding: Image understanding control strategies, Active contour models-makes, Pattern recognition methods in image understanding. Scene labeling and constraint propagation, Semantic image segmentation and understanding, Hidden markov models.

Unit 4 **08 Lectures**

3D Vision: JD vision tracks, Geometry for 3D vision, Single camera calibration,Two cameras, Stereopsis, Three or more cameras, Radiometry and 3D vision, Shape from X, 3D model based vision, 2D–view based representation of 3D scene.

Unit 5 **08 Lectures**

Motion Analysis: Differential motion analysis methods, Optical flow, Analysis based on correspondence of interest points, Kalman filters, Object tracking, Tracking in wavelet domain.

M. Tech. Second Semester

(CSE)

PAPER –IV-A (Elective): Natural Language Processing

Unit 1: Introduction and Applications **08 Lectures**

Natural language Processing (NLP), Brief history of NLP research, key issues, current applications, Language models.

Unit 2: Morphological and Syntactic Analysis **12 Lectures**

Morphological analysis, Part of Speech Tagging, Syntax and Grammar: From words to phrases, Classes of phrases, defining phrases using context-free grammars, Some context-free grammars for English, Syntactic Parsing – Top-down and bottom up parsing, Probabilistic Parsing.

Unit 3: Semantic **06 Lectures**

Semantic Analysis, Lexical, Semantics, Ambiguity, Word Sense disambiguation, Knowledge-based and Machine Learning Approaches to Word Sense Disambiguation, State of the art techniques in WSD.

Unit 4: Discourse Analysis **06 Lectures**

Local discourse Context and Anaphora Resolution, World Knowledge, Discourse Structure.

Unit 4: NLP Applications **08 Lectures**

Text summarization, Information Extraction, Machine Translation, spoken dialogue systems.

Reference:

1. Jurafsky and J. Martin, Speech and Language Processing, Prentice Hall.
2. S. Pinker, The Language Instinct, Penguin.
3. P. Mattews, Linguistics: A very short introduction, OUP.
4. C.D. Manning and H. Schutce, Foundations of Statistical Natural Language Processing, MIT Press.

M. Tech. Second Semester
(CSE)

PAPER –IV-B (Elective): Information Retrieval

Unit 1: Introduction **08 Lectures**

Introduction to Information Retrieval, Information Retrieval models, Boolean, Probabilistic and Vector space retrieval models

Unit 2: Indexing and Boolean retrieval **08 Lectures**

Tokenization, elimination of stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, posting lists & its implementations, Positional postings and phrase queries, Bi-word indexes, Positional indexes, Tolerant Retrieval, Index compression, Zipf's law, distributed and dynamic indexing

Unit 3: Vector space model **08 Lectures**

Term frequency and weighting, Inverse document frequency, Tf-idf weighting scheme, Scoring methods, Index elimination, Champion lists, Latent semantic indexing, cluster pruning, Evaluation methods

Unit 4: Query Expansion and Relevance Feedback **08 Lectures**

Query expansion, Relevance feedback and pseudo relevance feedback: Ide's & Rocchio's algorithm for relevance feedback, Relevance feedback on the web, Evaluation of relevance feedback strategies, Pseudo relevance feedback, Indirect relevance feedback, Query modification techniques.

Unit 5: Further topics: Clustering algorithms **08 Lectures**

Flat and hierarchical clustering: k-means, top down and bottom up clustering, XML retrieval – indexing, scoring and retrieval, Web Search: Crawling architecture, link analysis, pagerank and HITS algorithm, Introduction to Semantic Web

Books:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, "An Introduction to Information Retrieval", Cambridge University Press, 2009.

2. Ricardo Baeza-Yates & Berthier Ribeiro-Neto, "Modern Information Retrieval" (second edition), Addison-Wesley, 2010.

3. Selected papers from "Recommended Reading for IR Research Students" Moffat *et al.*, 2005

M. Tech. Third Semester
(CSE)

There will be only one elective paper

List of Electives:
Advanced Embedded System

1. High Speed Networks
2. Neural Networks and Deep Learning
3. Parallel Computing
4. Medical Imaging and Analysis
5. Visual Grouping and Object Recognition
6. Distributed Algorithms
7. Fault Tolerant Computing
8. Robotics
9. Grid Computing
10. Concurrent Systems and its Applications
11. Virtual Reality
12. Human Computer Interface
13. Cognition and Computing
14. Interactive System Design Methods
15. Quantum Computing

M.Tech – Third Semester
(Computer Technology)

PAPER I A (Elective): Advanced Embedded Systems

Unit 1: Review to Embedded system

Architecture &Instruction set of MCS-51 family microcontrollers. Delay generation. Look-up tablesand their use as decoder.Interrupt & data polling techniques for multitasking operations in microcontrollers.Optimization by hardware and software partitioning.

Unit 2: Reliable & Redundant design

Reliability considerations.Considerations of life time for electronic components under various operating conditions. Function of watch dog timer In microcontrollers. Design of Redundant hardware circuits. Hardware software optimization for reliable and redundant systems with simple interfacing circuits

Unit 3: Interfacing in harsh environment

Input to microcontrollers from switches and relays. Effects of contact bounce and Its reduction by hardware circuit. Software techniques to neutralise the effect of contact bounce. Operation of microcontroller in presence of EMI & RFI. Microcontroller I/Ointerfacing for high voltage and high current switching. Decoupling with opticalIsolators.Reduction of clock frequency to avoid effects of switching transients and enterferences.

Unit 4: PLC Design with microcontroller

Symbols used In PLC diagram for representation of relays, contacts, actuators and motors for conveyer belt drive and other process. Ladder diagram representation and simple case studies for PLCs. Design of PLC using microcontroller.

Unit 5: Special design considerations in modem microcontrollers

Provisions of handling analogue Input and output data in microcontrollers. Analogue comparators, A/D converters and PWM output techniques used for analogue operation of microcontrollers. Enhanced port pin current capabilities in microcontrollers.

References:

1. Solid state circuit Design with Microcontrollers: C.K.Dwivedi.
2.The 8051 Microcontroller Architecture, Programming & Application: Kenneth J. Ayala.
3.Microcontrollers :Rajkamal