Course Structure

For

Post graduate Degree Programme

In

Engineering & Technology

Regulation 2019

M.Tech in Computer Science & Engineering

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I SEMESTER [FIRST YEAR]

M.Tech. Computer Science & Engineering

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC		Mathematical Foundation of Computer Science	3	0	0	3
2	PC		Advanced Data Structures	3	0	0	3
3	PE1		Machine Learning	3	0	0	3
			Wireless Sensor Networks				
			Introduction to Intelligent System				
			Network Security				
			Smart Sensors and Internet of Things				
			Cloud Computing				
4	PE2		Data Science	3	0	0	3
			Distributed Systems				
			Advanced Wireless and Mobile Networks				
			Pattern Recognition				
			Data Mining and Data Warehousing				
5	Audit		Research Methodology and IPR	2	0	0	2
6	Audit		Audit Course	2	0	0	0
PRACTICAL / SESSIONAL							
7	PC		Laboratory- 1(Advanced Data Structures)	0	0	4	2
8	PE		Laboratory- 2 (Machine Learning)	0	0	4	2
TOTAL				16	0	4	18

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II SEMESTER [FIRST YEAR]

M.Tech. Computer Science & Engineering

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC		Advance Algorithms	3	0	0	3
2	PC		Soft Computing	3	0	0	3
3	PE3		Data Preparation and Analysis	3	0	0	3
			Secure Software Design and Enterprise Computing				
			Computer Vision				
			Data Visualization				
			Big Data Analytics				
4	PE4		Human and Computer Interaction	3	0	0	3
			GPU Computing				
			Digital Forensics				
			Distributed Systems				
			Blockchain & Cryptocurrency				
5	Audit		Audit Course	2	0	0	0
PRACTICAL / SESSIONAL							
6	PC		Laboratory-3 (Soft Computing)	0	0	4	2
7	PE		Laboratory-4 (Based on Electives)	0	0	4	2
8			Mini Project with Seminar	2	0	0	2
TOTAL				**16**	**0**	**12**	**18**

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III SEMESTER [SECOND YEAR]

M.Tech. Computer Science & Engineering

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PE		Mobile Applications and Services	3	0	0	3
			High Performance Computing				
			Optimization Techniques				
2	OE		Business Analytics	3	0	0	3
			Industrial Safety				
			Operations Research				
			Cost Management of Engineering Projects				
			Composite Materials				
			Waste to Energy				
PRACTICAL / SESSIONAL							
3			Dissertation-I/ Industrial Training	0	0	20	10
4							
5							
TOTAL				**6**	**0**	**12**	**16**

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IV SEMESTER [SECOND YEAR]

M.Tech. Computer Science & Engineering

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	MCSOE3011	Dissertation-I	0	0	32	16
TOTAL							16

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

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SCHEME OF INSTRUCTION SUMMARY

M.Tech. Computer Science & Engineering

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER				TOTAL CREDITS	%
		I	II	III	IV		
1	Professional Core (PC)	8	10			18	26
2	Professional Electives (PE)	8	8	3		19	28
3	Open Electives (OE)			3		3	4
4	Audit Course(AU), Thesis Work , Seminar and VIVA-VOICE	2		10	16	28	41
	TOTAL	18	18	16	16	68	100

Course Structure

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(Detailed Syllabus)

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Subject Code	Name of the Subject	L	T	P	C	
MPCCS1010	**Mathematical Foundation of Computer Science**	**4**	**0**	**0**	**3**	

Course Out Come

After completion of the course, students would be able to:
- To understand the basic notions of discrete and continuous probability.
- Tounderstandthemethodsofstatisticalinference,andtherolethatsamplingdistributions play in those methods

Tobeabletoperformcorrectandmeaningfulstatisticalanalysesofsimpletomoderate complexity.

Unit 1

Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Unit 2

Randomsamples,samplingdistributionsofestimators**,**MethodsofMomentsand Maximum Likelihood

Unit 3

Statistical inference**,** Introduction to multi variate statistical models: regression and classification problems, principal components analysis**,** The problem of over fitting model assessment.

Unit 4

Graph Theory: Isomorphism, Planar graphs, graph coloring, and Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition.

Unit 5

Specialized techniques to solve combinatorial enumeration problems. Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Unit 6 (As per choice of faculty)

Portion covered can be tested through Internal evaluation only not to be included in University Examination.

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References
1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi Probability and Statistics with Reliability, Queuing, and Computer Science Applications .Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.

Alan Tucker, Applied Combinatorics ,Wiley

CourseCode	Name of the subject	L	T	P	C	QP
MPCCS1020	Advanced Data Structures					
SYLLABUS						

Unit 1
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.
Hashing: Review of Hashing, Hash Function, COllision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit 2
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4
Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The
Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding
Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit 5
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

Unit 6
Recent Trends in Hashing, Trees, and various Computational geometry methods for efficiently solving the new evolving problem

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books

Ref. Books
1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

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2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

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Subject Code	Name of the Subject	L	T	P	C	
MPECS1031	Machine Learning	4	0	0	3	
Syllabus					

UNIT 1

Introduction: defining learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation, supervised learning, unsupervised learning, Reinforcement learning, learning algorithms

UNIT 2

Decision Tree Learning: Representing concepts as decision trees, Recursive induction of decision trees, Picking the best splitting attribute: entropy and information gain, Searching for simple trees and computational complexity, Over fitting, noisy data, and pruning.

UNIT 3

Ensemble Learning: Bagging, boosting, and Ada-Boost, Experimental Evaluation of Learning Algorithms, Measuring the accuracy of learned hypotheses, Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing

UNIT 4

Rule Learning: Translating decision trees into rules, Artificial Neural Networks: Neurons and biological motivation, Linear threshold units, Perceptions: representational limitation and gradient descent training, Multilayer networks and back propagation, Hidden layers and constructing intermediate, distributed representations, Over fitting, learning network structure, recurrent networks.

UNIT 5

Support Vector Machines: Maximum margin linear separators, Kernels for learning non-linear functions, Bayesian Learning: theory and Bayes rule. Naive Baes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. K-Nearest-neighbor algorithm, Case-Based learning. Deep Learning overview and importance over machine learning

REFERENCES:-
1. Machine Learning- Tom M. Mitchell,- MGH
2. Machine Learning: An Algorithm Perspective, Stephen Marsland, Taylor & Francis(CRC)
3. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge University Press.
4. Richard o, Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
5. Chris Bishop, Neural Network for Pattern Recognition, Oxford University Press, 1995

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Subject Code	Name of the Subject	L	T	P	C	
MPECS1032	Wireless Sensor Networks	4	0	0	3	
Syllabus						

Unit 1:

Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors

Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture

Hardware Platforms: Motes, Hardware parameters

Unit 2:

Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

Unit 3:

Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized ,duty-cycled

Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis

MAC Protocol Analysis : Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)

Unit 4:

Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution

Unit 5:

Routing protocols: Introduction, MANET protocols **Routing protocols for WSN**: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast **Opportunistic Routing Analysis**: Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks

Unit 6:

ADVANCED TOPICS Recent development in WSN standards, software applications.

References:

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley2010
2. KazemSohraby, Daniel Minoli and Taieb Znati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience2007
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network TechnologiesfortheInformationExplosionEra",springer2010

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Subject Code	Name of the Subject	L	T	P	C	
MPECS1033	**Introduction to Intelligent Systems**	4	0	0	3	
Syllabus						

Unit 1:
Biological foundations to intelligent systems I: Artificial neural networks, Back- propagation networks, Radial basis function networks, and recurrent networks.

Unit 2:
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit 3:
Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard Architectures.

Unit 5:
Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dumpster - Shafer Theory of
Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

Unit 6:
Recent trends in Fuzzy logic, Knowledge Representation

References:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving .Addison Wesley, 6th edition.

2. RussellS.andNorvigP.(2009).ArtificialIntelligence:AModernApproach.Prentice-Hall,3rd edition.

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Subject Code	Name of the Subject	L	T	P	C	
MPECS1034	Network Security	4	0	0	3	
Syllabus						

Unit 1:
Data security: Review of cryptography. Examples RSA, DES, ECC.

Unit 2:
Authentication, non-repudiation and message integrity. Digital signatures and certificates. Protocols using cryptography (example Kerberos). Attacks on protocols

Unit 3:
Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IPSec.

Unit 4:
Web security – SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies. Access Control, firewalls and host/network intrusion detection

Unit 5:
Other topics: Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication

Unit 6:
Recent trends in IOT security, IDS and Biometric.

References:
1. W. R. Cheswick and S. M. Bellovin. Firewalls and Internet Security. Addison Wesley,1994.
2. W. Stallings. Cryptography and Network Security. Prentice Hall,1999.
3. B. Schneier. Applied Cryptography. Wiley,1999.

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Subject Code	Name of the Subject	L	T	P		
MPECS1035	Smart Sensors and Internet of Things	4	0	0		
Syllabus						

Unit 1:
Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT

Unit 2:
Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications
Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc

Unit 3:
Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors

Unit 4:
Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical
Vapor, Anodization, Sol-gel

Unit 5:
Interface Electronic Circuit for Smart Sensors and Challenges for
Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor

Unit 6:
 Recent trends in smart sensor for day to day life, evolving sensors and their architecture

References:
1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing

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2.	Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

Subject Code	Name of the Subject	L	T	P	C	
MPECS1036	**Cloud Computing**	**4**	**0**	**0**	**3**	
Syllabus						

Unit 1:
Introduction to Cloud Computing
OnlineSocialNetworksandApplications,Cloudintroductionandoverview, Different clouds,Risks,Novel applications of cloud computing

Unit 2:
Cloud Computing Architecture
Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model
Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, GovernanceintheCloud,BarrierstoCloudComputingAdoptionintheEnterprise

Unit 3:
Security Issues in Cloud Computing Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security **Identity and Access Management** Trust Boundaries and IAM, IAM Challenges, Relevant IAMS tandardsandProtocols for CloudServices, IAMP racticesin the Cloud, Cloud Authorization Management

Unit 4:
Security Management in the Cloud Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS **Privacy Issues** Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

Unit 5:
Audit and Compliance
Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Unit 6: ADVANCED TOPICS
Recent developments in hybrid cloud and cloud security.

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References:

1. CloudComputingExplained:ImplementationHandbookforEnterprises,JohnRhoton,Publication Date: November 2,2009
2. CloudSecurityandPrivacy:AnEnterprisePerspectiveonRisksandCompliance(Theoryin Practice),TimMather,ISBN-10:0596802765,O'ReillyMedia,September2009

CourseCode	Name of the Subject	L	T	P	C	QP
MPECS1041	Data Science					
SYLLABUS						

Unit 1:

Introduction to CoreConcepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit 2:

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 3:

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 4:

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

Unit 5:

Applications of Data Science, Technologies for visualization, Bokeh (Python)

Unit 6:

Recent trends in various data Collection and analysis techniques, various
visualization techniques, application development methods of used in data science.

Teaching Methods: Chalk& Board/ PPT

Text Books:

Reference Books:
1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.

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2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Subject Code	Name of the Subject	L	T	P	C	
MPECS1042	Distributed Systems	4	0	0	3	
Syllabus						

Unit 1: Introduction Distributed System Concepts:

Introduction, Distributed Computing Models, Software and hardware design issues in distributed system,

Client-Server Model Case Studies: WWW 1.0 , 2.0 , 3.0s

Basic Network Communication:

LAN and WAN Technologies, Classification of Networks, Protocols for Network Systems, ATM, Protocols for Distributed Systems

Unit 2: Interprocess and Remote Communication:

Message Passing, IPC in Mach, CBCAST protocol in ISIS,RPC Introduction and Basics, RPC Implementation and Communication, Sun RPC, RMI Implementation.

Unit 3: Distributed System Synchronization:

Introduction, Clock Synchronization, Logical and Global state, Mutual Exclusion, Election Algorithms,

Deadlocks in Distributed Systems, deadlock in message communication

Distributed System Management:

Resource Management, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach

Process Management and Migration, Threads, fault tolerance

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Unit 4:   Distributed Shared Memory:
DSM Concepts, Hardware Design Issues in DSM Systems, Implementing Issues in DSM Systems
Heterogeneous and other DSM systems

Unit-5: Distributed File and database System:
Introduction DFS, File Models, DFS Design, Semantics File Sharing, DFS Implementation, File
Caching in DFS, Replication in DFS, Sun Network File System, Google File System

Unit-6: Emerging Trends in Distributed Systems
Emerging Trends Introduction, Grid Computing, Service Oriented Architecture, Cloud Computing
The Future of Emerging Trends

Text Books:

1. Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University
2. Distributed Operating Systems by P. K. Sinha, PHI

Reference Books:

1. Distributed Systems: Principles and Paradigms, Taunenbaum
2. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd
    Edition, Hagit Attiya and Jennifer Welch, Wiley India
3. Distributed Systems: Concepts and Design, G. Coulouris, J. Dollimore, and T. Kindberg,
4. Java Network Programming & Distributed Computing by David Reilly, Michael Reilly.

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Subject Code	Name of the Subject	L	T	P	C	
MPECS1043	**Advanced Wireless and Mobile Networks**	**4**	**0**	**0**	**3**	
Syllabus						

Unit 1:

Introduction: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies-CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modeling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.

Wireless Local Area Networks: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Ad-hoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

Unit 2:

Wireless Cellular Networks: 1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies

Unit 3:

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview.

Wireless Sensor Networks

Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

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Unit 4:	
WIRELESS PANs Bluetooth AND Zigbee, Introduction to Wireless Sensors.	
Unit 5:	
SECURITY: Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.	
Unit 6:	
Advanced Topics: IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Ad-hoc Networks.	
Additional Topics	

Additional Topics
1. Mobile (Data Link Layer, Network Layer, Transport and Application Layer)
2. Queuing Theory and Network Performance Analysis

Text Book
1. Mobile Communications by Jochen Schiller, Pearson Education.
2. Wireless and Mobile Network Architecture by Yi-Bing Lin and Imrich Chlamtac, John Wiley and Sons.
3. Wireless Communication and Networking by V.K.Garg, Elsevier.

Subject Code	Name of the Subject	L	T	P	C	
MPECS1044	**Pattern Recognition**	**4**	**0**	**0**	**3**	
Syllabus						

Unit 1:
Basics of Probability, Random Processes and Linear Algebra (recap): Probability: independence of events, conditional and joint probability, Bayes theorem Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra.

Unit 2:
Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors, singular values, singular vectors.
Bayes Decision Theory : Minimum-error-rate classification. Classifiers, Discriminant functions decision normal density and discriminant function Normal density and

Unit 3:
Parameter Estimation Methods : Maximum-Likelihood estimation :Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation. Parzen-window method. K-Nearest Neighbor method

Unit 4:
Dimensionality reduction: Principal component analysis - it relationship to Eigen analysis. Fisher

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discriminate analysis - Generalized Eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Non negative matrix factorization - a dictionary learning method.

Unit 5:

Linear discriminant functions : Gradient descent procedures, Perceptron, Support vector machines - a brief introduction Artificial neural networks: Multilayer perception – feed for wark neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks

Unit 6:

Non-metric methods for pattern classification : Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART)

References:

- K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

Subject Code	Name of the Subject	L	T	P	C	
MPECS1045	Data Mining and Data Warehousing	4	0	0	3	
Syllabus						

After completion of the course, students would be able to:

- Study of different sequential pattern algorithms
- Study the technique to extract patterns from time series data and it application in real world.
- Can extend the Graph mining algorithms to Web mining
- Help in identifying the computing framework for Big Data

Unit 1:

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;

Unit 2:

Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

Unit 3:

Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

Unit 4:

Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;

Unit 5:

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Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Unit 6:
Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

References:
1. Jiawei Hanand MKamber, Data Mining Concepts and Techniques, ,Second Edition, Elsevier Publication,2011.
2. Vipin Kumar, Introduction to Data Mining-Pang-Ning Tan, Michael Steinbach, AddisonWesley, 2006.
3. GDong and JPei, Sequence Data Mining ,Springer,2007.

Subject Code	Name of the Subject	L	T	P	C	
MPUCS1050	Research Methodology and IPR	4	0	0	3	
Syllabus						

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

Unit 2:
Effective literature studies approaches analysis plagiarism Research ethics.

Unit 3:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under

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PCT.

Unit 5:

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

Unit 6:

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

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

CourseCode	Name of the Subject	L	T	P	C	QP
MPUCS1060	**Advance Algorithms**					
	Syllabus					

Unit1

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortestpath in edge-weighted case (Dijkasra's), depth-first search and computation ofstrongly connected components, emphasis on correctness proof of the algorithmand time/space analysis, example of amortized analysis.

Unit 2

Matroids: Introduction to greedy paradigm, algorithm to compute a maximumweight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterizationof maximum matching by augmenting paths, Edmond's Blossom algorithm tocompute augmenting path.

Unit 3

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to computemaximum flow, Edmond-Karp maximum-flow algorithm.

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Matrix Computations: Strassen's algorithm and introduction to divide andconquer paradigm, inverse of a triangular matrix, relation between the timecomplexities of basic matrix operations, LUP-decomposition.	
Unit 4 **Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction todynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials:** Chinese RemainderTheorem, Conversion between base-representation and modulo-representation.Extension to polynomials. Application: Interpolation problem. **Discrete Fourier Transform (DFT):** In complex field, DFT in modulo ring. FastFourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	
Unit 5 **Linear Programming:** Geometry of the feasibility region and Simplex algorithm **NP-completeness:** Examples, proof of NP-hardness and NP-completeness. **One or more of the following topics based on time and interest** Approximation algorithms, Randomized Algorithms, Interior Point Method,Advanced Number Theoretic Algorithm	
Unit 6 Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	
Ref. Books 1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein. 2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman. 3. "Algorithm Design" by Kleinberg and Tardos.	

Subject Code	Name of the Subject	L	T	P	C	
	Soft Computing	**4**	**0**	**0**	**3**	
Syllabus						
Unit 1 **INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics						
Unit 2 **FUZZY LOGIC:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making						
Unit 3						

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NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feedforward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks	
Unit 4	
GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.	
Unit 5	
Matlab /Python Lib: Introduction to Matlab /Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic	
Unit 6	
Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques	

References

1. Jyh: Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, Neuro: Fuzzy and Soft Computing®, Prentice: Hall of India,2003.

2. George J. Klirand BoYuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications ®, Prentice Hall, 1995.

Subject Code	Name of the Subject	L	T	P	C	QP
	Data Preparation and Analysis					
SYLLABUS						
Unit1: **Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues						
Unit2: **Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformationand segmentation						

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Unit3: **Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, HypothesisGeneration
Unit4: **Visualization:** Designing visualizations, Time series, Reallocated data, Correlations andconnections, Hierarchies and networks, interactivity
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books:
Ref. Books: 1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

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Subject Code	Name of the Subject	L	T	P	C	QP
	Secure Software Design and Enterprise Computing					

SYLLABUS

Unit 1:
Secure Software Design
Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

Unit 2:
Enterprise Application Development
Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Unit 3:
Enterprise Systems Administration
Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit 4:
Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Unit 5:
Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Unit 6:
Case study of DNS server, DHCP configuration and SQL injection attack.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

Reference Books:
1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

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Subject Code	Name of the Subject	L	T	P	C	
	Computer Vision	**4**	**0**	**0**	**3**	
Syllabus						

Unit 1: Digital Image Formation and low-level processing
Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Unit 2: Depth estimation and Multi-camera views
Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel

Unit 3: Feature Extraction
Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Unit 4: Image Segmentation
Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection

Unit 5: Pattern Analysis
Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Unit 6: Motion Analysis
Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Textbooks
- Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
- Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

References
- Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
- K. Fukunaga ; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992

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Subject Code	Name of the Subject	L	T	P	C	
	Data Visualization	4	0	0	3	
Syllabus						

After completion of the course, students would be able to:

- familiarwiththedesignprocesstodevelopvisualizationmethodsandvisualizationsystems, and methods for their evaluation
- preparation and processing of data, visual mapping and the visualization
- have an understanding of large-scale abstract data

Unit 1:
Introduction of visual of perception visual representation of data, Gestalt principles, information over loads.

Unit 2:
Creating visual representations, visualization on reference model, visual mapping, visual analytics, Design of visualization applications.

Unit 3:
Classification of visualization systems, Interaction and visualization techniques misleading,Visualizationofone,twoandmulti-dimensionaldata,textandtext documents

Unit 4:
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

Unit 5:
Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations

Unit 6:
Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization

References:

1. WARD, GRINSTEIN, KEIM,. Interactive Data Visualization: Foundations, Techniques, and Applications. Natick :AK Peters,Ltd.

2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

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Subject Code	Name of the Subject	L	T	P	C	
	Big Data Analytics	**4**	**0**	**0**	**3**	
Syllabus					

Unit 1:
What is big data**,** why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans fire wallanalytics.

Unit 2:
Introduction to No SQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less data bases, materialized views, distribution models, sharding ,master-slaver eplication, peer- peer replication, shardingand replication, consistency, relaxing consistency, versionstamps,map-reduce,partitioningandcombining,composingmap-reduce calculations.

Unit 3:
Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, dataflow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

Unit 4:
Map Reduce workflows, unit tests with MRU nit , test data and local tests, anatomy of Map Reduce jobrun, classic Map-reduce, YARN, failure sin classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats

Unit 5:
Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassan draexamples, Cassandraclients, Hadoopintegration.

Unit 6:
Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts.Hive , data types and file formats, Hive QL data definition, HiveQL data manipulation, HiveQL queries.

References:

1. MichaelMinelli,MichelleChambers,andAmbigaDhiraj,"BigData,BigAnalytics:Emerging
2. BusinessIntelligenceandAnalyticTrendsforToday'sBusinesses",Wiley,2013.

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3.	P.J.SadalageandM.Fowler,"NoSQLDistilled:ABriefGuidetotheEmergingWorldof

Subject Code	Name of the Subject	L	T	P	C	QP
	Human and Computer Interaction					
	SYLLABUS					

Unit 1:
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

Unit 2:
Interactive Design basics – process – scenarios – navigation – screen design –Iteration and prototyping. HCI in software process – software life cycle –usability engineering – Prototyping in practice – design rationale. Design rules– principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

Unit 3:
Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

Unit 4:
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture,Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Unit 5:
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Unit 6:
Recent Trends: Speech Recognition and Translation, Multimodal System

Teaching Methods: Chalk& Board/ PPT

Text Books:

Reference Books:
1. Alan Dix, Janet Finlay, Gregory Avowed, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, "Mobile Design and Development", First Edition , O□Reilly Media Inc., 2009 (UNIT – IV)
3.Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O□Reilly,   2009.(UNIT-

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Course Code	Name of the subject	L	T	P	C	QP
Course Name	GPU Computing					
SYLLABUS						

Unit 1:
Introduction: History, Graphics Processors, Graphics Processing Units,GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators,Parallel programming, CUDA OpenCL / OpenACC,Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

Unit 2:
Memory: Memory hierarchy, DRAM / global, local / shared, private / local,textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Unit 3:
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU
Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit 4:
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects
Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit 5:
Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Unit 6:
Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books &Reference Books: :
1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

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CourseCode	Name of the Subject	L	T	P	C	QP
	Digital Forensics					

SYLLABUS

Unit 1:
Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics

Unit 2:
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

Unit 3:
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Unit 4:
Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

Unit 5:
Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Unit 6:
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

References:
1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

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CourseCode	Name of the Subject	L	T	P	C	QP
	Distributed Systems					

SYLLABUS
Unit 1: **INTRODUCTION** Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and Computer network Concepts **DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues
Unit 2: **DISTRIBUTED DATABASE DESIGN** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation **SEMANTICS DATA CONTROL** View management; Data security; Semantic Integrity Control **QUERY PROCESSING ISSUES** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data
Unit 3: **DISTRIBUTED QUERY OPTIMIZATION** Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms **TRANSACTION MANAGEMENT** The transaction Concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models **CONCURRENCY CONTROL** ConcurrencyControl in centralized database systems; ConcurrencyControl in DDBSs; Distributed ConcurrencyControl algorithms; Deadlock management
Unit 4: **RELIABILITY** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recoveryprotocols
Unit 5: **PARALLEL DATABASE SYSTEMS** Parallel architectures; parallel query processing and optimization; load balancing
Unit 6: **ADVANCED TOPICS** Mobile Databases, Distributed Object Management, Multi-databases
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books &Reference Books: :

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1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992..

Subject Code	Name of the Subject	L	T	P		
	Blockchain & Cryptocurrency	**4**	**0**	**0**		
	Syllabus					

Unit 1:
Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.

Unit 2:
Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Unit 3:
Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Unit 4:
Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Di_culty Level, Sybil Attack, Energy utilization and alternate.

Unit 5:
Cryptocurrency Regulation: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy.

Unit 6:
Blockchain Applications: Internet of Things, Medical Record Management System, Do-main Name Service and future of Blockchain.

References:
    1.   Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
    2.   Wattenhofer, The Science of the Blockchain

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Course Code	Name of the Subject	L	T	P	C	QP
MCSPE3011	Mobile Applications and Services					

SYLLABUS
Unit 1: Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User
Unit 2: More on UIs: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider
Unit 3: Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony,   Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics
Unit 4: Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia
Unit 5: Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android
Unit 6: Recent trends inCommunication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT
Text Books
Ref. Books   1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

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Course Code	Name of the Subject	L	T	P	C	QP
MCSPE3012	**Compiler for High Performance Computing**					
SYLLABUS						

Unit1:
High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.

Unit2:
Data Dependence: Data Dependence in Loops, Data Dependence inConditionals, Data Dependence in Parallel Loops, Program Dependence Graph.
Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains,Constant Propagation with FUD Chains, Data Dependence for Scalars. DataDependence Analysis for Arrays.

Unit3:
Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis.
Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission,Loop Reversal, Loop Interchanging, Loop Skewing, Linear LoopTransformations, Strip-Mining, Loop Tiling, Other Loop Transformations, andInter-procedural Transformations.
Optimizing for Locality: Single Reference to Each Array, Multiple References,General Tiling, Fission and Fusion for Locality.

Unit4:
Concurrency Analysis: Concurrency from Sequential Loops, Concurrency fromParallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.
Vector Analysis: Vector Code, Vector Code from Sequential Loops, VectorCode from For all Loops, Nested Loops, Round off Error, Exceptions, andDebuggers, Multi-vector Computers.

Unit5:
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout,Parallel Code for Array Assignment, Remote Data Access, Automatic DataLayout, Multiple Array Assignments, Other Topics.
Scalable Shared-Memory Machines: Global Cache Coherence, Local CacheCoherence, Latency Tolerant Machines.

Unit 6:
Recent trends in compiler design for high performance computing and messagepassing machines and scalable shared memory machine.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books

Ref. Books
1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

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Course Code	Name of the Subject	L	T	P	C	QP
MCSPE3013	Optimization Techniques					
SYLLABUS						

Unit 1:
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.

Unit 2:
General Structure of Optimization Algorithms, Constraints, The Feasible Region.

Unit 3:
Branches of Mathematical Programming: Optimization using calculus,Graphical Optimization, Linear Programming, Quadratic Programming,Integer Programming, Semi Definite Programming.

Unit 4:
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

Unit 5:
Real life Problems and their mathematical formulation as standard programming problems.

Unit 6:
Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

Ref. Books:
1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493-1914-3.
6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.

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8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

Course Code	Name of the Subject	L	T	P	C	QP
MCSOE3021	**Business Analytics**					
SYLLABUS						

Unit1:
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for
Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3:
Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, EnsuringData Quality, Measuring contribution of Business analytics, ManagingChanges.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive
analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive
analytics and its step in the business analytics Process, Prescriptive Modelling,
nonlinear Optimization.

Unit 4:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information,Utility and Decision Making.

Unit 6:
Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

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Text Books:

Reference Books:
1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.   2. Business Analytics by James Evans, persons Education.

Course Code	Name of the Subject	L	T	P	C	QP
MCSOE3022	Industrial Safety					
SYLLABUS						

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards,types, causes and preventive steps/procedure, describe salient points of factories act 1948 for healthand safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc,Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering,Primary and secondary functions and responsibility of maintenance department, Types of maintenance,Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

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Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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Course Code	Name of the Subject	L	T	P	C	QP
MCSOE3023	**Operations Research**					
	SYLLABUS					

Unit 1:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3:
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming

Unit 5
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Teaching Methods: Chalk& Board/ PPT

Text Books:

Reference Books:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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Course Code	Name of the Subject	L	T	P	C	QP
MCSOE3025	Composite Materials					
SYLLABUS						

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials.Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books:
1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

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Course Code	Name of the Subject	L	T	P	C	QP
MCSOE3026	**Waste to Energy**					
	SYLLABUS					

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue,Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

References:
1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

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