MAULANA AZAD NATIONAL URDU UNIVERSITY

SCHOOL OF TECHNOLOGY

DEPARTMENT OF CS&IT

Revised curriculum for with effective from Academic Year 2018-19

M.Tech. (Computer Science)

1. Programme Title:

Master of Technology (M.Tech.) in Computer Science.

2. Duration and Mode:

Duration of programme for a student shall be two (2) years with four consecutive semesters after admission. The mode of the programme is Regular (semester system).

3. Objective:

The objective of this programme is to train the manpower required

a. to meet the industry needs of the country,
b. to pursue research in specialized areas, and
c. to meet the growing needs of engineering colleges for trained faculty in Computer Science.

4. Eligibility Criteria:

A candidate will be eligible for admission in to M. Tech. (Computer Science) program if he/she has obtained the Bachelor of Technology degree in Computer Science/Information Technology/Electronics & Communication Engineering or Master of Computer Application or Master of Science in Computer Science/Information Sciences/Electronics degree from recognized University with not less than 55% marks in the aggregate or its equivalent CGPA. The knowledge of Urdu for the candidate is essential.

5. Intake:

The number of seats for the program is eighteen (18).

6. Admission:

a. The admission to the M. Tech programme is based on the rank secured by the candidate in a written test conducted by the University. Minimum qualifying marks shall be 30% in Entrance Test. The written test will be of 100 marks.

b. GATE qualified candidates are exempted from the entrance exam.

c. The 60% seats are reserved for candidates qualified in entrance exam and 40% seats

are reserved for GATE qualified candidates. For GATE qualified candidates the preference will be given according to the rank in GATE exam. However if suitable number of GATE qualified candidates have not applied, the said seats may be filled through the entrance qualified candidates and vice-versa.

7. **Syllabus:** Each theory or lab courses shall have prescribed syllabus approved by BOS from time to time, as per following prescriptions:

   a. **Theory Courses:** Five (5) units largely based on ONE standard textbook and two Reference Books prescribed by the concerned teacher.

   b. **Lab Courses:** At least TEN (10) individual generic assignments and ONE Mini-Project, to be prescribed by the concerned teacher and approved by HoD.

8. **Evaluation of Dissertation:**
   Every candidate shall be required to submit Dissertation as per the following details:-

Dissertation Part - I Evaluation:

The evaluation of MTech dissertation Part-I shall be done as per the following norms:

i. **Registration of Dissertation Part-I:** A candidate is permitted to register for the Dissertation Part–I after attaining the CGPA of 5.0 in first year courses (theory and practical subjects).

ii. After satisfying clause (ii), a candidate has to submit dissertation proposal, in consultation with his/her supervisor stating the title, objective, proposed methodology, plan of work and tentative outcome to the DRC for its approval. Only after obtaining the approval of DRC the student can initiate the dissertation work.

iii. A candidate shall present **two (02)** dissertation progress presentations (Term-1 and Term-2) as internal assessment and **one (01)** end semester presentation as the overall evaluation before DRC including candidate's supervisor.

iv. A candidate shall submit progress report at the end of the third semester mentioning the qualitative work done with probable outcomes.

Dissertation Part - II Evaluation:

The evaluation of Dissertation Part - II of the candidate shall be done as per the following details:-

i. **Registration of Dissertation Part - II:** A candidate is permitted to register for the Dissertation part – II after satisfactory completion of **Dissertation Part – I**.

ii. A candidate shall present **one (01)** progress presentation and **one (01)** pre-submission presentation in front of the DRC as the internal assessment of Dissertation Part - II.

iii. At the time of progress presentation, a candidate shall submit status report (in a spiral

binding) duly signed by the supervisor to the DRC.

iv. Pre-submission of the Dissertation work of a candidate shall be allowed after at least one research paper is communicated / published in reputed Conference or Journal. Pre-submission of the Dissertation work will be processed only after signed consent application of the respective supervisor to the DRC chairman.

v. At the time of pre-submission, a candidate shall submit the draft copy of thesis certified by the respective supervisor to the DRC chairman before an oral presentation in front of the DRC and Supervisor.

vi. Three copies of the thesis certified by the supervisor shall be submitted to the Department after approval of the DRC.

vii. The thesis shall be evaluated by one examiner selected by the Dean. For this, Head of the Department shall submit a panel of 3 examiners eminent in that field.

viii. If the report of the examiner is unsatisfactory, the candidate shall revise and resubmit the thesis, in the time frame of two months. If the report of the examiner is unsatisfactory again, the thesis shall be extended to six months.

ix. If the report of the examiner is satisfactory, Head of the Department shall make arrangement for the conduct of viva-voce examination. Viva-voce examination shall be conducted in front of the supervisor and the external examiner.

x. If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination within two months.

Curriculum

1	Course Title	Contact periods per week			Credits	Internal Marks	External Marks	Total Marks
		Lecture L	Tutorial T	Practical P				
Semester - 1								
MTCS101PCT	Advanced Network Security	3	1	0	4	30	70	100
MTCS102PCT	Advanced Computer Architecture	3	1	0	4	30	70	100
MTCS103PCT	Neural Networks	3	1	0	4	30	70	100
MTCS104PCT	Distributed Databases	3	1	0	4	30	70	100
MTCS101PET	Elective-I	3	1	0	4	30	70	100
MTCS150PCP	Distributed Databases Lab	0	0	4	2	50	50	100
MTCS151PCP	Seminar	0	0	4	2	50	50	100
MTCS101NCT	**Tarseel-e-Urdu	3	0	0	-	30	70	100
	Total	15	5	8	24	250	450	700
Semester - 2								
MTCS201PCT	Advanced Operating Systems	3	1	0	4	30	70	100
MTCS202PCT	Data Structure and Algorithm Design	3	1	0	4	30	70	100
MTCS203PCT	Distributed Systems	3	1	0	4	30	70	100
MTCS201PET	Elective-II	3	1	0	4	30	70	100
MTCS211PET	Elective-III	3	1	0	4	30	70	100
MTCS250PCP	Data Structure and Algorithm Design Lab	0	0	4	2	50	50	100
MTCS251PCP	Comprehensive Viva	-	-	-	2	50	50	100
	Total	15	5	4	24	250	450	700
Semester - 3								
MTCS350PCD	Dissertation Part - I	-	-	-	16	300	700	1000
	Total	-	-	-	16	300	700	1000
Semester - 4								
MTCS450PCD	Dissertation Part - II	-	-	-	16	300	700	1000
	Total	-	-	-	16	300	700	1000
	Grand Total				80	**1100**	**2300**	**3400**

List of electives

Course No.	Course Title	Contact periods per week			Credits
		Lecture L	Tutorial T	Practical P	
Elective-I					
MTCS101PET	Parallel Algorithm	3	1	0	4
MTCS102PET	Pattern Recognition	3	1	0	4
MTCS103PET	Cluster and Grid Computing	3	1	0	4
MTCS104PET	Wireless & Mobile Communication	3	1	0	4
MTCS105PET	Machine Learning	3	1	0	4
MTCS106PET	Fuzzy Systems	3	1	0	4
Elective-II					
MTCS201PET	Real Time System	3	1	0	4
MTCS202PET	Software Metrics	3	1	0	4
MTCS203PET	Software Quality Engineering	3	1	0	4
MTCS204PET	Wireless Mobile Network	3	1	0	4
MTCS205PET	Natural Language Processing	3	1	0	4
MTCS206PET	Applied Cryptography	3	1	0	4
Elective-III					
MTCS211PET	Human Computer Interaction	3	1	0	4
MTCS212PET	Bioinformatics	3	1	0	4
MTCS213PET	Information Security and Cyber Laws	3	1	0	4
MTCS214PET	Advanced Networks	3	1	0	4

Course Code	Course Title	Lecture			
MTCS101PCT	Advanced Network Security	L	T	P	Semester: I
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To describe the following electronic payment systems: NetBill, PayWords, MicroMint, fair exchange protocols.
2. To explain the two types of group management techniques: group key agreement and group key distribution.
3. To explain at least on secure MANET routing protocol

Course Outcomes:

1. Have a knowledge of the threats faced by computer operating systems, applications and networks that originate from network based attacks, intrusion and misuse
2. Have a knowledge of the types of countermeasures that can be put in place in computer systems, networks, and network infrastructures to identify, reduce or prevent problems caused by network attacks or misuse
3. Be capable of making informed choices of the appropriate countermeasures that should be put in place to protect systems from network attacks or misuse and to maintain network security

Detailed Contents:

Unit: 1	Introduction to the Concepts of Security: The need for security, Security Approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks.
Unit: 2	Modular arithmetic, prime numbers, relative prime numbers, Euler's function, GCD. Computer-based Symmetric Key Cryptographic Algorithms: Algorithm Types and Modes, International Data Encryption Algorithm (IDEA), RC5, Blowfish, AES, Differential and Linear Cryptanalysis.
Unit: 3	Computer-based Asymmetric Key Cryptography: Brief History of Asymmetric Key Cryptography, An overview of Asymmetric Key Cryptography, Rabin Algorithm, Elgamal Algorithm, Knapsack Algorithm, ID-based cryptography.
Unit: 4	Public Key Infrastructure: Digital Certificates, Private Key Management, The PKI Model, Internet Security Protocols: Secure Socket Layer, Secure Electronic Transaction, SHTTP, Time Stamping Protocol, 3-D Secure Protocol, Electronic payment systems: Electronic billing systems, Micropayments, Fair exchange protocols, E-mail Security.
Unit: 5	Understanding Session Hijacking, Spoofing, TCP Concepts Sequence numbers. Sniffing,, RDDoS, XSS Attack, WLAN Scanners, Securing Wireless Networks, Anonymous Wireless Communication, Jamming and anti-jamming techniques for wireless networks.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Cryptography and Network Security by Behrouz A. Forouzan, 2nd Edition TMH.
2	Cryptography and Network Security, W. Stallings, Prentice Hall, 5th Edition, 20102.

Reference Books:

1	Network Security Essentials, William Stallings ,Prentice Hall, 5th Edition, 2013
2	Firewalls and Internet Security, William R. Cheswick and Steven M. Bellovin, Addison-Wesley Professional, 2ndEdition, 2003.
3	Hackers Beware, Eric Core, EC-Council Press, 2003

Course Code	Course Title	Lecture			
MTCS102PCT	Advanced Computer Architecture	L	T	P	Semester: I
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To learn the fundamental aspects of computer architecture design and analyse
2. To focus on processor design, pipelining, superscalar, out-of-order execution, caches (memory hierarchies), virtual memory, storage systems, and simulation technique.
3. To understand different processor architectures and system-level design processes.

Course Outcomes:

1. Will know about computer performance, instruction set architecture design and implementation
2. Will know about uniprocessor implementation alternatives (single- cycle, multiple-cycle, and pipelined implementations).
3. Understand the organisation and operation of current generation parallel computer systems, including multiprocessor and multicore systems

Detailed Contents:

Unit: 1	**Review of Basic Organization and Architectural Techniques:** RISC processors, Characteristics of RISC processors, RISC Vs CISC, Classification of Instruction Set Architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level, Classification of parallel architectures.
Unit: 2	**Instruction Level Parallelism:** Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data, and control, Hazards, Overview of hazard resolution techniques, Dynamic instruction scheduling, Branch prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution**.**
Unit: 3	**Memory Hierarchies:** Basic concept of hierarchical memory organization, Main memories, Cache memory design and implementation, Virtual memory design and implementation, Secondary memory technology, RAID.
Unit: 4	**Thread Level Parallelism:** Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, Synchronization, Memory consistency, Multicore architecture, Review of modern multiprocessors.
Unit: 5	**Process Level Parallelism:** Distributed computers, Clusters, Grid, Mainframe computers. **Peripheral Devices:** Bus structures and standards, Synchronous and asynchronous buses, Types and uses of storage devices, Interfacing I/O to the rest of the system, Reliability and availability, I/O system design, Platform architecture.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Hennessey and Patterson, "Computer Architecture: A quantitative Approach", Morgan Kaufman.
2	

Reference Books:

1	Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill
2	Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill international Edition.

Course Code	Course Title	Lecture			Semester: I
MTCS103PCT	Neural Network	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
2. To provide knowledge of types of neural networks.
3. To provide knowledge of computation and dynamical systems using neural networks.

Course Outcomes:

1. The role of neural networks in engineering, artificial intelligence, and cognitive modelling.
2. Have an understanding of the concepts and techniques of neural networks through the study of the most important neural network models.
3. Have knowledge of sufficient theoretical background to be able to reason about the behavior of neural networks.

Detailed Contents:

Unit: 1	General characteristics of the human brain, Introduction to Biological Neural Networks, Nerve structure and synapse, Basic concepts of Neural Networks, Characteristics of Neural Networks, Terminologies, Applications of the artificial neural networks.
Unit: 2	Structure of a neural net (topology), Directed graphs, Models of Neuron, Neural Network Architectures, Artificial Neuron, Activation functions, Threshold function, Piecewise linear function, Sigmoidal function, Supervised learning, Unsupervised learning, Re-inforcement learning.
Unit: 3	Knowledge Representation, Artificial Intelligence, Learning rules, Error correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, Single layer perceptron, Multilayer perceptron, Back propagation, Recurrent networks, Network Pruning.
Unit: 4	Adaptive networks, Supervised Learning Neural Networks, Decision-based neural networks, Hierarchical neural networks, Probabilistic neural network, Radial basis function networks, Comparison of RBF Networks and Multilayer perceptron.
Unit: 5	Classification of linearly separable patterns, Boltzmann machine, Sigmoid Belief Networks, Helmholtz machine, Support vector machines, Self organization maps, Genetic Algorithms, Optimization, Prediction Systems, speech and decision-making.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	S. Haykin, "Neural Networks a comprehensive Foundation" second edition, Prentice-Hall India.
2	Laurene Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Prentice Hall, 1993.
3	Michael A Arbib, "The Handbook of Brain Theory and Neural Networks", Second Edition, MIT Press/

Reference Books:

1	Jacek M. Zurada, Introduction to artificial neural systems, Jaico Publ. House, 1994.
2	Anderson, —An introduction to Artificial Neural Networks‖, Prentice Hall.
3	B. Yegnanarayana, —Artificial Neural Networks‖, PHI

Course Code	Course Title	Lecture			Semester: I
MTCS104PCT	Distributed Databases	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To enhance the previous knowledge of database systems by deepening the understanding of the theoretical and practical aspects of the database technologies and showing the need for distributed database technology to tackle deficiencies of the centralized database systems.
2. To expose active and emerging research issues in distributed database systems and application development.
3. To apply theory to practice by building and delivering a distributed database query engine, subject to remote Web service calls.

Course Outcomes:

1. Explain the techniques used for data fragmentation, replication, and allocation during the distributed database design process.
2. Evaluate simple strategies for executing a distributed query to select the strategy that minimizes the amount of data transfer.
3. Describe distributed concurrency control based on the distinguished copy techniques and the voting methods.

Detailed Contents:

Unit: 1	Transaction and schedules, Concurrent Execution of transaction, Conflict and View Serializability, Testing for Serializability, Concepts in Recoverable and Cascade less schedules.
Unit: 2	Lock based protocols, time stamp based protocols, Multiple Granularity and Multisession Techniques, enforcing serializablity by Locks, multiple lock modes, Architecture for locking scheduler.
Unit: 3	Introduction to distributed databases, advantages and disadvantages of distributed database, additional functions of Distributed database, distributed DBMS, Distributed Transactions Management, Fragmentation and Replication Techniques, Fragmentation schema, allocation schema data replication.
Unit: 4	Recovery and atomicity in Distributed Databases, Traditional recovery techniques, Log based recovery, recovery techniques used for ensuring atomicity, Recovery with Concurrent Transactions, Checkpoints, Algorithm for recovery.
Unit: 5	Distributed Query Processing, Semi joins, general queries Cost based query optimization for Distributed database, integrity constraints in distributed database, Distributed Deadlock.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Silberschatz, orth and Sudershan, Database System Concept, Mc Graw Hill.
2	Garcia-Molina, Ullman,Widom,' Database System Implementation' Pearson Education

Reference Books:

1	Ceei and Pelagatti,'Distributed Database', TMH.
2	M.Tamer Ozsu, 'Principles of distributed database Systems' second edition Pearson education

Course Code	Course Title	Lecture			Semester: I
MTCS101PET	Parallel Algorithm	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the scope, design and model of parallelism
2. To understand analytical modeling and performance of parallel programs.
3. To solve a complex problem with message passing model and programming with MPI

Course Outcomes:

1. Develop message-passing parallel programs with MPI.
2. Reconstruction of emerging parallel algorithms with MPI.
3. Compare and contrast various parallel algorithms using shared memory and MPI

Detailed Contents:

Unit: 1	Parallel Algorithm Design**:** Boundary Value Problem, Finding the Maximum, Complexity measure for parallel algorithms.
Unit: 2	Parallel Combinatorial Algorithms: Permutations with and without repetitions, combinations, derangements.
Unit: 3	Parallel Searching Algorithms: Maximum/ minimum, median, k^{th} largest/smallest element, Parallel sorting algorithms.
Unit: 4	Parallel Graph Algorithms: Parallel graph search and tree traversal algorithms, parallel algorithms for connectivity problems, parallel algorithms for path problems.
Unit: 5	Programming for Parallel Algorithms: Shared-Memory Programming with OpenMP, Message-Passing Programming, Performance Analysis.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Introduction to Algorithms. Third edition. Cormen, Leiserson, Rivest, Stein. The MIT Press
2	

Reference Books:

1	Parallel Programming in C with MPI and OpenMP International Edition (2004) Michael J. Quinn McGraw-Hill
2	

Course Code	Course Title	Lecture			Semester: I
MTCS102PET	Pattern Recognition	L	T	P	
Version:	Date of Approval:	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Course Objectives:

1. To gain knowledge about state-of-the-art algorithms used in pattern recognition research
2. To understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
3. To apply pattern recognition techniques in practical problems.

Course Outcomes:

1. Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.
2. Apply pattern recognition techniques to real-world problems such as document analysis and recognition.
3. Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

Detailed Contents:

Unit: 1	**Pattern recognition fundamentals:** Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model.
Unit: 2	**Bayesian decision theory:** Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features, Missing and noisy features, Bayesian networks (Graphical models) and inferencing.
Unit: 3	**Maximum-likelihood and Bayesian parameter estimation:** Maximum-Likelihood estimation: Gaussian case, Maximum a Posteriori estimation, Bayesian estimation: Gaussian case, Problems of dimensionality, Dimensionality reduction: Fisher discriminant analysis, PCA Expectation-Maximization method: Missing features.
Unit: 4	**Sequential Models:** State Space, Hidden Markov models, Dynamic Bayesian, Non-parametric techniques for density estimation: Parzen-window method, K-Nearest Neighbour method **Linear discriminant functions:** Gradient descent procedures, Perceptron criterion function, Minimum-squared-error procedures, Ho-Kashyap procedures, Support vector machines.
Unit: 5	**Unsupervised learning and clustering:** Unsupervised maximum-likelihood estimates, Unsupervised Bayesian learning, Criterion functions for clustering, Algorithms for clustering: K-means, Hierarchical and other methods, Cluster validation, Low-dimensional representation and multidimensional scaling (MDS).

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Pattern Recognition principles: Julus T. Tou and Rafel C. Gonzalez, Addision –Wesley.
2. Pattern recognition and machine learning, Christopher M. Bishop, Springer 2006
3. A probabilistic theory of pattern recognition, Luc Devroye, László Györfi, Gábor Lugosi, Springer, 1996.

Reference Books:

1. Pattern classification, Richard O. Duda, Peter E. Hart and David G. Stork, Wiley, 2001
2. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley.

Course Code	Course Title	Lecture			Semester: I
		L	T	P	
MTCS103PET	Cluster and Grid Computing	3	0	0	
Version:	**Date of Approval:**				

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To focus on High Performance Computing clusters and web services and their applications in federated and economic models of Grid and Cloud computing.
2. To provide an insight for achieving cost efficient high performance system.
3. To deal with design and architecture of grid and cluster computing.

Course Outcomes:

1. Introduction to distributed and high-performance computing.
2. Grid toolkit approach: Globus Hourglass concept, communication, resource and process management, data access, security
3. Security: Confidentiality, integrity and availability. Authentication, authorization, assurance, auditing, accounting.

Detailed Contents:

Unit: 1	**Cluster Computing:** Introduction to concepts in Cluster based distributed computing Hardware technologies for cluster computing and software for cluster computing, and different Software Architecture for Cluster Computing.
Unit: 2	**Resource management and scheduling:** Managing, cluster resources: single system images, system level middleware, distributed task scheduling, monitoring and administering system resources Parallel I/O and Parallel Virtual File System. Scheduling: Condor, Maui Scheduler, Portable Batch System (PBS)**.**
Unit: 3	**Grid Computing:** Grids and Grid Technologies, Programming models and Parallelization Techniques, Grid Security Infrastructure, Setting up Grid, deployment of Grid software and tools, and application execution.
Unit: 4	**Standard application development tools and paradigms**: Performance evaluation tools, HINT, netperf, netpipe, ttcp, Iperf**.** message.
Unit: 5	**Data Management:** Application Case Study: Molecular Modeling for Drug Design and Brain Activity Analysis, Resource management and scheduling

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	William Gropp, Ewing Lusk, Thomas Sterling, Beowulf Cluster Computing with Linux, 2nd edition, MIT Press.
2	Bart Jacob, Michael Brown, Introduction to grid computing.
3	MPI The Complete Reference - 2nd Ed by Marc Snir, et. al., The MIT Press, 1998.

Reference Books:

1	Parallel Programming with MPI by Peter Pacheco, Morgan Kaufmann, 1998.
2	Gregory F. Pfister, In Search of Clusters: The ongoing battle in lowly parallel computing, Second Edition, Prentice Hall Publishing Company, 1998.

Course Code	Course Title	Lecture			Semester: I
		L	T	P	
MTCS104PET	Wireless & Mobile Communication	3	0	0	
Version:	**Date of Approval:**				

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the Wireless medium control and Mobile Architecture concepts.
2. To describe emerging technology in the Wireless mobile networking areas and assess their current capabilities, limitations and potential applications.
3. To study and analyse wireless network standards, network protocols, architecture, algorithms and other safety critical issues in real-life scenario.

Course Outcomes:

1. Examine and analyze the difference between Wireless and conventional communication techniques.
2. Examine and analyze network security issues like confidentiality, integrity, availability, authentication and authorization, DoS
3. Analyze and implement application of wireless and mobile communication based systems.

Detailed Contents:

Unit: 1	**Introduction:** Network Technologies and Cellular Communications, Discussion on Bluetooth &GSM. Introduction to Mobile Computing: novel applications, limitations, and architecture. **(Wireless) Medium Access Control:** Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.
Unit: 2	**Mobile Architecture:** Mobile Network Layer: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).
Unit: 3	**Mobile Transport Layer:** Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time out freezing, Selective retransmission, Transaction oriented TCP.
Unit: 4	**Mobile Ad hoc Networks (MANETs):** Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs.
Unit: 5	**Protocols and Tools:** Wireless Application Protocol WAP. (Introduction, protocol architecture, and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME, Latest Technologies.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Mobile and Personal communication System and Services- Raj Pandya.
2	Wireless Communication and Networks- William Stallings

Reference Books:

1	Fundamentals of Wireless Communication, David Tse and Pramod Viswanath, Cambridge University Press, 2005.
2	Wireless and Personal Communications Systems, Vijay Garg, Joseph Wilkes, Prentice-Hall, Englewood Cliffs, NJ, 1996.

Course Code	Course Title	Lecture			
MTCS105PET	Machine Learning	**L**	**T**	**P**	**Semester:** I
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the basic building blocks and general principles that allow one to design machine learning algorithms
2. To become familiar with specific, widely used machine learning algorithms
3. To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance.

Course Outcomes:

1. Develop an appreciation for what is involved in learning from data.
2. How to apply a variety of learning algorithms to data.
3. How to perform evaluation of learning algorithms and model selection.

Detailed Contents:	
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, Overfitting, 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. **Perceptrons:** representational limitation and gradient descent training. Multilayer networks and back propagation. Hidden layers and constructing intermediate. Overfitting, 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 Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logisitic 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.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	

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

Course Code	Course Title	Lecture			Semester: I
MTCS106PET	Fuzzy Systems	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand basic knowledge of fuzzy sets and fuzzy logic
2. To apply basic knowledge of fuzzy information representation and processing
3. To understand the basic notion of computational verb controllers.

Course Outcomes:

1. Identify different neural network architectures, their limitations and appropriate learning rules for each of the architectures.
2. Demonstrate knowledge and understanding of fuzzy system as they apply in engineering and science.
3. Develop models for different applications using fuzzy system and MATLAB.

Detailed Contents:	
Unit: 1	Introduction, Basic Types, Basic Concepts, Representations of Fuzzy Sets, Extension Principle for Fuzzy Sets, Types of Operations. Fuzzy Complements, Fuzzy Intersections: t- Norms., Fuzzy Unions: t-Conorms, Combinations of Operations. Aggregation Operations. Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals, Arithmetic Operations on Fuzzy Numbers, Fuzzy Equations.
Unit: 2	Crisp versus Fuzzy Relations, Projections and Cylindric Extensions, Binary Fuzzy Relations, Binary Relations on a Single Set. Fuzzy Equivalence Relations, Fuzzy Compatibility Relations. Fuzzy Ordering Relations, Fuzzy Morphisms, Sup-i Compositions of Fuzzy Relations, Compositions of Fuzzy Relations.
Unit: 3	Fuzzy Measures, Fuzzy Sets and Possibility Theory, Classical Logic: An Overview. Multivalued Logics. Fuzzy Propositions. Fuzzy Quantifiers. Linguistic Hedges. Inference from Conditional Fuzzy Propositions. Inference from Conditional and Qualified Propositions. Inference from Quantified Propositions, Information and Uncertainty, Nonspecificity of Fuzzy Sets. Fuzziness of Fuzzy Sets. Principles of Uncertainty.
Unit: 4	Fuzzy Expert Systems: An Overview. Fuzzy Implications. Selection of Fuzzy Implications. Multiconditional Approximate Reasoning. The Role of Fuzzy Relation Equations, Fuzzy Controllers: Overview, Fuzzy Neural Networks. Fuzzy Automata. Fuzzy Dynamic Systems.
Unit: 5	Fuzzy Databases. Fuzzy Information Retrieval, Individual Decision Making, Multiperson Decision Making, Multicriteria Decision Making, Multistage Decision Making, Fuzzy Systems and Genetic Algorithms.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	George J. Klir, Bo Yuan, "Fuzzy Sets and Fuzzy Logic", PHI
2	
Reference Books:	
1	Witold Pedrvcz and Femando Gomide. "An Introduction to Fuzzy Sets", PHI
2	

Course Code	Course Title	Lecture			Semester: I
MTCS150PCP	Distributed Database Lab	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	4	End Semester	:	50
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To developing and managing efficient and effective database applications requires understanding the fundamentals of database management systems, techniques for the design of databases, and principles of database administration.
2. To emphasize database concepts, developments, use and management in three main sections: database concepts, practice, and emerging trends.
3. To design databases and developing database applications using modern software tools will be emphasized.

Course Outcomes:

1. Understand the fundamentals of relational, object-oriented, and distributed database systems including: data models, database architectures, and database manipulations
2. Understand the theories and techniques in developing database applications and be able to demonstrate the ability to build databases using enterprise DBMS products such as Oracle or SQL Server.
3. Be familiar with managing database systems.

Detailed Contents:

Lab are based on the database design on oracle and visual basic through which students are required to develop a database application system and document the conceptual and logical design of the distributed database.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:	
1	
2	
Reference Books:	
1	
2	

Course Code	Course Title	Lecture			
MTCS201PCT	Advanced Operating System	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To read classic systems papers that shaped the field.
2. To present technical materials to others both orally and in written form.
3. To improve the accuracy and precision with which you express ideas.

Course Outcomes:

1. Master understanding of design issues associated with operating systems.
2. Master various process management concepts including scheduling, synchronization, and deadlocks.
3. Be familiar with various types of operating systems including UNIX.

Detailed Contents:

Unit: 1	**Introduction:** Operating system concept - processes and threads, process model, process creation, process termination, process hierarchies, and process states, Implementation of processes, Threads- Thread model, thread usage, Implementation of threads in user space and kernel, Hybrid implementations.
Unit: 2	**Inter Process Communication:** Race conditions, critical regions, Mutual Exclusion with busy waiting, sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing; Scheduling- scheduling in batch systems, Interactive systems, Real time systems, Thread scheduling.
Unit: 3	**Deadlocks:** Introduction, Deadlock Detection and Recovery – Deadlock Detection with one resource of each type, with multiple resource of each type, recovery from deadlock; Deadlock Avoidance, Deadlock Prevention.
Unit: 4	**Memory and Device Management:** Introduction, Swapping, Paging, Virtual memory – Demand paging, page replacement Algorithms; File System Management- Organization of File System, File Permissions, MS DOS and UNIX file system case studies, NTFS; Device Management- I/O Channels, Interrupts and Interrupt Handling, Types of device allocation.
Unit: 5	**Distributed Operating Systems:** Distributed operating system concept – Architectures of Distributed Systems, Distributed Mutual Exclusion, Distributed Deadlock detection, Agreement protocols, Threads, processor Allocation, Allocation algorithms , Distributed File system design; Real Time Operating Systems: Introduction to Real Time Operating Systems, Concepts of scheduling , Real time Memory Management.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Mukesh Singhal and Niranjan, "Advanced Concepts in Operating Systems", TMH, 1st Edition, 2001.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, 2nd Edition, 2006.

Reference Books:

1. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education, 2nd Edition, 2001.
2. Pradeep K. Sinha, "Distributed Operating Systems and concepts", PHI, First Edition, 2002

Course Code	Course Title	Lecture			
MTCS202PCT	Data Structure and Algorithm Design	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To analyse the asymptotic performance of algorithms.
2. To apply important algorithmic design paradigms and methods of analysis.
3. To synthesize efficient algorithms in common engineering design situations

Course Outcomes:

1. Basic ability to analyse algorithms and to determine algorithm correctness and time efficiency class.
2. Master a variety of advanced abstract data type (ADT) and data structures and their implementations.
3. Ability to apply and implement learned algorithm design techniques and data structures to solve problems

Detailed Contents:	
Unit: 1	**Introduction:** Algorithms, analysis of algorithms, Growth of Functions, Master's Theorem, Designing of Algorithms. Sorting and order Statistics: Heap sort, Quick sort, sorting in Linear time, Medians and Order Statistics.
Unit: 2	**Advanced Data Structure:** Red-Black Trees, Augmenting Data Structure. B-Trees, Binomial Heaps, Fibonacci Heaps, Data Structure for Disjoint Sets.
Unit: 3	**Decrease and Conquer:** Insertion Sort, Depth First Search and Breadth First Search, Topological Sorting, algorithms for Generating Combinatorial Objects. **Greedy Method:** minimum-cost spanning trees: Prim's and Kruskal's algorithms – Single source shortest paths: Dijkstra's algorithm and Bellman Ford algorithms.
Unit: 4	**Dynamic Programming:** Concepts**,** Dynamic programming v/s. divide and conquer, Applications-Matrix chain multiplication, Optimal binary search trees, All pairs shortest path problem-Warshal's and Floyd's algorithms, Longest Common sequence(LCS).
Unit: 5	**Decision Trees,** P, NP, NP-complete problems, NP-hard problem. Randomized Algorithms, String Matching, Approximation Algorithms.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	

Text Books:	
1	Cormen, Leiserson, Rivest and Stein, "Introduction to Algorithms", 2nd Edition, by, McGraw-Hill, 2000.
2	
Reference Books:	
1	E. Horowitz, and S. Sahni, "Fundamentals of Computer Algorithms", University Press.
2	Anany V. Levitin, Introduction to the Design and Analysis of Algorithms, Pearson. Sridhar, "Design and Analysis of Algorithms" Oxford Press.

Course Code	Course Title	Lecture			
MTCS203PCT	Distributed System	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To introduce concepts related to distributed computing systems.
2. To focus on performance and flexibility issues related to systems design decisions.
3. To expose students to current literature in distributed systems.

Course Outcomes:

1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies.
2. Demonstrate knowledge of the core architectural aspects of distributed systems.
3. Design and implement distributed applications.

Detailed Contents:

Unit: 1	**Characterization of Distributed Systems**: Resource sharing and the Web Challenges. Architectural models, Fundamental Models. **Theoretical Foundation for Distributed System:** Limitation of Distributed system, Logical clocks, Lamport's & vectors logical clocks.
Unit: 2	**Concepts in Message Passing Systems:** Message Ordering, Causal ordering of messages, global state, and termination detection. **Distributed Mutual Exclusion:** Classification of distributed mutual exclusion, requirement of Mutual exclusion, Token based and non token based algorithms.
Unit: 3	**Distributed Deadlock Detection:** resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms. **Agreement Protocols:** classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem.
Unit: 4	**Distributed Resource Management:** Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, **Failure Recovery in Distributed Systems:** Concepts in Backward and Forward recovery, Recovery in Concurrent systems, obtaining consistent Checkpoints, Recovery.
Unit: 5	**Fault Tolerance:** Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols. **Transactions and Concurrency Control:** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	Advanced Concepts in Operating Systems, M Singhal, N G Shivarathri, Tata McGraw-Hill Edition.
2	Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Ed.
Reference Books:	
1	Distributed Systems – Principles and Paradigms, A.S. Tanenbaum and M.V. Steen, Pearson Education
2	Distributed Computing, S.Mahajan and S.Shah, Oxford University Press.
3	Ramakrishna,Gehrke," Database Management Systems", Mc Grawhill

Course Code	Course Title	Lecture			
MTCS201PET	Real Time Systems	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To explain the basic concepts of RTS and resource allocation techniques of RTS.
2. To introduce the features specific for Real Time Systems.
3. To discuss the various issues involved in Real Time System design and development.

Course Outcomes:

1. Understand real time systems and real time operating systems.
2. Illustrate the various real time design principles.
3. Analyze the various risks associated with real time system.

Detailed Contents:

Unit: 1	**Real-time systems:** Real-time systems models, Types of real-time systems, internal structure of real-time systems, Performance measures, Examples of real-time systems and real-world applications, Modeling & Designing real-time system.
Unit: 2	**Real-Time Process Management:** Task scheduling for Uniprocessor systems, handling priorities with critical section, interrupts, task allocation & scheduling for multiprocessor systems, adaptive scheduling.
Unit: 3	**Programming Environment:** In depth Knowledge of RTOS programming languages, tools & techniques.
Unit: 4	**Real-Time System Design:** Design techniques for Reliability, Fault Tolerance & other application specific quality considerations.
Unit: 5	Trends in Real-Time System Design & Development in fields such as Robotics. Introduction to research topics.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. A.C. Shaw, Real-Time Systems and Software, Wiley.
2. J.E. Cooling, Real-Time Software Systems, International Thompson Computer Press.
3. Real-Time Systems Design and Analysis, P.H. Laplante, IEEE Press

Reference Books:

1. Real-Time Systems, J. Liu, Prentice-Hall, 2000
2. Real-Time Computer Control, R. Bennett, Prentice-Hall
3. Real-Time Systems, C.M. Krishna and K.G. Shin, McGraw-Hill

Course Code	Course Title	Lecture			
MTCS202PET	Software Metrics	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provide an overview of Software Metrics – Measurement – Metric Types – Scales.
2. To give examples of where Metrics are used and explain some of the issues with Software Metrics.
3. To look at why Software Metrics is important with regard to Object Oriented programming

Course Outcomes:

1. To be able to lead and implement measurement plans for process and product assessment.
2. To be able to analyze data for project estimation, planning and quality control in software projects.
3. Outlines some of the plans for the future.

Detailed Contents:	
Unit: 1	**Software Quality Assurance Framework:** What is Quality? Software Quality Assurance, Components of Software Quality Assurance, Software Quality Assurance Plan. Steps to develop and implement a Software Quality Assurance Plan.
Unit: 2	**Quality Standards:** ISO 9000 and Comparison ISO Standards, CMM, CMMI, PCMM, 3 Sigma, 6 Sigma, Software Quality Models.
Unit: 3	**Measurement basics:** What is Software Metrics?, Application Areas of Metrics, Categories of Metrics, Measurement Scale, Axiomatic Evaluation of Metrics on Weyuker's Properties. Analyzing the Metric Data: Summary statistics for preexamining data, Metric Data Distribution, Outlier Analysis, Correlation Analysis, Exploring Analysis.
Unit: 4	**Measuring Structure and Size:** Size Estimation, Halstead Software Science Metrics, Information flow Metrics, Measuring Quality, Software Quality metrics based on Defects, Usability Metrics, Testing Metrics, Reliability Models.
Unit: 5	**Object Oriented Metrics:** Coupling Metrics, Cohesion Metrics, Inheritance Metrics, Size Metrics, Reuse Metrics, Empirical software engineering, research in software quality.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	

Text Books:	
1	Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Pearson Education (Singapore) Pvt. Ltd., 2002.
2	Norman E. Fenton and Shari Lawrence, "Software Metrics", PfleegerThomson, 2003
3	D. Galin, "Software Quality Assurance: From Theory to Implementation", Addison Wesley.
Reference Books:	
1	Allan C. Gillies, "Software Quality: Theory and Management", Thomson Learning, 2003.
2	Mike Konrad and Sandy Shrum, CMMI, Mary Beth Chrissis, Pearson Education (Singapore) Pvt Ltd, 2003
3	Mordechai Ben Menachem/Garry S. Marliss, "Software Quality", Thomson Learning

Course Code	Course Title	Lecture			
MTCS203PET	Software Quality Engineering	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To describe approaches to quality assurance understand quality models evaluate the system based on the chosen quality model.
2. To identify applicable measurements for the verification and validation effort.
3. To execute the test design.

Course Outcomes:

1. Describe different approaches to testing software applications Analyze specifications and identify appropriate test generation strategies.
2. Develop an appropriate test design for a given test object.
3. Evaluate the testing effort based on adequate measures.

Detailed Contents:

Unit: 1	**Introduction:** Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement and Inspection Process, Documents and Metrics.
Unit: 2	**Software Quality Metrics:** Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance: Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators.
Unit: 3	**Software Quality Management and Models:** Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.
Unit: 4	**Software Quality Assurance:** Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.
Unit: 5	**Software Verification, Validation & Testing:** Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Jeff Tian, Software Quality Engineering (SQE), Wiley-Interscience, 2005; ISBN 0-471-71345-7.
2	

Reference Books:

1	Metrics and Models in Software Quality Engineering, Stephen H. Kan, Addison- Wesley (2002), ISBN: 0201729156
2	

Course Code	Course Title	Lecture			Semester: II
MTCS204PET	Wireless Mobile Networks	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To know the basics of wireless communication & how communication takes place in wireless networks.
2. To know Cellular communication, G.S.M and CDMA.
3. To know Mobile TCP.

Course Outcomes:

1. New trends in mobile/wireless communications networks.
2. The characteristics of mobile/wireless communication channels.
3. How to pursue research in the area of wireless communication

Detailed Contents:

Unit: 1	Introduction, Fundamentals of cellular systems, mobile ad-hoc and sensor networks, wireless PAN/LAN/MAN. Overview of probability theory, traffic theory, queuing theory, and discrete event driven simulations.
Unit: 2	Mobile radio propagation, multi-path propagation, path loss, slow fading, fast fading. Channel coding and Error Control Techniques. Cellular concept, frequency reuse, cell splitting, cell sectoring.
Unit: 3	Multiple radio access protocols, CSMA, CSMA/CD, CSMA/CA. Static and dynamic channel allocation techniques.
Unit: 4	Mobile Communication Systems: Registration, Roaming, Multicasting, Security and Privacy. Optical Networking.
Unit: 5	Wireless sensor networks, MAC protocols for wireless sensor networks, routing in sensor networks. Wireless PAN (Bluetooth), Wireless LAN (Wi-Fi), Wireless MAN (WiMAX).

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Dharma Prakash Agrawal and Qing-An Zeng, *Introduction to Wireless and Mobile Systems*, Tomson, 2010, 3rd edition (ISBN-13: 978-1-4390-6205-0; ISBN-10: 1-4390-6205-6)
2	

Reference Books:

1	Vijay K. Grag and Joseph E. Wilkes, *Wireless and Personal Communications Systems*, 1996 (ISBN: 0-13-234626-5).
2	Christian Huitema, *Routing in the Internet,* Prentice Hall, 1995 (ISBN: 0-13-132192-7)

Course Code	Course Title	Lecture			
MTCS205PET	Natural Language Processing	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics, as well as the resources of natural language data - corpora.
3. To conceive basics of knowledge representation, inference, and relations to the artificial intelligence.

Course Outcomes:

1. The students will get acquainted with natural language processing and learn how to apply basic algorithms in this field.
2. They will understand the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics, as well as the resources of natural language data - corpora.
3. They will also grasp basics of knowledge representation, inference, and relations to the artificial intelligence.

Detailed Contents:

Unit: 1	**Introduction:** Introduction to the Morphology, Syntax, Semantics by linking the "linguistics view" (computational linguistics) with the "artificial intelligence view" (natural language processing).
Unit: 2	**Morphology:** Analysis and generation of language on word level: e.g. problems with compounding and idiomatic phrases, homophonous strings as well as loan words and their processing using e.g. finite state automata as well as semantic networks. Ambiguities in words like "pen" and "pipe", but will also discuss some complex strings.
Unit: 3	**Syntax:** Analysis and generation of language on phrasal and sentence level: e.g. applications such as machine translation and grammar checking and the processing using phase structure grammars as well as unification based formalisms and relating those formalisms to recursive transition networks (RTNs) as well as augmented transition networks (ATNs).
Unit: 4	**Semantics:** Language ambiguities on the level of "meaning": represented by case structures and conceptual dependency structures. We will look at famous utterances such as: Colourless green ideas sleep furiously. And will discuss why the machine runs into problems during analysis, and how these problems can be overcome.
Unit: 5	**Applications of NLP:** Machine Translation, Grammar Checkers Dictation, Automatic Document Generation, NL Interfaces.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Daniel Jurafsky, James H. Martin "Speech and Language Processing" Second Edition, Prentice Hall, 2008.
2. Chris Manning and Hinrich Schütze, "*Foundations of Statistical Natural Language Processing*", MIT Press. Cambridge, MA: May 1999

Reference Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993

Course Code	Course Title	Lecture			
MTCS206PET	Applied Cryptography	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand how cryptographic algorithms keys and protocols, and an appropriate hardware (software) environment can solve security problem (confidentiality, integrity, authenticity).
2. To Show how security is achieved in real life systems in areas of telecom, government/identity, buildings/transportation, payment.
3. To know real-life applications of encryption, Message Authentication Codes (MAC) and Digital Signatures in smart cards and terminals, personal identity and crypto currency systems

Course Outcomes:

1. Learning how security problems are solved in the industry, and understanding why specific choices are made.
2. Understanding security (attacks and defenses) in complex real life systems and the role of keys, cryptographic algorithms and protocols, tamper resistant hardware and other types of countermeasures.
3. Study of entity authentication and data authentication, challenge-response.

Detailed Contents:

Unit: 1	Basic Encryption and Decryption: introduction to Ciphers, Monoalphabetic Substitutions such as the Caesar Cipher, Cryptanalysis of Monoalphabetic Ciphers, Polyalphabetic Ciphers such as Vigenere Tableaux, Cryptanalysis of Polyalphabetic Ciphers, Perfect Substitution Cipher such as the Vernam Cipher, Stream and Block Ciphers.
Unit: 2	Encryption; authentication; symmetric cryptography, asymmetric cryptography: public-key cryptosystems; digital signatures, message authentication codes. Steganography, One-way functions; pseudo-randomness and random number generators.
Unit: 3	Remote user authentication, notions of security; zero knowledge/ interactive proofs, multi-party cryptographic protocols, key exchange and applications.
Unit: 4	Cryptanalysis of cryptographic primitives and protocols, such as by side-channel attacks, differential cryptanalysis, or replay attacks; and cryptanalytic techniques on deployed systems.
Unit: 5	Advanced Topics - ECC, DNA cryptography, quantum cryptography, Digital Watermarking. Digital signatures: Definitions and applications, Lamport and Merkle schemes. overview of signatures based on discrete-log. certificates and trust management. , SSL/TLS and IPsec, Privacy mechanisms

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Handbook of Applied Cryptography by A. Menezes, P. Van Oorschot, S. Vanstone.
2	Cryptography by Behrouz A. Forouzan,TMH
3	Cryptography and Network Security by Stalling, PHI

Reference Books:

1	Cryptography & security services , Mechanism & application By Mogollon , Manuel , Cyber tech. Pub.
2	Cryptography and hardware security By Stalling, W PHI

Course Code	Course Title	Lecture			Semester: II
		L	T	P	
MTCS211PET	Human Computer Interaction	3	0	0	
Version:	**Date of Approval:**				

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provides a basic understanding of Human interfaces, their design principles ,tools as well as interfaces through thought process
2. To learn the design principles of developing a Human Computer Interface.
3. To Study of tools and devices required for designing a good interface

Course Outcomes:

1. Understand fundamental design and evaluation methodologies of human computer interaction.
2. Demonstrate knowledge of human computer interaction design concepts and related methodologies.
3. Apply theories and concepts associated with effective work design to real-world application

Detailed Contents:

Unit: 1	**Introduction:** Importance of user Interface –Characteristics of graphical and web user interfaces, importance of good design. Benefits of good design, Principles of good Screen design.
Unit: 2	System menus and navigation schemes, kinds of windows, device based controls, screen based controls, test and messages.
Unit: 3	Feedback, guidance and assistance, Internationalization and Accessibility, graphics, icons and images, colors, layout windows and pages.
Unit: 4	**Interaction design** - introduction, goals, usability. Conceptualizing interaction problem space, conceptual models, interface metaphors, interaction paradigms, cognition, conceptual framework for cognition, collaboration, communication, social mechanisms conceptual frame work.
Unit: 5	Affective aspects, Expressive interface, user frustration agents process of interaction design, activities, characteristics, practical issues, life cycle models, design , prototyping and conceptual design, physical design, evaluation, framework, testing modeling users-kinds of tests, doing user testing, experiments, predictive model.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	The essential guide to user interface design, Wilbert O Galitz, Wiley DreamTech. Designing the user interface. 3rd Edition Ben Sheidermann, Pearson Education Asia
2	Preece, Rogers, Sharp, "interaction design", John Wiley 2002
3	Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education.

Reference Books:

1	Sheiderman B Desiging the user interface, "Strategies for Effective Human Computer Interaction" , 2nd ed. Addison Wesley , 1992.
2	Sudifte AG , "Human Computer Interface Design" , 2nd ed, Macmillan ,1995.

Course Code	Course Title	Lecture			Semester: II
MTCS212PET	Bioinformatics	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the new field of bioinformatics (computational biology).
2. To be aware of how machine learning techniques can be employed in this area.
3. To concentrate on modern bioinformatics applications, particularly those which make good use of pattern recognition and machine learning methods.

Course Outcomes:

1. To have a basic knowledge of modern molecular biology and genomics.
2. To understand the advantages and disadvantages of different machine learning techniques in bioinformatics and how the relative merits of different approaches can be evaluated by correct benchmarking techniques.
3. To understand how theoretical approaches can be used to model and analyse complex biological systems

Detailed Contents:

Unit: 1	**Introduction: biology, physics:** Biological hierarchy, Information stages, Physical processes, **Methods of gene sequencing:** Detailed discussion on Sequences searching methods.
Unit: 2	**Gene expression:** Current and prospective methods of gene profiling. Data acquisition. Data standardization. Linear approximations of data; DNA chips, Protein targeting, Data normalization, Linear view.
Unit: 3	**Statistics approaches:** Probabilistic notions, Multivariate issues, Clustering, Information handling, Experimental and computational methods of structure determination for proteins and nucleic acids.
Unit: 4	**Ontology:** Annotation of genes, their products and functions. System biology, evolution, hierarchy, Medical informatics, Software support: Software availability, Software targets, Text parsing, BioPerl. Statistics, R-system.
Unit: 5	**Recent Advances & Applications of Bio-Informatics:** Recent trends in Computing with bio-systems.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	David W. Mount, "Bioinformatics, Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press.
2	Andreas D. Baxevanis, "Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins", Second Edition.
3	D.E. Krane and M.L. Raymer, "Fundamental Concepts of Bioinformatics", Pearson Education, 2003.

Reference Books:

1	B. Bergeron, "Bioinformatics Computing", Prentice –Hall, 2003.
2	Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids", Cambridge University Press

Course Code	Course Title	Lecture			Semester: II
		L	T	P	
MTCS213PET	Information Security and Cyber Laws	3	0	0	
Version:	**Date of Approval:**				

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To develop the skills to imbibe the Information Security issues at technological ground and then relate it to complex cyber world legal problems.
2. To give a detailed understanding of national and international regulatory paradigms and its mechanics regarding Cyber Law.
3. To study of cyber-security and the regulation of the Internet and the Internet of Things

Course Outcomes:

1. Understand the structure, mechanics and evolution of the Internet in the context of emerging crime threats and technological and other trends in cyberspace.
2. Evaluate the effectiveness of cyber-security, cyber-laws (e.g. the Budapest Convention) and other countermeasures against cybercrime and cyber warfare.
3. Understand the different theoretical and cross-disciplinary approaches (criminological, political, legal and information security/management).

Detailed Contents:

Unit: 1	Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages 18 Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Principles of Information Security: Confidentiality, Integrity Availability and other terms in Information Security.
Unit: 2	Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems.
Unit: 3	Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls: Design and Implementation Issues, Policies.
Unit: 4	IT Act; The rights the various parties have with respect to creating, modifying, using distribution. Computer Software and Intellectual Property-Objective, Copyright Protection, Reproducing, Defenses, Patent Protection. Database and Data Protection-Objective.
Unit: 5	Introduction to Trade mark – Trade mark Registration Process – Post registration Procedures – Trade mark maintenance. Introduction to Copyrights – Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership. Introduction to Trade Secret – Maintaining Trade Secret.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Godbole," Information Systems Security", Willey.
2. Merkov, Breithaupt," Information Security", Pearson Education.
3. Sood,"Cyber Laws Simplified", Mc Graw Hill.

Reference Books:

1. Furnell, "Computer Insecurity", Springer.
2. Schou, Shoemaker, " Information Assurance for the Enterprise", Tata McGraw Hill.
3. IT Act 2000.

Course Code	Course Title	Lecture			
MTCS214PET	Advanced Networks	L	T	P	Semester: II
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provide a broad coverage of introductory and advanced topics in the field of computer networks.
2. To have depth knowledge of computer networks.
3. To recognize the different internetworking devices and their functions

Course Outcomes:

1. Analyze the services and features of the various layers of data networks.
2. Design, calculate, and apply subnet masks and addresses to fulfill networking requirements.
3. Analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.

Detailed Contents:

Unit: 1	Requirements , Network architecture , Networking principles, Network services and Layered architecture , Network services and Layered architecture , Future networks (Internet , ATM , Cable TV, Wireless – Bluetooth, Wi-Fi, WiMax, Cell phone).
Unit: 2	Virtual circuits, Fixed size packets, Small size packets, Integrated service, History, Challenges, ATM Network protocols, IP over ATM, Wireless networks: Wireless communication basics, architecture, mobility management, wireless network protocols. Ad-hoc networks Basic concepts, routing; Bluetooth (802.15.1), Wi-Fi (802.11), WiMAX (802.16), Optical Network: links, WDM system, Optical LANs, Optical paths and networks.
Unit: 3	Control of networks: objectives and methods of control, Circuit switched networks, ATM networks. Mathematical background for control of networks like Circuit switched networks, Datagram and ATM networks.
Unit: 4	Routing architecture, Routing between peers (BGP) , IP switching and Multi-Protocol Label Switching (MPLS), MPLS Architecture and related protocols, Traffic Engineering (TE) and TE with MPLS, NAT and Virtual Private Networks (L2, L3, and Hybrid), CIDR –Introduction, CIDR addressing, CIDR address blocks and Bit masks.
Unit: 5	Mobile IP- characteristics, Mobile IP operation, Security related issues. Mobility in networks, Voice and Video over IP (RTP, RSVP, QoS) IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, etc., neighbour discovery, auto-configuration, routing. Application Programming Interface for IPv6.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Tanenenbaum, " Computer Network",PHI.
2	

Reference Books:

1	Srinivasan Keshav" An Engineering Approach To Computer Networking ",Pearson
2	D. Bertsekas , R Gallagar ,"Data Networks and Internets" PHI.

Course Code	Course Title	Lecture			Semester: II
MTCS250PCP	Data Structure and Algorithm Design Lab	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	2	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand basic data structures and abstract data types.
2. To understand the basic concepts of computational complexity.
3. To design and implement efficient algorithms based on the selected data structures

Course Outcomes:

1. Understand the purpose and mathematical background of algorithm analysis and be able to apply this to determine the run time and memory usage of algorithms.
2. Understand the variety of ways that linearly and weakly ordered data can be stored, accessed, and manipulated.
3. Understand the characteristics and optimal behaviour of hash tables for access and retrieval.

Detailed Contents:

Lab experiments are based on the syllabus prescribed for Data Structure and Algorithm Design viz. Heap sort, Quick sort, Insertion Sort, Depth First Search, Breadth First Search, Prim, Kruskal, Dijkstra, Bellman Ford, Warshal and Floyd algorithms etc.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:	
1	
2	
Reference Books:	
1	
2	