Shivaji University, Kolhapur
Department of Technology
M. Tech (Computer Science and Technology)-I
Curriculum Structure
Semester – I

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
	AC 511	Research Methodology (Audit)	2	-	-	-
1	CS 511	Mathematical Foundation of Computer Science	4	-	-	4
2	CS 512	Design and Analysis of Algorithms	4	-	-	4
3	CS 513	Artificial Neural Network (ANN)	4	-	-	4
4	CS 514	Elective-I	3	-	-	3
5	CS515	Elective- II	3	-	-	3
6	CS516	Seminar -I	-	-	2	2
7	CS517	Mathematical Foundation of Computer Science Lab	-	-	2	1
8	CS518	Design and Analysis of Algorithms Lab	-	-	2	1
9	CS519	Artificial Neural Network (ANN) Lab	-	-	2	1
		Total	**20**		**8**	**23**
Total Contact hours per week = 28						

Elective - I
Advance Database Systems
Bio Informatics
Advanced Compilers

Elective - II
Advanced Operating Systems
Real Time Systems
Web Engineering

Shivaji University, Kolhapur
Department of Technology
M. Tech (Computer Science and Technology)-I
Curriculum Structure
Semester – II

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	CS521	Parallel Computer Architecture	4	-	-	4
2	CS522	Computer Vision and Image Processing	4	-	-	4
3	CS523	Computer Security	4	-	-	4
4	CS524	Elective-III	3	-	-	3
5	CS525	Elective-IV	3	-	-	3
6	CS526	Seminar - II	-	-	2	2
7	CS527	Parallel Computer Architecture Lab	-	-	2	1
8	CS528	Computer Vision and Image Processing Lab	-	-	2	1
9	CS529	Computer Security Lab	-	-	2	1
		Total	**18**	**-**	**8**	**23**
Total Contact hours per week = 26						

Elective - III
Data-Mining and Warehousing
Business Intelligence
Web services and SOA

Elective - IV
Geographical Information Systems
Artificial Intelligence and Natural Language Processing
System modeling and simulation

Shivaji University, Kolhapur
Department of Technology
M. Tech (Computer Science and Technology)-II
Curriculum Structure
Semester – III

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	CS611	Industrial Training	-	-	2**	4
2	CS612	Dissertation Phase-I	-	-	5**	10
		Total			7	14
Total Contact hours per week = 5**						

** Average contact hours/week/student

Shivaji University, Kolhapur
Department of Technology
M. Tech (Computer Science and Technology)-II
Curriculum Structure
Semester – IV

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
2	CS622	Dissertation Phase-II	-	-	5**	20
		Total			5	20
Total Contact hours per week = 5**						

** Average contact hours/week/student

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- I
IN 501: Research Methodology

Teaching Scheme: **L:** 2 **T:** -- **Credits:** --

Unit 1 Research Methodology: An Introduction **Hrs**
Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem **6**

Unit 2 Research Design
Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling **8**

Unit 3 Measurement and Scaling Techniques
Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques **6**

Unit 4 Methods of Data Collection and Analysis
Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation **6**

Unit 5 Techniques of Hypotheses, Parametric or Standard Tests
Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses,. Chi-square Test, Comparing Variance, As a non-parameteric Test, Conversion of Chi to Phi, Caution in using Chi-square test **6**

Unit 6 Analysis of Variance and Co-variance
ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis**,** factor Analysis, R-type Q Type factor Analysis, Path Analysis **6**
Interpretation and Report **2**

Reference Books:

1. *"Research Methodology",* C.R. Kothari, Wiley Eastern.
2. *"Formulation of Hypothesis",* Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
3. *"Research in Education",* John W Best and V. Kahn, PHI Publication.
4. *"Research Methodology- A step by step guide for beginners",* Ranjit Kumar, Pearson Education
5. *"Management Research Methodology-Integration of principles, methods and Techniques",* K.N. Krishnaswami and others, Pearson Education.

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 511: Mathematical Foundation of Computer Science

Teaching Scheme: **L:** 4 **T:** - **Credits:** 4

Unit 1 Introduction **Hrs**

Mathematical notions and terminology of sets, sequences and tuples, functions and relations graphs, strings and languages. Boolean logic properties and representation. Definitions, Theorems and types of proofs, formal proofs, deductive, reduction to definition, proof by construction, contradiction, induction, indirect, automatic, counter-examples **5**

Unit 2 State Machines and Grammars

Types of Languages, Types of grammar, recurrence relations, Regular expressions, Finite State Machines, DFA, NFA, Equivalence of DFA & NFA., Kleen's Theorem, pumping Lemma, Applications **5**

Push down automata and CFG

PDA, N-PDA, CFG, ambiguous grammar, non ambiguous grammar, CNF, Parsers: Top-down, Bottom-up, applications **5**

Unit 3 Turing Machines

Turing machines, variations of TMs, Combining TM's, programming techniques for TMs, Universal Turing Machines, recursive and recursively enumerable languages **6**

Unit 4 Decidability and Reducibility

Decidable languages, decidable problems concerning context-free languages, FA, PDA, Turing Machines, Undecidable problems from language theory, A simple undecidable problem (PCP), The halting problem- Diagonalization method, Reduction problems, mapping reducibility **8**

Unit 5 Computability

Primitive recursive functions, computable functions, primitive recursive functions. Computability examples, the recursion theorem **6**

Unit 6 Computational Complexity

Tractable and intractable problems, growth rates of functions. Time complexity of TM. Tractable decision problems. Theory of Optimization **6**

Reference Books:

1. "Introduction to Theory of Computation", Michael Sipser, Thomson Brools Cole.
2. "Introduction to Automata Theory, Language and Computations", J.E. Hoperoft, Rajeev Motwani & J. D. Ullman, Pearson Education Asia, 2nd Edition.
3. **"**Introduction to Languages and Theory of Computation", John. Martin MGH.3rd Edition.
4. "Discrete Mathematical Structures with Applications to Computer Science", J. P. Trembley and R. Manohar.
5. "Theory of Computer Science", E. V. Krishamoorthy.

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 512: Design and Analysis of Algorithms

Teaching Scheme: **L:** 4 **T:** - **P:** - **Credits:** 4

Unit 1 Introduction **Hrs**

Algorithm definition and specification, Performance analysis randomized algorithms, Divide and Conquer method, Binary search, Merge sort Quick sort and convex hull. **3**

Greedy method and Dynamic Programming

General methods, Job sequencing with deadlines, Minimum cost spanning trees, Optimal merge patterns, All pairs shortest paths, Optimal binary search trees, Reliability design, Traveling salesman problem and flow shop scheduling. **6**

Unit 2 Lower bound Theory

Comparison trees, Oracles and adversary arguments, lower bounds through reductions. **5**

Unit 3 NP-Hard and NP- complete problems

Basic concepts, cook's theorem. NP –hard graph problems, NP-hard scheduling problems. NP-Hard code generation's problems. **6**

Unit 4 PARAM Algorithms

Introduction, computational model, Fundamental techniques and algorithms, Merging, lower bounds. **5**

Unit 5 Mesh Algorithms

Computational model, Packet routing fundamental algorithms, merging, computing the convex hull. **6**

Unit 6 Hypercube Algorithms

Computational model, PPR routing fundamental algorithms, merging, computing the convex hull. **6**

Reference Books:

1. *"Fundamentals Of Computer Algorithms",* Ellis Horowitz, Sartaj Sahni and Sanguthewar Rajasekaran (Galgotia Publications)

2. *"Design And Analysis Of Algorithms",* Aho, Hopcraft & Ulman (Addison Wesley)

3. *"Introduction to Algorithms",* Thomas H. Cormen, Charles S. Leiserson, Ronald L. Rivest and Clifford Stein (PHI), 2nd Edition.

4. *"Randomized Algorithms",* Rajeev Motwani and Prabhakar Raghavan (Cambridge University Press)

Department of Technology
M. Tech (Computer Science & Technology) - I
Semester- I

CS 513: Artificial Neural Network

Teaching Scheme: **L:** 4 **T:** - **P:** - **Credits:** 4

Unit 1 Introduction **Hrs**
Inspiration from Neuroscience, History, Issues. Hopfield model: Associative memory problem, model, stochastic networks capacity of stochastic n/w. **6**

Unit 2 Optimization problems
Weighed matching problem, Traveling salesman problem, Graph bipartioning, optimization problems in image processing. **6**

Unit 3 Simple Perceptions
feed forward n/w, Threshold units, linear units, nonlinear units stochastic units, capacity of simple perception. **6**

Unit 4 Multi-layer Network
Back propagation, examples and applications performance of multilayer feed forward n/w Kohoanen self organizing n/w cognition & neocognutron. **7**

Unit 5 Recurrent Network
Boltzmann n/w, Recurrent Back propagation, Learning time sequence, Reinforcement learning**. 6**

Unit 6 Learning
Supervised, Unsupervised (Hebbian competitive), adaptive resonance theory, Traveling salesman problem. Application of artificial Neural Network. **7**

Reference Books

1. Introduction to the theory of neural Computation-Hertz Keogh, Palmer

2. Artificial Neural Networks- B. Yegnanarayana (PHI)

3. Genetic Algorithms-David E. Goldberg (Addison Wesley)

Department of Technology
M. Tech (Computer Science & Technology) - I
Semester- I
CS 514: Advanced Database System (Elective- I)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Database Design Concepts **Hrs**

Database models, Relational model as a navigating example, design of relational schema with various dependency constraints, General DBMS architecture, Responsibilities of DBMS- Crash recovery, concurrency control, query optimization, transaction processing, security, etc **6**

Unit 2 Types of Databases

Design issues of Object databases, Parallel databases, Distributed databases, Web databases, and Deductive databases **6**

Unit 3 Distributed database management system

Features of DDS, Distribution transparency, DDB design, Query translation, Optimization Management of distributed transaction, concurrency control, reliability, agents, homogeneous DDS, DDS administration. **7**

Unit 4 Object database management system

Fundamentals of ODS, Design issues, Object management, Encapsulation inheritance, ORDBMS, Implementation challenges, object query processing, Transaction management, Query optimization. O-O Query languages and interfaces. **7**

Unit 5 Advanced Transaction Processing

Transaction Processing Monitors, Transactional workflows, Real time transactions, Transaction management in commercial databases **6**

Unit 6 Security Issues and Performance measure In Databases

Security and authorization, authorization in SQL, Encryption and authentication, Security issues in Oracle/DB2 Performance tuning, Performance benchmarks, standardization, performance tuning in Oracle / IBM DB2 **7**

Reference Books

1. Database system concepts- Silberschatz, Korti, Sudershan, McGraw Hill International
2. Distributed Database Principals and systems - Stephan ceri, Giuseppe Pelagatti. (McGraw Hill)
3. Database Management Systems, Raghu Ramakrishnan & Johannes Gehrke
4. Principals of distributed Database system (2nd edition) - M. Tamer Ozsu. Patrick valduriez (Pearson)
5. Object Oriented Interface and Databases - Rajesh Narang, Prentic Hall of India.
6. Oracle 8 DBA handbook, Loney, TMGH.
7. Oracle 8 Advanced Tunning & Administration, Eyal Aranoff, K. Loney, Noorali Sonawalla, TMGH.
8. Oracle Architecture, O'rielly Publications

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 514: Bio Informatics (Elective- I)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 **Hrs**

Introduction, chronological history of Bioinformatics, evolution of Bioinformatics, Objectives of Bioinformatics, Importance of bioinformatics, Bioinformatics in business, future scope of Bioinformatics. **6**

Unit 2

Bioinformatician and bioinformaticist, role, need and importance of Biology, Computer Science, mathematics and information technology in bioinformatics, biological classification and nomenclature, life in space and time. **7**

Unit 3

Introduction, information networks, protein and genome information resources, DNA sequence analysis, pairwise alignment techniques, multiple alignment techniques, secondary databases, analysis packages. **7**

Unit 4

The dawn of sequencing, the biological sequence or structure deficit, human genome project and its status, homology and analogy, web browsers **6**

Unit 5

Molecular biology networks, National centre for biotechnological information, specialized genomic resources. Building a sequence search protocol, practical approach for structural and functional interpretation. **7**

Unit 6

Introduction to analysis package, commercial databases, softwares and comprehensive packages, internet packages specializing in DNA and protein analysis **6**

References:

1. T.K. Attwood and Parry Smith, Introduction to Bioinformatics, Benjamin-Cummings Publishing Company, 2001.

2. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 3rd Edition, 2008

3. Krane and Raymer, Fundamental Concepts in Bioinformatics, Benjamin-Cummings, 2002.

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 514: Advanced Compilers (Elective- I)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Basics of Compiler Design **6**
Planning a compiler, approaches to compiler design, compiler development tools – Lex and Yaac.

Unit 2 Code Generation **6**
Efficient code generation for expressions, code generator generators, code generation for pipelined machines, register allocation techniques.

Unit 3 Code Optimization **8**
Classical theory of data flow analysis, bi-directional data flows, unified algorithm for data flow analysis, theory of data flow analysis, program representation for optimization – SSA form.

Unit 4 Parallel Compilers **6**
Motivation and overview, Structure of a Parallelzing compiler. Parallelism detection: data dependence, direction vectors, loop carried and loop independent dependences.

Unit 5 Compilation for Distributed Machines **7**
Data partitioning, instruction scheduling, register allocation, machine optimization. Dynamic compilation.

Unit 6 Advanced Topics **6**
Just in time (JIT) compilers, Auto scheduling compilers.

Reference Books:

1 Aho, Ulman, Sethi, "Compiler Principles and Techniques", Addison Wesley

2. Muchnik, "Advanced Compiler Design and Implementation", Kauffman(1998)

3. Wolf M., "Optimizing Super Compiler for Super Computers", Pitman(1989)

4. Banerjee U., kluwer, "Loop Optimization", PHI (1997)

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 515: Advanced Operating Systems (Elective- II)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Distributed Computing System Fundamentals **Hrs**

Introduction to distributed computing systems. Models, popularity, distributed operating system. Design issues of distributed operating system. Distributed computing environment **4**

Unit 2 Communication Techniques in Distributed Computing Systems

Message Passing: Features of a good message-passing system. Issues in IPC by Message Passing. Synchronization, Buffering, Multidatagram Messages. Encoding and Decoding of Message Data, process addressing, failure handling, group communication.

Remote Procedure Calls: RPC model. Implementing RPC mechanism. Stub generation, RPC messages, marshaling arguments and results. Server management. Parameter-passing semantics, call semantics. Communication protocols for RPCs, Client-Server Binding, Exception handling. Security, Special types of RPC, RPC in heterogeneous Environments, lightweight RPC.

Distributed Shared Memory: General Architecture of DSM systems. Design and implementation Issues of DSM. Granularity, Structure of Shared Memory Space, Consistency models, Replacement strategy, Thrashing **12**

Unit 3 Synchronization

Clock synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms **4**

Unit 4 Resource and Process Management

Resource Management: Features of global scheduling algorithm. Task assignment approach, Load –balancing and Load-Sharing approach.

Process Management: Introduction, Process Migration, Threads **8**

Unit 5 Distributed File System and Security Issues

Distributed File Systems: Features of Good DFS, File models, File- Accessing models. File-Sharing Semantics. File-Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design principles,

Case study: DCE Distributed File Service.

Security: Potential Attacks to Computer systems, Cryptography, Authentication, Access Control, Digital Signatures, Design Principles, Case Study: DCE Security service **8**

Unit 6 Case Study

Case study of any commercial distributed system **3**

Reference Book:

1. *"Distributed Operating Systems Concepts and Design",* P. K. Sinha, PHI.
2. *"Modern Operating System",* Singhal.
3. *"Distributed Systems Concepts and Design",* G. Coulouris, J. Dollimore & T. Kindberg.
4. *"Modern Operating Systems",* A. S. Tanenbaum, PHI.

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 515: Real Time Systems (Elective- II)

Teaching Scheme: **L:** 3 **T:** - **Credits:** 3

Unit 1 Basic Real-Time Concepts **Hrs**

Terminology, Real-Time design Issues, Example Real-Time Systems, brief history,Language features, Commonly used programming languages, Phases of the software life cycle, Non temporal Transitions in the Software life cycle, Spiral Model, Natural languages, Mathematical specification, flowcharts, structure charts, Pseudocode and Programming Design languages, Finite state Automata, Data flow diagrams, Petri nets, Warnier-Orr Notation, State charts, Sanity in using graphical Techniques **7**

Unit 2 Real Time Kernels: Polled Loop Systems, Phase/ State-Driven Code, Coroutines, Interrupt-Driven Systems, Foreground/ Background Systems, Full-Featured Real-Time Operating systems, POSIX.

Inter-Task Communication and Synchronization: Buffering Data, Mailboxes, Critical Regions, Semaphores, Event flags and signals, Deadlock **6**

Unit 3 Real-Time Memory Management: Process Stack Management, Dynamic Allocation, Static Schemes.

System Performance Analysis and Optimization: Response-Time Calculation, Interrupt latency, Time-Loading and its Measurement, Scheduling is NP-Complete, Reducing Response times and Time-loading, Analysis of Memory requirements, Reducing Memory- Loading, I/O Performance **6**

Unit 4 Queuing Models: Probability functions, Discrete, Basic Buffer size calculation, Classical Queueing theory, Little's Law, Erlang's Formula.

Reliability, Testing and Fault Tolerance: Faults, Failures, Bugs and Effects, Reliability, Testing, Fault Tolerance **5**

Unit 5 Multi Processing Systems: Classification of Architectures, Distributed Systems, Non-Von Neuman Architectures. **Hardware/ Software Integration:** Goals of Real-Time system integration, Tools, Methodology, The software Heisenberg Uncertainity Principle **6**

Unit 6 Real-Time Applications

Real-Time systems as complex systems, First Real-time application, Real time Databases, Teal-Time Image Processing, Real-Time Unix, Building Real-time Applications with Real-time programming languages **7**

Reference Books:

1. *"Real-Time Systems Design and Analysis, An Engineer's Handbook",* Phillip .A. Laplante, PHI, 2nd Edition.
2. *"Real-Time Systems Design",* Levi Shem, Tov and Ashok K. Agrawala, New York, McGraw Hill.
3. *"Proceedings of IEEE Special Issue on Real-Time Systems Design",* Jan. 1994.
4. *"Real-Time Systems Design and their Programming Languages",* Burns, Alan and Andy Wellings, New York, Addison-Wesley.
5. *"The Design of Real-Time Applications",* M. Blackman, New York, John Wiley & Sons.
6. *"Real-Time Systems",* C. M. Krishna, K. G. Shin, TMGH.

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 515: Web Engineering (Elective- II)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Introduction **6**

Motivation, Categories of web applications, Characteristics of web applications.

Requirements Engineering

Introduction, Fundamentals, RE specifics in web engineering, Principles of RE for web applications, Adapting RE methods to web application development

Unit 2 Modeling Web Application **6**

Introduction, Fundamentals, Modeling specifics in web engineering, Modeling requirements, Content modeling, Hypertext modeling, Presentation modeling, Customization modeling, Methods and tools

Unit 3 Web Application Architectures **6**

Introduction, Fundamentals, Specifics of web application architectures, Components of a generic web application architecture, Layered architectures, Data-aspect architectures.

Unit 4 Web Application Design and Technologies for Web Applications **7**

Introduction, Web design from an evolutionary perspective, Presentation design, Interaction design, Functional design, Client/Server communication on the web, Client side technologies, Document-specific technologies, Server-side technologies

Unit 5 Testing Web Applications **8**

Introduction, Fundamentals, Testing specifics in web engineering, Test approaches, Test scheme, Test methods and techniques, Test automation.

Operation and Maintenance of Web Applications: Introduction, Challenges following the launch of a web application, Content management, Usage analysis, Web usability engineering methods, Web usability engineering trends.

Unit 6 The Semantic Web **6**

Fundamentals of the semantic web, Technological concepts, Specifics of semantic web applications, Tools

Text Book:

1.Gerti Kappel, Birgit Proll, SiegfriedReich, Werner Retschitzegeer (Editors): Web Engineering, Wiley India, 2007.

Reference Books:

1. Roger Pressman, David Lowe: Web Engineering: A Practitioner's Approach, McGraw Hill

Department of Technology
M. Tech (Computer Science & Technology) - I
Semester- I
CS 516: Seminar I

Teaching Scheme: **P:** 2 **T:** - **Credits: 2**

Seminar-I shall be delivered on one of the advanced topics chosen in consultation with the guide after compiling the information from the latest literature and also internet. The concepts must be clearly understood and presented by the student. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. All modern methods of presentation should be used by the student. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed, preferably in IEEE format) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any. Guide should guide concern student 2hrs /week/student for seminar.

(Student is expected to submit seminar report in Latex/Microsoft word in the standard format style file available in the department)

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 517: Mathematical Foundation of Computer Science Lab

Teaching Scheme: **L: -** **P:** -2 **Credits:** 1

This lab consists of a set of minimum 8-10 Practical problems/ Tutorials / Research Problems and simulations based on the syllabus.

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- I

CS 518: Design and Analysis of Algorithms Lab

Teaching Scheme: **L: -** **T: -** **P: 2** **Credits:** 1

This lab consists of a set of minimum 8-10 Practical problems/ Tutorials / Research Problems and simulations based on the following topics:

1. Divide and Conquer method- Binary search, Merge sort Quick sort
2. Job sequencing with deadlines
3. Minimum cost spanning trees
4. All pairs shortest paths
5. Optimal binary search trees
6. Reliability design
7. Lower bound Theory
8. NP-Hard and NP- complete problems
9. PARAM Algorithms
10. Mesh Algorithms
11. Hypercube Algorithms

Department of Technology
M. Tech (Computer Science & Technology) - I
Semester- I

CS 519: Artificial Neural Network Lab

Teaching Scheme: **L: -** **T: -** **P: - 2** **Credits:** 1

This lab consists of a set of minimum 8-10 Practical problems/ Tutorials / Research Problems and simulations based on the following topics:

1. Mc-Culloch Pitts Model
2. Hopfield model: Associative memory problem
3. Optimization problems
4. Simple Perceptions
5. feed forward n/w,
6. Multi-layer Network
7. Recurrent Network
8. Learning- Supervised Learning and Unsupervised Learning

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 521: Parallel Computer Architecture

Teaching Scheme: **L:** 4 **P:** - **Credits:** 4

Unit 1: System Architecture **8**

History /Evolution, Definition: Hardware /Software Architecture Flynn's Classification: SISD, SIMD, MISD, MIMD, Physical Models: PVP, MPP, SMP, Cluster of Workstations (COW). Memory Architectures: Shared, Distributed & Hybrid, UMA, NUMA, CC-NUMA, Performance Metrics & Benchmarks, Architectural Trends based on TOP500 List of Supercomputers.

Unit 2: Advanced Microprocessor Techniques **8**

CISC, RISC, EPIC, Superscalar, Superpipelined, ILP, TLP. Power Wall, Moore's Law redefined, Multicore Technologies Intel's TickTalk Model. Study of State-of-the –Art Processors: Intel//AMD x86 Series, Intel //IBM Itanium// POWER series, Introduction to Graphics Processing Units (GPU: NVIDIA)

Unit 3: System Interconnects **4**

SAN: System Area Networks, Storage Area Networks including InfiniBand, GigaBit Ethernet. Scalable Coherent Interface (SCI) Standard.

Unit 4: Storage **4**

Internal/ External, Disk Storage, Areal Density, Seek Time, Disk Power, Advanced RAID Levels, SATA vs SAS Disks, Network Attached Storage (NAS) and Direct Attached Storage, I/O Performance Benchmarks.

Unit 5: Software Architecture **8**

Parallel Programming Models: Message Passing, Data Parallel, MPI /PVM Typical HPCC Software Stack including Cluster Monitoring Tools e.g. GANGLIA CUDA Programming Environment.

Unit 6: Case Studies **8**

A typical Petaflop System based on Hybrid CPU/GPU Architectures, IBM SP System, C-DAC's latest PARAM System.

References:

1. John L. Hennesy and David Patterson, Computer Architecture : A Quantitative Approach, 4th Edition**,** 2007

2. Kai Hwang and Zhiwei Xu, Scalable Parallel Computers, McGraw- Hill, 1998.

3. Data Manuals of respective Processors available at Website.

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 522: Computer Vision and Image Processing

Teaching Scheme: **L:** 4 **T: -** **P: -** **Credits:** 4

Unit 1 **Hrs**

Digital Image Fundamentals: - Digital image Representation – Functional Units of an Image processing system. Visual perception – Image Model _ Image sampling and Quantization – grayscale resolution – pixel relationship – image geometry. Image Transforms – Unitary Transform, Discrete Fourier Transform, Cosine Transform, Sine Transform, Hadamard Transform, Slant and KL Transform. **7**

Unit 2

Image Enhancement – Histogram processing – Spatial operations – Image smoothing- Image Sharpening – Color Image Processing methods- Color Image Models **6**

Unit 3

Image restoration and compression Degradation Model – Discrete Formulation – Circulant matrices – Constrained and Unconstrained restoration geometric transformations fundamentals – Compression Models – Error Free Compression – Lossy Compression – International Image Compression Standards. **7**

Unit 4

Image Analysis and Computer Vision: Spatial feature Extraction – Transform feature –Edge detection-Boundary Representation-Region Representation-Moment Representation-Structure-Shape Features-Texture-Scene Matching and Detection-Image Segmentation-Classification techniques-Morphology-Interpolation. **7**

Unit 5

Sensing 3D shape: how the 3rd dimension changes the problem. Stereo 3D description, 3Dmodel, matching, TINA. Direct 3D sensing-structured light, range finders, range image segmentation. **6**

Unit 6

Emerging IT applications: Recognition of characters, Fingerprints and faces-Image databases. **5**

Reference Books

1. Fundamentals of Digital Image Processing-A.K.Jain
2. Image Processing and machine vision-Milan Sonka,Vaclav Hlavae
3. Pattern Recognition Principles-J.T. Tou and R.C.Gonzalez
4. Syntactic Pattern Recognition and applications.-King Sun Fun
5. Computer vision-Fairhurst (PHI).

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 523: Computer Security

Teaching Scheme: **L:** 4 **T:** - **P:** - **Credits:** 4

Unit 1 Basic Cryptography and Cipher Techniques **Hrs**
Classical crypto system, Stream & block ciphers, introduction to finite fields, DES, AES, RC5, Differential and liner cryptography **8**

Unit 2 Asymmetric key cryptography
Introduction to number theory, RSA, key management, Diffi-Hellman key exchange elliptic curve arithmetic, elliptic curve cryptography, Zero knowledge proof systems. **7**

Unit 3 Authentication
Authentication requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACS, Digital Signatures, Authentication Protocols, Digital Signature Standard **6**

Unit 4 Network Security
Electronic Mail Security - Pretty Good Privacy, S/MIME, IP Security – IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating security Payload **6**

Unit 5 Web Security
Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction **6**

Unit 6 Malicious Logic and System Security
Introduction, computer viruses, worms, Intruders - Intruders, Intruder detection, Password Management, Malicious Software - Viruses and Related Threats, Virus Countermeasures, Firewall - Firewall Design Principles, Trusted systems, recent trends in IP security- case study, legal issues, tools used to detect and prevent attacks **8**

Reference Books:

1. *"Cryptography and Network Security Principles and Practices",* Williams Stallings (LPE).
2. *"Handbook of Applied Cryptography",* Menezes, A. J., P. C. Van Oorschot, and S. A. Vanstone.
3. *"Applied Cryptography: Protocols & Algorithms",* Schneier, Bruce.
4. IP security-Case study, tools from appropriate white papers or journal papers from internet

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II

CS 524: Data Mining and Warehousing (Elective- III)

Teaching Scheme: **L:** 3 **T:** - **Credits:** 3

Unit 1: Introduction to Data Mining **Hrs**
Data Flood, Data Mining and Knowledge Discovery, Data Mining Tasks Data Preparation for Knowledge Discovery, Data understanding, Data cleaning, Data transformation, False "predictors" , Feature reduction, Randomization. **4**

Unit 2: Knowledge Representation
Decision tables, Decision trees, Decision rules, Rules involving relations, Instance-based representation ,Classification -Statistical Based Algorithms, Decision Trees Based Algorithms, Neural Networks Based Algorithms, Rules, Regression, Instance-based (Nearest neighbor), Case study **6**

Unit 3: Clustering
Introduction, Clustering Methods, Ways of scaling clustering algorithms, Case study **6**

Unit 4
Associations, Transactions, Frequent itemsets, Association rules, Applications **6**

Unit 5: **8**
Data warehousing, OLAP and Data mining, web warehousing, Schema integration and data cleaning, Deduplication, Data marts: Multidimensional databases (OLAP)
Advanced topics: ETL, Integrating OLAP and mining, Online aggregation, Recap, future and visions.

Unit 6:
Advanced Topics: Mining Multimedia Databases, Text Mining, Web Mining, Spatial Mining, Temporal Mining
Data Mining Applications, Additional Themes on Data Mining, Social impacts of Data Mining, Trends in Data Mining **8**

References:
1. Jiawei Han, Micheline Kamber. Data Mining: Concepts and Techniques. Morgan-Kaufmann,
2. Heikki Mannila, Padhraic Smyth, David Hand. Principles of Data Mining, MIT Press, 2001.
3. Margaret H. Dunham. Data Mining: Introductory and Advanced Topics, Pearson Education, 2003
4. Soumen Chakrabarti. Mining the Web- Discovering Knowledge from Hypertext Data, Morgan-Kaufmann, 2003
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2006
6. Ian H. Witten & Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan-Kaufmann, 2000.
7. T Hastie, R Tibshirani, J H Friedman,The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer Verlag, 2001.

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 524: Business Intelligence (Elective- III)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Introducing the Technical Architecture **Hrs**

The value of architecture, Technical Architecture overview, Back room Architecture, Presentation Server Architecture, Front room Architecture, Infrastructure, Metadata, Security. **7**

Unit 2 Introducing Dimensional Modeling

Making the Case for Dimensional Modeling, Dimensional Modeling primer, Enterprise Data Warehouse Bus Architecture, More on Dimensions & Facts. **6**

Unit 3 Designing the Dimensional Modeling

Modeling Process overview, Getting Organized, Four Step Modeling Process, Design the Dimensional Model. **5**

Unit 4 Introducing Extract, Transformation & Load

Round up the requirements, the 34 subsystems of ETL, Extracting Data, Cleaning & Conforming data. **6**

Unit 5 Introducing Business Intelligence Applications

Importance of B.I. Applications, Analytical cycle for B.I., Types of B.I. Applications, Navigating Applications via the B.I portal. **6**

Unit 6 Designing & Developing B.I Applications

B.I. Application resource planning, B.I. Application Specification, B.I. Application Development, B.I. Application maintenance **6**

Text Book:

1. The Data Warehouse Lifecycle Toolkit By Raiph Kimball,Ross, 2nd edition, Wiley Publication

Reference Books:

1. Data Warehousing in the Real World – Anahory & Murray, Pearson Edt.
2. Data Warehousing Fundamentals – Ponniah [Wiley Publication]

Department of Technology

M. Tech (Computer Science & Technology) - I

Semester- II

CS 524: Web Services and SOA (Elective- III)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Web services Technologies **6**

What is Web services, Evolution and differences with Distributed computing, WSDL, SOAP, UDDI, Transactions, Business Process Execution Language for Web Services, WS-Security and the Web services security specifications, WS-Reliable Messaging, WS-Policy, WS-Attachments

Unit 2 SOA Fundamentals **6**

Defining SOA, Business Value of SOA, Evolution of SOA, SOA characteristics, concept of a service in SOA, misperceptions about SOA, Basic SOA architecture, infrastructure services, Enterprise Service Bus (ESB), SOA Enterprise Software models, IBM On Demand operating environment

Unit 3 SOA Planning and Analysis **6**

Stages of the SOA lifecycle, SOA Delivery Strategies, service-oriented analysis, Capture and assess business and IT issues and drivers, determining non-functional requirements (e.g., technical constraints, business constraints, runtime qualities, nonruntime qualities), business centric SOA and its benefits, Service modeling, Basic modeling building blocks, service models for legacy application integration and enterprise integration, Enterprise solution assets(ESA)

Unit 4 SOA Design and implementation **8**

Service-oriented design process, design activities, determine services and tasks based on business process model, choosing appropriate standards, articulate architecture, mapping business processes to technology, designing service integration environment (e.g., ESB, registry), Tools available for appropriate designing, implementing SOA, security implementation, implementation of integration patterns, services enablement, quality assurance

Unit 5 Managing SOA Environment **6**

Distributing service management and monitoring concepts, operational management challenges, Service-level agreement considerations, SOA governance (SLA, roles and responsibilities, policies, critical success factors, and metrices), QoS compliance in SOA governance, role of ESB in SOA governance, impact of changes to services in the SOA lifecycle

Unit 6 Web 2.0 technologies

Introduction to Ajax, Ajax Design Basics, JavaScript, Blogs, Wikis, RSS feeds 4

Reference Books

1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design**"**, Prentice Hall Publication, 2005.

2. Norbert Bieberstein, Sanjay Bose, Marc Fiammante, Keith Jones, Rawn Shah, **"**Service-Oriented Architecture Compass: Business Value, Planning, and Enterprise Roadmap**"**, IBM Press Publication, 2005.

3. *Sandy Carter*, "The New Language of Business: SOA & Web 2.0**",** IBM Press, 2007.

4. Thomas Erl*,* **"**Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services**",** Prentice Hall Publication, 2004

5. Dave Chappell*,* "Enterprise Service Bus**",**O'Reilly Publications, 2004

6. Sanjiva Weerawarana*, Francisco Curbera, Frank Leymann, Tony Storey, Donald F. Ferguson*, "Web Services Platform Architecture: SOAP, WSDL, WS-Policy, WSAddressing, WS-BPEL, WS-Reliable Messaging, and More**",** Prentice Hall Publication, 2005
7. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services**",** Addison Wesley Publication, 2004
8. *Thomas Mattern, Dan Woods*, "Enterprise SOA: Designing IT for Business Innovation**",** O'Reilly publications, April 2006

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 525: Geographical Information Systems (Elective- IV)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1
Introduction to GIS, Spatial Data, Spatial Data Modeling, Attribute Data Management **6**

Unit 2
Data, Input, Editing, Data Analysis **6**

Unit 3
Analytical Modeling in GIS. **Output:** From New Maps to Enhanced decisions **7**

Unit 4
Development of Computer methods for handling spatial data **6**

Unit 5
Data quality issues, Human and Organizational issues **6**

Unit 6
GIS project Design and Management, Future of GIS **6**

Reference Books:
1. *"An Introduction to Geographical Information Systems",* Ian Heywood, Sarah Cornelius & Steve Carver, Pearson Education.

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 525: Artificial Intelligence and Natural Language Processing (Elective- IV)

Teaching Scheme: **L:** 3 **T:** - **P:** - **Credits:** 3

Unit 1 Introduction, Problems, Problem Spaces, and Search **6**

The AI problem, the underlying assumption, what is an AI technique? , the level of the model, criteria for success, some general reference, defining the problem as a state space search, production systems, problem characteristics, production system characteristics, issues in the design of search programs, additional problems

Unit 2 Heuristic Search Techniques **6**

Generate-and-test, Hill climbing, Best-first search, Problem reduction, constraint satisfaction, means-end analysis

Unit 3 Knowledge Representation Issues, Predicate Logic **7**

Representation and mappings, approaches to knowledge representation, issues in knowledge representation, the frame problem, representing simple facts in logic, representing instance and ISA relationships, computable functions and predicates, resolution, natural deduction

Unit 4 Representing Knowledge Using Rules, Statistical Reasoning **8**

Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching, control knowledge, probability and bayes theorem, certainty factors and rule-based systems, Bayesian networks, dempster-shafer theory, fuzzy logic.

Unit 5 Goals of NLP, Resources for NLP **6**

Survey of applications, Levels of linguistic processing: morphology, syntax, semantics, lexicons and knowledge bases

Unit 6 Computational morphology **8**

lemmatisation, Part-of-Speech Tagging, Finite-State Analysis.
Ambiguity and its resolution: Syntactic ambiguities and heuristics, lexical ambiguities and selectional restrictions, indeterminacy of reference

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair, " Artificial Intelligence" third edition, McGraw Hill
2. Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds) *Readings in natural language processing*. Los Altos, CA, 1986: Morgan Kaufmann.
3. Jurafsky, D. & J. Martin. 2000. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition* Prentice Hall.

Department of Technology
M. Tech (Computer Science & Technology) - I
Semester- II
CS 525: System Modeling and Simulation (Elective- IV)

Teaching Scheme: **L:** 3 **T: -** **P: -** **Credits:** 3

Unit 1 Introduction **6**

When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study. The basics of Spreadsheet simulation, Simulation example: Simulation of queuing systems in a spreadsheet.

Unit 2 General Principles, Simulation Software **8**

Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling; List processing. Simulation in Java; Simulation in GPSS

Statistical Models in Simulation: Review of terminology and concepts; Useful statistical models; Discrete distributions; Continuous distributions; Poisson process; Empirical distributions.

Unit 3 Queuing Models **6**

Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues; Rough-cut modeling: An illustration.

Unit 4 Random-Number Generation, Random-Variate Generation **6**

Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties.

Unit 5 Input Modeling **6**

Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; Selecting input models without data; Multivariate and Time-Series input models.

Unit 6 Estimation of Absolute Performance **8**

Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations.

Verification, Calibration, and Validation; Optimization: Model building, verification and validation; Verification of simulation models; Calibration and validation of models, Optimization via Simulation

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson, 2010.

Reference Books:

1. Lawrence M. Leemis, Stephen K. Park: Discrete – Event Simulation: A First Course, Pearson, 2006.
2. Averill M. Law: Simulation Modeling and Analysis, 4th Edition, Tata McGraw-Hill, 2007 iewski.

Department of Technology

M. Tech (Computer Science & Technology) - I

CS 516: Seminar II

Teaching Scheme: **P:** 2 **T: -** **Credits: 2**

Seminar II shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. All modern methods of presentation should be used by the student. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed, well formatted preferably in IEEE format) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any. Guide should guide concern student 2hrs /week/student for seminar.

(Student is expected to submit seminar report in Latex/Microsoft word in the standard format style file available in the department)

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II

CS 527: Parallel Computer Architecture Lab

Teaching Scheme: **L:** - **P:** - 2 **Credits:** 1

This lab consists of a set of minimum 8-10 Practical problems/ Tutorials / Research Problems and simulations based on the syllabus.

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II

CS 528: Computer Vision and Image Processing Lab

Teaching Scheme: **L:** - **T:** - **P: 2** **Credits:** 1

This lab consists of a set of minimum 8-10 Practical problems/ Tutorials / Research Problems and simulations based on the syllabus.

Department of Technology

M. Tech (Computer Science & Technology) - I
Semester- II
CS 529: Computer Security Lab

Teaching Scheme: **L: -** **T: -** **P: 2** **Credits:** 1

This lab includes some cryptographic algorithms and problems. Few sample laboratory experiments are as follows:

1. Study of different Substitution and Transposition techniques.
2. Given Hill Cipher Key;
   Encrypt your message, "……."
   Show calculations and result.
   Show corresponding decryption to get the original plaintext.
3. Implement numerical encryption using one round version of DES. Start with same bit pattern for K and P as,
   0 – 0000 1- 0001 2- 0010 ……
   …… E- 1110 F- 1111.
   a. Derive k1 – first round key
   b. Derive L0 and R0
   c. Expand R0 to get E[R0]
   d. Calculate A= E[R0] XOR K1
   e. Group the 48 bit result of (d) into sets of 6 bits and evaluate the corresponding S-box substitution.
   f. Concatenate the results of (e) to get a 32 bit result, B.
   g. Apply permutation to get P(B)
   h. Calculate R1=P(B) XOR L0
   i. Write down ciphertext.
4. Using S-DES decrypt the string (10100010) using the key (0111111101). Show intermediate results after each function (IP, FK, SW, FK, IP-1). Then decode the first 4 bits of the plaintext string to a letter and the second 4 bits to another letter where we decode A through P in base 2 (i.e. A=0000, B=0001,….P=1111).
   Hint: as a midway check, after SW, the string should be (00010011).
5. Perform encryption and decryption using RSA algorithm
6. Study of Digital Signature Algorithm.
7. Study of Kerberos. How version 5 is different from version 4?
8. Study of role of encryption in the operation of virus.
9. Discuss examples of applications of IPsec.
10. List and briefly define the principal categories of SET participants.
11. List and define intruder classes and intrusion detection.
12. Firewall techniques to control access and enforce a security policy.

Department of Technology

M. Tech (Computer Science & Technology) - II

Semester- III

CS 611: Industrial Training

Teaching Scheme: **L: -** **T: -** **P: 5*** **Credits:** 4

The student shall undertake software development project at any of the industry/research organization/software company under the guidance of internal guide and a suitable Co-guide from that industry/research organization/software company for duration of eight weeks at the end of first year (during summer). The report of the development work is to be submitted to the University in the first week of semester III.

(Student is expected to submit report in Latex/Microsoft word in the standard format style file available in the department)

Department of Technology

M. Tech (Computer Science & Technology) - II

Semester- III

CS 612: Dissertation Phase I

Teaching Scheme: **L: -** **T: -** **P: 5*** **Credits:** 10

The dissertation title should be identified on the basis of the literature survey and a presentation be delivered. The synopsis of the dissertation be prepared and submitted to the University for its Approval.

The student shall carry work related to the dissertation with the consent of the guide. This work shall include related hardware/software assignments, field work (if required) as decided by the guide. The student shall submit monthly progress report to the department and shall deliver a presentation at the end of Semester III submitting the progress of the work done. The work is to be jointly assessed for oral examinations by internal (guide) and external examiners appointed by the University. For the dissertation phase I and phase II concern guide should guide to each student minimum for **2** hrs per week till the final submission of the dissertation of the concern student.

(Student is expected to submit seminar report in Latex/Microsoft word in the standard format style file available in the department)

Department of Technology

M. Tech (Computer Science & Technology) - II
Semester- IV
CS 621: Dissertation Phase II

Teaching Scheme: **L: -** **T: -** **P: 5*** **Credits:** 20

The student shall submit monthly progress report to the department and shall deliver a presentation of the work at the end of Semester IV submitting the report on the dissertation work. A pair of referees, as appointed by the University, one of which will be the guide and the other - external examiner will access the dissertation work during the oral examination.

For the dissertation phase I and phase II concern guide should guide to each student minimum for **2** hrs per week till the final submission of the dissertation of the concern student.

(Student is expected to submit seminar report in Latex/Microsoft word in the standard format style file available in the department)

Equivalence of M. Tech (Computer Science and Technology)-I Semester I & II

The above detailed syllabus is a revised version of the M. Tech (Computer Science and Technology)-I course being conducted by the Shivaji University at the Technology Department of the University. This syllabus is to be implemented from June 2012-13.

The Equivalence for the subjects of Computer Science and Technology at M. Tech Semester I and II pre-revised course under the faculty of Engineering and Technology is as follows.

M. Tech Semester I (Computer Science and Technology)

Sr. No	M. Tech (Computer Science and Technology) Semester I Pre-revised syllabus	M. Tech (Computer Science and Technology) Semester I & II Revised syllabus
1.	-	Research Methodology (Audit)
2.	Theory of Computer Science	Mathematical Foundation of Computer Science
3.	Advanced Operating System	Elective-II Advanced Operating Systems -
4.	Design and Analysis of Algorithms	Design and Analysis of Algorithms
5.	Elective – I & II Artificial Neural Network	Artificial Neural Network (ANN)
6.	Elective – I & II -Data Mining	Elective-III -Data-Mining and Warehousing -
7.	Seminar – I	Seminar- I

M. Tech Semester II (Computer Science and Technology)

Sr. No	M. Tech (Computer Science and Technology) Semester II Pre-revised syllabus	M. Tech (Computer Science and Technology) Semester I & II Revised syllabus
1.	Computer Network Administration	-
2.	Advanced Computer Architecture	Parallel Computer Architecture
3.	Advanced Database Design	Elective-I Advance Database Systems
4.	Elective – III & IV Digital Security	Computer Security
5.	Mobile Computing	-
6.	Seminar – II	Seminar – II
7.	-	Computer Vision and Image Processing
8.		Elective-IV- Geographical Information Systems

M. Tech (Computer Science and Technology)-II Semester III

Sr. No	M. Tech (Computer Science and Technology) Semester II Pre-revised syllabus	M. Tech (Computer Science and Technology) Semester II Revised syllabus	Remark
1	Software Development	Industrial Training	--
2	Dissertation Phase – I	Dissertation Phase-I	--

M. Tech (Computer Science and Technology)-II Semester IV

Sr. No	M. Tech (Computer Science and Technology) Semester II Pre-revised syllabus	M. Tech (Computer Science and Technology) Semester II Revised syllabus	Remark
1	Dissertation Phase – II	Dissertation Phase-II	--