**DEPARTMENT OF TECHNOLOGY**

**FIRST YEAR M.TECH**

**COMPUTER SCIENCE AND TECHNOLOGY**

Scheme of Teaching and Examination
Semester – I

| Subject Code | Subject | Teaching Scheme (Hours / Week) | | | | Examination Scheme (Marks) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Theory | | | Practical | | |
| | | L | T | P | Credit | Scheme | Max. marks | Min. Passing $ | Scheme | Max. marks | Min. Passing |
| AC 511 | Research Methodology (Audit) | 2 | - | - | - | Institute Level | | | -------- | ------- | -------- |
| CS211 | Mathematical Foundation of Computer Science | 4 | - | - | 04 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS 512 | Design and Analysis of Algorithms | 4 | - | - | 04 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS 513 | Artificial Neural Network (ANN) | 4 | | - | 04 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS 514 | Elective-I | 3 | - | - | 03 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS515 | Elective- II | 3 | - | - | 03 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | | | |
| CS516 | Seminar -I | - | - | 2 | 02 | -------- | -------- | -------- | IOE | 50 | 20 |
| CS517 | Mathematical Foundation of Computer Science Lab | | | 2 | 01 | -------- | -------- | -------- | IOE (IPE + EPE) | 50 | 20 |
| CS518 | Design and Analysis of Algorithms Lab | - | - | 2 | 01 | -------- | -------- | -------- | IOE (IPE + EPE) | 50 | 20 |
| CS519 | Artificial Neural Network (ANN) Lab | | | 2 | 01 | | | | IOE (IPE + EPE) | 50 | 20 |
| | **Total** | **20** | **-** | **8** | **23** | | **500** | | | **200** | |

| Elective - I |
|---|
| Advance Database Systems |
| Bio Informatics |
| Advanced Compilers |

| Elective - II |
|---|
| Advanced Operating Systems |
| Real Time Systems |
| Web Engineering |

**Total Credits: 23**
**Total Contact Hours/Week: 28**
**Note:**
$: Minimum 40% marks required in SEE as passing head.
• Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.
CIE – Continuous Internal Evaluation, SEE – Semester End Examination,
IPE – Internal Practical Evaluation, EPE–External Practical Examination,
IOE– Internal Oral Evaluation, EOE–External Oral Examination

**DEPARTMENT OF TECHNOLOGY**

**FIRST YEAR M.TECH**

**COMPUTER SCIENCE AND TECHNOLOGY**

Scheme of Teaching and Examination
Semester – II

| Subject Code | Subject | Teaching Scheme (Hours / Week) | | | | Examination Scheme (Marks) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Theory | | | Practical | | |
| | | L | T | P | Credit | Scheme | Max. marks | Min. Passing $ | Scheme | Max. marks | Min. Passing |
| CS521 | Parallel Computer Architecture | 4 | - | - | 4 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS522 | Computer Vision and Image Processing | 4 | - | - | 4 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS523 | Computer Security | 4 | - | - | 4 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS524 | Elective-III | 3 | - | - | 3 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS525 | Elective-IV | 3 | - | - | 3 | CIE | 50 | 20 | -------- | ------- | -------- |
| | | | | | | SEE | 50 | 20 | -------- | ------- | -------- |
| CS526 | Seminar - II | - | - | 2 | 2 | -------- | -------- | -------- | IOE | 50 | 20 |
| CS527 | Parallel Computer Architecture Lab | - | - | 2 | 1 | -------- | -------- | -------- | IOE (IPE + EPE) | 50 | 20 |
| CS528 | Computer Vision and Image Processing Lab | - | - | 2 | 1 | -------- | -------- | -------- | IOE (IPE + EPE) | 50 | 20 |
| CS529 | Computer Security Lab | - | - | 2 | 1 | | | | IOE (IPE + EPE) | 50 | 20 |
| | **Total** | **18** | **-** | **08** | **23** | | **500** | | | **200** | |

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

| **Elective - IV** |
|---|
| Geographical Information Systems |
| Artificial Intelligence and Natural Language Processing |
| System modelling and simulation |

**Total Credits: 23**
**Total Contact Hours/Week: 26**

**Note:**
$: Minimum 40% marks required in SEE as passing head.

• Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

CIE – Continuous Internal Evaluation, SEE – Semester End Examination,
IPE – Internal Practical Evaluation, EPE–External Practical Examination,
IOE– Internal Oral Evaluation, EOE–External Oral Examination

**DEPARTMENT OF TECHNOLOGY**

**SECOND YEAR M.TECH**

**COMPUTER SCIENCE AND TECHNOLOGY**

Scheme of Teaching and Examination
Semester – III

| Subject Code | Subject | Teaching Scheme (Hours / Week) | | | | Examination Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credit | Practical | | |
| | | | | | | Scheme | Max. marks | Min. Passing |
| CS611 | Industrial Training | - | - | 5** | 04 | IOE | 50 | 20 |
| | | | | | | EOE | 50 | 20 |
| CS612 | Dissertation Phase-I | - | - | 5** | 10 | IOE | 100 | 40 |
| | | | | | | EOE | 100 | 40 |
| | **Total** | | **-** | **10** | **14** | | **300** | |

**Total Credits: 14** **Total Contact Hours/Week: 10****

** Average contact hours/week/student

**DEPARTMENT OF TECHNOLOGY**
**SECOND YEAR M.TECH**

**COMPUTER SCIENCE AND TECHNOLOGY**

Scheme of Teaching and Examination
Semester – IV

| Subject Code | Subject | Teaching Scheme (Hours / Week) | | | | Examination Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credit | Practical | | |
| | | | | | | Scheme | Max. marks | Min. Passing |
| CS622 | Dissertation Phase-II | - | - | 5** | 20 | IOE | 100 | |
| | | | | | | EOE | 200 | |
| | **Total** | **-** | **-** | **05** | **20** | | **300** | |

**Total Credits: 20** **Total Contact Hours/Week:** 5**

**** Average contact hours/week/student**

**Note:**
$: Minimum 40% marks required in SEE as passing head.

• Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

CIE – Continuous Internal Evaluation, SEE – Semester End Examination,
IPE – Internal Practical Evaluation, EPE–External Practical Examination,
IOE– Internal Oral Evaluation, EOE–External Oral Examination

| **Title of the Course:**<br>**Research Methodology(AC511)** | L-2 | T-0 | P-0 | Cr-0 |
|---|---|---|---|---|

Pre-Requisite Courses:

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.


Course Objectives :

- Understand some basic concepts of research and its methodologies.
- Identify appropriate research topics.
- Select and define appropriate research problem and parameters.
- Prepare a project proposal (to undertake a project)
- Organize and conduct research (advanced project) in a more appropriate manner.
- Write a research report and thesis.
- Write a research proposal.

Course Learning Outcomes:

- To define research and describe the research process and research methods .
- To know how to apply the basic aspects of the research process in order to plan and execute a research project
- To effectively use the library and its resources in gathering information related to the learners' research project.
- To understand the process of sampling, the uses of questionnaires as data-gathering instruments, how a survey is carried out in terms of process and method, the uses of surveys and to be able to capture their own data.

Assessments:

Course Contents:

**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-parametric 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**

| **Title of the Course:**<br>**Mathematical Foundation of Computer Science(CS511)** | L-4 | T- | P-2 | Cr-4 |
|---|---|---|---|---|

Pre-Requisite Courses:

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.


Course Objectives :

- Provide students with the broad background skills necessary to learn, practice, and grow in computer science.
- Provide students with the fundamental core and advanced knowledge of computer science.
- Provide students with adequate skills for effective communication of computer science technicalities, both in written and oral form.
- Produce students who can use and practice computer science in various application areas.

Course Learning Outcomes:

The MFCS Curriculum is designed so that each student will have demonstrated the following competencies upon graduating:

- Ability to analyze a problem and identify and define the computing requirements to solution.
- Ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs.
- Ability to analyze the local and global impact of computing on individuals, organizations and society.
- Recognition of the need for and having the ability to engage in research.
- Ability to apply mathematical foundations, arithmetical principles, and computer science theory in the modelling and design of computer-based systems that demonstrates trade-offs involved in design choices.
- Ability to apply design and development principles in the construction of software systems of varying complexity.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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 **Push down automata and CFG:**PDA, N-PDA, CFG, ambiguous grammar, non-ambiguous grammar, CNF, Parsers: Top-down, Bottom-up. **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**

| **Title of the Course:**<br>**Design and Analysis of Algorithms(CS512)** | L-4 | T- | P-2 | Cr-4 |
|---|---|---|---|---|

Pre-Requisite Courses:

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)

Course Objectives:

The study of algorithm includes many important and active areas of research. The course describes and use major algorithmic techniques (divide-and-conquer, dynamic programming, linear programming, greedy paradigm, and cite problems for which each technique is suitable. Evaluate and compare different algorithms using worst-, average-, and best-case analysis. Detail information about lower bound theory. Explain the difference between tractable and intractable problems, and identify the basic complexity classes, such as P, NP and NP- complete. Give detail description about parallel algorithm designing techniques such as PRAM, MESH and Hypercube algorithms which will be useful for research in parallel computing.

Course Learning Outcomes:

Use and apply current technical concepts and practices in core computing and information technologies. Analyze a problem, and identify and define the computing requirements appropriate to its solution. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains; apply the algorithms and design techniques to solve problems; analyze the complexities of various problems in different domains. The parallel algorithms will be useful.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

**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 pair's 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. **7**

| **Title of the Course:**<br>**Artificial Neural Network(CS513)** | L-4 | T- | P-2 | Cr-4 |
|---|---|---|---|---|

Pre-Requisite Courses:

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)

Course Objectives :

1. Learning types of neural network architectures (ANN) design methodology of the main classes of learning algorithms, knowledge of alternative techniques for training ANN using hybrid genetic algorithms. Know alternatives to implement parallel / distribute the ANN.
2. Know the main types of practical applications. Developing skills of software implementation and evaluation of specific algorithms. Establishing connections with other disciplines.

Course Learning Outcomes:

1. An ability to solve complicated problems using biological neuron system & calculate equation of terminal network.
2. An ability to design and implement neural network systems.
3. Describe the relation between real brains and simple artificial neural network models.
4. Explain and contrast the most common architectures and learning algorithms for Multi-Layer Perceptrons, Radial-Basis Function Networks and Kohonen Self-Organising Maps.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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**

| **Title of the Course:**<br>**Advanced Database System (Elective- I)(CS514)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|

Pre-Requisite Courses:

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


Course Objectives :

- Describe the basic concepts of Relational Database Design, SQL and Database System catalog and responsibilities of DBMS.
- Explain types of database as Object database, Parallel database, Distributed database, Web database and Deductive database.
- Study in detail Distributed DBMS.
- Study in detail Object DBMS.
- Explain the concepts of transaction management and advanced transaction processing.
- Explain the Database Security issues and Performance measures in databases.

Course Learning Outcomes:

- Develop your knowledge and understanding of the underlying principles of Relational Database Management System in detail.
- Be familiar with new data management applications and build capacity to learn DBMS advanced features.
- Develop your competence in enhancing database models using distributed databases.
- Build up your capacity to implement and maintain an object database management system.
- Master transaction processing, concurrency control and crash recovery.
- Master query processing and optimization, advanced indexing and data organization for DBMS.
- Be familiar with security issues and performance measure in DBMS like Oracle/IBM DB2

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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**<br>Transaction Processing Monitors, Transactional workflows, Real time transactions, Transaction management in commercial databases **6**<br><br>**Unit 6 Security Issues and Performance measure In Databases**<br>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** |
| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Advanced Operating Systems (Elective- II)(CS515)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|

Pre-Requisite Courses:

Reference Books:

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.

Course Objectives :

The student should have learned the following:

1. The differences among: concurrent, networked, distributed, and mobile.
2. Resource allocation and deadlock detection and avoidance techniques.
3. Remote procedure calls.
4. IPC mechanisms in distributed systems.

Course Learning Outcomes:

From this subject the student will gain enough understanding of distributed operating systems, be able to explain the principles underlying the functioning of distributed systems as well as how these principles are applied in distributed systems and what the problems and challenges are. The student will understand and estimate the impact of different design choices, system features on distributed systems.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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**

| |
|---|
| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Seminar I(CS516)** | L- | T- | P-2 | Cr-2 |
|---|---|---|---|---|
| Pre-Requisite Courses: | | | | |
| Course Objectives :<br>• Awareness of how to use values in improving your own professionalism<br>• Implement values for bridging and harmonising your employees<br>• Learning about personal and communication styles for team building<br>• Learning from history, art and music from natural human life<br>• Learning management of values<br>• Using values for your business development<br>• Increase knowledge of Emotional Intelligence learn at the seminar Basics and principals of value management<br>• Characteristics and components of Emotional Intelligence(EI)<br>• Improvement of your own EI<br>• Control and management of your emotions and emotions of others<br>• Motivation and implementation of values into your company<br>• How to unite employees and management of your company<br>• How to build and support great and valuable talent.<br>• Using art and music in your company | | | | |
| Course Learning Outcomes:<br>• Students will demonstrate the ability to perform close and critical readings.<br>• Students will demonstrate the ability to consider critically the motives and methods of scholarship and the relationship between them.<br>• Students will demonstrate the ability to distinguish opinions and beliefs from researched claims and evidence and recognize that kinds of evidence will vary from subject to subject. For instance, some fields call for quantitative support while others work more commonly with quoted, textual evidence.<br>• Students will demonstrate the ability to ask disciplinarily appropriate questions of the material and recognize when lines of inquiry fall outside of disciplinary boundaries.<br>• Students will demonstrate the ability to evaluate, credit, and synthesize sources | | | | |
| Assessments:<br>Related Literature survey quality of information presentation, Knowledge acquired. | | | | |
| Course Contents:<br>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.<br>(Student is expected to submit seminar report in Latex/Microsoft word in the standard format style file available in the department) | | | | |
| Module wise Measurable Students Learning Outcomes | | | | |
| Outcomes as regards to improvement in Communication Skills | | | | |
| Computer Usage / Lab Tool | | | | |
| Laboratory Experiences: | | | | |
| Independent Learning Experiences: | | | | |

| **Title of the Course:**<br>**Mathematical Foundation of Computer Science Lab** | L-0 | T- | P-2 | Cr-1 |
|---|---|---|---|---|

Pre-Requisite Courses:

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.


Course Objectives :

- Provide students with the broad background skills necessary to learn, practice, and grow in computer science.
- Provide students with the fundamental core and advanced knowledge of computer science.
- Provide students with adequate skills for effective communication of computer science technicalities, both in written and oral form.
- Produce students who can use and practice computer science in various application areas.

Course Learning Outcomes:

The MFCS Curriculum is designed so that each student will have demonstrated the following competencies upon graduating:

- Ability to analyze a problem and identify and define the computing requirements to solution.
- Ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs.
- Ability to analyze the local and global impact of computing on individuals, organizations and society.
- Recognition of the need for and having the ability to engage in research.
- Ability to apply mathematical foundations, arithmetical principles, and computer science theory in the modelling and design of computer-based systems that demonstrates trade-offs involved in design choices.
- Ability to apply design and development principles in the construction of software systems of varying complexity.

Assessments:

4. Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).
5. Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).
6. The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by Department of Technology, Shivaji University, Kolhapur. w.e.f. 2012-13

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

Course Contents:

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

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Design and Analysis of Algorithms Lab** | L- | T- | P-2 | Cr-1 |
|---|---|---|---|---|

Pre-Requisite Courses:

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)

Course Objectives:

The study of algorithm includes many important and active areas of research. The course describes and use major algorithmic techniques (divide-and-conquer, dynamic programming, linear programming, greedy paradigm, and cite problems for which each technique is suitable. Evaluate and compare different algorithms using worst-, average-, and best-case analysis. Detail information about lower bound theory. Explain the difference between tractable and intractable problems, and identify the basic complexity classes, such as P, NP and NP- complete. Give detail description about parallel algorithm designing techniques such as PRAM, MESH and Hypercube algorithms which will be useful for research in parallel computing.

Course Learning Outcomes:

Use and apply current technical concepts and practices in core computing and information technologies. Analyze a problem, and identify and define the computing requirements appropriate to its solution. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains; apply the algorithms and design techniques to solve problems; analyze the complexities of various problems in different domains. The parallel algorithms will be useful.

Assessments:

4. Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

5. Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).

6. The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by Department of Technology, Shivaji University, Kolhapur. w.e.f. 2012-13

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

Course Contents:

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

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Artificial Neural Network Lab** | L- | T- | P-2 | Cr-1 |
|---|---|---|---|---|

Pre-Requisite Courses:

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)

Course Objectives :

1. Developing skills of software implementation and evaluation of specific algorithms. Establishing connections with other disciplines.
2. Implementation and design of problems related to neural networks.

Course Learning Outcomes:

1. An ability to solve complicated problems using biological neuron system & calculate equation of terminal network.
2. An ability to design and implement neural network systems.
3. Describe the relation between real brains and simple artificial neural network models.
4. Explain and contrast the most common architectures and learning algorithms for Multi-Layer Perceptrons, Radial-Basis Function Networks and Kohonen Self-Organising Maps.

Assessments:

4. Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).
5. Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).
6. The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by Department of Technology, Shivaji University, Kolhapur. w.e.f. 2012-13

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

Course Contents:

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

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Bio Informatics (Elective- I)(CS514)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|

Pre-Requisite Courses:

Reference Books:

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.

Course Objectives :

Graduates of the Bioinformatics program will demonstrate expertise in the following core competencies essential to success:

1. Extract information from different types of bioinformatics data (gene, protein, disease, etc.), including their biological characteristics and relationships
2. Employ different data representation models and formats used for bioinformatics data representation, including mark-up languages such as SBML and CellML, and ontologies such as GO ontology
3. Apply the different approaches used for data integration and data management, including data warehouse and wrapper approaches
4. Master computational techniques and diversified bioinformatics tools for processing data, including statistical, machine learning and data mining techniques
5. Analyze processed data with the support of analytical and visualization tools
6. Carry out bioinformatics research under advisement, including systems biology, structural bioinformatics and proteomics
7. Interact with non-bioinformatics professionals, such as biologists and biomedical researchers, to better understand their bioinformatics needs for improved support and service delivery
8. Design and develop bioinformatics solutions by adapting existing tools, designing new ones or a combination of both

Course Learning Outcomes:

- Set a solid background in bioinformatics
- For a given biological sequence analysis problem, students should be able to choose and modify suitable computational models to solve the problem
- Interpret the advantages and/or disadvantages of the approach
- Be able to identify and pursue research topics in bioinformatics.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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**

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

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| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Advanced Compilers (Elective- I)(CS514)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|
| Pre-Requisite Courses: | | | | |

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)

Course Objectives:
- This course will focus on advanced topics in scalar optimization and code generation for an optimizing compiler.
- Students should gain a working knowledge of best practice algorithms and techniques.
- This course will focus on advanced topics in scalar optimization and code generation for an optimizing compiler.
- Students should gain a working knowledge of best practice algorithms and techniques.

Course Learning Outcomes:
1. Understanding of the challenges involved in compilation.
2. Understanding of the phases involved in compilation, and knowledge of the techniques applied.
3. Ability to understand design decisions in modern compilers and to justify these.
4. Ability to develop and apply modifications to standard compilation techniques wherever this is necessary.
5. Ability to analyze compilation tasks and to apply standard compilation techniques.
6. Ability to implement standard compilation algorithms.
7. Gain an understanding of the challenges involved in compilation for modern architectures and the approaches taken in modern compilers

Assessments:
Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).
1. CIE (50% weightage) includes :
Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)
Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)
2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.
3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**Unit 1 Basics of Compiler Design** **Hrs**

Planning a compiler, approaches to compiler design, compiler development tools – Lex and Yaac. **6**

**Unit 2 Code Generation**

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

**Unit 3 Code Optimization**

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. **8**

**Unit 4 Parallel Compilers**

Motivation and overview, Structure of a Parallelizing compiler. Parallelism detection: data dependence, direction vectors, loop carried and loop independent dependences. **6**

**Unit 5 Compilation for Distributed Machines**

Data partitioning, instruction scheduling, register allocation, machine optimization. Dynamic compilation. **7**

**Unit 6 Advanced Topics**

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

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| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Real Time Systems(Elective- II)(CS515)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|

Pre-Requisite Courses:

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.


Course Objectives :

1. The main objective of this course is to provide a general introduction to real-time computer control systems and to provide examples of real-time systems including functionality and implementation platforms.
2. Study real time kernels and inter task communication and synchronization.
3. Describe in detail real time memory management and system performance analysis.
4. Study queuing models. Discuss issues related to reliability, testing and fault tolerance.
5. Understand hardware and software design and implementation of real-time systems
6. Describe real time applications of RTOS.

Course Learning Outcomes:

1. Clearly differentiate the different issues that arise in designing soft and hard real-time, concurrent, reactive, safety-critical and embedded systems.
2. Explain the various concepts of time that arise in real-time systems.
3. Analyze and apply a variety of scheduling mechanisms suitable for soft and hard real-time systems.
4. Conduct simple performance and schedulability analysis to demonstrate that a system can successfully meet real-time constraints.
5. Explain the additional problems that arise in developing distributed and Networked real-time systems.
6. Describe the design and implementation of systems that support real-time applications. Justify and critique facilities provided by real-time operating systems and networks.
7. Design, construct and analyze a small, concurrent, reactive, real-time system.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

**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, Pseudo code 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 Queuing 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 Neumann Architectures. **Hardware/ Software Integration:** Goals of Real-Time system integration, Tools, Methodology, The software Heisenberg Uncertainty 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**

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Web Engineering(Elective- II)(CS515)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|

Pre-Requisite Courses:

Textbook:
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

Course Objectives :
To provide students with conceptual and practical knowledge and skill required to develop web applications and web services.

Course Learning Outcomes:
Upon completion of the course:
1. Perform analysis modelling and design modelling for web applications.
2. Identify candidate tools and technologies for developing web applications.
3. Develop user interfaces for web applications.

Develop web application and web services.

Assessments:
Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).
1. CIE (50% weightage) includes :
Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)
Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)
2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.
3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:** **Hrs**

**Unit 1 Introduction**
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 **6**

**Unit 2 Modeling Web Application**
Introduction, Fundamentals, Modeling specifics in web engineering, Modeling requirements, Content modeling, Hypertext modeling, Presentation modeling, Customization modeling, Methods and tools **6**

**Unit 3 Web Application Architectures**
Introduction, Fundamentals, Specifics of web application architectures, Components of generic web application architecture, Layered architectures, Data-aspect architectures. **6**

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

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| side technologies **7**<br><br>**Unit 5 Testing Web Applications**<br>Introduction, Fundamentals, Testing specifics in web engineering, Test approaches, Test scheme, Test methods and techniques, Test automation.<br>**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. **8**<br><br>**Unit 6 The Semantic Web**<br>Fundamentals of the semantic web, Technological concepts, Specifics of semantic web applications, Tools **6** |
| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Parallel Computer Architecture(CS521)** | L-4 | T- | P-2 | Cr-4 |
|---|---|---|---|---|

Pre-Requisite Courses:

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.


Course Objectives :

To enable the student to study the architecture of high performance computer systems and to examine alternative architectures for computer systems designed to meet specific requirements. It equips you with the skills to undertake performance comparisons, improve the performance of applications.

Course Learning Outcomes:

- Understand and analyze the most important parallel architectures in order to distinguish their main differences.
- Understand and analyze how modern computer systems are designed, including details about pipeline, memory organization, virtual and physical memory, asynchronous memory technology.
- Understand and analyze techniques to create and use instruction-level parallelism, memory-level parallelism, and thread-level parallelism..
- Understand and analyze reasons that delimit computer systems with regard to bandwidth, energy consumption.
- Ability to describe design of multiprocessor systems of combination of SIMD and MIMD structures, especially with graphic processors

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :
   Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)
   Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)
2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.
3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**Unit 1: System Architecture** **Hrs**

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. **8**

**Unit 2: Advanced Microprocessor Techniques**

CISC, RISC, EPIC, Superscalar, Super pipelined, ILP, TLP. Power Wall, Moore's Law redefined, Multicore Technologies Intel's Tick Talk Model. Study of State-of-the –Art Processors: Intel//AMD x86 Series, Intel //IBM Itanium// POWER series, Introduction to Graphics Processing Units (GPU: NVIDIA) **8**

**Unit 3: System Interconnects**

SAN: System Area Networks, Storage Area Networks including InfiniBand, GigaBit Ethernet. Scalable Coherent Interface (SCI) Standard. **4**

**Unit 4: Storage**

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. **4**

**Unit 5: Software Architecture**

Parallel Programming Models: Message Passing, Data Parallel, MPI /PVM Typical HPCC Software Stack including Cluster Monitoring Tools e.g. GANGLIA CUDA Programming Environment. **8**

**Unit 6: Case Studies**

A typical Pet flop System based on Hybrid CPU/GPU Architectures, IBM SP System, C-DAC's latest PARAM System. **8**

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

| Independent Learning Experiences: |
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| **Title of the Course:**<br>**Computer Vision and Image Processing(CS522)** | L-4 | T-0 | P-2 | Cr-4 |
|---|---|---|---|---|

Pre-Requisite Courses:

References:


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-Fair Hurst (PHI).


Course Objectives :

Digital imaging has emerged as the dominant technology for acquiring and working with images, whether on the web, with a still camera, or video. Here the issues associated with extracting useful information from digital images will be introduced from an artificial intelligence perspective. These include image data structures, pre-processing for noise reduction and feature enhancement, edge detection, segmentation, object recognition, scene graphs, graph matching, top-down and bottom-up image analysis. At the end of the course, students should be knowledgeable concerning the major steps and algorithms in the end-to-end computer vision process beginning with image acquisition and ending with a machine-produced description of the relevant scene semantics. Students should also have a working knowledge of the Mat lab computing tools for image analysis

Course Learning Outcomes:

After completing the course students will be able to-

1. Explain the main characteristics of different computer vision and image processing techniques through observation of their operations.
2. Implement different computer vision and image processing solutions.
3. Perform critical assessment of the effectiveness of different computer vision and image processing approaches.
4. Apply and combine suitable computer vision and image processing principles to create new and improved solutions for real-world applications.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :
   Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)
   Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)
2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.
3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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**

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| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Computer Security(CS523)** | L-4 | T-0 | P-2 | Cr-4 |
|---|---|---|---|---|

Pre-Requisite Courses:

Textbook:

References:

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

Course Objectives:

- Identify and explain the concepts, policies, and technologies associated with a layered and diversified defences-in-depth strategy.
- Discuss the objectives of access control methods and describe how the available methods are implemented in the defence of a network.
- Identify the impact of a layered defence on the performance of the network.
- Define the concepts of auditing in a network, including the types of audits and the handling of data.

Course Learning Outcomes:

Upon successful completion of this course, the students will be able to:

- Write a suitable set of security policies for different scenarios.
- Apply various access control techniques to ensure authenticity.
- Compare the basic tools and techniques used to attack systems.
- Explain the different types of attacks.
- Specify procedures for password/username management.
- Explore the use of security tools in defending user/group accounts.
- Explore techniques for integrity management.
- Demonstrate the use of logging, auditing, and backup techniques for security
- Explain the basic cryptography concepts.

Assessments:

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

Course Contents:

**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**

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

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| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Data Mining and Warehousing (Elective- III)(CS524)** | L-3 | T- | P- | Cr-3 |
|---|---|---|---|---|

Pre-Requisite Courses**:**

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.


**Course Objectives :**

• Learn the concepts of database technology evolutionary path which has led to the need for data mining and its applications.
• Examine the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.
• Apply pre-processing statistical methods for any given raw data.
• Explore DWH and OLAP, and devise efficient & cost effective methods for maintaining DWHs.Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems, make predictions of outcomes.
• Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques
• Select and apply proper data mining algorithms to build analytical applications.
Evaluate systematically supervised and unsupervised models and algorithms w.r.t their accuracy.
• Develop practical work of DM techniques and design hypotheses based on the analysis to conceptualize a DM solution to a practical problem.

**Course Learning Outcomes:**

Having successfully completed the course, student will be able to:
• Evaluate and implement a wide range of emerging and newly-adopted methodologies and technologies to facilitate the knowledge discovery.
• Assess raw input data, and process it to provide suitable input for a range of data mining algorithms.
• Discover and measure interesting patterns from different kinds of databases
• Characterize and discriminate data summarization forms and determine data mining functionalities. Evaluate and select appropriate data-mining algorithms and apply, and interpret and report the output appropriately.
• Design and implement of a data-mining application using sample, realistic data sets and oden tools.

**Assessments:**

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).
1. CIE (50% weightage) includes :
Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)
Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)
2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.
3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

**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:**

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. **8**

**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**

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| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course: Seminar II(CS526)** | L-0 | T-0 | P-2 | Cr-2 |
|---|---|---|---|---|
| **Pre-Requisite Courses:** | | | | |
| **References:** | | | | |

**Course Objectives :**

- Awareness of how to use values in improving your own professionalism
- Implement values for bridging and harmonising your employees
- Learning about personal and communication styles for team building
- Learning from history, art and music from natural human life
- Learning management of values
- Using values for your business development
- Increase knowledge of Emotional Intelligence learn at the seminar Basics and principals of value management
- Characteristics and components of Emotional Intelligence(EI)
- Improvement of your own EI
- Control and management of your emotions and emotions of others
- Motivation and implementation of values into your company
- How to unite employees and management of your company
- How to build and support great and valuable talent.
- Using art and music in your company.

**Course Learning Outcomes:**

- Students will demonstrate the ability to perform close and critical readings.
- Students will demonstrate the ability to consider critically the motives and methods of scholarship and the relationship between them.
- Students will demonstrate the ability to distinguish opinions and beliefs from researched claims and evidence and recognize that kinds of evidence will vary from subject to subject. For instance, some fields call for quantitative support while others work more commonly with quoted, textual evidence.
- Students will demonstrate the ability to ask disciplinarily appropriate questions of the material and recognize when lines of inquiry fall outside of disciplinary boundaries.
- Students will demonstrate the ability to evaluate, credit, and synthesize sources

**Assessments:**

Related Literature survey quality of information presentation, Knowledge acquired

**Course Contents:**

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)

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| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Parallel Computer Architecture Lab** | L- | T- | P-2 | Cr-1 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**Textbook:**

**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.

**Course Objectives :**

To enable the student to study the architecture of high performance computer systems and to examine alternative architectures for computer systems designed to meet specific requirements. It equips you with the skills to undertake performance comparisons, improve the performance of applications

**Course Learning Outcomes:**

Understand and analyze the most important parallel architectures in order to distinguish their main differences.

- Understand and analyze how modern computer systems are designed, including details about pipeline, memory organization, virtual and physical memory, asn memory technology.
- Understand and analyze techniques to create and use instruction-level parallelism, memory-level parallelism, and thread-level parallelism.
- Understand and analyze reasons that delimit computer systems with regard to bandwidth, energy consumption
- Ability to describe design of multiprocessor systems of combination of SIMD and MIMD structures, especially with graphic processors
- Understand and analyze desirable characteristics, such as energy efficient and reliable, and how they are achieved in embedded systems, PC and servers for commercial and scientific computing.
- able to evaluate enabling technologies such as high-speed links and storage area networks

Understand the performance of multicore processors using SPEC benchmarks.

**Assessments:**

**4.** Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**5.** Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).

**6.** The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by

Department of Technology, Shivaji University, Kolhapur. w.e.f. 2012-13 13

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

**Course Contents:**

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

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Computer Vision and Image Processing Lab** | L- | T-0 | P-2 | Cr-1 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**Textbook:**

**References:**

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).

**Course Objectives :**

To enable the student to study the architecture of high performance computer systems and to examine alternative architectures for computer systems designed to meet specific requirements. It equips you with the skills to undertake performance comparisons, improve the performance of applications

**Course Learning Outcomes:**

- .Understand and analyse the most important parallel architectures in order to distinguish their main differences.
- Understand and analyse how modern computer systems are designed, including details about pipeline, memory organization, virtual and physical memory, as memory technology.
- Understand and analyse techniques to create and use instruction-level parallelism, memory-level parallelism, and thread-level parallelism.
- Understand and analyse reasons that delimit computer systems with regard to bandwidth, energy consumption
- Ability to describe design of multiprocessor systems of combination of SIMD and MIMD structures, especially with graphic processors
- Understand and analyse desirable characteristics, such as energy efficient and reliable, and how they are achieved in embedded systems, PC and servers for commercial and scientific computing.
- Able to evaluate enabling technologies such as high-speed links and storage area networks
- Understand the performance of multicore processors using SPEC benchmarks.

**Assessments:**

**4.** Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**5.** Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).

**6.** The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by

Department of Technology, Shivaji University, Kolhapur. w.e.f. 2012-13 13

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

**Course Contents:**

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

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Computer Security Lab** | L- | T-0 | P-2 | Cr-1 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**Textbook:**

**References:**

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

**Course Objectives :**

- Identify and explain the concepts, policies, and technologies associated with a layered and diversified defence-in-depth strategy.
- Discuss the objectives of access control methods and describe how the available methods are implemented in the defence of a network.
- Identify the impact of a layered defence on the performance of the network.
- Define the concepts of auditing in a network, including the types of audits and the handling of data.

**Course Learning Outcomes:**

Upon successful completion of this course, the students will be able to:

- Write a suitable set of security policies for different scenarios.
- Apply various access control techniques to ensure authenticity.
- Compare the basic tools and techniques used to attack systems.
- Explain the different types of attacks.
- Specify procedures for password/username management.
- Explore the use of security tools in defending user/group accounts.
- Explore techniques for integrity management.
- Demonstrate the use of logging, auditing, and backup techniques for security.
- Explain the basic cryptography concepts.

**Assessments:**

**4.** Final laboratory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**5.** Semester End Examination (SEE) for laboratory consists of External Practical Evaluation (EPE)/External Oral Examination (EOE). Continuous Internal Examinations (CIE) for laboratory consists of Internal Practical Evaluation (IPE) / internal oral Evaluation (IOE).

**6.** The assessment of laboratory course from the 1st semester onwards shall be carried out in two parts.

i. CIE of laboratory consists of IPE/IOE shall be based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in oral or Practical/Oral examinations uniformly distributed throughout the semester.

ii. SEE of laboratory shall be based on performing an experiment followed by an oral examination or a written examination.

iii. The relative weightage for CIE and SEE for assessment of laboratory courses shall be 50% and 50% respectively from second year onwards and a minimum performance of 40% in both CIE and SEE separately shall be required to get the passing grade.

iv. SEE for laboratory course shall normally be held one week before the SEE for theory courses and shall be conducted by a panel of examiners consisting of external and internal examiner. This activity shall be coordinated by

Department of Technology, Shivaji University, Kolhapur. w.e.f. 2012-13

Department Examination Coordinator (DEC) in consultation with Coordinator of the respective department.

**Course Contents:**

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 cipher text.
4. Using S-DES decrypt the string (10100010) using the key (0111111101). Show intermediate results after each

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| 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).<br>Hint: as a midway check, after SW, the string should be (00010011).<br><br>*1.* Perform encryption and decryption using RSA algorithm<br>6. Study of Digital Signature Algorithm.<br>7. Study of Kerberos. How version 5 is different from version 4?<br>8. Study of role of encryption in the operation of virus.<br>9. Discuss examples of applications of IPsec.<br>10. List and briefly define the principal categories of SET participants.<br>11. List and define intruder classes and intrusion detection.<br>12. Firewall techniques to control access and enforce a security policy. |
| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Business Intelligence (Elective- III)** | L-3 | T-0 | P- | Cr-3 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**Textbook:**

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

**References:**

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

**Course Objectives :**

1. To introduce students to the concepts, processes and practice of decision making at both individual and group levels in relation to the appropriate utilization of the ICT in today's Organizations.
2. To provide an understanding of the senior management perspective regarding the use of business intelligence (BI) systems.
3. To encourage students to consider the strategic use of BI technology for strategic advantage, and to provide practical understanding of the BI concepts and technologies in business organizations

**Course Learning Outcomes:**

1. Apply theoretical concepts of the course materials to the decision-making and BI processes and technologies in order to prepare students for making appropriate managerial decisions in future real-life situations.
2. Undertake systematic investigation/research related to the decision support and BI systems and technologies for today's dynamic business environment.
3. Develop professional attitudes in students in relation to the team work, interpersonal Communication, and business ethics.

**Assessments:**

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

**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, and 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**

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course:**<br>**Web Services and SOA (Elective- III)** | L-3 | T-0 | P- | Cr-3 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**References:**


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


**Course Objectives :**

- Design modern Service-Oriented Architectures (SOA).
- Evaluate and analyze your organization to map it as a "set of services"
- Develop logical service model.
- Convert logical designs into specification that can drive any development process
- Select the right service technology to support each of the four service-oriented business scenarios.
- Position your organization to create new applications by leveraging existing services

**Course Learning Outcomes:**

- Understand and describe the principles of service oriented architecture
- Understand and describe the standards and technologies of modern web services implementations
- Effectively use market-leading development tools to create and consume web services
- Identify and select the appropriate framework components in the creation of web service solutions
- Apply object-oriented programming principles to the creation of web service solutions
- Analyze the requirements of a medium-difficulty programming task, and create software that meets the requirements
- For a given specification, determine the appropriate web services style and design
- Compare service oriented architecture with other kinds of design principles

**Assessments:**

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

**Unit 1 Web services Technologies** **Hrs**

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 **6**

**Unit 2 SOA Fundamentals**

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 **6**

**Unit 3 SOA Planning and Analysis**

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, non-runtime qualities), business centric SOA and its benefits, Service modelling, Basic modelling building blocks, service models for legacy application integration and enterprise integration, Enterprise solution assets(ESA)

**6**

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| **Unit 4 SOA Design and implementation**<br>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 **8**<br>**Unit 5 Managing SOA Environment**<br>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 **6**<br>**Unit 6 Web 2.0 technologies**<br>Introduction to Ajax, Ajax Design Basics, JavaScript, Blogs, Wikis, RSS feeds **4** |
| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Artificial Intelligence and Natural Language Processing**<br>**(Elective- IV)** | L-3 | T-0 | P-0 | Cr-3 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**References:**


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.


**Course Objectives :**

- To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.
- To have an appreciation for the engineering issues underlying the design of AI systems.
- To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.
- To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as resolution, etc. that play an important role in AI programs.

**Course Learning Outcomes:**

- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Formalise a given problem in the language/framework of different AI methods (e.g., as a search problem, as a logical theory, as a planning problem, as an MDP, etc).
- Implement basic AI algorithms (e.g., standard search algorithms or resolution).
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

**Assessments:**

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

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

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 **6**

**Unit 2 Heuristic Search Techniques**

Generate-and-test, Hill climbing, Best-first search, Problem reduction, constraint satisfaction, means-end analysis **6**

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

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 **7**

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

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. **8**

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

Survey of applications, Levels of linguistic processing: morphology, syntax, semantics, lexicons and knowledge bases **6**

**Unit 6 Computational morphology**

Lemmatisation, Part-of-Speech Tagging, Finite-State Analysis.

**Ambiguity and its resolution:** Syntactic ambiguities and heuristics, lexical ambiguities and selection restrictions, indeterminacy of reference **8**

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| Title of the Course:<br>System Modelling and Simulation (Elective- IV) | L-3 | T-0 | P-0 | Cr-3 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**Textbook:**

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

**References:**

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.

**Course Objectives :**

1. Describe the role of important elements of simulation and modeling paradigm.
2. Analyze and design Monte Carlo simulation algorithms.
3. Analyze and design discrete-event simulation algorithms.
4. Output analysis for discrete-event simulation algorithms.
5. Modelling techniques for event systems

**Course Learning Outcomes:**

On successful completion of the module, students will be able to:

- Demonstrate an in-depth understanding of discrete simulation modelling and its benefits in manufacturing industry
- Build relevant factory simulation models using the latest software system
- Apply simulation modelling techniques to solve different production scheduling problems
- Critically analyse the results produced by simulation models and to recommend creditable solutions

**Assessments:**

Out of total 100% theory weightage, 50% weightage are allotted for Continuous Internal Evaluation (CIE). In CIE minimum 20% weightage are required to become eligible for Semester End Examination. (SEE).

1. CIE (50% weightage) includes :

Internal Test – 1, of 25% in 5th week on 1st and 2nd UNIT - (Duration 1hr.)

Internal Test - 2, of 25% in 10th week on 3rd and 4th UNIT - (Duration 1hr.)

2. For the Semester End Examination (SEE), 50% weightage (3 hrs. duration) paper will be set, in which student must secure minimum 40 % as university examination passing head and Minimum 40% marks required in CIE to become eligible for SEE.

3. Final theory letter grade will be awarded (100 %) will be the addition of CIE (50%) and SEE (50%).

**Course Contents:**

**Course Contents:** **Hrs**

**Unit 1 Introduction**

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. **6**

**Unit 2 General Principles, Simulation Software**

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. **8**

**Unit 3 Queuing Models**

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. **6**

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

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. **6**

**Unit 5 Input Modeling**

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. **6**

**Unit 6 Estimation of Absolute Performance**

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 **8**

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| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course:**<br>**Industrial Training** | L-0 | T-0 | P-0 | Cr-4 |
|---|---|---|---|---|
| **Pre-Requisite Courses:** | | | | |
| **References:** | | | | |

**Course Objectives :**

- Providing opportunity for students to acquire practical skills and experience working on projects alongside industry experts.
- Providing an opportunity for students to acquire interpersonal skills and ability for team work through interaction with professionals in their field of study.
- learning about ethics in the industry
- learning accepted safety practices in the industry
- providing an opportunity for students to learn about the industry of their discipline and related environment
- Providing an opportunity for the industry to identify potential employees and to feedback comments on the degree programme at large.
- providing opportunity to obtain knowledge of how to make optimal decisions to resolve work challenges

**Course Learning Outcomes:**

- Provide opportunities for organization to assess them as prospective employees.
- Explain industrial problems and suggest possible solutions.
- Present a proper report, both orally and in writing on their work experience.
- Assess the adequacy of training.
- Explore options in career plans and goals.
- Make a gradual transition from academia to career.

**Assessments:**

**Course Contents:**

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)

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| Module wise Measurable Students Learning Outcomes |
| Outcomes as regards to improvement in Communication Skills |
| Computer Usage / Lab Tool |
| Laboratory Experiences: |
| Independent Learning Experiences: |

| **Title of the Course: Dissertation Phase I** | L-0 | T-0 | P-5 | Cr-10 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**References:**

**Course Objectives :**

The candidate is expected to complete the following work

- Survey of literature relevant to the area of the work.
- Study of Base Paper and Problem Formulation.
- Formulation of the solution.
- Analysis of the Formulated Solution.
- Expected Outcome.

**Course Learning Outcomes:**

- Ability to practically apply various technological concepts for the work.
- Ability to communicate effectively and professionally.
- Ability to solve critical practical oriented real time problems.
- Submission of report.

**Assessments:**

Quality Of Information Presentation

**Course Contents:**

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)

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences:

| **Title of the Course: Dissertation Phase II** | L-0 | T-0 | P-5 | Cr-20 |
|---|---|---|---|---|

**Pre-Requisite Courses:**

**References:**

**Course Objectives :**

The candidate is expected to complete the following work

- Design of the Formulated Solution.
- Experimental procedures, Test Procedures, Data Collection.
- Complete Implementation of the Base paper work.
- Analysis of the Results, if any..
- Formulation of proposed solution (Enhancement)

**Course Learning Outcomes:**

- Complete implementation of research work.
- Thesis report of completed work.
- Research paper submission in conference or journal.
- Submission of report regarding conference participation or Journal publication.
- Research paper with experimental result, result analysis.

**Assessments:**

Quality Of Information Presentation

**Course Contents:**

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)

Module wise Measurable Students Learning Outcomes

Outcomes as regards to improvement in Communication Skills

Computer Usage / Lab Tool

Laboratory Experiences:

Independent Learning Experiences: