# HIMACHAL PRADESH TECHNICAL UNIVERSITY
# HAMIRPUR

## Syllabus & Examination Scheme

*for*

**B. Tech.**

**In**

**(Artificial Intelligence and Machine Learning (AI and ML)**

**(Batch 22-26)**

**1st to 6th Semester**

As per National Education Policy (NEP)-2020

***(w.e.f. the Academic Year 2022-2023)***

## Semester-I

| Sr. No. | Category | Subject Code | Subject Title | L | T | P/D | Credits | Evaluation Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment (IA) | ESE | Subject Total |
| **Theory:** | | | | | | | | | | |
| 1 | BS | PHY-101L | Applied physics | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 2 | ES | CS-101L | Computer Programming and Problem Solving | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 3 | ES | EE-101L | Basic Electrical Engineering | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 4 | BS | MA-101L | Applied Mathematics-1 | 3 | 1 | 0 | 04 | 40 | 60 | 100 |
| 5 | HS | EVS-101L | Energy and Environment | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 6 | HS | HS-111L | Technical Communication Skills | 2 | 0 | 2 | 03 | 40 | 60 | 100 |
| **Labs:** | | | | | | | | | | |
| 1 | BS | PHY-101P | Applied Physics Lab | 0 | 0 | 2 | 01 | 30 | 20 | 50 |
| 2 | ES | CS-201P | Computer Programming Lab | 0 | 0 | 2 | 01 | 30 | 20 | 50 |
| 3 | ES | EE-101P | Electrical Engineering Lab | 0 | 0 | 2 | 01 | 30 | 20 | 50 |
| | | | **Total** | **17** | **01** | **08** | **22** | | | |

## Semester-II

| Sr. No. | Category | Subject Code | Subject Title | L | T | P/D | Credits | Evaluation Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment (IA) | ESE | Subject Total |
| **Theory:** | | | | | | | | | | |
| 1 | PC | CHM-201L | Applied Chemistry | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 2 | PC | CS-201L | Object Oriented Programming | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 3 | PC | EC-101L | Basics Of Electronics Engineering | 3 | 0 | 0 | 03 | 40 | 60 | 100 |
| 4 | PC | MA-201L | Applied Mathematics-II | 3 | 1 | 0 | 04 | 40 | 60 | 100 |
| 5 | PC | HS-115L | Universal Human Values for Holistic, Value-Based Education | 2 | 1 | 0 | 03 | 40 | 60 | 100 |
| 6 | FC | HS-116L | Human Consciousness & Yoga | 2 | 0 | 2 | 03 | 40 | 60 | 100 |
| **Labs:** | | | | | | | | | | |
| 1 | BS | CHM-201P | Applied Chemistry Lab | 0 | 0 | 2 | 01 | 30 | 20 | 50 |
| 2 | PC | CS-201P | Object Oriented Programming Lab | 0 | 0 | 2 | 01 | 30 | 20 | 50 |
| 3 | BS | EC-201P | Basics Of Electronics Engineering Lab | 0 | 0 | 2 | 01 | 30 | 20 | 50 |
| | | | **Total** | **16** | **02** | **08** | **22** | | | **750** |

**Legends:**

**L** - Lecture
**T** - Tutorial
**P** - Practical
**CT** - Class Test
**IA** - Internal Assessment
**ESE** - End Semester Examination
**FW** - Documentation/ File work and presentation
**LP** - Lab performance
**ESVE** - End Semester Exam. / Viva-voce Exam.
**PC** - Programme Core

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## Semester-IV

| S. No. | Category | Subject Code | Subject Title | L | T | P/D | Credits | Evaluation Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment (IA) | ESE | Subject Total |
| **Theory:** | | | | | | | | | | |
| 1 | FC | MA-411 | Optimization and Calculus of Variations | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | PC | CS-ML-411 | Introduction to Machine Learning | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 3 | PC | CS-412 | Design and Analysis of Algorithm | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 4 | PC | CS-413 | Artificial Intelligence and Expert Systems | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 5 | PC | EC-411 | Microprocessors and Interfacing | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 6 | FC | HS-411 | Entrepreneurship and Startups | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 7 | OE | - | Open Elective-II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| **Labs:** | | | | | | | | | | |
| 1 | PC | CS-ML-411P | ML Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| 2 | PC | CS-412P | DAA Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| 3 | PC | CS-413P | AI Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| | | | **Total** | **19** | **05** | **06** | **25+2** | | | **800** |
| **UG Diploma Exit Option** | | | | | | | | | | |
| 1 | EE | CSEE-416P | **Internship-I** | **8weeks/ 2months** | | | **6** | | | |

***Note: Student can exercise exit option after 2nd Year for which he/she will be awarded UG Diploma provided they secure an additional 6 credits through summer internships/apprenticeship for 2 months after 4th semester. The concerned student has to apply for UG Diploma exit at the time of registration of 4thsemester. Total Credits earned by the student opting UG Diploma exit after 4th Semester is 47+49+6=102 credits**

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## Semester-III

| Sr. No. | Category | Subject Code | Subject Title | L | T | P/D | Credits | Evaluation Scheme(Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment (IA) | ESE | Subject Total |
| **Theory:** | | | | | | | | | | |
| 1 | FC | MA-312 | Probability and Statistics | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | PC | CS-311 | Operating System | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 3 | PC | CS-312 | Data Structure and Algorithms | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 4 | PC | CS-314/CS-411 | Python Programming | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | PC | CS-315/CS-414 | Computer Architecture & Organisation | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 6 | FC | HS-311 | Economic Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | OE | - | Open Elective-I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| **Labs:** | | | | | | | | | | |
| 1 | PC | CS-311P | Operating System Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| 2 | PC | CS-312P | Data Structure and Algorithms Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| 3 | PC | CS-314P/CS-411P | Python Programming Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| | | | **Total** | **20** | **04** | **06** | **25+2** | | | **850** |

**Open Elective-I**

| S. No. | Category | Course Code | Subject | Teaching Hours Per Week | | | Credits | Examination | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | | IA Marks | ESE Marks | Total Marks |
| 1 | OE | HS-301 | German Language–I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 2 | OE | HS-302 | French Language–I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 3 | OE | HS-303 | Design Thinking | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 4 | OE | EC-311 | Digital Electronics | 2 | 0 | 0 | 2 | 40 | 60 | 100 |

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## Semester-V

| S. No. | Category | Subject Code | Subject Title | L | T | P/D | Credits | Evaluation Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment (IA) | ESE | Subject Total |
| **Theory:** | | | | | | | | | | |
| 1 | PC | CSPC-511 | Computer Networks | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | PC | CSPC-512 | Theory of Computation | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 3 | PC | CSPC-415 | Database Management System | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 4 | PC | CSPC-514 | Software Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Labs:** | | | | | | | | | | |
| 1 | PC | CSPC-511P | Computer Networks Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| 2 | PC | CSPC-415P | DBMS Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| | | | **Total** | **12** | **03** | **04** | **17** | | | **600** |

## Semester-VI

| S. No. | Category | Subject Code | Subject Title | L | T | P/D | Credits | Evaluation Scheme (Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment (IA) | ESE | Subject Total |
| **Theory:** | | | | | | | | | | |
| 1 | PC | CSPC-611 | Digital Image Processing | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | PC | CSPC-612 | Information and Network Security | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | PC | CSPC-613 | Compiler Design | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 4 | PE | CSPE-611(x) | Professional Elective-I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | PE | CSPE-612(x) | Professional Elective-II | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| **Labs:** | | | | | | | | | | |
| 1 | PC | CSPC-611P | DIP Lab | 0 | 0 | 2 | 1 | 30 | 20 | 50 |
| 2 | EE | CSEE-612P | Capstone Project-I | 0 | 0 | 4 | 2 | 30 | 20 | 50 |
| | | | **Total** | **15** | **03** | **02** | **21** | | | **600** |
| | | | | | | | | | | |

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## List of Professional Electives

| Professional Elective-I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Category | Subject Code | Subject Title | Teaching Hours Per Week | | | Credits | Stream /Specialization |
| | | | | L | T | P/D | | |
| 1 | PE | CSPEML-611(i) | Optimization Techniques in Machine Learning | 3 | 0 | 0 | 3 | AI/ML |
| 2 | PE | CSPEML-611(ii) | Big Data Mining and Analytics | 3 | 0 | 0 | 3 | AI/ML |
| 3 | PE | CSPEML-611(iii) | Deep Learning | 3 | 0 | 0 | 3 | AI/ML |

| Professional Elective-II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S. No. | Category | Subject code | Subject Title | Teaching Hours Per Week | | | Credits | Stream /Specialization |
| | | | | L | T | P/D | | |
| 1 | PE | CSPEML-612(i) | Bayesian Learning and Decision Making | 3 | 1 | 0 | 4 | AI/ML |
| 2 | PE | CSPEML-612(ii) | Computer Vision | 3 | 1 | 0 | 4 | AI/ML |
| 3 | PE | CSPE-612(iii) | Cloud Computing | 3 | 1 | 0 | 4 | AI/ML |

| Professional Elective-III | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S. No. | Category | Subject Code | Subject Title | Teaching Hours Per Week | | | Credits | Stream /Specialization |
| | | | | L | T | P/D | | |
| 1 | PE | CSPE-711(i) | Data Visualization | 3 | 1 | 0 | 4 | AI/ML |
| 2 | PE | CSPEML-711(i) | Responsible and Ethical AI | 3 | 1 | 0 | 4 | AI/ML |

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| Professional Elective-IV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S. No. | Category | Subject code | Subject Title | Teaching Hours Per Week | | | Credits | Stream /Specialization |
| | | | | L | T | P/D | | |
| 1 | PE | CSPEML-712(i) | AI in Healthcare | 3 | 1 | 0 | 4 | AI/ML |
| 2 | PE | CSPEML-712(ii) | Generative AI | 3 | 1 | 0 | 4 | AI/ML |

| Open Elective-I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S. No. | Category | Subject code | Subject Title | Teaching Hours Per Week | | | Credits | Stream /Specialization |
| | | | | L | T | P/D | | |
| 1 | OE | CSOEML-712(i) | IOT | 3 | 1 | 0 | 4 | AI/ML |
| 2 | OE | CSOEML-712(ii) | Robotics | 3 | 1 | 0 | 4 | AI/ML |
| 3 | OE | CSOEML-712(iii) | Machine Learning with Python | 3 | 1 | 0 | 4 | AI/ML |
| 4 | OE | CSOEML-712(iii) | AI for Everyone | 3 | 1 | 0 | 4 | AI/ML |

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# SEMESTER-III

| MA-312 Probability and Statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **Probability and Random Variables:** Introduction, basic concepts–sample space, events, basic rules and axioms events, counting sample space, conditional probability and independence, permutations and combinations, rules of probability, bayes theorem. random variables – concept of random variable, percentiles, probability distributions – discrete & continuous, mean, variance and covariance of random variables, Chebyshev sine quality. |
| **Unit-II:** |
| **Standard Probability Distributions:** Discrete distributions - uniform, binomial, multinomial, hypergeometric, negative binomial, distributions-Bernoulli, Poisson, exponential, Gaussian Poisson, Fnormal, gamma, Weibull and beta distributions and their properties-function of random variables. |
| **Unit-III:** |
| **Sampling Distributions:** Fundamentals of Data: Collection, Summarization, and Visualization; Sampling and Sampling Distributions Random sampling, sampling distributions of means, estimation, properties of point estimators, confidence interval, maximum likelihood and bayes estimators, prediction intervals. Central Limit Theorem; Methods of Estimation, Unbiased estimators; Confidence Interval Estimation: Z-interval, t-interval |
| **Unit-IV:** |
| **Testing of Hypothesis:** Hypothesis Testing, Types of Errors, Rejection Region Approach and p-value Approach. Testing of hypothesis for mean, variance, proportions and differences using normal, t, Chi-square and F distributions, tests for independence of attribute sand goodness off it.<br>**Linear Correlation and Regression Analysis:** Introduction, linear regression model, regression coefficient, lines of correlation, rank correlation |

**Text Books:**


1. Gupta, S.C, and Kapur, J.N., *—Fundamentals of Mathematical Statistics*‖, Sultan Chand, Ninth Edition, NewDelhi,1996.
2. Johnson. R.A., ***Miller & Freund's Probability and Statistics for Engineers,*** Sixth Edition, Pearson Education, Delhi, 2000.
3. Douglas C. Montgomery and George C. Runger, ***Applied Statistics and Probability for Engineers*** , 5thEdition,2011.


**Reference books:**


1. Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, *—Probability and Statistics for Engineers and Scientists* ‖, Seventh Edition, Pearson Education, Delhi,2002.
2. Lipschutz. S and Schiller. J, ***Schaum's outlines-Introduction to Probability and Statistics***, McGraw-Hill, New Delhi, 1998.
3. S.M. Ross, *Introduction to ProbabilityandStatisticsforEngineersandScientists*‖4th edition.


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| CS- 311 Operating System | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of the end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:** To understand the role, responsibilities and the algorithms involved for achieving various functionalities of an Operating System.

| |
|---|
| **Unit-I:** |
| **Introduction and System Structures:** Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Functions, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, Operating-System Design and Implementation.<br>**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Multi-threaded programming: Multi-core Programming, Multithreading Models. |
| **Unit-II:** |
| **Process Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling.<br>**Concurrency:** The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors.<br>**Deadlock:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. |
| **Unit-III:** |
| **Memory Management:** Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Demand Paging, Page Replacement, Allocation of Frames, Thrashing.<br>**File Systems:** File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management. |
| **Unit-IV:** |
| **Disk Management:** Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure.<br>**Networks, Security and Design Principles**: Overview of network operating system, distributed operating system, security attacks, security mechanisms and policies, OS Virtualization, Unix/Linux Case study. |

**Course Learning Outcomes (CLOs):**
After the completion of the course, the student will be able to:

1. Explain the basics of an operating system viz. system programs, system calls, user mode and kernel mode.

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2. Select particular CPU scheduling algorithms for specific situations and analyse the environment leading to deadlock and its rectification.
3. Explicit memory management techniques viz. caching, paging, segmentation, virtual memory, and thrashing.
4. Understand the concepts related to file systems, disk scheduling and security, protection.
5. Comprehend the concepts related to concurrency.

**Text Books:**


1. Silberschatz A., Galvin B. P. and Gagne G., Operating System Concepts, John Wiley & Sons Inc (2013) 9th ed.
2. Stallings W., Operating Systems Internals and Design Principles, Prentice Hall (2018) 9th ed.


**Reference Books:**


1. Bovet P. D., Cesati M., Understanding the Linux Kernel, O' Reilly Media (2006), 3rd ed.
2. Kifer M., Smolka A. S., Introduction to Operating System Design and Implementation: The OSP 2 Approach, Springer (2007).


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| CS- 312 Data Structure and Algorithms | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:** To become familiar with different types of data structures and them applications.

| |
|---|
| **Unit-I:** |
| **Data Structures:** Definition, primitive and derived data types, abstract data types, need for data structures, types of data structures. **Algorithm:** Definition, characteristics, development of algorithm, Analysis of complexity: - time complexity, space complexity, order of growth, asymptotic notation with example, obtaining the complexity of the algorithm. **Arrays:** Definition, 1d and 2d arrays, operations on arrays, sparse matrices, structures and arrays of structures. |
| **Unit-II:** |
| **Linked list:** Representation of linked list in memory, allocation & garbage collection, operations on linked list, doubly linked lists, circular linked list, linked list with header node, applications. **Stacks:** representation of stack in memory, operations on stack and applications. **Queues:** Representation of queues in memory, operations on queues, circular queues, double ended queues, priority queues, applications. |
| **Unit-III:** |
| **Trees:** Introduction, representation of tree in memory. **Binary Trees:** Terminology, binary tree traversal, binary search tree, insertion, deletion & searching in binary search tree, heap trees, types of heap trees, insertion, deletion in heap tree with example, heap sort algorithm, introduction of AVL trees & B-trees. **Graphs:** Definition, representation of graph (adjacency matrix, adjacency list), traversing a graph (DFS & BFS), dijkstra's algorithm for shortest distance, minimum spanning tree. |
| **Unit-IV:** |
| **Searching and sorting:** Need for searching and sorting, linear and binary search, insertion sort, selection sort, merge sort, quick sort, radix sort and bubble sort. **Hash Tables:** Introduction, hash function, collision resolution techniques in hashing, deletion from hash table. |

**Course Learning Outcomes (CLOs):**
On completion of this course, the students will be able to

1. Implement basic data structures in solving fundamental problems.
2. Implement various searching and sorting techniques.
3. Implement tree and graph data structures along with their related operations.
4. Evaluate and apply appropriate data structure(s) for real-world problems.

**Text Books:**


1. Seymour Lipschutz : Theory and practice of Data structure , Tata Mc. Graw Hill 1998
2. Tenebaum, A. Langsam Y and Augenstein , A. J: Data structures using C++ , Prentice Hall Of India.


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**Reference Books:**


1. Data structures and Algorithms in C++ by Micheal T. Goodrich, Wiley India publication.
2. Data structures, R. Venkatesan, S. Lovelyn Rose, Wiley India publication.
3. Data Structures using C++ By Patil, Oxford University press.
4. Data Structures, Algorithm and Object-Oriented programming, Gregory L. Heileman, Tata Mc-Graw Hills.
5. S. Sahni, Data structure Algorithms ad Applications in C++, WCB/McGraw Hill.
6. J.P. Tremblay and P.G. Sorenson, —An Introduction to Data Structures with applications‖, Tata McGraw Hill.


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| CS-314/ CS-411 Python Programming | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 0 | 0 | 3 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e., one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**: This course will help you to understand the basics of Data Science which includes Programming, Mathematics, and Statistics before getting started with advanced machine learning techniques. Students will also gain knowledge in various data pre-processing techniques and data visualization techniques.

| **Unit-I:** |
|---|
| **Introduction to Python:** Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, type () Function and Is Operator, Dynamic and Strongly Typed Language.<br>**Control Flow Statements:** if Decision Control Flow Statement, the if…else Decision Control Flow Statement, the if-elif-else, Decision Control Statement, Nested if Statement, the while Loop, The for Loop, The continue and break Statements |
| **Unit–II:** |
| **Functions,** Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters.<br>**Strings,** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, |
| **Unit–III** |
| **Lists,** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement<br>**Dictionaries**, Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, |
| **Unit-IV:** |
| **Tuples and Sets,** Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries.<br>**Files,** Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files. Reading and Writing CSV file. |

**Course Learning Outcomes (CLO):**
On completion of this course, the students will be able to:

1. To know the concept of functions in Python, like "if" and different types of loops.
2. Be able to convert datatypes and work with lists.
3. To know the difference between running Python programs on Mac and Windows
4. Be able to work with CSV files

**Textbooks:**

1. Gowri Shankar S, Veena A, **"Introduction to Python Programming",** 1st edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372.

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| CS-315/ CS-414 Computer Architecture & Organisation | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e., one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| **Unit-I:** |
|---|
| **Basics of Digital Electronics:** Codes, logic gates, flip flops, registers, counters, multiplexer, de multiplexer, decoder, and encoder. **Register Transfer and Micro operations:** Register transfer language, register transfer, bus & memory transfer, logic micro-operations, shift micro-operation. **Computer Arithmetic:** Unsigned, signed and floating-point data representation, addition, subtraction, multiplication and division algorithms. booths multiplication algorithm. |
| **Unit–II:** |
| **Basic Computer Organization:** Instruction codes, computer instructions, timing & control, instruction cycles, memory reference instruction, input/output & interrupts, complete computer description & design of basic computer. **Control Unit:** Hardwired vs Micro programmed control unit. **Central Processing Unit:** General register organization, stack organization, instruction format, addressing modes, data transfer & manipulation, program control, RISC, CISC. |
| **Unit–III** |
| **Input-Output Organization:** Peripheral devices, I/O interface, Modes of data transfer: Programmed I/O, Interrupt-Initiated I/O, DMA transfer, I/O processor. Serial Communication. **Memory Unit:** Memory hierarchy, processor vs. memory speed, main memory, auxiliary memories, high-speed memories, cache memory, associative memory, virtual memory, and memory management hardware. |
| **Unit-IV:** |
| **Introduction to Parallel Processing:** Flyn's classification, pipelining, arithmetic pipeline, instruction pipeline, characteristics of multiprocessors, inter connection structures, inter processor arbitration, inter processor communication & synchronization. Performance evaluation SPEC marks LINPACK Whetstone Dhrystone etc., transaction processing benchmarks. **Case Studies:** Case studies of some contemporary advanced architecture for processors of families like Intel, AMD, IBM etc./ Seminar on state-of the-art technology. |

**Text Books:**


1. Mano, Morris M., Computer System Architecture, Prentice Hall.
2. Hayes, J.P., Computer Architecture and Organization, Mc Graw Hill.


**Reference Books:**


1. Hennessy, J.L., Patterson, D.A, and Goldberg, D., Computer Architecture A Quantitative Approach, Pearson Education Asia.
2. Leigh, W.E. and Ali, D.L., System Architecture: software and hardware concepts, South Wester Publishing Co.


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| HS-311 Economic Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 3 | 0 | 0 | 3 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e., one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:** The educational objectives of this course are Choose the concept of scarcity to explain economic trade-offs, opportunity costs, and rational behaviour. Discover the determinants of foreign trade flows and exchange rates, and their effects on the domestic economy.

| |
|---|
| **Unit-I:** |
| **Introduction**: Definition, Nature, Scope, Importance and significance of Economics. For Engineers, Distinction between Micro and Macroeconomics. Concept of Utility and Its Types. **Demand and Supply:** Demand, Kinds of Demand, Demand Function, Law of Demand. Elasticity of Demand: Concept, Types, Measurement and importance. Demand Forecasting and its techniques. |
| **Unit-II:** |
| **Production Function:** Concept and types, Returns to Factor and Returns to Scale, Law of Variable Proportions. **Cost and Revenue:** Concept of Cost, Short run and Lung-run Cost Curves, Relationships among various costs, Break-even Analysis. Revenue Curves: Concept and Types. |
| **Unit-III:** |
| **Market Structure:** Perfect Competition, Monopoly, Monopolistic Competition Oligopoly. **Banking:** Commercial Banks- Function, Central Bank (RBI)- Function and Role of Banks in Economic Development. |
| **Unit-IV:** |
| **National Income:** Definition of National Income and its Aggregates, Methods of Calculating National Income. **Inflation:** Meaning, Types, Theories, Causes, Effects and Control. Business Cycle – Meaning- Phases of business cycle. Balance of Payments, Monetary and Fiscal Policies. |

**Course Learning Outcomes (CLOs):**
After the completion of the course, the student will be able to:
1. Identify the determinants of supply and demand; demonstrate the impact of shifts in both market supply and demand curves on equilibrium price and output.
2. Determine the roles that prices and markets play in organizing and directing economic activity
3. Calculate and graph the short-run and long-run costs of production, supply and demand elasticities.
4. Describe governmental efforts to address market failure such as monopoly power, externalities, and public goods.
5. Examine and interpret a nation's economic performance indicators such as economic growth, unemployment and inflation from a macroeconomic perspective.
6. Articulate the mechanics and institutions of international trade and their impact on the macro economy.

**Textbooks:**
1. Steven A. Greenlaw, David Shapiro, **"Principles of Economics"**,2nd Edition, Rice University – OpenStax,

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2020.ISBN-13: 978-1947172371

**Reference Books:**

1. N. Gregory Mankiw, **"Principles of Economics"**,8th Edition, Cengage Learning, 2016.ISBN-13:978-0357038314.
2. 3Niall Kishtainy, **"The Economics Book: Big Ideas Simply Explained"**,1st Edition, DK Publishers, 2012.ISBN-13:978-0756698270.
3. Yves Hilpisch, **"Python for Finance: Mastering Data-Driven Finance"**, 2nd Edition, O'Reilly Media, 2018 ISBN-13:978-1492024330.

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| CS-311P Operating System Lab | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | |
| L | T | P | C | Practical Internal Assessment | Practical External Assessment | Total |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 |

Following is the list of experiments out of which minimum 08 experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. Overview of single user systems, network operating system and multiuser system.
2. User administration in window sand Linux operating system.
3. Write a program for the simulation of following non-pre-emptive CPU scheduling algorithms to find turn around time and waiting time.
   1. FCFS b)SJF c) Round Robin(pre-emptive) d)Priority
4. Write a program for the simulation of following file allocation strategies.
   1. Sequential b) Indexed c) Linked
5. Write a program for the simulation of following contiguous memory allocation techniques
   1. Worst-fit b)Best-fit c)First-fit
6. Write a program for the simulation of following file organization techniques
   1. Single level directory b)Two level directory c)Hierarchical
7. Write a program for the simulation of Bankers algorithm for the purpose of deadlock avoidance.
8. Write a program for the simulation of following disk scheduling algorithms
   1. FCFS b)SCAN c)C-SCAN
9. Write a program for the simulation of following page replacement algorithms
   1. FIFO b)LRU c)LFU
10. Write a program for the simulation of producer-consumer problem using semaphores.
11. Study the Linux operating system and implement various commands.
12. Write a program do the following:
    a) Find the attribute of file. b) To change the attribute of file. c) Create the directory. d) Delete the directory. e) Create the file. f) Delete the file g) Find the size of Hard Disk, RAM, and VRAM, cache.
13. Study of various viruses / worms and tools.

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| CS- 312P Data Structure and Algorithms Lab | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | |
| L | T | P | C | Practical Internal Assessment | Practical External Assessment | Total |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 |

Following is the list of experiments out of which minimum 08 experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. Write recursive program which computes then Fibonacci number
2. Write recursive program which computes the factorial of a given number.
3. Write a program to implement linear search using arrays
4. Write a program to implement binary search using arrays
5. Write c program to implement bubble sort, to sort a given list of integers in ascending order.
6. Programtoimplementinsertionsorttosortagivenlistofintegersinascendingorder.
7. Program to implement INSERTIONSORT to sort a list of numbers
8. Write a program that implement merge sort, to sort a given list of integers in ascending order.
9. Write a program that implement stack using arrays
10. Write a program that implement stack using linked list Program
11. Write a program that implement Queue using array
12. Write a program that implement Queue using linked lists.
13. Write program to implement linked list operations (Creation, Insertion, Deletion, reversing).
14. Write a program to implement binary tree
15. Write a program to implement heap sort using arrays.

| CS-314P/CS-411P Python Programming Lab | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | |
| L | T | P | C | Practical Internal Assessment | Practical External Assessment | Total |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 |

**NOTE: -** Following is the list of experiments out of which 8-10 experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure and student intake.

**List of experiments:**

1. Demonstrate about Basics of Python Programming
2. Demonstrate about fundamental Data types in Python Programming. (i.e., int, float, complex, bool and string types) Demonstrate the working of following functions in Python. i) id () ii) type() iii)range()
3. Write a Python program to demonstrate various base conversion function
4. Write a Python program to demonstrate various type conversion functions
5. Demonstrate the following Operators in Python with suitable examples: i) Arithmetic Operators ii) Relational Operators iii) Assignment Operator iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
6. Write Python programs to demonstrate the following:
   1. Input() ii)print()iii)'sep'attributeiv)'end'attributev)replacementOperator({})
7. Demonstrate the following Conditional statements in Python with suitable examples. i) if statement ii) if else statement iii) if-else-if statement
8. Demonstrate the following Iterative statements in Python with suitable examples. i) while loop ii) for loop
9. Write a Python program to demonstrate various ways of accessing the string. i) By using Indexing (Both Positive and Negative) ii) By using Slice Operator
10. Python program to perform read and write operations on a file.

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| HS-301 German Language-I | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Unit-I:**

**Wichtige Sprachhandlungen:**Phonetics–Sichbegrüßen-Sichundanderevorstellenformell/informell-Zahlenvon1bis1Milliarde-verstehen&sprechen.
**Grammatik:** regelmäßige Verbenim Präsens - —sein‖ und habenim Präsens - Personal pronomenim Nominativ
**Unit-II:**
**Wichtige Sprachhandlungen:**TelefonNummernverstehenundsprechenUhrzeitenverstehen und sagenVerneinung —nicht und kein‖ (formell und informell).
**Grammatik**:Wortstellung–Aussagesatz–W-FrageundSatzfrage(Ja/NeinFrage) Nomenbuchstabieren und notierenbestimmter und unbestimmter Artikelund Negativartikelim Nom. & Akkusativ
**Unit-III:**
**Wichtige Sprachhandlungen:**Tageszeitenverstehenund über Terminesprechen- Verabredungenverstehen–AufgabenimHaushaltverstehen.
**Grammatik:** Personal pronomenim Akkusativ und Dativ - W-Fragen —wie, wer, wohin,wo,was usw.-Genitivbei Personennamen- Modal verbenim Präsens —können, müssen,möchten‖
**Unit-IV:**
**WichtigeSprachhandlungen:**Sichaustauschen,wasmankann,muss–BezeichnungenLebensmittel – Mengenangabenverstehen –PreiseverstehenundEinkaufzettelschreiben
**Grammatik:**Wortstellungin SätzenmitModalverben – Konnektor ‖und‖ – —noch‖-kein-------mehr – —wieviel, wieviele, wie alt, wielange‖ – PossessivartikelimNominativ

**TextBook**
1.StudiodA1.DeutschalsFremdsprachewithCD.(KursbuchundSprachtraining).

**References**
1. GermanforDummies
2. SchulzGriesbach

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| HS-302 French Language-I | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Content:**

**Unit-I:**

**Grammar and Vocabulary:** Usage of the French verb —se presenter‖, a verb ofself-introductionandhowtogreetaperson-—saluer‖.:Definitearticles, —prepositionsdelieu‖ subject pronouns.
**ListeningandSpeaking:**TheauthenticsoundsofthelettersoftheFrenchalphabet and the accents that play a vital role in the pronunciation of the words. Pronunciation of words like Isabelle, presentezandlaliaison – vousetes, vousappelez and role play of introducing each other–group activity.

**Writing:**CorrectspellingsofFrenchscientificandtechnicalvocabulary.Particularsinfillingan enrolment/registration form.
**Reading:**Readingofthetextandcomprehensionofafamousscientistandansweringquestions.

**Unit-II:**

**GrammarandVocabulary:**Verbofpossession—avoir'and1stgroupverbs—er‖, possessive adjectives and pronouns of insistence- moi, lui..andnumbers from 0 to20.
**Listening and Speaking: N**asal sounds of the words like feminine, ceinture,parfum and how to ask simple questions on one 's name, age, nationality, addressmailid and telephonenumber.
**Writing:**Conjugationsoffirstgroupverbsandparagraphwritingonself-introduction and introducing a third person. **Reading Comprehension:**readingatextthat speaks ofone's profileand answeringquestions.

**Unit-III:**

**GrammarandVocabulary:**Negativesentences,numbersfrom20to69,verb—aimer‖landseasonsoftheyearandleisureactivities.
**Listening and Speaking:** To express one's likes and dislikes and to talk ofone'spastime activities (sportsactivities), je fais du ping-pong and nasalsoundsofwords– janvier,champagne.
**Writing-**Conjugationsoftheirregularverbs:faireandsavoirandtheirusage.Paragraphwriting on one'sleisureactivity-(passétemps favori).
**Reading:**atextonseasonsandleisureactivities–answeringquestions.

**Unit-IV:**

**Grammar and Vocabulary:** les verbes de direction- to ask one's way and togivedirections,verbes-pouvoirandvouloirand2ndgroupverbs,a droite,lapremiereagaucheandvocabularyrelatingto accommodation.'
ListeningandSpeaking:Toreadandunderstandthemetromapandhencetogiveonedirections– dialogue between two people.
**Writing:**Paragraphwritingdescribingtheaccommodationusingthedifferentprepositionslikeen facede, derriere-to locate.
**Reading Comprehension:** Atext/adialogue between twoonlocation and directions-ouest laposte/lapharmacie,labibliotheque?.....

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**Text Book**

1. Learn French: A Comprehensive Guide to Learning French for Beginners by Simple LanguageLearning
2. French: A Linguistic Introduction by Douglas Kibbee (Author), Frederic Jenkins (Author),Zsuzsanna Fagyal (Author)

**References**


1. An Introduction to the French Language by MDe Fivas
2. French for Americans--Volume 1: A clear and easy method for beginners by Sidonie Besser(Author)


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| HS-303 Design Thinking | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Unit-I:**
**An Insight to Learning**: Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting. **Remembering Memory**: Understanding the Memory process, Problems in retention, Memory enhancement techniques. **Emotions: Experience & Expression**: Understanding Emotions: Experience & Expression, Assessing Empathy , Application with Peers.

**Unit-II:**
**Basics of Design Thinking**: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples)– Empathize, Define, Ideate, Prototype, Test. **Being Ingenious & Fixing Problem**: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative

**Unit-III:**
**Process of Product Design**: Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, **Prototyping &Testing**: What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing. **Celebrating the Difference**: Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences.

**Unit-IV:**
**Design Thinking & Customer Centricity**: Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design. **Feed-back, Re-Design & Re-Create**: Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation –"Solving Practical Engineering Problem through Innovative Product Design &Creative Solution".

**Text Book:**

1. Design Thinking- Techniques and Approaches by N.Siva Prasad
2. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company


**References:**

1. Design Thinking for innovation Research and practices by springers
2. Design Thinking for Startups: A Handbook for Readers and Workbook for Practitioners by Jimmy Jain


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| EC-311 Digital Electronics | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:** The educational objectives of this course are:

- To present a problem oriented introductory knowledge of Digital circuits and its applications.
- To focus on the study of electronic circuits.

| |
|---|
| **Unit-I:** |
| **Number System:** Binary, Octal, Hexadecimal, and decimal numbers of systems and their inter conversion, BCD numbers (8421-2421), gray code, excess-3 code, cyclic code, code conversion, ASCII, EBCDIC codes. Binary addition and subtraction, Signed and unsigned binary numbers, 1's and 2's complement representation. |
| **Unit-II:** |
| **Boolean Algebra:** Basic logic circuits: Logic Gates (AND, OR, NOT, NAND, NOR, EX-OR, Ex Nor and their truth tables), Universal Gates, laws of Boolean algebra, De- Morgan's theorem, Min term, Max term, POS, SOP, K-Map, Simplification of Boolean theorem, don't care condition. |
| **Unit-III:** |
| **Logic Families:** Introduction to digital logic family such as RTL, DTL, TTL, ECL, CMOS, IIR, HTL etc., their comparative study, Basic circuit, performance characteristics, Wired logic, open collector output etc. **Combinational Logic:** The Half adder, the full adder, subtractor circuit. Multiplexer, demultiplexer, decoder, BCD to seven segment Decoder, encoders. **Flip flop and Timing circuit:** Set-reset laches, D-flipflop, R-S flip flop, J-K Flip flop, Master slave flip flop, edge triggered flip flop, T flip flop. |
| **Unit-IV:** |
| **Registers &Counters:** Synchronous/Asynchronous counter operation, Up/Down synchronous counter, application of counter, Serial In / Serial Out Shift register, Serial In/Parallel Out Shift register, Parallel In/Parallel Out shift register, parallel in/ Serial Out shift Register, Bi-Directional Register. |

**Course Outcomes (CO's):**

On successful completion of the course

- The student can acquire the basic knowledge of measurement principles and their application in electrical engineering.
- The students will be able to effectively employ electrical and electronics instruments for measurements of various electrical quantities.

**Textbooks:**


1. Digital Fundamentals by Morris and Mano, PHI Publication.
2. Fundamental of digital circuits by A. ANAND KUMAR, PHI Publication.
3. Digital Fundamentals by FLOYD & JAIN, Pearson's Pub


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# SEMESTER-IV

| MA-411 Optimization and Calculus of Variations | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| **Unit-I:** |
|---|
| **Introduction:** A survey of some simplified examples of common real-world situations leading to optimization problems, basic formulation and theory of optimization problems. **Linear programming:** Linear programming (optimization of linear functions subject to linear constraints): basic theory; simplex method, duality, practical techniques. |
| **Unit-II:** |
| **Linear programming:** Basic LPP-solution techniques (Simplex, Artificial Basis), complimentary slackness theorem, fundamental theorem of duality, degenerate solutions, cycling, applications - elements of dynamic programming including Hamiltonian, bellman's optimality principle. **Transportation and Assignment Problems:** Solution of a balanced transportation problem, degeneracy in transportation problems and alternate solutions, mathematical problems in formulation of assignment problems. |
| **Unit-III:** |
| **Non-linear programming:** Non-linear programming (optimization of non-linear functions subject to constraints) with lagrange multipliers, Karush-Kuhn-Tucker optimality conditions, convexity, duality. **Approximation methods for nonlinear programming:** Line search methods, gradient methods, conjugate gradient methods, Networking techniques – PERT and CPM. |
| **Unit-IV:** |
| **Calculus of Variations:** Basic definitions-functional, extremum, variations, function spaces; necessary conditions for an extremum, euler-lagrange equation, convexity and its role in minimization, minimization under constraints; existence and nonexistence of minimizers, applications - isoperimetric problems, geodesics on the surface. |

**Text Books:**


- C. B. Gupta, —***Optimization Techniques in Operation Research,*** I. K. International Publishing House Pvt. Ltd.
- A.S. Gupta, ***Calculus of Variations and Applications***, PHI Prentice hall India.
- Mukesh Kumar Singh, ***Calculus Of Variations*** ,Krishna Prakashan Media(P)Ltd.
- J.K. Sharma, ***Operations Research–Problems and Solutions***, Macmillian Pub.


**Reference books:**


- I.M. Gelfand S.V. Fomin, ***Calculus of Variations*** Dover Publications Inc Mineola, New York.
- Purna Chand Biswal, ***Optimization in Engineering***, Scitech Publications India Pvt. Ltd.
- B.S. GREWAL, ***Higher Engineering Mathematics***, Krishna Publications
- G. Hadly, ***Linear Programming***, Narosa Publishing House
- Kanti Swarup, P.K. Gupta and Manmohan, ***Operations Research,*** Sultan Chand & amp; Sons.

| CS-ML-411 Introduction to Machine Learning | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **Introduction:** Machine-Learning Paradigms: Introduction to Machine learning, datasets, Feature sets, Dataset division: test, train and validation sets, cross validation, Applications of Machine Learning, processes involved in Machine Learning, Forms of Learning: Supervised and Unsupervised Learning, reinforcement learning, Real life examples of Machine Learning. |
| **Unit–II:** |
| **Supervised Learning:** Classification and Regression: K-Nearest Neighbor, Linear Regression, Multi linear Regression, Logistic Regression, Support Vector Machine (SVM), Decision Tree, Naïve Bayes Algorithm, Random Forest Algorithm |
| **Unit–III** |
| **Unsupervised learning:** Types: Clustering, Association, Dimensionality Reduction<br>Clustering Hierarchical-Agglomerative Clustering and Divisive clustering; Partitional Clustering, Clustering Algorithms: K-means Clustering, Mean-Shift Algorithm, Hierarchical Clustering, Association Rules, Dimensionality Reduction: PCA(Principal Component Analysis), K-nearest neighbors and discriminant analysis. |
| **Unit-IV:** |
| **Reinforcement learning**<br>Types of Reinforcement learning: Positive and Negative, Reinforcement Learning Algorithm Models: Model-based and Model-free algorithms, On Policy and Off Policy, Markov Decision Process, Q learning, Application of reinforcement learning |

**Text Books:**


- Machine Learning–Tom M. Mitchell, -MGH
- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,201
- R.S. Suttonand A. G.Barto. Reinforcement Learning-An Introduction.MITPress.1998
- Reinforcement Learning: An Introduction Book by Andrew Barto and Richard S. Sutton
- Introduction to Machine Learning with Python: A Guide for Data Scientists Book by Andreas C.
- Müllerand Sarah Guido ,Machine Learning: The New AI Bookby Ethem Alpayd ın
- Applied Supervised Learning with Python: Bookby Benjamin Johnstonand Ishita Mathur
- Supervised Learning with Python: Concepts and Practical Implementation Using Python, Book by Vaibhav


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| CS-412 Design and Analysis of Algorithm | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **Introduction and Complexity Analysis:** Algorithms Introduction: Algorithm Design paradigms-motivation, concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations |
| **Unit–II:** |
| **Divide and Conquer Approach:** Structure of divide-and-conquer algorithms: sets and disjoint sets: Union and Find algorithms, quick sort, Finding the maximum and minimum, Quick Sort, Merge sort, Heap, and heap sort. **Greedy Algorithms:** Optimal storage on tapes, Knapsack problem, Job sequencing with deadlines, Minimum Spanning trees: Prim's algorithm and Kruskal's algorithm, Huffman codes. |
| **Unit–III** |
| **Graph Algorithms**: Representation of graphs, BFS, DFS, Topological sort, strongly connected components; single source shortest paths: Bellmen-Ford algorithm, Dijkstra's algorithm; All pairs shortest path: The Warshall's algorithm. **Dynamic Programming:** Overview, difference between dynamic programming and divide and conquer, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence, 0/1 knapsack. **Backtracking:** 8-Queen Problem, Sum of subsets, graph coloring, Hamiltonian cycles. |
| **Unit-IV:** |
| **Branch and Bound:** LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem, Traveling Salesman Problem. **Computational Complexity**: Complexity measures, Polynomial vs. non polynomial time complexity; NP-hard and NP-complete classes, examples, cook's theorem (without proof). |

**Course Learning Outcomes (CLOs):**
After completion of this course, the students will be able to:

1. Analyse the complexity of algorithms, to provide justification for the selection, and to implement the algorithm in a particular context.
2. Apply various algorithmic design paradigms such as greedy, dynamic, backtracking etc. to solve common engineering problems.
3. Identify basic properties of graphs and apply their algorithms to solve real life problems.
4. Demonstrate the application of algorithms and selection of appropriate data structures under several categories such as string matching, randomized algorithms and genetic logarithms.

**Textbooks & References:**


1. Fundamentals of Computer Algorithms by E. Horowitz and S. Sahni, Galgotia.
2. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press, Cambridge.
3. The Design and Analysis of Computer Algorithms by A.V. Aho, J.E. Hopcroft and J.D. Ullman, Addison Wesley.

| CS- 413 Artificial Intelligence and Expert Systems | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **Introduction:** Introduction to artificial intelligence, background and applications, turing test and rational agent approaches, introduction to intelligent agents, their structure, behaviour and environment.<br>**Problem Solving and Searching Techniques**: Problem characteristics, production systems, breadth first search, depth first search, heuristics search techniques, best first search, A*algorithm, hill climbing, AND/OR graph AO*, constraint satisfaction problem, means-end analysis, introduction to game playing, min max and alpha beta pruning. |
| **Unit–II:** |
| **Knowledge Representation:** introduction to first order predicate logic, well-formed formulas, quantifiers, rule-based system, resolution principle, unification, forward reasoning: conflict resolution, backward reasoning, structured knowledge representation. AI programming language: PROLOG: Syntax, procedural and declarative meaning, PROLOG unification mechanism, converting english to PROLOG facts and rules, goals, anonymous variable, lists, use of fail, CUT, NOT |
| **Unit–III:** |
| **Introduction to Neural Network:** Hop field network, single and multi layer networks, perceptions, back-propagations learning, Boltzman machine. Introduction to genetic algorithm: The genetic algorithm, genetic operators, working of genetic algorithm, problem with genetic algorithm. |
| **Unit-IV:** |
| **Expert System:** introduction, skills/knowledge, characteristics of expert system, knowledge engineering, inferencing, forward chaining and backward chaining expert system tools, applications and future scope<br>Natural language processing: Introduction, language parsing, syntactic and semantic analysis, top down and bottom-up parsing, chart parsing, knowledge representation languages, ELIZA, speech<br>Recognition |

**Text Books:**


1. Russell and Norvig, ***Artificial Intelligence- A Modern Approach***, Pearson Prentice Hall.
2. DW Patterson, ***Artificial Intelligence and Expert Systems***, Prentice Hall of India.
3. B. Vegnanarayana, ***Artificial neural networks,*** Prentice Hall of India P Ltd.


**Reference Books:**


1. Elaine Rich, Kevin Knight, ***Shivashankar B. Nair, Artificial Intelligence***, Tata Mc Graw Hill.
2. Nils J Nilsson, ***Artificial Intelligence A New Synthesis***, Morgan Kaufmann


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| EC-411 Microprocessors and Interfacing | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:** The educational objectives of this course are to understand the basics of processors and microprocessors and interfacing with real world to study basic programming.

| **Unit-I:** |
|---|
| **Introduction to Microprocessor**: History and Evolution, types of microprocessors, 8085 Microprocessor, Architecture, Bus Organization, Registers, ALU, Control section, Instruction set of 8085, Instruction format, Addressing modes, Types of Instructions. Microprocessor timings, Microinstructions, Instruction cycle, Machine cycles, T states, State transition diagrams, Timing diagram for different machine cycles.<br>**Assembly Language Programming and Timing Diagram:** Assembly language programming in 8085, Macros, Labels and Directives |
| **Unit–II:** |
| **Serial I/O, Interrupts and Comparison of Contemporary Microprocessors:** Serial I/O using SID, SOD. Interrupts in 8085, RST instructions, Issues in implementing interrupts, Multiple interrupts and priorities, Daisy chaining, Interrupt handling in 8085, Enabling, disabling and masking of interrupts. |
| **Unit–III** |
| **Data Transfer techniques:** Data transfer techniques, programmed data transfer, parallel data transfer using 8155. Programmable parallel ports and handshake input/output, Asynchronous and Synchronous data transfer using 8251A. Programmable interrupt controller 8259A. DMA transfer, cycle stealing and burst mode of DMA, 8257 DMA controller |
| **Unit-IV:** |
| **Microprocessor Interfacing Techniques:** Interfacing memory and I/O devices, addressing memory, interfacing static RAMs, Interfacing and refreshing dynamic RAMs, interfacing a keyboard, Interfacing LED and seven segment displays, interfacing a printer, Interfacing A/D converters, D/A converters.<br>**Architecture of 8086:** Memory Address space and data organization, segment registers and memory segmentation, generating memory addresses, IO address space, addressing modes, Comparison of 8086 and 8088, minimum mode maximum mode, system timing, introduction to Pentium and further series of microprocessors. Brief comparison of contemporary 8-bit microprocessors like Z-80, M68000 with 8085. |

**Course Outcomes:** On completion of this course the student will be able to:

- Describe the architecture & organization of 8085 & 8086 Microprocessor.
- Understand and classify the instruction set of 8085/8086 microprocessor and distinguish the use of different instructions and apply it in assembly language programming.
- Relate the addressing modes used in the instructions.
- Realize the Interfacing of memory & various I/O devices with 8085/8086 microprocessor.
- Familiarize the architecture and operation of Programmable Interface Devices and realize the programming & interfacing of it with 8085 microprocessors.
- Interface various peripheral IC's with Intel 8085/8086 microprocessor for its various applications

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**Textbooks & References:**

- Fundamentals of Microprocessors and Microcomputers by B. Ram, Dhanpat Rai and Sons.
- Microprocessor Architecture, Programming and applications with the 8085/8080A by R.S. Gaonkar, Wiley.
- Microprocessors& Interfacing by Douglas V Hall, McGraw Hill.
- Microprocessors and Digital Systems by Douglas V Hall, McGraw Hill.
- Introduction to Microprocessor by A.P. Mathur, Tata McGraw Hill.

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| HS-411 Entrepreneurship and Startups | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:** To understand the Entrepreneurship, Idea and Customer, business models, Marketing, Sales, and Support.

| |
|---|
| **Unit-I:** |
| **Entrepreneurship Concepts:** Understanding nuances of being an entrepreneur; Difference between a startup venture and small business; Identifying entrepreneurial styles.<br>**Idea/Problem and Customer:** Identifying problems worth solving, identifying business opportunities, methods for problem interviews; Design thinking process; Generation of potential solutions; Identifying customer segment and early adopters, difference between a consumer and a customer, craft your value proposition, outcome driven innovation, testing out solutions for the problems; Unique value proposition |
| **Unit–II:** |
| **Business Model Validation:** Basic lean approach and canvas, types of business models, documenting business plan with a lean canvas, documenting hypotheses; Introduction to risks; Develop solution demos; The problem-solution test, solution interviews, sizing the opportunity, building a minimum viable product; The product-market fit test; Revenue streams; How companies with different business models earn money; Understanding income, costs, gross and net margins; Identifying primary and secondary revenue streams; Costing and pricing; How to finance your business idea; Financing your venture at different stages, what investors expect from you; Various sources of funding and pros & cons of each |
| **Unit–III** |
| **Building a Resourceful Team:** Shared leadership model, role of a good team in a venture's success, what to look for in a team, define clear roles and responsibilities; How to pitch to candidates to attract to join your team, explore collaboration tools and techniques - brainstorming, mind mapping; Kanban board. |
| **Unit-IV:** |
| **Marketing, Sales, and Support:** Understanding the difference between product and brand and link between them; Product/service positioning; Channels and strategies, budgeting and planning; Sales planning, target setting; Unique sales propositions (USP); Follow-up and closing sale; Planning and tracking, importance of project management to launch and track progress; Understanding time management, workflow, delegation of tasks; Business regulations of starting and operating a business; Documentation, how to find help to get started; Various government scheme |

**Course Learning Outcomes (CLOs) :**
After the completion of the course, the student will be able to:

- Understanding nuances of being an entrepreneur; Difference between a startup venture and small business.
- Identifying problems worth solving, find the difference between customer and consumer.
- Make resourceful team and manage it.

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- For marketing, sales and Support to the startup and business.

**Textbooks:**

- Blank, S. G., & Dorf, B. (2012). The startup owner's manual: The step-by-step guide for building a great company. Pescadero, Calif: K & S Ranch.
- Reference Books:
- Maurya, A (2016). Scaling Lean: Mastering the Key Metrics for Startup Growth. Portfolio/Penguin. Sethi, A. (2016). From Science to Startup, Springer.

**References:**

- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009

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| CS- ML-411P ML Lab | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | |
| L | T | P | C | Practical Internal Assessment | Practical External Assessment | Total |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 |

Following is the list of experiments out of which minimum 08 experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. Write a program to import and export data using Pandas library functions.
2. Implement Linear Regression Models.
3. Develop Logistic Regression Model for a given dataset.
4. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.
5. Write a program for support vector machines.
6. Write a program to implement K- Means clustering Algorithm
7. Implement Dimensionality reduction using Principal Component Analysis (PCA) method.
8. Write a program to implement reinforcement learning algorithm.

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| CS- 412P DAA Lab | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | |
| L | T | P | C | Practical Internal Assessment | Practical External Assessment | Total |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 |

Following is the list of experiments out of which minimum 08 experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. Write a program to perform Insertion sort for any given list of numbers.
2. Write a program to perform Quick Sort for the given list of integer values.
3. Write a program to find Maximum and Minimum of the given set of integer values.
4. Write a Program to perform Merge Sort on the given two lists of integer values.
5. Write a Program to perform Binary Search for a given set of integer values recursively and non-recursively.
6. Write a program to find solution for knapsack problem using greedy method.
7. Write a program to find minimum cost spanning tree using Prim's Algorithm.
8. Write a program to find minimum cost spanning tree using Kruskal's Algorithm.
9. Write a program to perform Single source shortest path problem for a given graph.
10. Write a program to find solution for job sequencing with deadlines problem.
11. Write a program for all pairs shortest path problem.
12. Write a program to solve N-QUEENS problem.
13. Write a program to solve Sum of subsets problem for a given set of distinct numbers.

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| CS-413P AI Lab | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | |
| L | T | P | C | Practical Internal Assessment | Practical External Assessment | Total |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 |

Following is the list of experiments out of which minimum 08 experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. Write a program to implement breadth first search algorithm.
2. Write a program to implement depth first search algorithm.
3. Study of PROLOG programming language, functions and its facts.
4. Write a program to implement the Hill Climbing algorithm.
5. Write a program to build and display Neural network using Tenser flow Keres.
6. Write a program to implement back-propagations learning.
7. Write a program to implement Genetic algorithm.
8. Study of expert system tools and its applications.
9. Write a program to implement Traveling salesman problem.
10. Write a program to implement four queen problem.
11. Write a program to solve monkey banana problem.
12. Write a program to implement Tower of Hanoi.

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| HS-401 Law for Engineers | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **Constitutional Law:** Nature of Indian Constitution(features), fundamental rights, duties and directive Principles of State Policy (DPSP 's), forms of Governments, structure of Government of India, role and responsibility of executive, legislature/parliament and judiciary, nature of Indian federal system, centre , state and relations. Basic structure of the Indian constitution, basic features of the Indian, constitutional amendments – Golak Nath, Keshwananda Bharti, Maneka Gandhi (1978) and S. R. Bommai case(1994),(floor test). |
| **Unit–II:** |
| **Law of contract:** General principles of Indian Contract Act, 1862, kinds of Government contracts and dispute settlement, standard and printed form of contract, essential elements of valid contract proposal, acceptance communication and revocation thereof, relevance of time in contractual obligation.<br>Main objectives of Arbitrates and Conciliation Act-1996, tort and law of tort, general principles of tort law, classifications of torts: property vs. person. |
| **Unit–III** |
| **Administrative Law:** Evolution, nature and its scope, conceptual objection against growth of administrative rule of law and separation of power, clarification of administrative actions, judicial review of administrative actions, exclusion of judicial review and concept of-Ombudsman‖; Right to InformationAct,2005 (Sub Section 1-20)<br>**Environmental Law:** Definition, meaning and its nature, environmental (Protection) Act-1986, Water (Preservation and Control of Pollution) Act-1974, Air(Prevention and Control of Pollution)Act-1981;Environmental pollution, overall remedies and procedures. |
| **Unit-IV:** |
| **Human Rights:** Legality of human rights, universal declaration of human rights,1948, difference between civil and political rights, individual and human rights human rights of child, weaker section of society, prisoners, and refugees, International Human Rights Commission. |

**Text Books:**

- D.D. Basu, ***Shorter Constitution of India***, Prentice Hall of India,(1996)
- Meena Rao, ***Fundamental concepts in Law of Contract***, 3rd Edn. Professional Offset, (2006)
- H.O. Agarwal, ***International Law and Human Rights***, Central Law Publications, (2008)

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**Reference Books:**


1. H.M. Seervai, ***Constitutional Law of India***, Tripathi Publications,(1993).
2. S.K. Kapur, ***Human Rights under International Law and Indian Law,*** Central Law Agency, (2001)
3. Neelima Chandiramani, ***The Law of Contract: An Outline***, 2nd Edn. Avinash Publications Mum, (2000)
4. Avtar Singh, ***Law of Contract***, Eastern Book Co.,(2002).\
5. AnsonW.R.(1979),***Law of Contract***, Oxford University Press.


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| HS-402 German Language-II | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **WichtigeSprachhandlungen:**Zimmersuche,Möbel**Grammatik**:VerbenmittrennbarenVorsilbenimPräsensundPerfekt.VerbenmittrennbarenVorsilbenundModalverbenimPräsens.VerbenmituntrennbarenVorsilbenimPerfekt.UnregelmäßigeundgemischteVerbenimPerfekt. |
| **Unit–II:** |
| **WichtigeSprachhandlungen**:Kleidung,Farben,Materialien.**Grammatik:**formelleImperativsätzemit—Sie‖ informelle ImperativsätzeVorschlägemit —wir‖ —sollen/wollenwir‖ -Sollich? Modalpartikeln —doch‖—mal‖ —doch mal. |
| **Unit–III** |
| **WichtigeSprachhandlungen:**Sehenswürdigkeite(Prater,BrandenburgerTör,Kolossium,Eifeltürm).<br>**Grammatik:** Ortsangabenmit Akk. Und Dativ —alle‖,‖man‖Indefinitepronomen—etwas‖, —nichts‖. |
| **Unit-IV:** |
| **WichtigeSprachhandlungen:**EssenundTrinkenimRestaurant,PartyvorbereitungundFeier.<br>**Grammatik:**NomenausAdjektivennach —etwas‖und —nichts‖<br>NomenausdemInfinitivvonVerben,zusammegesetzteNomenundihreArtikel.AdjektiveimNom.undAkk.nachunbestimmtenArtikel,Negativartikelund<br>Possessivartikel |

**Text Books:**
1.StudiodA1.DeutschalsFremdsprache withCD.(KursbuchundSprachtraining).

**References**
**1.** GermanforDummies
2. SchulzGriesbach

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| HS-403 French Language-II | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Content:**

| |
|---|
| **Unit-I:** |
| **Grammar and Vocabulary:** The second group verbs: Finir,rougir,grossir,grandir. —Les preposition de temps‖: à, en, le, de 7h à 8h, jusqu' à, vers.Listening and Speaking – the semi- vowels: Voilà, pollutant. Writing – the days of the week, months, technical subjects, time,—lesspécialitésscientifiquesetl 'annéeuniversitaire, paragraph writing about time table. **Reading:** Reading of the text and comprehension –answering questions. |
| **Unit–II:** |
| Grammar and Vocabulary–The adjectives, the nationality, feminine & masculine noun forms—lesmétiersscientifiques‖.Listening and Speaking– Vowels: soirée,année,près de,très. Writing: Countries name, nationality, —les métiersscientifiques‖, numbers from:69toinfitiveand some measures of unit. Reading Comprehension: reading a text. |
| **Unit–III** |
| Grammar and Vocabulary– near future, The demonstrative adjectives, Express the aim by using the verb, Listening and Speaking ––Laliaisoninterdite– enhaut‖. Writing–some scientific terms, French expressions to accept an invitation. Sentence framing. Reading Comprehension– reading a text. |
| **Unit-IV:** |
| |
| **Grammar andVocabulary**–theverbs:manger,boire,thepartitivearticlesListening and Speaking – —le _e' caduc Writing- the food, the ingredients, fruits, vegetables, expression of quantity, paragraph writing about food habits. Reading–Reading a text. |

**Text Books:**

1. Learn French: A Comprehensive Guide to Learning French for Beginners by Simple Language Learning
2. French: A Linguistic Introduction by Douglas Kibbee (Author), Frederic Jenkins (Author), ZsuzsannaFagyal(Author)

**References Books:**

1. An Introduction to the French Language by MDe Fivas
2. French for Americans--Volume1:Aclear and easy method for beginners by Sidonie BesserAu

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| HS-404 Indian Constitution | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| |
|---|
| **Unit-I:** |
| **Introduction to Constitution:**<br>Meaning and importance of the Constitution, salient features of Indian Constitution. Preamble of the Constitution. Fundamental rights-meaning and limitations. Directive principles of state policy and Fundamental duties-their Enforcement and their relevance. |
| **Unit–II:** |
| **Union Government:**<br>Union Executive- President, Vice-president, Prime Minister, Council of Ministers. Union Legislature- Parliament and Parliamentary proceedings. Union Judiciary-Supreme Court of India–composition and powers and functions. |
| **Unit–III** |
| **State and Local Governments:**<br>State Executive- Governor, Chief Minister, Council of Ministers. State Legislature-State Legislative Assembly and State Legislative Council. State Judiciary-High court. Local Government-Panchayat raj system with special reference to 73rd and Urban Local Self Govt. with special reference to 74$^{th}$ Amendment. |
| **Unit-IV:** |
| **Election provisions, Emergency provisions, Amendment of the constitution:** Election Commission of India-composition, powers and functions and electoral process. Types of emergency-grounds, procedure, duration and effects. Amendment of the constitution-meaning, procedure and limitations. |

**Text Books/Suggested Learning Resources:**


1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B. L. Fadia Sahitya Bhawan; New edition(2017)
3. Introduction to the Constitution of India D D Basu Lexis Nexis; T wenty-Third2018 edition
4. M.V. Pylee,"IntroductiontotheConstitutionofIndia",4thEdition,Vikaspublication,2005.
5. Durga Das Basu (DD Basu) , "Introduction to the constitution of India",(Student Edition),19thedition,Prentice-HallEEE, 2008.


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| IKS-311 Indian Knowledge System | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 2 | 0 | 0 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

| **Unit-I: The Constitution – Introduction** |
|---|
| • The history of the making of the Indian constitution<br>• Preamble and the basic structure, and its interpretations<br>• Fundamentals rights and duties and their interpretation<br>• State policy Principles |
| **Unit-II: Union Government** |
| • Structure of the Indian Union<br>• President- role and power<br>• Prime minister and council of ministers<br>• Lok Sabha and Rajya Sabha |
| **Unit-III: State Government** |
| • Governor- Role and Power<br>• Chief Minister and Council of Ministers<br>• State Secretariat |
| **Unit-IV: Local Administration** |
| • District Administration<br>• Municipal Corporation<br>• Zila Panchayat |

**Suggested Learning Resources:**

| No. | Title of Book | Author | Publications |
|---|---|---|---|
| | Ethics and Politics of the Indian Constitution | Rajeev Bhargava | Oxford university Press, New delhi, 2008 |
| | The Constitution of India | B.L. Fadia | Sahitya Bhawan, New edition, 2017 |
| | Introduction of the Constitution of India | DD Basu | Lexis Nexis; twenty Third 2018 edition |

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# SEMESTER V

| CSPC-511 Computer Networks | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- The objective of the course is to equip the students with a general overview of the concepts and fundamentals of computer networks.
- Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.

| |
|---|
| **Unit-I:** |
| **Introductory Concepts**: Goals and Applications of Networks, LAN, WAN, MAN, Wireless network, Network software: Protocol hierarchies, design issues of layers, Interfaces and services. Reference Model: The OSI reference model, TCP/IP reference model **Physical Layer**: Data Modems, Multiplexing Techniques, Frequency Division, Multiplexing Hierarchies, Transmission Media, Error Detection: Parity Check Codes, Cyclic Redundancy Codes. |
| **Unit-II:** |
| **Data Link Layer**: Data link layer design issues, services provided to network layers, Framing, Error control, Flow control, Error detection and correction, Elementary data link protocols, An unrestricted Simplex protocol, A Simplex Stop-and-Wait protocol, Simplex Protocol for a noisy channel, Sliding Window protocols, A one-bit Sliding protocol, A protocol using go-back-N, A protocol using selective repeat, Protocol specification and verification, Example data link protocol-HDLC, PPP and SLIP |
| **Unit-III:** |
| **Network Layer:** Design issues, Routing algorithms, Congestion Control Algorithms, Quality of Service, Internetworking. **Transport Layer:** Transport services, Design issues, elements of transport protocols, simple transport protocols, Connection management, TCP, UDP. |
| **Unit-IV:** |
| **Session, Presentation and Application Layer:** Session Layer, Design issues, remote procedure call. Presentation Layer, Design issues, Data compression techniques, cryptography. Application Layer - File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other Applications |

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**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

- Gain the knowledge of the basic computer network technology.
- Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
- Obtain the skills of sub netting and routing mechanisms.
- Familiarity with the essential protocols of computer networks, and how they can be applied in network design and implementation.

**Textbooks:**

- Computer Networks—Andrew S Tanenbaum, David.j. Wetherall,5th Edition. Pearson Education/PHI

**Reference Books:**

- An Engineering Approach to Computer Networks- S.Keshav, 2nd Edition, Pearson Education
- Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.

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| CSPC-512 Theory of Computation | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- To provide introduction to some of the central ideas of theoretical computer science from the perspective of formal languages.
- To introduce the fundamental concepts of formal languages, grammars and automata theory, classify machines by their power to recognize languages.
- Employ finite state machines to solve problems in computing, and to understand deterministic and non-deterministic machines.
- To understand the differences between decidability and undecidability.

| **Unit-I:** |
|---|
| **Machines:** Basic machine, FSM, Transition graph, Transition matrix, Deterministic and nondeterministic FSMS, Equivalence of DFA and NDFA, Mealy and Moore machines, minimization of finite automata, Two-way finite automata. |
| **Unit-II:** |
| **Regular Sets and Regular Grammars:** Alphabet, words, Operations, Regular sets, Finite automata and regular expression, Pumping lemma and regular sets, Application of pumping lemma, closure properties of regular sets. |
| **Unit-III:** |
| **Formal Grammars and Languages:** Basic definitions and examples of languages, Chomsky hierarchy, Regular grammars, context free & context sensitive grammars, context free languages, non-context free languages, Chomsky normal forms, binary operations on languages. Simplification of CFG, Elimination of Useless symbols, Unit productions, Null productions, Greiback Normal form, Chomsky normal form – Problems related to CNF and GNF |
| **Unit-IV:** |
| Turing Machines and Pushdown Automata: TM model, representation and languages acceptability of TM Design of TM, Universal TM and Other modification, composite and iterated TM, Pushdown automata, Acceptance by PDA. |

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**Course Learning Outcomes (CLOs):** After the completion of the course, the student will be able to:

- Able to understand the concept of abstract machines and their power to recognize the languages.
- Able to employ finite state machines for modeling and solving computing problems.
- Able to design context free grammars for formal languages.
- Able to distinguish between decidability and undecidability.
- Able to gain proficiency with mathematical tools and formal methods.

**Textbooks:**

- Introduction to Automata Theory, Languages, and Computation, 3rd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
- Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekaran, 2nd edition, PHI.

**Reference Books:**

- Introduction to Languages and The Theory of Computation, John C Martin, TMH.
- Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
- A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
- Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.
- Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
- K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

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| CSPC-415 Database Management System | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- To understand the basic concepts and the applications of database systems
- To master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrency control
- To become familiar with database storage structures and access techniques

| **Unit-I:** |
|---|
| Data base System Applications, Purpose of Database Systems, View of Data – Data Abstraction – Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – Database Architecture – Storage Manager – the Query Processor Data base design. ER diagrams – ER Model - Entities, Attributes and Entity sets – Relationships and Relationship sets – ER Design Issues – Concept Design – Conceptual Design. Introduction to the Relational Model – Structure – Database Schema, Keys – Schema Diagrams |
| **Unit-II:** |
| Relational Query Languages, Relational Operations. Relational Algebra – Selection and projection set operations – renaming – Joins – Division. Overview of the SQL Query Language – Basic Structure of SQL Queries, Set Operations, Aggregate Functions – GROUPBY – HAVING, Nested Sub queries, Views, Triggers. |
| **Unit-III:** |
| Normalization – Introduction, non-loss decomposition and functional dependencies, First, Second, and third normal forms, Boyce /Codd normal form. Higher Normal Forms - Introduction, Multi-valued dependencies and fourth normal form, Join dependencies and fifth normal form |
| **Unit-IV:** |
| Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation –Recovery and Atomicity |

**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

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- Explain the features of database management systems and Relational database.
- Create and populate a RDBMS for a real life application, with constraints and keys, using SQL and retrieve any type of information from a data base by formulating complex queries in SQL.
- Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database and build indexing mechanisms for efficient retrieval of information from a database.

**Textbooks:**

- Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rd Edition.
- A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill.
- Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.

**Reference Books:**

- Fundamentals of Database Systems, Elmasri Navathe Pearson Education.
- An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition.

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| CSPC-514 Software Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 0 | 0 | 3 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
- Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams.
- These practices help in developing large size and complex software.
- With concepts and knowledge gained from this course, one can easily become part of industrial software production.

| **Unit-I:** |
|---|
| **Introduction to Software Engineering:** The evolving role of software, changing nature of software, software myths. A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. **Software Development Processes:** Waterfall model, Incremental Models – Iterative Model and RAD Model, Evolutionary Models – Prototype and Spiral Model, Component Based Development, Unified Process, Rapid Software Development. **Software Requirements:** Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document. |
| **Unit-II:** |
| **Requirements engineering process:** Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management. System models: Context models, behavioral models, data models, object models, structured methods. Software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams. |
| **Unit-III:** |
| **Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. **Product metrics:** Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance. |

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| Unit-IV: |
| --- |
| **Metrics for Process and Products:** Software measurement, metrics for software quality. Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. **Quality Management**: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards. |

**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

- Get familiar with various software development process models, requirement engineering concepts and software design principles.
- Understand software project metrics, quality concepts and estimate effort in software development.
- Understand software design and principles.
- Understand coding practices, styles and software testing approaches.
- Develop software cooperatively in a team with an understanding about software risk.

**Textbooks:**

- Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition.
- Software Engineering- Sommerville, 7th edition, Pearson Education.
- The unified modeling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education.

**Reference Books:**

- Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley.
- Software Engineering principles and practice- Waman S Jawadekar, The Mc Graw-Hill Companies.
- Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

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| CSPC-511P Computer Networks Lab | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 | 2 Hours |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 | |

Following is the list of experiments out of which minimum 08experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. To become familiar with networking accessories and facilities in the Department of Computer Science and Engineering:
   - Find out what networking devices are installed in the department
   - Describe the network type and topology of the department
   - File and printer sharing in different OSs
   - Network address configuration in different OSs
   - Finding IP and MAC address in different OSs
   - Workgroup and domain configuration
   - Use of utilities: arp, ipconfig/ifconfig, tracert, nslookup
2. Examine packets flow across a network segment and see the operation of various Internet protocols across the different layers in TCP/IP stack. (Hint: Use utilities netstat, snoop, tcpdump, …)
3. Use UNIX sockets to implement a simple client and server that communicate over the network. (Reference: Unix Network Programming by W. Richard Stevens, Prentice Hall)
4. Simulate various multiple access protocols (Aloha, slotted Aloha, p-persistent and non-persistent) and compare their performance at different loads.
5. Write a program to display the IP address and MAC address of a machine.
6. Implement ARP and RARP protocols for CSE LAN.
7. Install Ethereal on a computer. Set Ethereal to capture with a filter option of your choice. Load a webpage or send an email to a friend and stop capturing. Analyze the packets. See if you can read any or all of the data transmitted. Write down your findings.
8. Write a program to simulate routing using flooding. Each packet should contain a counter that is decremented on each hop. When the counter gets to zero, the packet is discarded. Time is discrete, with each line handling one packet per time interval. Make three versions of the program: all lines are flooded, all lines except the input line are flooded, and only the (statically chosen) best k lines are flooded. Compare flooding with deterministic routing (k = 1) in terms of both delay and the bandwidth used.

9. Write a program that simulates a computer network using discrete time. The first packet on each router queue makes one hop per time interval. Each router has only a finite number of buffers. If a packet arrives and there is no room for it, it is discarded and not transmitted. Instead, there is an end-to-end protocol, complete with timeouts and acknowledgement a packet, which eventually regenerates the packet from the source router. Plot the throughput of the network as a function of the end-to-end timeout interval, parameterized by error rate.

10. Design and implement a chat system that allows multiple groups of users to chat. A chat coordinator resides at a well-known network address, uses UDP for communication with chat clients, sets up chat servers for each chat session, and maintains a chat session directory. There is one chat server per chat session. A chat server uses TCP for communication with clients. A chat client allows users to start, join, and leave a chat session. Design and implement coordinator, server, and client code.

11. Study different networking devices such as repeaters, bridge, switch, router, gateways, firewall, proxy server.

12. Study different networking tools like, crimping tool, LAN tester, connecting cables, screw driver, NIC, LAN card, RJ45, RJ11, I/O box etc.

13. Create and connect straight and cross ethernet cable in Lab.

14. Study and implement LAN in Lab using switch.

15. Study and implement firewall setting in Lab.

16. Study and implement router configuration using simulation software like packet tracer, network simulator (ns2/ns3) etc.

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| CSPC-415P DBMS Lab | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 | 2 Hours |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 | |

Following is the list of experiments out of which minimum 08experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. Design a Database and create required tables. For e.g. Bank, College Database
2. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
3. Write a sql statement for implementing ALTER, UPDATE and DELETE
4. Write the queries to implement the joins
5. Write the query for implementing the following functions: MAX(), MIN(),AVG(),COUNT()
6. Write the query to implement the concept of Integrity constraints.
7. Write the query to create the views
8. Perform the queries for triggers.
9. Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints.
10. Write the query for creating the users and their role.

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# SEMESTER

# VI

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| CSPC-611 Digital Image Processing | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement) and advanced image analysis (e.g. image compression, image segmentation, Pattern Recognition).
- To assess the performance of image processing algorithms and systems.

| Unit-I |
|---|
| **Digital Image Fundamentals:** Digital Image Processing, Origins of Digital Image Processing Application of Digital Image Processing, Steps in Digital Image Processing, Components of an Image Processing System, Image formation, Image sampling and Quantization, Image transforms – Fourier transforms. |
| **Unit-II** |
| **Image Enhancement Techniques:** Histogram modification techniques - Image smoothening Image Sharpening - Image Restoration - Degradation Model – Noise models - Spatial filtering – Frequency domain filtering. |
| **Unit-III** |
| **Image Compression & Segmentation:** Compression Models - Elements of information theory, Error free Compression -Image segmentation –Detection of discontinuities, Thresholding, Otsu's Threshold, Region based segmentation - Morphology. |
| **Unit-IV** |
| **Representation and Description:** Representation schemes- Boundary descriptors- Regional descriptors - Relational Descriptors. **Pattern Recognition:** Classification, Structure of PR System. |

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**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

- Learn different techniques employed for the enhancement of images.
- Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
- Learn different feature extraction techniques for image analysis and recognition.
- Understand the rapid advances in Machine vision.

**Textbooks:**

- Digital Image Processing by R. Gonzalez and R. E. Wood, Prentice Hall of India.
- Digital Image Processing by W.K. Pratt, McGraw Hill.
- Fundamentals of Digital Image Processing by A. K. Jain, Prentice Hall of India.
- Pattern Recognition-Statistical, Structural and neural approach by R. Schalkoff, John Willey & Sons.

**Reference Books:**

- Feature Extraction and Image Processing for Computer Vision by M. Nixon, Academic Press.
- Introductory Computer Vision and Image Procession by A. Low, McGraw Hill.
- Image Processing: Analysis and Machine Vision by Milan Sonka, Roger Boyle, and Vaclav Hlavac.

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| CSPC-612 Information and Network Security | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
- To understand various protocols for network security to protect against the threats in the networks.

| **Unit-I** |
|---|
| **Computer Security**: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security. **Cryptography:** Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography. |
| **Unit-II** |
| **Administering Security**: Security Planning, Risk Analysis, Organizational Security policies, Physical Security. **Program Security**: Secure Programs, Non-malicious Program Errors, viruses, and other malicious code, Targeted Malicious code, controls Against Program Threats, File Protection Mechanisms. |
| **Unit-III** |
| **Network Security Introduction**: Model for network security. Threats in Network, Network Security Controls, Firewalls, Intrusion Detection Systems, Secure E-Mail. Database Security: Security requirements, Reliability and integrity, Sensitive data, Inference, multilevel database. |
| **Unit-IV** |
| **Network Security:** Packet sniffing and spoofing, Attacks on TCP protocol, SYN flood, TCP reset attack, session hijacking attack, Firewalls: Packet filter, Stateful firewall, Application firewall. IP tables. **Authentication Requirement**, Functions, Message Authentication Code, Hash Functions, Security of Hash Functions And Macs, Digital Signatures, Key Management: Key Distribution Techniques, Kerberos. |

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**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

- Provide security of the data over the network.
- Do research in the emerging areas of information and network security.
- Implement various networking protocols.
- Protect any network from the threats in the world.

**Textbooks:**

- Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, First Edition, Wiley India Pvt Ltd, 2009.
- Cryptography and Network Security: Principles and Practice 5th Edition, William Stallings, Pearson,2010.
- Michael Whitman and Herbert Mattord, Management of Information Security, Fourth Edition, Cengage Learning, 2014.

**Reference Books:**

- Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.
- Behrouz A Fourouzan, Debdeep Mukhopadhyay, Cryptography and Network, 2nd Edition,TMH,2011.
- Harold F. Tipton, Information Security Management Handbook, Sixth edition, CRC Press, 2012.
- Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill, 2013.
- Michael Whitman and Herbert Mattord, Principles of Information Security, Fifth Edition, Cengage Learning, 2015.

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| CSPC-613 Compiler Design | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

- To teach concepts of language translation and phases of compiler design.
- To inculcate knowledge of common forms of parsers, parsing LL parser and LR parser.
- To demonstrate intermediate code using technique of syntax directed translation.
- To illustrate the various optimization techniques for designing various optimizing compilers.

| Unit-I |
|---|
| **Introduction to Compilers:** Definition of compiler, interpreter and its differences, Structure of a compiler, pass and phases of translation, bootstrapping, Lexical Analysis, Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, Lex, Finite Automata, Regular Expressions to Automata, Minimizing DFA. |
| **Unit-II** |
| **Syntax Analysis:** Parsing, Role of Parser, Grammars, Context-free grammars, derivations, ambiguity, classes of parsing, Top Down Parsing: Recursive Descent Parser, Predictive Parser-LL(1), Bottom Up Parsing: Shift Reduce Parser-LR Parser-LR(0), Introduction to SLR Parser, CLR Parser and LALR Parser, Error Handling and Recovery in Syntax Analyzer, YACC, Precedence Parser. |
| **Unit-III** |
| **Intermediate Code Generation:** Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking. |
| **Unit-IV** |
| **Run-Time Environment:** Need for runtime memory management, Address resolution of runtime objects at compile time, Type checking, Language features influencing run time memory management. **Code Generation:** Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management, Issues in Code Generation, Design of a simple Code Generator. **Code Optimization:** Principal Sources of Optimization, Basic Blocks, Peep-hole optimization, DAG, Data Flow Analysis. |

**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

- Use compiler construction tools and describes the Functionality of each stage of compilation process.
- Construct Grammars for Natural Languages and find the Syntactical Errors/Semantic errors during the compilations using parsing techniques.
- Analyze different representations of intermediate code.
- Construct new compiler for new languages

**Textbooks:**


- Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman (2007), Compilers Principles, Techniques and Tools, 2nd edition, Pearson Education, New Delhi, India.
- Tremblay, J .P. a nd Sorenson, P .G., " Theory and Practice o f Compiler Writing", SR Publications.
- K. L. P Mishra, N. Chandrashekaran (2003), Theory of computer science- Automata Languages and computation, 2nd edition, Prentice Hall of India, New Delhi, India.


**Reference Books:**


- Louden, K .C., "Compiler Construction: Principles and Practice", Course Technology.
- Tremblay, J.P. and Sorenson, P.G., "Parsing Techniques: A Practical Guide", Ellis Horwood.
- Andrew W. Appel (2004), Modern Compiler Implementation C, Cambridge University Press, UK.
- Cooper, K .D. a nd T orczon, L., "Engineering a Compiler", M organ Kaufmann.


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| CSPC-611P Digital Image Processing | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 0 | 0 | 2 | 1 | Maximum Marks: 30 | Maximum Marks: 20 | 50 | 2 Hours |
| | | | | Minimum Marks: 12 | Minimum Marks: 08 | 20 | |

Following is the list of experiments out of which minimum 08experiments must be performed in the lab. The additional experiments may be performed by the respective institution depending on the infrastructure available.

**List of experiments:**

1. To acquire an image, store in different formats and display the properties of the images.
2. Perform image enhancement, smoothing and sharpening, in spatial domain using different spatial filters and compare the performances.
3. Perform image enhancement, smoothing and sharpening, in frequency domain using different filters and compare the performances.
4. Apply histogram equalization for enhancing the given images.
5. Perform noise removal using different spatial filters and compare their performances.
6. For any image perform edge detection using different operators and compare the results.
7. To find the discrete Fourier transform of a gray scale image and perform inverse transform to get back the image.
8. Analyze the rotation and convolution properties of the Fourier transform using any gray scale image.

| CSEE-612P Capstone Project-I | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | C | Internal Assessment | End Semester Examination | Total | |
| 0 | 0 | 4 | 2 | Maximum Marks: 40 | Maximum Marks: 60 | 50 | 2 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 20 | |

**Course Objectives:** To facilitate the students, learn and apply an engineering design process in electrical engineering, including project resource management. As a part of a team, the students will make a project, that emphasizes, hands-on experience, and integrates analytical and design skills. The idea is to provide an opportunity to the students to apply what they have learned throughout the course of graduate program by undertaking a specific problem.

**Course Description/Guidelines:** Capstone Project is increasingly interdisciplinary and requires students to function on multidisciplinary teams. It is the process of devising a system, component or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. It typically includes both analysis and synthesis performed in an iterative cycle. Thus, students should experience some iterative design in the curriculum. As part of their design experience, students have an opportunity to define a problem, determine the problem scope and to list design objectives.

The project must also demonstrate that students have adequate exposure to design, as defined, in engineering contexts. Engineering standards and realistic constraints are critical in engineering design. The program must clearly demonstrate where standards and constraints are taught and how they are integrated into the design component of the project. The students will work in groups as:

- Each group will have 4-5 students.
- Each group should select their team leader and maintain daily diary.
- Each Group will work under mentorship of a faculty supervisor.
- Each group must meet the assigned supervisor (2hrs slot/week) till the end of the semester (record of attendance will be maintained), as per the time slot which will be provided to them by the respective supervisor.

This is mandatory requirement for the fulfilment of the attendance as well as the successful completion of the project. The faculty supervisor of the project will continuously assess the progress of the works of the assigned groups. Completed Capstone Project-I and documentation in the form of Capstone Project-I report (template provided in Annexure-I) is to be submitted at the end of semester and appear for project demonstration and viva.

1. **Capstone Project Report:** Students should prepare a mini project report as per the given template and guidelines.

2. **PowerPoint Presentation:** Prepare a PPT of around 10 slides. The PPT content must be as follows:
   - Project Tile, Student Details and Mentor Name (First Slide)
   - Introduction and Problem Statement (Max 2 Slides)
   - Methodology (Max 3 Slides)

- Results and Discussion (Max 3 Slides)
- Conclusion and Future Work (1 Slide)

**Course Learning Outcomes (CLOs):** After the completion of the course, the student will be able to:

- Develop skills necessary for structuring, managing, and executing the projects.
- Design, develop, debug, document, and deliver a project and learn to work in a team environment.
- Develop written and oral communication skills.
- Become proficient with software development tools and environments
- Apply interdisciplinary knowledge to engineering design solutions, taking into account professional and ethical issues.

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# Capstone Project-I Report

**on**

# TITLE

**Submitted in partial fulfilment of the requirement for the award of the degree of**

**BACHELOR OF TECHNOLOGY**

**IN**

**COMPUTER SCIENCE & ENGINEERING**

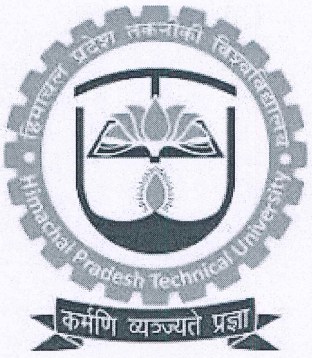
**Submitted by:**


**Student Name** **University Roll No.**


*Under the Mentorship of*

**Mentor Name**

**Designation**





**Department of Computer Science and Engineering**
**Himachal Pradesh Technical University**
**Main Campus, at Daruhi. Hamirpur**


**(Session Year)**

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# CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the project report entitled **"Title of the project"** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering of the Graphic Era (Deemed to be University), Dehradun shall be carried out by the under the mentorship of **Mentor Name, Designation**, Department of Computer Science and Engineering, Himachal Pradesh Technical University, Hamirpur.

Name:

University Roll no:

# Table of Contents

# Chapter 1

# Introduction

**(2 to 3 pages)**

In the following sections, a brief introduction and the problem statement for the work has been included.

## 1.1 Introduction

As estimated by John et al. in [1], ……..The detailed review of related techniques has been given in [2, 3].

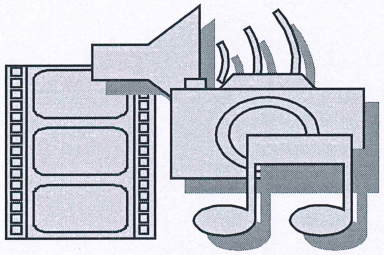

**Figure 1.1** Wrapper method for feature selection

## Chapter 2

# Literature Survey

**(2 to 3 pages)**

In this chapter some of the major existing work in these areas has been reviewed.

## Chapter 3

# Methodology

Explain your methodology using phrases, flowcharts, detailed diagrams, etc.

**(2 to 3 pages)**

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# Chapter 4

## Result and Discussion

This section will contain all your results from the above methodology used.

The result could be graphs, diagrams, tables, matrices, etc.

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# Chapter 5

## Conclusion and Future Work

This section will contain conclusion of your work. Further contains vision and ideas about future methods or new solution to your current problem statement.

## References


[1] N. K. Kanhere and S. T. Birchfied, "Real-time incremental segmentation and tracking of vehicles at low camera angles using stable features," *IEEE Trans. Intell. Transp. Syst.*, vol. 9, no. 1, pp.148-160, March 2008 **(Example : Journal papers)**

[2] K. Onoguchi, "Moving object detection using a cross correlation between a short accumulated histogram and a long accumulated histogram", Proc. 18th Int. Conf. on Pattern Recognition, Hong Kong, August 20 - 24, 2006, vol. 4, pp. 896 – 899 **(Example : Conference papers)**

[3] T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms", 2nd ed., The MIT Press, McGraw-Hill Book Company, 2001 **(Example : Text Book/ Magazine)**

[4] Open Source Computer Vision (OpanCV) [Online]. Accessed on 21st April 2022: http://opencv.willowgarage.com/wiki/ **(Example : Website)**


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# Professional Electives-I

| CSPEML-611(i) Optimization Techniques in Machine Learning | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 0 | 0 | 3 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:

The students will be able to understand and analyze how to deal with changing data. They will also be able to identify and interpret potential unintended effects in your project. They will understand and define procedures to operationalize and maintain your applied machine learning model.

| **Unit-I** |
|---|
| **Introduction**: What is optimization, Formulation of LPP, Solution of LPP: Simplex method, Basic Calculus for optimization: Limits and multivariate functions, Derivatives and linear approximations: Single variate functions and multivariate functions. |
| **Unit-II** |
| **Machine Learning Strategy:** ML readiness, Risk mitigation, Experimental mindset, Build/buy/partner, setting up a team, Understanding and communicating change. Responsible Machine Learning AI for good and all, Positive feedback loops and negative feedback loops, Metric design and observing behaviours, Secondary effects of optimization, Regulatory concerns |
| **Unit-III** |
| **Machine Learning in production and planning:** Integrating info systems, users break things, time and space complexity in production, when to retain the model? Logging ML model versioning, Knowledge transfer, Reporting performance to stakeholders. |
| **Unit-IV** |
| **Care and feeding of your machine learning model:** MLPL Recap, Post deployment challenges, QUAM monitoring and logging, QUAM Testing, QUAM maintenance, QUAM updating, Separating Datastack from Production, Dashboard Essentials and Metrics monitoring. |

**Course Learning Outcomes (CLOs):**

After the completion of the course, the student will be able to:

1. Understand and analyze how to deal with changing data.
2. Understand and interpret potential unintended effects in their project.
3. Understand and define procedures to operationalize and maintain the applied machine learning model.
4. Understand how to optimize the use of Machine Learning in real-life problems.

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**Textbooks/ Reference Books:**

1. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.

2. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021

3. Optimization for Machine Learning, Suvrit Sra, Sebastian Nowozin and Stephen J. Wright, MIT Press, 2011.

4. Optimization in Machine Learning and Applications, Suresh Chandra Satapathy, Anand J. Kulkarni, Springer, 2019.

5. Algorithms for Optimization by Mykel J. Kochenderfer and Tim A. Wheeler, MIT Press, 2019.

6. Accelerated Optimization for Machine Learning: First-Order Algorithms by Cong Fang, Huan Li, and Zhouchen Lin, Springer, 2020.

7. https://www.coursera.org/learn/optimize-machine-learning-model-performance

| CSPEML-611(ii) Big Data Mining and Analytics | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 0 | 0 | 3 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives:**

The students should be able to understand and apply big data flow to actual projects as well as apply data analytics life cycle to big data projects. The student should identify and successfully apply appropriate techniques and tools to solve big data problems.

**Unit-I**

**Introduction to Big data:** Introduction to Big Data Platform, Traits of Big data, Challenges of Conventional Systems, Web Data, Evolution of Analytic Scalability, Analysis vs Reporting, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error.

**Unit-II**

**Basic data analysis and data analytic methods using R:** Regression Modelling, Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Networks, Support Vector and Kernel Methods, Analysis of Time Series: Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks: Learning and Generalization, Competitive Learning, Principal Component Analysis and Neural Networks, Fuzzy Logic: Extracting Fuzzy Models from Data Fuzzy Decision Trees, Stochastic Search Methods. Introduction to R, Statistics for Model Building and Evaluation.

**Unit-III**

**Frequent item sets and clustering:** Mining Frequent item sets: Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent item sets in a Stream, Clustering Techniques: Hierarchical, K-Means, Frequent Pattern based Clustering Methods.

**Mining data streams**: Introduction to Streams Concepts: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream: Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis, Stock Market Predictions.

**Unit-IV**

**Framework, technologies, tools and visualization**: Map Reduce: Hadoop, Hive, Map R, Sharding, NoSQL Databases: S3, Hadoop Distributed File Systems, Visualizations: Visual Data Analysis Techniques, Interaction Techniques; Systems and Analytics Applications, Analytics using Statistical packages, Industry challenges and application of Analytics.

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**Course Learning Outcomes (CLOs):** After the completion of the course, the student will be able to:

1. Understand and apply big data flow to actual projects as well as apply data analytics life cycle to big data projects.
2. Apply appropriate techniques and tools to solve big data problems.
3. Describe big data and use cases from selected business domains.
4. Explain NoSQL big data management.
5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

**Text Books/Suggested References:**


1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to data Science and its Applications", Wiley publications, 2014.

2. V.K. Jain, Big Data & Hadoop, Khanna Book Publishing Co., Delhi. (ISBN 978-93-82609-131)

3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2003.

4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2020.

5. Jeeva Jose, Beginner's Guide for Data Analysis using R Programming, Khanna Book Publishing House, 2019.

6. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley, 2012.

7. Glenn J. Myatt, "Making Sense of Data", Wiley, 2006


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| CSPEML-611(iii) Deep Learning | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 0 | 0 | 3 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:
To introduce the fundamentals of deep learning and the main research activities in this field. To learn architectures and optimization methods for deep neural network training.

| |
|---|
| **Unit-I** |
| **Introduction:** History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation. |
| **Unit-II** |
| **Activation functions and parameters:** Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Parameters v/s Hyper-parameters. |
| **Unit-III** |
| **Auto-encoders & Regularization:** Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images, Batch Normalization. |
| **Unit-IV** |
| **Deep Learning Models:** Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogleNet, ResNet. Introduction to RNNs, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs. Deep Learning Applications. |

**Course Learning Outcomes (CLOs):** After the completion of the course, the student will be able to:

1. Understand the fundamentals of deep learning and the main research activities in this field.
2. Remember architectures and optimization methods for deep neural network training.
3. Implement, apply and test relevant learning algorithms in TensorFlow.
4. Critically evaluate the method's applicability in new contexts and construct new applications

**Text Books/Reference Books**:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016

2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009

3. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.

4. https://nptel.ac.in/courses/106/106/106106184/ 5. https://www.coursera.org/specializations/deep-learning

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# Professional Electives-II

| CSPEML-612(i) Bayesian Learning and Decision Making | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:
To help students understand basic mathematical and statistical techniques commonly used in pattern recognition. To introduce students to a variety of pattern recognition algorithms.

| **Unit-I** |
|---|
| **Introduction and mathematical Preliminaries:** Principles of pattern recognition: Uses, mathematics, Classification and Bayesian rules, Clustering vs classification, Basics of linear algebra and vector spaces, Eigen values and eigen vectors, Rank of matrix and SVD |
| **Unit-II** |
| **Pattern Recognition basics:** Bayesian decision theory, Classifiers, Discriminant functions, Decision surfaces, Parameter estimation methods, Hidden Markov models, dimension reduction methods, Fisher discriminant analysis, Principal component analysis, non-parametric techniques for density estimation, nonmetric methods for pattern classification, unsupervised learning, algorithms for clustering: Kmeans, Hierarchical and other methods. |
| **Unit-III** |
| **Feature Selection and extraction:** Problem statement and uses, Branch and bound algorithm, Sequential forward and backward selection, Cauchy Schwartz inequality, Feature selection criteria function: Probabilistic separability based and Interclass distance based, Feature Extraction: principles. |
| **Unit-IV** |
| **Visual Recognition:** Human visual recognition system, Recognition methods: Low-level modelling (e.g. features), Midlevel abstraction (e.g. segmentation), High-level reasoning (e.g. scene understanding); Detection/Segmentation methods; Context and scenes, Importance and saliency, Large-scale search and recognition, Egocentric vision, systems, Human-in-the-loop interactive systems, 3D scene understanding. |

**Course Learning Outcomes (CLOs):**
After the completion of the course, the student will be able to:

1. Understand basic mathematical and statistical techniques commonly used in pattern recognition.
2. Apply a variety of pattern recognition algorithms.
3. Understand and apply various pre-processing algorithms.
4. Apply various algorithms for image classification.

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**Textbooks:**


1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.
2. Pattern Classification by Richard O. Duda , Peter E. Hart, David G. Stork, Wiley, 1973.
3. https://nptel.ac.in/courses/106/106/106106046/


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| CSPEML-612(ii) Computer Vision | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:
The students will be able to work with images and videos in several ways. These methods can be used as pre-processing steps for complex models.

| Unit-I |
|---|
| **Image representation and analysis:** Introduction to computer Vision, Numerical representation of images, Image augmentation, enhancement, processing, color transforms, geometric transforms, feature recognition and extraction. **Image Segmentation:** Object detection, breaking image into parts, finding contours and edges of various objects in image, Background subtraction for video |
| **Unit-II** |
| **Object Motion and tracking**: Tracking a single point over time, motion models to define object movement over time, analyze videos as sequences of individual image frames, methods to track a set of features over time, matching features from image frame to other, tracking a moving car using optical flow. |
| **Unit-III** |
| **Robotic localization:** Bayesian statistics to locate a robot in space, sensor measurements to safely navigate an environment, Gaussian uncertainty, histogram filter for robot localization in python. |
| **Unit-IV** |
| **Image Restoration:** Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters |

**Course Learning Outcomes (CLOs):** After completion of course, students would be able to:

1. Understand images and videos representation in a detailed manner.
2. Apply ML techniques for image processing in different scenarios.
3. Apply various object detection and image segmentation algorithms.
4. Apply various image restoration techniques and algorithms.

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**Textbooks:**

1. Audio Video Systems, Bali & Bali, Khanna Book Publishing 2020.
2. Handbook of Image and Video Processing by Alan C. Bovik, Academic Press, 2000.
3. Python 3 Image Processing, Ashwin Pajankar, BPB Publication, 2019.
4. https://www.coursera.org/learn/image-processing.

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| CSPE-612(iii) Cloud Computing | | | | | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | Credit | Marks Distribution | | | Duration of End Semester Examination |
| L | T | P | | Internal Assessment | End Semester Examination | Total | |
| 3 | 1 | 0 | 4 | Maximum Marks: 40 | Maximum Marks: 60 | 100 | 3 Hours |
| | | | | Minimum Marks: 16 | Minimum Marks: 24 | 40 | |

**Instructions to the question paper setter:**
Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e. one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

**Course Objectives**:
- To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
- To motivate students to do programming and experiment with the various cloud computing environments
- To expose the students to the frontier areas of Cloud Computing.
- To shed light on the Security issues in Cloud Computing.

| Unit-I |
|---|
| **Basic Concepts:** Cloud Computing Overview, Origins of CC, Cloud components, Essential characteristics, On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing. |
| **Unit-II** |
| **Cloud Insights:** Architectural influences, High-performance computing, Utility and Enterprise grid computing, Cloud scenarios, Benefits, scalability, simplicity, vendors, security, Limitations Sensitive information, Application development security level of third party, security benefits, Regularity issues, Government policies. |
| **Unit-III** |
| **Cloud Architecture- Layers and Models:** Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds, Private clouds, Community clouds, Hybrid clouds, Advantages of Cloud computing. |
| **Unit-IV** |
| **Cloud Programming and Software Environments:** Parallel and Distributed Programming paradigms, Programming on Amazon AWS and Microsoft Azure, Programming support of Google App Engine, Emerging Cloud software Environment, Cloud Access: authentication, authorization and accounting, Reliability and fault-tolerance, security, privacy policy and compliance, federation, interoperability and standards. |

**Course Learning Outcomes (CLOs):** After the completion of the course, the student will be able to:

- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

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- Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
- Provide the appropriate cloud computing solutions and recommendations according to the applications used.
- Explain the core issues of cloud computing such as security, privacy, and interoperability.

**TEXT BOOK**:

- Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014
- Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012.
- Cloud computing a practical approach - Anthony T. Velte, Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill, New Delhi – 2010.
- Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008.

**REFERENCE BOOKS**:


- Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
- Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
- Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp 2011.
- Cloud computing for dummies- Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Wiley Publishing, Inc, 2010.
- Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009.