REGULATIONS AND SYLLABUS

for

Master of Technology
in
DATA SCIENCE
(w.e.f. 2019-20 admitted batch)

A University Committed to Excellence
M.Tech. in Data Science (DS)  
REGULATIONS  
(w.e.f. 2019-20 admitted batch)

1. ADMISSION
Admission into M.Tech. in Data Science (DS) program of GITAM(Deemed to be University) is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA
2.1 A pass in B.E./B.Tech./AMIE in any branch of Engineering or its equivalent or MCA/M.Sc.
2.2 Admissions into M.Tech will be based on the following:
   (i) Score obtained in GAT (PG), if conducted.
   (ii) Performance in Qualifying Examination/Interview.
   (iii) Candidates with valid GATE score shall be exempted from appearing for GAT(PG).
2.3 The actual weightage to be given to the above items will be decided by the authorities at the time of admissions.

3. CHOICE BASED CREDIT SYSTEM
3.1 Choice Based Credit System (CBCS) was introduced with effect from 2015-16 admitted batch and revised with effect from academic year 2019-20 in order to promote:
   • Student centered Learning
   • Activity based learning
   • Students to learn courses of their choice
   • Cafeteria approach
3.2 Learning objectives and outcomes are outlined for each course to enable a student to know what he/she will be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM
4.1 The Program Consists of
   i) Core Courses (compulsory) which give exposure to a student in core subjects related area.
   ii) Program Electives.
   iii) Open Electives
   iv) Mandatory and Audit Courses
4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.
4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.
   • One credit for each Lecture / Tutorial hour per week.
   • One credit for two hours of Practicals per week.
4.4 The curriculum of the four semesters M.Tech. program is designed to have a total of 68 credits for the award of M.Tech. degree
5. **MEDIUM OF INSTRUCTION**
The medium of instruction (including examinations and project reports) shall be English.

6. **REGISTRATION**
Every student has to register for the courses in each semester at the time specified in the academic calendar.

7. **ATTENDANCE REQUIREMENTS**
7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the semester-end examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his/her juniors.

7.2 However, the Vice-Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 65% and 74% on genuine grounds and on payment of prescribed fee.

8. **EVALUATION**
8.1 The assessment of the student’s performance in a theory course shall be based on two components: Continuous Evaluation (40 marks) and semester-end examination (60 marks).

8.2 A student has to secure a minimum of 40% in any theory course in the two components (ref. 8.1) put together to be declared to have passed the course, subject to the condition that the student must have secured a minimum of 24 marks out of 60 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical/ Project Work/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table1.

8.4 Audit courses are assessed through continuous evaluation for satisfactory or not satisfactory only. No credits will be assigned.

### Table 1: Assessment Procedure

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Component of Assessment</th>
<th>Marks Allotted</th>
<th>Type of Assessment</th>
<th>Scheme of Evaluation</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Theory Courses</td>
<td>40</td>
<td>Continuous Evaluation</td>
<td>i) Thirty (30) marks for mid Semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60</td>
<td>Semester-end Examination</td>
<td>ii) Ten (10) marks for Quizzes, Assignments and Presentations. Sixty (60) marks for Semester-end examinations</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Course</td>
<td>Total Marks</td>
<td>Evaluation</td>
<td>Details</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 2 | Practical Courses                                                      | 100         | Continuous     | i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the semester.  
   |                                                                                        |             | Evaluation     | ii) Ten (10) marks for casestudies.  
   |                                                                                        |             |                | iii) Forty (40) marks for two tests of 20 marks each (one at the mid-term and the other towards the end of the semester) conducted by the concerned labteacher. |
| 3 | Technical Seminar (II Semester)                                        | 100         | Continuous     | Through five periodic seminars of 20 marks each                         |
| 4 | Project Work (III Semester)                                            | 100         | Continuous     | i) Forty (40) marks for periodic assessment on originality, innovation, sincerity and progress of the work, assessed by the project supervisor.  
   |                                                                                        |             | Evaluation     | ii) Thirty (30) marks for mid-term evaluation for defending the project, before a panel of examiners.  
   |                                                                                        |             |                | iii) Thirty (30) marks for final report presentation and viva-voce, by a panel of examiners*. |
| 5 | Project Work (IV Semester)                                             | 50          | Continuous     | i) Twenty (20) marks for periodic assessment on originality innovation, sincerity and progress of the work, assessed by the project supervisor.  
   |                                                                                        |             | Evaluation     | ii) Fifteen (15) marks for mid-term evaluation for defending the project, before a panel of examiners*.  
   |                                                                                        |             |                | iii) Fifteen (15) marks for interim report presentation and viva-voce. |
|   | Total                                                                  | 100         | Semester-end   | Fifty (50) marks for final project report and viva-voce examination assessed by external examiners. |
|   |                                                                        |             | Examination    |                                                                        |
Audit courses are assessed for PASS or FAIL only. No credits will be assigned to these courses. If a student secures a minimum of 40 out of 100 marks during continuous evaluation, he/she will be declared PASS, else FAIL. PASS grade is necessary to be eligible to get the degree.

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGE EVALUATION

9.1 If a student is not satisfied with his/her grade, the student can apply for answer book verification on payment of prescribed fee for each course within one week after announcement of results.

9.2 After verification, if a student is not satisfied with revaluation marks/grade, he/she can apply for challenge valuation within one week after announcement of answer book verification result or two weeks after the announcement of results, which will be valued by two examiners i.e., one Internal and one External examiner in the presence of the student on payment of prescribed fee. The challenge valuation fee will be returned, if the student is successful in the appeal by securing a better grade.

10. SUPPLEMENTARY AND SPECIAL EXAMINATIONS

10.1 The odd semester supplementary examinations will be conducted after conducting regular even semester examinations during April/May.

10.2 The even semester supplementary examinations will be conducted after conducting regular odd semester examinations during October/November.

10.3 A student who has secured ‘F’ Grade in Project work shall have to improve his/her work and reappear for viva-voce after satisfactory completion of work approved by panel of examiners.

10.4 A student who has completed period of study and has “F” grade in final semester courses is eligible to appear for special examination.

11. MASSIVE OPEN ONLINE COURSES (MOOCs)

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (MOOCs) during the period of study. Students without any backlog courses up to first semester are permitted to register for MOOCs in second semester up to a maximum of 6 credits from program elective/open elective/audit courses. However the Departmental Committee (DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency will be decided by the respective Board of
12. GRADING SYSTEM

12.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades and Grade Points

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Grade</th>
<th>Grade Points</th>
<th>Absolute Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O (outstanding)</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>2</td>
<td>A+ (Excellent)</td>
<td>9</td>
<td>80 to 89</td>
</tr>
<tr>
<td>3</td>
<td>A (Very Good)</td>
<td>8</td>
<td>70 to 79</td>
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<tr>
<td>4</td>
<td>B+ (Good)</td>
<td>7</td>
<td>60 to 69</td>
</tr>
<tr>
<td>5</td>
<td>B (Above Average)</td>
<td>6</td>
<td>50 to 59</td>
</tr>
<tr>
<td>6</td>
<td>C (Average)</td>
<td>5</td>
<td>45 to 49</td>
</tr>
<tr>
<td>7</td>
<td>P (Pass)</td>
<td>4</td>
<td>40 to 44</td>
</tr>
<tr>
<td>8</td>
<td>F (Fail)</td>
<td>0</td>
<td>Less than 40</td>
</tr>
<tr>
<td>9</td>
<td>Ab (Absent)</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5.0 for a Pass in the semester.

13. GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

\[
\text{GPA} = \frac{\sum (C \times G)}{\sum C}
\]

where, C = number of credits for the course,

G = grade points obtained by the student in the course.

13.2 The Cumulative Grade Point Average (CGPA), is calculated using the above formula considering the grades obtained in all the courses, in all the semesters up to that particular semester.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for Award of Class

<table>
<thead>
<tr>
<th>Class</th>
<th>CGPA Required</th>
</tr>
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<tbody>
<tr>
<td>First Class with Distinction</td>
<td>( \geq 8.0^* )</td>
</tr>
<tr>
<td>First Class</td>
<td>( \geq 6.5 )</td>
</tr>
<tr>
<td>Second Class</td>
<td>( \geq 5.5 )</td>
</tr>
<tr>
<td>Pass Class</td>
<td>( &gt; 5.0 )</td>
</tr>
</tbody>
</table>

* In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in the first attempt.
14. **ELIGIBILITY FOR AWARD OF THE M.Tech. DEGREE**

14.1 Duration of the program: A student is ordinarily expected to complete the M.Tech. Program in four semesters of two years. However a student may complete the program in not more than four years including studyperiod.

14.2 However the above regulation may be relaxed by the Vice-Chancellor in individual cases for cogentand sufficient reasons.

14.3 A student shall be eligible for award of the M.Tech. Degree if he / she fulfills all the followingconditions.

   a) Registered and successfully completed all the courses and projectworks.

   b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulatedperiod.

   c) Has no dues to the Institute, Hostels, Libraries, NCC / NSS etc,and

   d) No disciplinary action is pending against him /her.

15. **DISCRETIONARY POWER**

   Not withstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.
M. Tech in DATA SCIENCE
Effective from academic year 2019-20 admitted batch

### Semester I

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>19ECS701</td>
<td>Advanced Data Structures</td>
<td>PC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<tr>
<td>2.</td>
<td>19ECS703</td>
<td>Mathematical Foundations of Computer Science</td>
<td>PC</td>
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<td>PC</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
<td>19EMC741</td>
<td>Research Methodology and IPR</td>
<td>MC</td>
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<td>7.</td>
<td>19ECS721</td>
<td>Advanced Data Structures Lab</td>
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<td>8.</td>
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<td>9.</td>
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**Total Credits: 21**

### Semester II

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<th>Course Name</th>
<th>Category</th>
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<th>T</th>
<th>P</th>
<th>C</th>
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<td>Deep Learning and Data Analytics Laboratory</td>
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<td>8.</td>
<td>19ECS792</td>
<td>Technical Seminar</td>
<td>PW</td>
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<td>9.</td>
<td>19EAC7XX</td>
<td>Audit Course II</td>
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**Total Credits: 21**

### Semester III

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<th>Course Name</th>
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<td>PW</td>
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**Total Credits: 13**

### Semester IV

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<th>T</th>
<th>P</th>
<th>C</th>
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<td>19ECS892</td>
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<td>PW</td>
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**Total Credits: 13**

### Number of Credits

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<td>PE</td>
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<td>2.</td>
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### AUDIT COURSE I and II

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Category</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
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<tbody>
<tr>
<td>1.</td>
<td>19EAC741</td>
<td>English for Research Paper Writing</td>
<td>AC</td>
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<td>2.</td>
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<td>6.</td>
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<td>7.</td>
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<td>Enlightenment Skills</td>
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<td>8.</td>
<td>19EAC750</td>
<td>Developing Soft Skills and Personality</td>
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### OPEN ELECTIVE

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This course provides an overall idea of to design, implement and to perform various operations like search, insert, delete etc., operations on the complex data structures. As a part string matching techniques and text data compression algorithms were also considered.

**Course Objectives:**
- Learn to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Understand the necessary mathematical abstraction to solve problems.
- Familiarize with advanced paradigms and data structure used to solve algorithmic problems.
- Analyze efficiency and proof of correctness of various algorithms.

**Unit I**
9L
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

**Learning Outcomes**
After completion of this unit the student will be able to
- define adt, understand hashing (L1)
- design and implement a hash function with the above collision resolution techniques (L6)

**Unit II**
9L

**Learning Outcomes**
After completion of this unit, the student will be able to
- create and perform operations like insert, delete and search operations on skipped lists (L6)
- differentiate between singly linked list/ doubly linked list and skip list with respect to space complexity and time complexity to perform search, insert and delete operations. (L2)

**Unit III**
9L

**Learning Outcomes**
After completion of this unit, the student will be able to
- organize data in a hierarchy form / non linear way (L4)
- perform search, insert and delete operations in the above data structures. (L4)

**Unit IV**
9L

**Learning Outcomes**
After completion of this unit, the student will be able to
- perform various string handling and string matching algorithms mainly considering similarity and identity in to account. (L6)
- understand various text data compression techniques (L2)
Unit V
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

Learning Outcomes
After completion of this unit, the student will be able to
• distinguish between one dimensional range search and two dimensional range search (L2)
• understand the database management query concepts in this domain (L2)

Textbook(s):

Course Outcomes:
After completion of this course, the student will be able to
• understand the implementation of symbol table using hashing techniques (L2)
• develop and analyze algorithms for red-black trees, b-trees and splay trees. (L3)
• develop algorithms for text processing applications. (L5)
• identify suitable data structures and develop algorithms for computational geometry problems. (L4)
The purpose of this course is to provide a clear understanding of the concepts that underlying fundamental concepts and tools in mathematics with emphasis on their applications to computer science. It emphasizes mathematical definitions and proofs as well as applicable methods.

**Course Objectives:**
- Familiarize the student about the concepts of Probability and Probabilistic Distributions.
- Evaluate principles of Random Sampling and derive the Problems
- Enable the student to interpret wider range of visual and numerical data, and carry out basic inferential procedures
- Illustrate the knowledge of mathematical modelling
- Utilize the knowledge of computing and mathematics appropriate to the discipline.
- Be familiar with the concepts of graph theory and using them in solving computer science problems.

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

**Learning Outcomes**
After completion of this unit, the student will be able to
- use the axioms of probability, define conditional probability. (L2)
- write axioms, and infer meaningful conclusions about the data. (L1)
- define conditional probability and understand intuitively about the conditional probability. (L1)
- identify the need for central limit theorem. (L2)
- use probabilistic inequalities such as Chernoff bound, Markov and Chebyshev's inequalities. (L2)

**Unit II**  
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

**Learning Outcomes**
After completion of this unit, the student will be able to
- understand the concepts of estimation theory. (L2)
- describe the sampling distribution of a sample proportions. (L2)
- calculate probabilities of a sample proportion. (L3)

**Unit III**  

**Learning Outcomes**
After completion of this unit, the student will be able to
- summarize data visually and numerically. (L4)
- learn the mathematical and probabilistic foundations of statistical inference. (L1)
- reduce the dimensionality of data. (L3)
- fit the Regression lines and analyze multivariate data. (L1)

**Unit IV**  
Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

**Learning Outcomes**
After completion of this unit, the student will be able to
- apply the basic concepts of graph theory and note the different properties of graphs(L4).
- apply the basic concepts to solve combinatorial problems(L4)
• describe and solve some real time problems using concepts of graph theory (L2)

**Unit V**  
Computer science and engineering applications  

**Learning Outcomes**

After completion of this unit, the student will be able to

• compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems. (L4)
• knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. (L5)
• how machine learning algorithms works - a basic introduction. (L1)
• why we want to study big data and how to prepare data for machine learning algorithms. (L1)
• acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer. (L2)

**Text Book(s)**

4. Alan Tucker, Applied Combinatorics, Wiley

**Course Outcomes:**

After completing this Course, the student should be able to

• evaluate principles of random sampling and derive the problems (L4).  
• understand the concepts of estimation theory (L2).  
• fit the regression lines and analyse multivariate data (L3)  
• compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems (L4)
The course is concentrated on the study and development of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. It involves algorithm design techniques, methods for analyzing the performance of corresponding algorithms and improving their efficiency, and to provide performance guarantees.

Course Objectives:

- Introduce the advanced methods of designing and analyzing algorithms.
- Identify an appropriate algorithm and implement it for a specific problem.
- Understand different classes of problems concerning their computation difficulties.
- Solve problems using dynamic programming, network flow algorithms, graph algorithms and approximation algorithms.
- Analyze recent developments in the area of algorithmic design.

Unit I 6 L

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis.

Learning Outcomes

- describe different sorting algorithms and their time complexity (L2)
- apply various graph traversal algorithms to find shortest paths (L3)
- outline the difference between BFS and DFS algorithms (L4)
- review the correctness of algorithm time and space analysis (L2)

Unit II 8 L

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

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

Learning Outcomes

- calculate the maximum matching in graph related problems (L3)
- compute algorithms for maximum weight and maximal independent set. (L3)
- apply MST for real world problems (L3)
- discover augmenting paths in graphs using various algorithms (L3)

Unit III 9 L


Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix.

Learning Outcomes

- solve network flow problems using network flow algorithms (L3)
- implement divide and conquer paradigm for matrix multiplication (L3)
• analyze how efficiency can be achieved by matrix computation algorithms (L4)

Unit IV
10 L
Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Learning Outcomes:
After completion of this unit the student will be able to
• practice more examples on dynamic programming (L3)
• determine shortest paths in a graph using dynamic programming (L5)
• assess various representations of data (L5)
• develop algorithms for interpolation problems (L6)

Unit V
9 L
Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest. Approximation algorithms, Randomized Algorithms, Interior Point Method.

Learning Outcomes
After completion of this unit, the student will be able to
• explain linear programming concepts (L2)
• examine NP-hardness and NP-completeness problems (L4)
• illustrate approximation algorithms (L4)
• analyze randomized algorithms (L4)

Text Book(s):

Course Outcomes:
After completion of the course, students would be able to:
• analyze the complexity/performance of different algorithms. (L4)
• determine appropriate algorithm that is suitable for solving a particular set of problems. (L3)
• explain more complex algorithms and proofs in written form (L3)
• categorize different problems in various classes according to their complexity. (L4)
• design and analyze techniques for algorithms and ways to approach NP-complete problems (L6)
• apply techniques to solve new problems that may arise in various applications (L3)
This course introduces the student to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Course Objectives

- To familiarize the meaning, objectives and sources of research
- To acquaint the student with the importance and methods of literature review/research ethics
- To impart the knowledge of technical writing for preparing reports, presentations, research proposals, conference/journal publications
- To introduce the terminology and process of obtaining intellectual property rights
- To expose the intricacies in the process of obtaining patent rights

Unit I 5L
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning of a research problem (L1)
- list the different sources of research problem (L2)
- enumerate the different criteria of good research and list the different errors in selecting research problem (L2)
- contrast the different approaches of research (L3)
- compare the different methods for data collection and analysis (L5)

Unit II 5L
Effective literature studies approaches, analysis Plagiarism, Research ethics

Learning Outcomes

After the completion of this unit, the student will be able to

- list and elaborate the different steps of the research process (L1)
- explain the importance of carrying out an effective literature review (L2)
- identify the research gaps from literature review (L5)
- describe the ethical principles to be following during research process and authorship (L2)
- define the terminology and list the methods to avoid being accused of plagiarism (L1)
- list the different types of research misconduct (L2)

Unit III 5L
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Learning Outcomes

After the completion of this unit, the student will be able to

- list the attributes, reasons and guidelines for effective technical writing (L1)
- contrast between conference paper, technical presentation and journal paper (L3)
- choose a particular research contribution for patenting or journal publication (L4)
- describe the terminology related to citation, citation index, h-index etc (L2)
Unit IV


Learning Outcomes
After the completion of this unit, the student will be able to
• describe the codes and standards in building intellectual property rights(L2)
• list the subject, importance and requirements for of patentability(L1)
• explain the process of patenting and commercialization in academia(L2)
• enumerate the procedure for application preparation, filing and grant of Patents(L2)

Unit V


Learning Outcomes
After the completion of this unit, the student will be able to
• explain the scope of patent rights(L2)
• describe the process for licensing and transfer of technology(L2)
• identify the sources of patent information and databases(L1)
• elaborate the administration of patent system(L2)
• describe the new developments in IPR in computer software, biological systems etc(L3)

Text Book(s):

References:

Course Outcomes
After successful completion of the course, the student will be able to
• define the meaning, sources, approaches for research problems (L1)
• explain the guidelines for carrying out effective literature review and identify research gaps(L2)
• describe effective guidelines for preparing technical reports, research publications, presentations and research proposals(L2)
• describe the codes, standards and process of obtaining intellectual property rights(L3)
• enumerate the new developments of IPR in engineering systems(L3)
1. Develop programs for
   a. HeapSort
   b. MergeSort
   c. Quick sort by taking random element as pivot
   d. Selection

2. Program to perform insertion, deletion and search operations on the following:

3. Implement the functions of a dictionary using Hashing.

4. Implement hash tables with linear probing and double hashing. Demonstration of inserting and deleting elements.

5. Skip list: Implementations and operations.

6. Develop a program to perform insertion, deletion and search operations on the following Trees
   a. Binary Search Tree
   b. B-Trees
   c. AVL Tree
   d. Red Black Trees

7. Implement the code for the following problems using Dynamic Programming:
   a. Matrix Chain Multiplication Problem.
   b. String matching algorithm.
1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib, Scikit
2. Perform Data exploration and preprocessing in Python
3. Implement regularised Linear regression
4. Implement Naive Bayes classifier for dataset stored as CSV file.
5. Implement regularized logistic regression
6. Build models using different Ensembling techniques
7. Build models using Decision trees
8. Build model using SVM with different kernels
9. Implement K-NN algorithm to classify a dataset.
Due to advent of technology, internet, and advanced applications like social media, huge amount of digital data has been accumulated in data centers/Cloud Databases, which has lead to a situation “we are drowning in data but starving from knowledge”. To make use of this various data mining functionalities like Association Analysis, Classification, Clustering, Outlier Analysis and Web mining used to find golden nuggets which are useful for decision making process.

Data warehousing (DW) is an integral part of knowledge discovery process, where DW plays a vital role. DW is an integration of multiple heterogeneous data repositories under a unified schema at a single site. The students will acquire knowledge in Data modeling, design, architecture, Data warehouse implementation and further development of data cube technology.

**Course Objectives**

This course will introduce the concepts, techniques, design and applications of data mining and data warehousing. It will enable the students to understand and implement classical algorithms in data mining. They will learn how to analyze the data, identify the problems and choose the relevant algorithms to apply. Then, they will be able to assess the strengths and weaknesses of the algorithms and analyze their behavior on real datasets.

- Understand the importance of Data Mining and its applications
- Introduce various types of data and pre-processing techniques
- Learn various multi-dimensional data models and OLAP Processing
- Study concepts of Association Analysis
- Learn various Classification methods
- Learn basics of cluster analysis

**Unit I**

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

**Learning outcomes**

After completion of this unit, student will be able to

- understand the basic concepts of data mining (L2)
- learn the KDD process (L2)
- learn different data mining tasks (L2)
- Understand the use of frequent patterns in business analysis (L2)
- Implement apriori algorithm and FP-growth algorithm (L3)

**Unit II**

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

**Learning outcomes**
After completion of this unit, student will be able to
- Understand various types of data sets and attributes: (L2)
- Apply different statistical techniques on different types of attributes to find the similarities and dissimilarities (L3)
- Learn different data preprocessing techniques and apply them on data sets: (L2)
- Learn the basics of data warehousing and different OLAP operations: (L2)

**Unit III**
Minining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis and Similarity search in Time-series analysis.

**Learning outcomes**
After completion of this unit, student will be able to
- Learn Categories of Time-Series Movements (L2)
- Find the Trend Discovery in Time-Series (L1)
- Know about Similarity Search in Time-Series Analysis(L2)

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

**Learning outcomes**
After completion of this unit, student will be able to
- Know about stream data processing and stream data systems (L2)
- Apply Sequential Pattern Mining in Data Streams(L3)
- Understand the Class Imbalance Problem(L2)
- Analyse Graph Mining and Social Network Analysis(L4)

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

**Learning outcomes**
After completion of this unit, student will be able to
- Understand the Taxonomy of Web mining(L2)
- Work with Automatic classification of web documents(L4)
- Learn about Web usage mining(L2)

**Textbook(s):**
1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, 2/e, Elsevier Publishers, 2011.
2. Vipin Kumar, Pang-Ning Tan, Michael Steinbach, Introduction to Data
Mining, Addison Wesley, 2006.

Course Outcomes
At the end of this course, student will be able to
• understand the functionality of various data warehousing and data mining components: (L2)
• understand various OLAP operations: (L2)
• understand the strengths and limitations of various data mining models: (L2)
• implement the data mining algorithms with different datasets: (L3)
• compare various approaches of data mining implementations: (L2)
• identify and apply appropriate data mining technique to solve a problem: (L3)
This course will help the students to get familiar with Distributed Database System concepts, system architecture, design strategies and issues, query optimization, transaction concepts and issues in reliability.

Course Objectives:
- Understand basic concepts related to Distributed Database System and Architecture.
- Comprehend the underlying design strategies, issues and query processing.
- Demonstrate different query optimization and query optimization algorithms.
- Familiarize fundamentals of transaction management based on concurrency control and reliability.

Unit I
Introduction: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts
Distributed Database Management System Architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

Learning Outcomes:
- define the key objectives of a distributed database system.(L1)
- discuss some of the advantages of distributed database system. (L1)
- discuss some of the problems in database systems(L2)
- illustrate the architecture of distributed DBMS(L2)

Unit II
Distributed Database Design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation
Semantics Data Control: View management; Data security; Semantic Integrity Control
Query Processing Issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

Learning Outcomes:
- list the various design strategies and issues. (L1)
- illustrate the data control, integrity and security(L2)
- build the layers of query processing(L3)
- apply the objectives of query processing and query decomposition. (L4)

Unit III
Distributed Query Optimization: Factors governing query optimization; Centralized query
optimization; ordering of fragment queries; Distributed query optimization algorithms.

Learning Outcomes:
After completion of this unit, the student will be able to
• compare the various factors governing query optimization(L2)
• build the queries.(L3)
• compare the distributed and centralized query optimization(L4)
• test for different optimization algorithms.(L4)

Unit IV 8L
Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models.
Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Learning Outcomes
After completion of this unit, the student will be able to
• apply the transaction management concepts.(L4)
• apply the transaction models (L4)
• distinguish between the concurrency control in centralized ddbss (L4)
• examine the various concurrency control algorithms.(L4)

Unit V 6L
Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Learning Outcomes
After completion of this unit, the student will be able to
• compare the various issues in ddbss. (L4)
• categorize the failures. (L4)
• distinguish between the reliability techniques.(L4)
• evaluate the working of commit and recovery protocols.(L5)

TextBook(s):
2. D. Bell and J. Grimson “Distributed Database Systems”, Addison-Wesley,1992

Course Outcomes:
After completion of this course, the student will be able to
• define the basic concepts, advantages and the architecture of distributed dbms(L1)
• demonstrate the distributed design issues, data control and query processing issues(L2)
• identify the various distributed query optimization factors. (L3)
• evaluate the transaction management models and concurrency control. (L4)
• elaborate on the reliabilityissues and protocols.(L4)
Machine Learning is the science of making machines think intelligently without being explicitly programmed. Machine learning is pervasive in everyday life today. This course is designed to enable students get in-depth understanding of different machine learning techniques including deep learning and reinforcement learning and apply them on real-life data.

Course Objectives:
- Understand the fundamental concepts of Supervised learning.
- Explore descriptive problem solving through unsupervised learning strategies.
- Acquire skills in developing as well as evaluating different machine learning models.
- Demonstrate the application of different deep learning methodologies.
- Gain an understanding of concepts like Reinforcement Learning and Active Learning.

Unit I
Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class

Learning Outcomes
After completion of this unit, the student will be able to:
- explain the concept of machine learning and their applications to different real world datasets. (L2)
- demonstrate the working of different supervised learning algorithms and assess their suitability to a given problem. (L3)
- extend a binary classification problem to solve a multi-class classification problem. (L3)

Unit II
Unsupervised Learning: Clustering: K-means, Dimensionality Reduction: PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models)

Learning Outcomes
After completion of this unit, the student will be able to:
- demonstrate the working of different dimensionality reduction techniques on high-dimensional datasets (L3)
- illustrate the working of Generative Models mathematically. (L3)

Unit III
Evaluating Machine Learning algorithms, Model Selection, Ensemble Methods (Boosting, Bagging, Random Forests)

Learning Outcomes
After completion of this unit, the student will be able to:
- interpret ensemble models as a function of different weak classifiers. (L3)
- compare the performances of different classification models. (L4)

Unit IV
Modeling Sequence/Time-Series Data, Deep Learning (Deep generative models, Deep Boltzmann
Machines, Deep auto-encoders, Applications of Deep Networks) and Feature Representation Learning

**Learning Outcomes**

After completion of this unit, the student will be able to:

- understand the methods for handling time series and sequence data. (L2)
- demonstrate the working of different deep learning approaches on complex data. (L3)

Unit V

Scalable Machine Learning (Online and Distributed Learning) Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

**Learning Outcomes**

After completion of this unit, the student will be able to:

- apply reinforcement learning approach to applications like bioinformatics and personalized recommendation. (L3)
- analyses the working of Active Learning approach on complex data. (L4)

**Text Book(s)**

2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, 3/e, Morgan Kaufmann, 2011.

**Course Outcomes:**

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

- relate knowledge about application of machine learning techniques to real world problems. (L3)
- apply deep learning methodologies to applications such as image recognition, video tagging etc. (L3)
- generate suitable unsupervised learning approaches to descriptive machine learning models. (L4)
- utilize supervised learning approaches to perform predictive modeling of data. (L3)
- assess different machine learning algorithms based on performance evaluation measures. (L5)
The course gained increasing importance in the nineties, as the Web became an important medium for business and e-commerce transactions. It was recognized early on that the Web provided unprecedented opportunities for personalization, which were not available in other channels. In particular, the Web provided ease in data collection and a user interface that could be employed to recommend items in a non-intrusive way. Recommender systems have grown significantly in terms of public awareness since then. The topic of recommender systems is very diverse because it enables the ability to use various types of user-preference and user-requirement data to make recommendations. The most well known methods in recommender systems include collaborative filtering methods, content based methods, and knowledge-based methods. The increasing importance of the Web as a medium for electronic and business transactions has served as a driving force for the development of recommender systems technology. An important catalyst in this regard is the ease with which the Web enables users to provide feedback about their likes or dislikes.

Course Objectives

- Enable the student to tell about information retrieval and relevant models, illustrating methods of finding similarity while elaborating on recommender systems
- Familiarize the student to demonstrate on content based filtering and classification systems
- Explain various methods of Collaborative Filtering
- Distinguish various hybridization design approaches
- Evaluate various recommender systems and their evaluation designs

Unit-I

Introduction: Overview of Information Retrieval, Retrieval Models
Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Learning Outcomes:
After completion of this unit the student will be able to

- Show how information retrieval can be efficiently done using Recommender Systems(L1)
- Illustrate how Matrix operations and covariance matrices can be used to find similarities among items for Recommender Systems(L2)
- List Applications of Recommender Systems(L4)
- Interpret issues with Recommender Systems(L5)

Unit II

Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, preprocessing and feature extraction, Obtaining item features from tags, Methods for learning
user profiles, Similarity based retrieval, Classification algorithms.

**Learning Outcomes:**
After completion of this unit the student will be able to
- Explain high level architecture of content-based systems(L2)
- List advantages and drawbacks of content based filtering(L4)
- Identify item profiles and discover features of documents for preprocessing and extraction and obtain item features from tags(L3)
- Appraise methods for learning user profiles along with similarity based retrieval and classification algorithms(L5)

**Unit III** 14 L
Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

**Learning Outcomes:**
After completion of this unit the student will be able to
- Appraise various methods of collaborative filtering(L5)
- Discuss attacks on collaborative recommender systems(L6)

**Unit IV** 13 L
Hybrid approaches: Opportunities for hybridization
Monolithic hybridization design: Feature combination, Feature augmentation
Parallelized hybridization design: Weighted, Switching, Mixed
Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies

**Learning Outcomes:**
After completion of this unit the student will be able to
- List opportunities for hybridization(L4)
- Explain Monolithic, parallelized and pipelined hybridization design(L2)
- Interpret limitations of hybridization strategies(L5)

**Unit V** 14 L
Evaluating Recommender System: Introduction, General properties of evaluation research
Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations, Types of Recommender System

**Learning Outcomes:**
After completion of this unit the student will be able to
- Evaluate Recommender Systems(L5)
- Interpret various evaluation designs(L5)
- Appraise types of Recommender Systems(L5)

**Textbook(s):**

Course Outcomes:
After completion of this course, the student will be able to..
- Interpret issues with Recommender Systems(L5)
- Explain high level architecture of content-based systems(L2)
- Apply various methods of collaborative filtering(L5)
- Interpret limitations of hybridization strategies(L5)
- Evaluate Recommender Systems Analyze the malware.
The purpose of this course is to provide a clear understanding about various data analytic techniques available to solve real world business problems, communicate findings, and effectively present the results using data visualization techniques. The knowledge gained helps in applying the data science concepts and methods to solve problems in real-world contexts.

Course Objectives:

• Familiarize the student about the concepts of data visualization and formal inference procedures.
• Enable the student to interpret wider range of visual and numerical data
• Train the student on basic machine learning algorithms
• Demonstrate the Applications of Data Science, Technologies for visualization Handling of variables using Python

Unit I 6 L
Introduction to core concepts and technologies: Introduction, Terminology, data science Process, data science toolkit, Types of data, Example applications

Learning Outcomes:
After completion of this unit the student will be able to
• understand the basic concepts of data science (L2)
• identify the types of data (L2)

Unit II 7 L
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources

Learning Outcomes:
After completion of this unit the student will be able to
• understand about how to collect the data, manage the data, explore the data, store the data (L2)

Unit III 10 L
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Learning Outcomes:
After completion of this unit the student will be able to
• understand the basic measures of central tendency. (L2)
• classify the data using svm and navie Bayesian. (L2)
Unit IV  11 L
Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Learning Outcomes
After completion of this unit the student will be able to
• familiarize about the visualization of data. (L4)
• apply coding techniques to data for securing the data. (L4)

Unit V  7 L
Applications of Data Science, Technologies for visualisation, Bokeh (Python)

Learning Outcomes
After completion of this unit the student will be able to
• understand the various concepts of data science and can be able to handle simple applications of data science using python.(L2)

Textbooks(s):

Course Outcomes:
After completing this Course, the student should be able to
• identify the types of data (L1).
• understand about how to collect the data, manage the data (L2).
• classify the data using svm and naive bayesian (L3)
• apply coding techniques to data for securing the data (L4)
This course provides an overview of techniques to explore, analyze, and leverage data. The goal of data preparation is to create the data and provide insight into methods for analysis and processing of the data generated by modern information systems. The data that was acquired from different sources will likely have many problems. It requires cleaning the data, and putting the data in the right format for analysis by addressing data quality issues that is checking the data for accuracy. The course also provides methods for how to prepare data for analysis, perform exploratory data analysis, and develop meaningful data visualizations.

**Course Objectives:**
- Learn gather data from data sources and clean the data.
- Prepare data marts and transform data for statistical analysis.
- Perform exploratory data analysis and apply statistical methods to data for further refining.
- Develop meaningful Data Visualizations.
- Create visualizations by using summary statistics and visualization methods for data exploration.

**Unit I**
**9 L**
Data Gathering and Preparation: Introduction to Big data, Terminology, Big data life cycle, Process for Making Sense of Data, Describing Data, Data sources, Data understanding, Data preparation

**Learning Outcomes**
After completion of this unit the student will be able to
- outline the different characteristics of data(L2)
- summarize the process of preparing the data(L4)
- collect the data from different sources(L2)
- classify and describe the data types of raw data(L2)

**Unit II**
**9 L**
Data Cleaning: Data Tables, Graphs, Understanding Relationships, Visualizing Relationships between Variables, Calculating Metrics about Relationships, Data Visualization

**Learning Outcomes**
After completion of this unit, the student will be able to
- examine the data formats in the tables(L4)
- identify the relationships and their measures of data variables(L4)
- modify the relationships for analysis purpose(L6)
- construct visualizations to find the relationships. (L6)
Unit III                      8 L
Exploratory Analysis: Descriptive statistics, inferential statistics, comparative statistics, Clustering and association

Learning Outcomes
After completion of this unit, the student will be able to
• understand different statistical methods used to prepare data (L2)
• apply statistical methods on data for further analysis (L4)
• use hypothesis tests to re-verify the data (L3)
• develop clusters and associations for the data (L5)

Unit IV                    10 L
Visualization: Designing visualizations, Time series, Geo-located data

Learning Outcomes
After completion of this unit, the student will be able to
• use various time series in visualization (L3)
• distinguish various forms of visualizations (L4)
• design data visualizations for complex datasets (L6)
• generate visualizations for geo located data (L6)

Unit V             8 L
Correlations and connections, Hierarchies and networks, interactivity

Learning Outcomes
After completion of this unit the student will be able to
• understand the concept of correlations and connections (L2)
• explain how interactivity can be used for visualization. (L4)
• imagine the basic hierarchies in a network for interactivity. (L5)

Textbook(s):
4. Tamraparni Dasu, Exploratory Data Mining and Data Cleaning, A John Wiley & Sons, Inc.

Course outcomes:
After completing this Course, the student should be able to
• familiarize in converting data into valuable information. (L1)
• develop strategies for dealing with imperfect data. (L5)
• distinguish clustering and association and apply them in solving statistical problems. (L2)
• design visualizations for exploratory analysis. (L3)
• review the concept of correlations and connections for geo located data. (L3)
• visualize the basic hierarchies in a network for interactivity. (L2)
This course gives an introduction to some fields in soft computing with its principal components of Fuzzy logic, Neural Networks and Genetic Algorithms. It also focuses on simple implementation of neural networks and fuzzy logic using Matlab/Python. This course would be quite useful to study the fundamental concepts of soft computing for the pursuit of allied research also.

Course Objectives:
- Understand the fundamental concepts of soft computing and machine learning
- Perform operations on fuzzy sets
- Develop neural networks algorithms in machine learning
- Illustrate and apply genetic algorithms in machine learning
- Get practical exposure to implement artificial neural networks and fuzzy logic through matlab/Python

Unit I

Learning outcomes
After completion of this unit the student will be able to
- define soft computing and neural network(L-1)
- illustrate the evolution of the field of soft computing(L-1)
- explain the basics of machine learning(L-2)

Unit II

Learning outcomes
After completion of this unit the student will be able to
- name what are fuzzy sets, fuzzy operations and relations(L-1)
- define fuzzy reasoning and fuzzy inference systems (L-1)
- illustrate fuzzy expert systems and decision making using fuzzy logic (L-2)

Unit III
Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance
architectures, Advances in Neural networks

**Learning outcomes**
After completion of this unit the student will be able to

- list various forms of neural networks (L1)
- define different types of learning a neural network (L1)
- identify how autonomous agents choose optimal decisions in their environments (L3)
- go through reinforcement learning

**Unit IV** 5L

**Learning outcomes**
After completion of this unit the student will be able to

- model genetic learning method by an analogy to biological evolution (L3)
- experiment with hypothesis space search in genetic learning (L3)
- apply the concepts of genetic programming (L4)

**Unit V** 12L
Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

**Learning outcomes**
After completion of this unit the student will be able to

- identify various fundamental concepts of Matlab/Python (L3)
- experiment with toolboxes of neural network and fuzzy logic (L3)
- inspect a simple implementation of artificial neural network and fuzzy logic (L4)

**Text Book(s):**

**Course outComes:**
After completion of this course, the student will be able to

- illustrate the evolution and basics of soft computing and machine learning. (L1)
- Experiment with fuzzy sets, operations, fuzzy inference and expert systems. (L5)
- list various forms of neural networks and their learning. (L1)
- illustrate genetic algorithms and their applications. (L3)
- experiment with Matlab/Python to understand the implementation of artificial neural network and fuzzy logic. (L5)
19ECS722: SOFT COMPUTING LABORATORY

L T P C
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1. Tutorial on Tensorflow
2. Tutorial on keras
3. Implement Union, Intersection, complement and difference operations on Fuzzy sets.
5. Build Logistic Regression Classifier using Neural Networks
6. Build Deep neural network for classification
7. Build neural network for Regression
8. Build a classification model using different parameter initialization techniques.
10. Implement Genetic algorithm.
1. Implement Convolution and pooling operations of CNN.
2. Build a Convolution Neural Network using Transfer learning.
3. Build a Convolution Neural Network for Neural Style Transfer.
4. Build a Convolution Neural Network for object detection.
5. Implement forward and backward pass in RNN
6. Build a LSTM model
7. Build a simple Auto encoder
8. Build a neural network for clustering
9. Word Count program using Map Reduce.
10. Create, load data to tables and manipulate the data in Hbase & Hive
Each student shall survey a technical topic related to a chosen specialization and prepare/submit a report in a specified format. It is advisable for students to choose a topic of interest to be continued as M.Tech Project in the 3rd & 4th Semester. The guidelines to carry out the research shall include the following:

1. Literature Review
2. Identification of Gap
3. Objectives and Expected Outcomes
4. Methodology / Innovative solution

Each student has to prepare a power point presentation on a selected technical topic with a novelty and get it evaluated by the faculty assigned for this purpose.
This course is all about data visualization, the art and science of turning data into readable graphics. We'll explore how to design and create data visualizations based on data available and tasks to be achieved. This process includes data modeling, data processing (such as aggregation and filtering), mapping data attributes to graphical attributes, and strategic visual encoding based on known properties of visual perception as well as the task(s) at hand. Students will also learn to evaluate the effectiveness of visualization designs, and think critically about each design decision, such as choice of color and choice of visual encoding. Provides all the theory, details, and tools necessary to build visualizations and systems involving the visualization of data. Shows how various public and commercial visualization systems are used to solve specific problems in diverse domains.

Course Objectives
- Enable the student to tell about data visualization and relevant models, illustrating methods of finding similarity while representing on visualization of data.
- Familiarize the student to demonstrate on Techniques of spatial and Time oriented data.
- Explain various methods of Visualization on trees, graphs and networks.
- Distinguish various Interaction design approaches.
- Evaluate various data visualization systems and their diverse designs.

Unit-I: Introduction
- Types of Data, Structure within and between Records, Data Preprocessing.
- The Visualization Process in Detail, Semiology of Graphical Symbols, The Eight Visual Variables Historical Perspective, Taxonomies.

Learning Outcomes:
- After completion of this unit the student will be able to
- show how data visualization can be visualized (L2)
- illustrate how visualization data is structured can be used to find similarities among items for perception in visualization. (L2)
- list the visualization process (L4)
- interpret of visual variables and graphical symbols (L5)
Unit II
Visualization Techniques for Spatial Data: One-Dimensional Data, Two-Dimensional Data, Three-Dimensional Data, Dynamic Data Combining Techniques.
Visualization Techniques for Geospatial Data: Visualizing Spatial Data, Visualization of Point Data, Visualization of Line Data, Visualization of Area Data, Other Issues in Geospatial Data Visualization.
Learning Outcomes:
After completion of this unit the student will be able to
• explain visualization techniques for spatial data (L2)
• list out issues in geospatial data, visualization (L4)
• visualizing dynamic data combining techniques (L3)
• elaborate visualizing time-oriented data (L5)

Unit III
Visualization Techniques for Multivariate Data Point-Based Techniques, Line-Based Techniques, Region-Based Techniques, Combinations of Techniques.
Visualization Techniques for Trees, Graphs, and Networks: Displaying Hierarchical Structures, Displaying Arbitrary Graphs/Networks.
Learning Outcomes:
After completion of this unit the student will be able to
• interpret visualization techniques for multivariate data (L3)
• illustrate hierarchical structures and arbitrary graphs/networks. (L4)
• evaluate single document visualization and document visualization (L6)

Unit IV
Interaction Techniques Screen Space, Object Space (D Surfaces), Data Space (Multivariate Data Values), Attribute Space (Properties of Graphical Entities), Data Structure Space (Components of Data Organization), Visualization Structure Space (Components of the Data Visualization) Animating Transformations Interaction Control.
Designing Effective Visualizations: Steps in Designing Visualizations, Problems in Designing Effective Visualizations.
Learning Outcomes:
After completion of this unit the student will be able to
• list opportunities for effective visualizations (L4)
• explain unified framework, data space(L2)
• interpret limitations of designing effective visualizations.(L5)

Unit V  
Comparing and Evaluating Visualization Techniques  
User Tasks, User Characteristics  
Data Characteristics, Visualization Characteristics, Structures for Evaluating Visualizations  
Benchmarking Procedures, An Example of Visualization Benchmarking  
Visualization Systems  
Systems Based on Data Type, Systems Based on Analysis Type  
Text Analysis and Visualization, Modern Integrated Visualization Systems Toolkits  
Issues of Applications  

Learning Outcomes:
After completion of this unit the student will be able to
• evaluate and comparison of different techniques.(L5)
• interpret various visualization systems(L5)
• appraise types of research direction(L5)

Textbook(s):

Course Outcomes:
After completing this Course, the student should be able to
• state the basics of data visualization (L1)
• understand the importance of data visualization and the design and use of many visual components(L2)
• apply various visualization structures such as tables, spatial data, time-varying data, tree and network, etc.(L3)
• apply basics of colors, views, and other popular and important visualization-based issues. (L3)
• analyze basic algorithms in data visualization (L4)
19ECS767: BIG DATA ANALYTICS

The course is designed which largely involves collecting data from different sources, manage it in a way that it becomes available to be consumed by analysts and finally deliver data products useful to the organization business. The process of converting large amounts of unstructured raw data, retrieved from different sources to a data product useful for organizations forms the core of Big Data Analytics.

Course Objectives:
- Optimize business decisions and create competitive advantage with Big Data analytics.
- Introducing Java concepts required for developing map reduce programs.
- Derive business benefit from unstructured data.
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
- To introduce programming tools Hbase & HIVE in Hadoop echo system.

Unit I

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

Learning Outcomes:
After completion of this unit the student will be able to
- demonstrate the big data concepts for real world data analysis (L1).
- building a complete business data analytic solution and apply structure of Hadoop data with Hive (L6).

Unit II

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

Learning Outcomes:
After completion of this unit, the student will be able to
- develop Map Reduce concepts through Java (L2).
- demonstrate the big data concepts for real world data analysis (L1)
- analyze the configuring of Hadoop clusters effectively (L3).

Unit III

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

**Learning Outcomes:**
After completion of this unit, the student will be able to
- Analyze the configuring of Hadoop clusters effectively (L3).
- Develop Map Reduce concepts through Java (L2).

**Unit IV**
12L
MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

**Learning Outcomes:**
After completion of this unit, the student will be able to
- develop Map Reduce concepts through Java (L2).
- analyze the configuring of Hadoop clusters effectively (L3).
- illustrate Hadoop API for Map reduce framework (L4).

**Unit V**
10L

**Learning Outcomes:**
After completion of this unit, the student will be able to
- Analyze the configuring of Hadoop clusters effectively (L3).
- Illustrate Hadoop API for Map reduce framework (L4).
- Develop basic programs of map reduce framework particularly driver code, mapper code, reducer code (L5).
- Building a complete business data analytic solution and apply structure of Hadoop data with Hive (L6).

**Textbook(s):**

**Course Outcomes:**
After completing this Course, the student should be able to:
- demonstrate the big data concepts for real world data analysis (L1).
- develop Map Reduce concepts through Java (L2).
• analyze the configuring of Hadoop clusters effectively (L3).
• illustrate Hadoop API for Map reduce framework (L4).
• develop basic programs of map reduce framework particularly driver code, mapper code, reducer code (L5).
• Building a complete business data analytic solution and apply structure of Hadoop data with Hive (L6).
The course is designed to enable the student to define about various data storage technologies and networks like storage media etc. It concentrates on the technologies and techniques along with their limitations. It explains about the data memory hierarchy with fast caches located in between CPU and main memory, about hardware and software design for access with performance issues and also data access methods. This course lays the foundation about the data storages in different sources with partitions and security.

Course Objectives
• To introduce different storage media and their technologies.
• To determine the usage and access methods of different media along with performance
• To provide the details of network attached storage media.
• To describe the underlying architecture and design of storage media
• To understand reliability, performance, security issues of network attached storage media.

Unit-I

Learning Outcomes:
After completion of this unit the student will be able to
• classify different types of storage media (L2)
• illustrate the technologies involved in storing data (L3)
• identify techniques used to read/write operations (L4)
• distinguish the issues and limitations of storage media and technologies.(L4)

Unit II
Usage and access – positioning in the memory hierarchy, hardware and software design for access, performance issues.

Learning Outcomes:
After completion of this unit the student will be able to
• identify the position memory hierarchy for a particular storage media.(L2)
• explain the details of hardware and software for a particular memory type.(L4)
• summarize the design issues for accessing data from a memory type.(L2)
• outline the performance issues while retrieving data.(L4)

Unit III
Large Storages – Hard Disks, Networked Attached Storage, Scalability issues, Networking issues.

Learning Outcomes:
After completion of this unit the student will be able to
• illustrate networked storage capabilities which include management principles storage
  network design principles(L3)
• predict the scalability issues in large storages.(L5)
• determine the networking issues in large storages(L5)
• assess performance degradation, security issues, configuration conflicts, network
  performance issues.(L5)

Unit IV 10L
Storage Architecture - Storage Partitioning, Storage System Design, Caching, Legacy
Systems.

Learning Outcomes:
After completion of this unit the student will be able to
• explain system design in storage architecture.(L4)
• implement the storage partitioning.(L3)
• identify cache storage problems.(L2)
• define the legacy systems in storing the old systems data for future reference and for
  many other reasons.(L1)

Unit V 10L
Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids.

Learning Outcomes:
After completion of this unit the student will be able to
• identify the storage cluster/grids that employs multiple self-contained storage nodes.(L2)
• explain the hardware and software components.(L4)
• assess storage performance, reliability and security issues.(L5)

Textbook(s):
2. Nigel Poulton, Data Storage Networking: Real World Skills for the Comptia Storage, Sybex,
   Wiley, 2014

Course Outcomes
After completion of the course, students will be able to
• apply, implement and manage various storage technologies storing information.(L3)
• evaluate the design and performance issues in accessing information.(L4)
• organize network attached storage devices and manage the scalability issues as well as
  the emerging long-term data storage technology alternatives. (L4)
• analyze storage devices principles including architecture, design and partitioning. (L4)
• interpret quality issues of networked storage devices along with hardware and software
  components. (L3)
Web Analytics is the measurement, collection, analysis, and reporting of Internet data for purposes of understanding and optimizing Web usage. Web Analytics is a tool that can measure Web site traffic. This course will begin by discussing the definition and categories of Web Analytics, some examples of Web-based Analytics such as Click Stream Analysis, A/B testing, to name a few. This course will also tackle Web Search and Retrieval and connection.

Course Objectives:
- Identify, define and interpret commonly used web metrics and KPIs.
- Understand and discuss clickstream data collection techniques, their impact on metrics, and their inherent limitations.
- Apply the common monitoring or analysis tasks and techniques used in web analytics.
- Articulate how effectively use the resulting insights to support website design decisions, campaign optimisation, search analytics, etc.
- Determine the robustness in social environment by diffusion of innovation

Unit I
Introduction – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization

Learning Outcomes:
After completion of this unit the student will be able to:
- enumerate the social network and different methods.(L1)
- understand the terminology of graphs and measures of networks.(L2)
- determine the systematic method to evaluate social media efforts, replacing anecdotes with scientifically based evidence.(L2)

Unit II
Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys.

Learning Outcomes:
After completion of this unit the student will be able to:
- understand the relationship between social media systems and the networks they implicitly and explicitly created.(L1)
- apply clickstream data collection techniques, their impact on metrics, and their inherent limitations.(L3)
- analyze the qualitative and quantitative data from the website and to drive a continual improvement of the online experience.(L4)

Unit III
Web Search and Retrieval: Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models
**Learning Outcomes:**
After completion of this unit the student will be able to:
- understand the amount of data sent and received by visitors to a website in web traffic model(L1)
- compare and contrast the functionality of search engine algorithms updates.(L2)
- develop an optimization strategy following best practices for a client to implement to help increase their ranking.(L3)
- critique the role of advertisements and corporate funding in the development of search(L4)

**Unit IV**
10L
Learning Outcomes:
After completion of this unit the student will be able to:
- understand the Link Analysis and its impact on the connections(L1)
- distinguish the affiliations in the social connections(L2)
- construct the random graphs by using the tools(L3)

**Unit V**
11L
Connection: Connection Search, Collapse, Robustness Social involvements and diffusion of innovation
Learning Outcomes:
After completion of this unit the student will be able to:
- understand the off-site and on-site web analytics (L2).
- analyze the Key Analytic Metrics to Monitor the Average Time on Site/Page, Bounce/Exit Rates, etc.(L4)
- examine the KPI(Key Performance Indicator) which evaluates the success of an activity(L3)

**Textbook(s):**

**Course Outcomes:**
After completion of the course, students will be able to
- determine the systematic method to evaluate social media efforts, replacing anecdotes with scientifically based evidence.(L2)
- apply clickstream data collection techniques, their impact on metrics, and their inherent
• develop an optimization strategy following best practices for a client to implement to help increase their ranking.
• construct the random graphs by using the tools
• analyze the Key Analytic Metrics to Monitor the Average Time on Site/Page, Bounce/Exit Rates, etc.
Most modern computers come with Graphical Processing Units (GPUs) that can be used for general purpose computing. GPUs provide much more computing power than CPUs do, by using more of their hardware resources for computing than CPUs do. GPUs deal with memory access latency primarily through multi-threading; when some threads are stalled accessing data, other threads can perform computation without a significant context-switch penalty. This course will describe different approaches to solve such problems, in order to develop efficient parallel algorithms for a variety of problems.

Course Objectives:
- Explain theoretical and empirical knowledge about graphics programming, memory management using for evaluating various parameters across the devices.
- Enable to acquire knowledge about different synchronization methods exists within the CPU and learn about common application kernels.
- Familiarize algorithms to provide parallel solutions to computationally challenging problems.
- Enable to implement such solutions on GPU using CUDA, and show effectiveness of the GPU based solutions using standard benchmarks and tools.

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

Learning Outcomes:
After completion of this unit the student will be able to
- show the various parallel programs. (L1)
- understand the different graphics processors(L2)
- identify the kernels and Thread mappings .(L2)
- develop simple programs(L3)

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

Learning Outcomes:
After completion of this unit, the student will be able to
- understand the categories of memories.(L2)
- implement dynamic memory allocation (L3).
- explain arrays and pointers(L2).
Unit III  9L
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence.
Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists.
Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels,
Using libraries(such as Thrust), and developing libraries.

Learning Outcomes:
After completion of this unit, the student will be able to
• explain the synchronization procedures(L2).
• summarize about CPU and GPU functions(L4).
• explain the concurrent data structures(L2).

Unit IV  9L
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects
Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream,
Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and
kernel execution, pitfalls.

Learning Outcomes:
After completion of this unit, the student will be able to
• understand the debugging process of GPU programs(L2).
• explain about pitfalls and event based synchronization(L2).

Unit V  6L
Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning Advanced topics:
Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous
processing

Learning Outcomes:
After completion of this unit, the student will be able to
• implement the different scenarios using graph simulations(L4)
• explain Image processing(L2).
• outline about deep learning(L2).

Text Book(s)
1. David Kirk, Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-on Approach,
   Morgan Kaufman, 2010

Course Outcomes
After completion of course, students would be able to:
• Understand the GPU and its aspects(L1)
• Demonstrate synchronization and kernel functions(L3).
• Determine different web based applications using deep learning (L3).
In Machine Learning tasks such as speech recognition and computer vision, the mapping of raw data to the output is often a complicated function with many factors of variation. Deep Learning focuses to learn feature hierarchies with features at higher levels in the hierarchy formed by the composition of lower level features. This course aims to cover the basics of Deep Learning and some of the underlying theory with a particular focus on supervised Deep Learning along with a good coverage of unsupervised methods.

Course Objectives:
- Recall neural networks and learn dropout regularization and its role in improving the efficiency.
- Learn various architectures and visualization of Convolution Neural Networks.
- Learn deep recurrent architectures and its effectiveness.
- Learn various encoders of deep unsupervised leaning.
- Apply deep learning mechanisms to various learning problems

Unit I

Learning Outcomes:
After completion of this unit the student will be able to
- recall gradient descent and back propagation algorithms of FFNN (L1)
- examine relu function and its importance (L4)
- assess dropout regularization of neural networks (L5)

Unit II
Convolution Neural Network: Architectures, convolution / pooling layers, Visualizing Convolution Networks, Python/NumPy Tutorial

Learning Outcomes:
After completion of this unit the student will be able to
- explain the underlying mechanism of CNN (L2)
- analyze the working principle of pooling layers (L4)
- contrast variants of CNN (L4)

Unit III
Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures, Reservoir Computing (basic idea), The Unreasonable Effectiveness of Recurrent Neural Networks

Learning Outcomes:
After completion of this unit the student will be able to
• explain the encoder and decoders of RNN architectures (L2)
• illustrate reservoir computing and its usage (L2)
• inspect the effectiveness of RNN (L4)

Unit IV

Deep Unsupervised Learning: Auto encoders (standard, sparse, denoising, contractive, etc), Variational Auto encoders, Adversarial Generative Networks, Auto encoder and DBM.

Learning Outcomes:
After completion of this unit the student will be able to
• outline various encoders of unsupervised learning (L2)
• analyze adversarial networks and variational encoders (L4)
• examine DBM (L4)

Unit V


Learning Outcomes:
After completion of this unit the student will be able to
• build a NN for automatic image captioning (L6)
• improve the efficiency of NN (L6)
• elaborate Generative networks for image generation (L6)

Textbook(s):
3. Francois Chollet, Deep Learning with Python, 1/e, Manning Publications Company, 2017

Course Outcomes:
After completion of this course, the student will be able to
• explain the basics of deep learning and relu function (L2).
• define dropout regularization and its importance in improving the efficiency (L1).
• construct the architectures of CNN and their usage (L3).
• outline variations of RNN and their implementations (L2).
• elaborate the underlying unsupervised techniques in deep learning (L6).
• analyze and build CNN for various real time applications (L4).
The course is designed to enable the student to learn about the network perspective and how to apply it to answer important questions in various fields in social science. The course teaches students a range of social network analysis techniques, provides training in social network analysis software and students work on an independent research project.

Course Objectives:
- Familiarize the student with how network analysis can contribute to increasing knowledge about diverse aspects of society.
- Explain social network data using various software packages.
- Demonstrate results from social network analysis, both orally and in writing.
- Understand a broad range of network concepts and theories.

Unit I
- Networks and Relations, Relations and Attributes, Analysis of Network Data, Interpretation of Network Data, An Overview. The Development of Social Network Analysis, Sociometric analysis and Graph Theory, Interpersonal Configurations and cliques.

Learning Outcomes:
- After completion of this unit the student will be able to understand a Networks relations and attributes (L1).
- list the steps involved in Sociometric analysis (L1).
- interpret the Configurations and cliques (L1).

Unit II
- Analyzing Relational Data, Collecting Relational Data, Selection and Sampling of Relational Data, Preparation of Relational Data, Organizing Relational Data. Lines, Neighbourhoods and Densities, Sociometric and Graph Theory, Density: Ego-centric and Socio-centric, A Digression on absolute density, Community Structure and density.

Learning Outcomes:
- analyze relational data (L2).
- construct preparation of relational data (L2).
- develop Graph Theory (L2).
- demonstrate the usage of Egocentric and socio centric (L2).

Unit III
- Centrality Peripherality and Centralization, Centrality: Local and Global, Centralization and Graph Centres, bank Centrality in Corporate Networks, Components, Cores and Cliques, Components, Cycles and Knots, The Contours of components, Cliques and their intersections.

Learning Outcomes:
After completion of this unit, the student will be able to
• make use Cycles ,knots cliques (L3).
• Analyze local and global centrality (L3)
• solve problems related to cliques and their intersections (L3).

Unit IV 8L
Positions, sets and clusters, the structural equivalence of points, Clusters: Combining and dividing points, Block Modelling with CONCER, Towards Regular Structure Equivalence

Learning Outcomes:
After completion of this unit, the student will be able to
• understand the concept of Clusters (L4).
• apply the structural equivalenc of points (L4).
• make use of block modelling (L4).
• infer the regular structure equivalence (L4).

Unit V 10L
Network Dynamics and Change over Time, Modelling change in Network Structure, Testing Explanations. Dimensions and displays, Distance, space and metrics, principal components and factors, Non-metric methods, Advances in Network Visualization, Elites, Communities and influence. Accessing twitter

Learning Outcomes:
After completion of this unit, the student will be able to
• understand network dynamics (L5).
• compare distance, space and metrics (L5).
• make use of accessing twitter (L5).

Textbook(s):
1. John Scott, Social Network Analysis, 3/e, SAGE Publications, 2017

Course Outcomes:
After completion of the course, the student will be able to
• understand a Networks relations and attributes (L1).
• analyze relational data (L2).
• solve problems related to cliques and their intersections (L3).
• infer the regular structure equivalence (L4).
• make use of accessing twitter (L5).
The course provides fundamentals of data security and various access control techniques mechanisms that are introduced along with application areas of access control techniques. It also contains an RBAC and smart card technology that has great deal of attention for commercial and real time applications.

**Course Objectives**

- To narrate and evaluate the design principles of conventional discretionary and mandatory security techniques.
- To learn Different RBAC frameworks for modelling a secure system
- To know methods for assigning access to information in a company based on the individual’s need for the information,
- To specify security administrator and enforce security policies that map naturally to the organization’s structure.
- To utilize a technology that decreases the cost of network administration while improving the enforcement of network security policies.
- To understand reliable and quality data transmission using smart cards.

**Unit I**

Introduction to Access Control, Purpose and fundamentals of access control, brief history.


**Learning Outcomes**

After completion of this unit the student will be able to:

- list the origins, history, and central concepts of access control (L1)
- review the technical realization and security of data (L2)
- compare principles of conventional discretionary and mandatory security techniques. (L2)
- identify access control policies, access control models, and access control mechanisms. (L1)

**Unit II**

Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy.

**Learning Outcomes**

After completion of this unit the student will be able to:

- review popular forms of access controls in use today (L2)
- interpret the basic concepts of RBAC and its advantages for system, application, and
network security (L3)
• compare security levels of different RBAC models. (L2)
• incorporate roles to users using RBAC (L6)

Unit III 8L
Biba’s integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system, Temporal Constraints in RBAC, MAC and DAC.

Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi-line Insurance Company.

Learning Outcomes
After completion of this unit the student will be able to
• describe the similarities and differences between roles and groups (L1)
• develop access control mechanisms and models (L3)
• illustrate the research concepts and associated prototypes that have been developed to integrate RBAC model concepts into existing enterprise IT infrastructures. (L3)
• trace the integration of the RBAC model into the Web applications (L2)

Unit IV 9L
SmartCard based Information Security, Smartcard operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle- 5 phases, smart card terminals.

Learning Outcomes
After completion of this unit the student will be able to
• identify smart card applications like identification, financial, mobile phones (SIM), public transit, computer security, schools, and healthcare (L1)
• explain how Smart cards provide computing, portability and secure storage of data and value. (L4)
• understand the integration of smart cards into system to introducesecurity. (L2)
• construct preset permissions set by the card issuer. (L3)

Unit V 12L
Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems, Recent Trends related to data security management, vulnerabilities in different DBMS.

Learning Outcomes
After completion of this unit the student will be able to
• record the experience of a real company in its transition from conventional access control methods to RBAC. (L1)
• develop prototypes to integrate the RBAC model into the various enterprise technologies. (L3)
• evaluate the benefits and costs of RBAC from the vantage point of a software end user. (L5)
• report insights related to delegated administration and other functionalities afforded RBAC users. (L2)

Textbook(s):

Course Outcomes:
After completion of course, students would be able to:
• understand and implement classical models. (L2)
• analyse the data, identify the problems, and choose the relevant models (L4)
• assess the strengths and weaknesses of various access control models and to analyse their behaviour. (L5)
• assign security levels are assigned to users, with subjects acting on behalf of users and objects. (L3)
• Use of a common mechanism for a wide variety of purposes. (L3)
19ECS775: NATURAL LANGUAGE PROCESSING

Natural language processing (NLP) is one of the most important technologies of the information age. Understanding complex language utterances is also a crucial part of artificial intelligence. Natural language processing (NLP) is the relationship between computers and human language. More specifically, natural language processing is the computer understanding, analysis, manipulation, and/or generation of natural language. This course enables the students to learn the Natural language processing at different levels like Morphological Level, Syntactic Level, Semantic Level, Discourse Level and Pragmatic Level.

Course Objectives
- Understand the leading trends and systems in natural language processing.
- Understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
- Recognize the significance of pragmatics for natural language understanding.
- Describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Unit I 8L
Introduction – Models and Algorithms - Regular Expressions, Finite State Automata, Morphology, Morphological Parsing

Learning outcomes
After completion of this unit the student will be able to
- learn the Regular expressions and finite state automata (L2)
- learn the morphology (L2)
- understand the morphological parsing (L2)

Unit II 8L
N-grams Models of Syntax - Counting Words - Unsmoothed, Smoothing, Entropy, Part of Speech Tagging

Learning outcomes
After completion of this unit the student will be able to
- understand the syntactic level (L2)
- learn different models of syntax (L2)
- understand Speech tagging (L2)

Unit III 8L

Learning outcomes
After completion of this unit the student will be able to
- learn Context Free Grammars for English (L2)
- understand Sentence-Level Constructions (L2)
• analyze Probabilistic Context – Free Grammars.(L4)

Unit IV  

Learning outcomes
After completion of this unit the student will be able to
• understand the discourse level.(L2)
• learn Machine Translation.(L2)
• analyze Statistical Approaches.(L4)

Unit V  
Applications of Natural Language Processing- Recent Research in NLP using Deep Learning: Factoid Question Answering, similar question detection, Dialogue topic tracking, Neural Summarization, Smart Reply

Learning outcomes
After completion of this unit the student will be able to
• understand the applications of NLP(L2)
• understand the research trends using Deep Learning.(L2)
• learn Dialogue topic tracking.(L2)

Textbook(s):

Course Outcomes
At the end of the course the student will be able to
• understand approaches to syntax and semantics in NLP.(L2)
• apply approaches to discourse, generation, dialogue and summarization within NLP.(L3)
• analyze current methods for statistical approaches to machine translation.(L4)
• evaluate machine learning techniques used in NLP, including hidden Markov models
• and probabilistic context-free grammars as applied within NLP(L4)
This course introduces the student to the different aspects of research paper writing including planning, preparation, layout, literature review write-up etc. Specifically the perspective and style of writing in different sections of a research paper is highlighted. Students will be exposed to English language skills relevant to research paper writing.

Course Objectives:
- To write clearly, concisely and carefully by keeping the structure of the paper in mind.
- To use standard phrases in English and further improve his command over it.
- To write with no redundancy, no ambiguity and increase the readability of the paper.
- To plan and organize his paper by following a logical buildup towards a proper conclusion.
- To decide what to include in various parts of the paper.
- To write a suitable title and an abstract in order to attract the attention of the reader.
- To identify the correct style and correct tense.
- To retain the scientific value of the paper by using minimum number of words.

Unit I
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Learning Outcomes:
After the completion of this unit, the student will be able to
- To know the expectations of various journals and referees (L2)
- To know the typical structure of a paper (L3)
- Learn to put words in a sentence in the correct order (L4)
- To write short and clear sentences from the very beginning of the paper (L4)
- To increase the readability of the paper by making it easy to read and 100% clear (L4)
- Learn to be concise without losing any important content (L4)
- To avoid some typical grammar mistakes made in research papers (L4)

Unit II

Learning Outcomes:
After the completion of this unit, the student will be able to
- Learn to make useful contribution worth recommending for publication (L4)
- Learn good use of language to make readers notice the key findings (L4)
- Learn to anticipate or predict possible objections to the claims made in the paper (L5)
- To understand what is plagiarism, and how to paraphrase other people's work (L4)
- Learn to attract the right kind of readers with a suitable title (L3)
- Learn to sell the abstract to potential readers by attracting their curiosity (L2)
Unit III 6L
**Review of the Literature**, Methods, Results, Discussion, Conclusions, The Final Check. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

**Learning Outcomes:**
After the completion of this unit, the student will be able to
- have a deep knowledge about everything that has been previously written on the topic and decide what is important to know in Introduction. (L3)
- Learn to provide the right amount of literature regarding the sequence of events leading up to the current situation in the Literature review (L4)

Unit IV 6L
**Writing Skills:** Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

**Learning Outcomes:**
After the completion of this unit, the student will be able to
- Learn to describe the materials used in experiments and/or the methods used to carry out the research (L2)
- The key skill is in reporting the results simply and clearly (L3)
- Learn to structure the Discussion and satisfy the typical requirements of the referees (L4)
- Learn to provide a clear and high-impact take-home message in the conclusion (L5)

Unit V 6L
**Good Paper Writing:** Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

**Learning Outcomes:**
After the completion of this unit, the student will be able to
- Learn various lists of frequently used phrases that have a general acceptance in all disciplines and use in specific sections of the paper (L3)
- Learn various kinds of things one should look for when doing the final check (L3)

**Text Book(s):**

**References:**

**Course Outcomes:**
By the end of the course the students will be able to:
- Frame the structure of the paper precisely. (L2).
- Improve his command over English by using standard phrases. (L3).
- Avoid repetition and mistakes in the paper and increase its readability. (L3).
- Organize the paper logically towards a proper conclusion. (L4).
- Decide on the content to be included in various parts of the paper. (L5).
- Identify whether to use personal or impersonal style in the paper. (L5).
- Express the content in a clear and concise way. (L6).
- Attract the attention of the reader by providing a suitable title and an appropriate abstract. (L6).
This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives
- to provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.
- to ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures.
- equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision-making and Problem solving methods for Disaster Management.
- to develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I
Introduction
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Learning Outcomes
After the completion of this unit, the student will be able to
- define the meaning, list the factors and mention the significance of disaster (L1)
- distinguish between hazard and disaster (L3)
- compare manmade and natural disaster (L3)
- list the types of disaster and describe their magnitude (L2)

Unit II

Learning Outcomes
After the completion of this unit, the student will be able to
- list the different repercussions of disasters and hazards(L1)
- describe the characteristics of natural disasters and the magnitude of their losses(L2)
- describe the characteristics of man-made disasters and the magnitude of their losses(L2)
- elaborate the outbreaks of diseases and epidemics after disasters (L3)
Unit III

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the seismic zones and their characteristics (L2)
- identify the areas prone to floods and droughts (L1)
- distinguish between landslides and avalanches (L3)
- identify areas prone to cyclonic and costal hazards (L4)
- enumerate the post disaster diseases and epidemics (L2)

Unit IV

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, media reports: governmental and Community Preparedness.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the monitoring of phenomena triggering a disaster/hazard (L2)
- evaluate the risk with the use of remote sensing and meteorological data (L5)
- list the governmental and community measures for disaster preparedness (L2)

Unit V


Learning Outcomes

After the completion of this unit, the student will be able to

- define and list the elements of disaster risk (L1)
- enumerate the measures for risk reduction (L2)
- apply the techniques of risk assessment (L4)
- identify the means of people’s participation in risk assessment (L2)

Text Book(s):

2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
Course Outcomes
At the end of the course, student will be able to
• Identify management activities in pre, during and post phases of Disasters. (L1)
• Plan disaster management activities and specify measure for risk reduction(L4)
• apply risk assessment techniques in real life disaster scenarios(L4)
19EAC744: VALUE EDUCATION

This course is intended to expose the student to the need for human values and methods to cultivate them for leading an ethical life with good moral conduct. Students taking this course will be able to experience a change in personal and professional behavior with these ethical principles guiding him throughout life.

Course Objectives
- to expose the student to need for values, ethics, self-development and standards
- to make the student understand the meaning of different values including duty, devotion, self-reliance etc.
- to imbibe the different behavioral competencies in students for leading an ethical and happy life.
- to expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy profession life.

Unit I

Learning Outcomes
After the completion of this unit, the student will be able to
- define the social values and individual attitudes for self-development (L1)
- describe the Indian vision of humanism (L2)
- distinguish between moral and non-moral acts (L3)
- list the standards and value principles for moral conduct (L2)

Unit II

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the importance of cultivating values (L2)
- list the different traits of self-developed individual (L1)
- explain the need for loving nature/country/humanity (L2)

Unit III

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the benefits of positive thinking, integrity and discipline(L2)
• list the different methods for avoiding fault finding, anger(L1)
• explain the methods to overcome suffering, religious intolerance, self-destructive habits(L2)

Unit IV

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the science of reincarnation(L2)
• explain the relation between self-management and good health(L1)
• elaborate the role of different religions in reaching the common goal(L3)
• list the different techniques for mind-control to improve personality and studies(L1)

Text Book(s):

Course Outcomes
After successful completion of the course, the student will be able to
• describe the need for human values and methods for self development (L2)
• elaborate the different traits and benefits of a self-developed individual (L1)
• list the different attributes of self-developed individual (L1)
• elaborate the role and scope of books/faith/health/religions in character building and competence development(L3)
This course is intended to expose the student to the philosophy of Indian constitution. Students will be able to understand their fundamental rights/duties and governance structure. Students also appreciate the role of election commission in establishing a democratic society.

Course Objectives
- to familiarize the student about the need for a constitution
- to make the student understand the role of constitution in a democratic society
- to acquaint the student with key constitutional features and fundamental rights of a citizen
- to impart the organs of governance and local administration hierarchy and their responsibilities
- to familiarize the student with the role, responsibilities and administration hierarchy of election commission

Unit I

Learning Outcomes
After the completion of this unit, the student will be able to
- list the outline of drafting committee and their roles in the making of Indian constitution (L1)
- describe the need and role of a constitution in a democratic society(L2)
- elaborate the salient features of Indian constitution(L3)

Unit II

Learning Outcomes
After the completion of this unit, the student will be able to
- list the fundamental rights of a citizen(L1)
- explain the intricacies in the different rights(L2)
- elaborate the fundamental duties of a citizen(L3)
- describe the principles of state policy(L2)

Unit III
**Organs of Governance**: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Learning Outcomes
After the completion of this unit, the student will be able to
- present the hierarchy of governance (L2)
- list the role/responsibilities/powers of different organs of governance(L1)
- elaborate the guidelines for appointment/transfer of judges(L2)
Unit IV  6L

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the administrative organizational hierarchy of municipalities and panchayats(L2)
• appreciate the role/responsibilities/powers of mayor, CEO, elected officials(L3)
• appreciate the importance of grass root democracy(L3)

Unit V  6L

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the administrative hierarchy of election commission(L2)
• elaborate the roles/responsibilities/powers of election commissioners at different levels of hierarchy(L3)
• outline the welfare activities of SC/ST/OBC/Women by different bodies(L3)

Text Book(s):
1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1/e, 2015.

Course Outcomes
After successful completion of the course, the student will be able to
• describe the philosophy and salient features of Indian constitution(L2)
• list the constitutional rights and duties of a citizen(L1)
• elaborate the central and local administrative hierarchy and their roles(L2)
• describe the roles/responsibilities/powers of different governing and administrative bodies(L2)
• explain the structure/functioning and power of election commission(L2)
This course is aimed to familiarizing the student with pedagogical principles, practices and methodologies. This course is intended for students interested in pursuing a career in teaching and research.

**Course Objectives**
- to familiarize the student about the need for pedagogy studies, background and conceptual framework
- to expose the student to pedagogical practices in formal/informal classrooms
- to acquaint the student with type of curriculum and guidance materials for effective pedagogy
- to familiarize the student with classroom practices and curriculum assessment procedures
- to make the student understand the effect of undertaking research on teaching quality

**Unit I**

**Learning Outcomes**
After the completion of this unit, the student will be able to
- define the aim and rationale behind teacher education (L1)
- classify the different theories of learning (L1)
- elaborate the need and role of curriculum, teacher education (L1)

**Unit II**
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

**Learning Outcomes**
After the completion of this unit, the student will be able to
- describe the different pedagogical practices used by teachers in formal and informal classrooms (L1)
- explain the pedagogical practices employed in developing countries (L1)
- enumerate the duties of faculty in terms of teaching, research, consultancy, administration (L1)

**Unit III**

**Learning Outcomes**
After the completion of this unit, the student will be able to
- list the measures for effective pedagogy (L1)
- identify the different documentation required to formalize curriculum implementation and quality assessment (L1)
- describe the teachers attitudes and beliefs in pedagogic strategies (L2)
Unit IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Learning Outcomes

After the completion of this unit, the student will be able to
• define the organizational hierarchy in a school administration system (L1)
• list the different barriers to learning (L3)
• enumerate the methods to overcome limited resources and handle large class sizes (L3)
• describe the follow-up support and peer-support in classroom practices (L2)

Unit V

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Learning Outcomes

After the completion of this unit, the student will be able to
• explain the need for and role of research in teaching profession (L2)
• list the different research activities to be taken up by teachers (L1)
• describe the impact of research on teaching quality and learning process (L2)

Text Book(s):


Course Outcomes

After successful completion of the course, the student will be able to
• describe the theories of learning and conceptual framework of pedagogy (L2)
• explain the pedagogical practices used by teachers in formal and informal classrooms (L2)
• visualize the administrative hierarchy of schools and colleges and define the role (L3)
• appreciate the need for research and define the future direction of teaching career (L3)
• describe the impact of curriculum and assessment on the teaching learning process of a student (L3)
This course is aimed to familiarize the student with basic principles of yoga and different physical/mental practices for managing mind and body. This course helps the student in managing stress during education, home and workplace. Further, principles learnt in this course help in building overall personality for a stress-free, happy and independent life.

Course Objectives

- to familiarize the student about eight parts of yoga and their significance
- to expose the student to the importance and meaning of Yam and Niyam
- to make the student understand the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc
- to introduce the different yogic poses with a knowledge of their benefits for mind and body
- to familiarize the effect of different types of breathing techniques in concept and in activity

Unit I
Definitions of Eight parts of yoga (Ashtanga).

Learning Outcomes

After the completion of this unit, the student will be able to

- list the eight parts of yoga (L1)
- describe the effects of different parts of yoga on mind and body(L2)
- elaborate the importance of yoga in stress management and personality development(L3)

Unit II
Yam and Niyam.
Do’s and Don’t’s in life.
   i) Ahinsa, satya, asthey, bramhacharya and aparigraha
   ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Learning Outcomes

After the completion of this unit, the student will be able to

- elaborate the importance of Yam and Niyam(L2)
- describe the meaning and significance of Ahinsa, satya, asthey etc(L2)
- explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life(L3)

Unit III
Asan and Pranayam
   i) Various yog poses and their benefits for mind & body
   ii) Regularization of breathing techniques and its Effects-Types of pranayam.

Learning Outcomes

After the completion of this unit, the student will be able to

- demonstrate the different physical asanas and explain their physical and phychological effects(L4)
- demonstrate the different breathing techniques and describe their physical and mental effects (L4)
• distinguish between different types of pranayamam(L5)

Text Books
1. Janardan, Yogic Asanas for Group Tarining-Part-I, Swami Yogabhyasi Mandal, Nagpur
2. Swami Vivekananda, “Rajayoga or conquering the Internal Nature”, Advaita Ashrama, Kolkata

Course Outcomes
After successful completion of the course, the student will be able to
• describe the eight parts of yoga and their significance(L1)
• explain the the importance and meaning of Yam and Niyam(L2)
• define the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc(L1)
• demonstrate the different yogic poses and explain their benefits for mind and body(L4)
• demonstrate the different types of breathing techniques and explain their physical and mental benefits(L5)
This course is aimed to familiarize the student with life enlightenment skills for personality development. This course helps the student in building his holistic personality through human values, ethics and spiritual attributes.

**Course Objectives**
- to familiarize the student to good personality traits through moral stories
- to make the student understand the goal of human life and importance of good personality in reaching the goal
- to expose the student to the study of Shrimad-Bhagwad-Geeta for developing his/her personality and achieve the highest goal in life
- to familiarize the student to leadership skills for driving nation and mankind to peace and prosperity
- to expose the role of Neetishatakam for developing versatile personality of students.

**Unit I**
Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont’s)
Verses- 71,73,75,78 (do’s).

**Learning Outcomes**
After the completion of this unit, the student will be able to
- describe the moral stories illustrating the traits of good personality(L2)
- define the meaning and importance of wisdom, pride, heroism, virtue etc(L1)
- identify do and donts in life from the foundations of human morals/ethics(L5)

**Unit II**
Approach to day to day work and duties.
Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

**Learning Outcomes**
After the completion of this unit, the student will be able to
- describe the characteristics and principles of bhakti yogam, jnana yogam and karma yogam (L1)
- identify the use of different yogic characteristics in different activities of daily life/duties(L4)
- apply the use of yogic principles for leading a stress-free, happy and fruitful life with good developed personality(L4)
Unit III

Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. Shrimad BhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Learning Outcomes
After the completion of this unit, the student will be able to
• list the characteristics of role model proposed by verses of bhagavad gita(L1)
• explain the methods for obtaining life enlightenment through the practice of four yoga appropriately (L2)
• describe the characteristics of karma yogi/jnana yogi for developing leadership personality (L2)

Text Book(s):
1. Swami Swarupananda, “Srimad Bhagavad Gita”, Advaita Ashram (Publication Department), Kolkata
2. P. Gopinath, Bhartrihari’s Three Satakam (Niti-Sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes
After successful completion of the course, the student will be able to
• List the different parables of neethisathakam and identify their morals(L1)
• enumerate the different traits of human personality for life enlightenment(L2)
• describe the leadership attributes for driving nation and mankind to peace and prosperity(L2)
• explain the applicability of different types of yoga to day-to-day work and duties resulting in responsible personality (L2)
19EAC750: DEVELOPING SOFT SKILLS AND PERSONALITY

Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The course aims to cause a basic awareness within the students about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.

Course Objectives
- to familiarize the student to the criteria for self-assessment and significance of self-discipline
- to expose the student to attitudes, mindsets, values and beliefs
- to acquaint the student to plan career and goals through constructive thinking
- to enable the student to overcome barriers for active listening and persuasive speaking
- to familiarize the skill of conducting meetings, writing minutes and involving in active group discussions

Unit I 8L
Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline

Learning Outcomes
After the completion of this unit, the student will be able to
- identify strengths & limitations through self-assessment(L3)
- list the attributes of personalities will good will-power and self-drives(L1)
- describe the reasons for building self-esteem and self-confidence(L2)
- explain the significance of self discipline(L2)

Unit II 8L
Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs

Learning Outcomes
After the completion of this unit, the student will be able to
- define the characteristics of different perceptions, attitudes and personality types(L1)
- distinguish between fixed and growing mindsets(L3)
- define the importance and meaning of values and beliefs(L2)

Unit III 8L
Motivation and Achieving Excellence; Self-Actualisation Need; Goal Setting, Life and Career Planning; Constructive Thinking

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the need for having high motivation and achieving excellence(L2)
- define the need for self-actualization(L1)
- plan the life and career goals based on self assessment(L4)
- explain the attributes of constructive thinking(L2)
Unit IV

Communicating Clearly: Understanding and Overcoming barriers; Active Listening; Persuasive Speaking and Presentation Skills.

Learning Outcomes
After the completion of this unit, the student will be able to
• self-assess the barriers for communicating clearly (L4)
• list the attributes of active listening (L1)
• describe the minimal aspects of effective presentation (L2)
• organize ideas resulting a persuasive talk (L3)

Unit V

Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the format and structure of writing meeting minutes (L2)
• identify the essential components of memos and notices (L3)
• explain the principles of effective email communication (L2)
• list the basic etiquette of telephone conversation (L1)
• describe the effective body traits during group discussion and interviews (L2)

Text Books

Course Outcomes
After successful completion of the course, the student will be able to
• carry out self assessment and describe the significance of self-discipline (L4)
• define, classify and compare attitudes, mindsets, values and beliefs (L3)
• plan career and goals through constructive thinking and personal assessment (L4)
• overcome barriers for active listening and persuasive speaking (L5)
• conduct meetings, write minutes and involve in active group discussions (L3)
This course introduces students to the science of business analytics. The goal is to provide students with the foundation needed to apply data analytics to real-world challenges they confront daily in their professional lives. Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for managing agencies, organizations or clients in their workspace.

Course Objectives
- To familiarize the scope, process and advantages of business analytics
- To acquaint the student with the modeling and problem solving skills in business analytics
- To impart the organization and management of business analytics
- To introduce the forecasting models and techniques used in analytics
- To expose the formulation and decision strategies used in business analytics

Unit I  8L

Learning Outcomes
After the completion of this unit, the student will be able to
- define the scope and process of business analytics (L1)
- choose an organizational structure to implement a business analytics process (L4)
- describe the statistical tools and methods used for data modeling and analysis (L2)
- identify the sampling and estimation requirements for data analysis (L1)

Unit II  8L

Learning Outcomes
After the completion of this unit, the student will be able to
- identify the relationships and trends in data (L1)
- utilize linear regression methods for identifying data relationships (L4)
- list the types of data and their models used for business analytics (L1)
- describe the methods for visualization and exploration of data (L2)

Unit III  8L
Organization Structures of Business analytics: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
Learning Outcomes
After the completion of this unit, the student will be able to
• describe the management issues in the organization structures (L2)
• define the designing information policy and its usage (L1)
• list the methods for ensuring data quality measuring contribution (L1)
• explain the use of data mining methodologies for predictive analytics analysis (L3)
• describe the use of prescriptive analytics methods in business analytics process (L2)

Unit IV

Learning Outcomes
After the completion of this unit, the student will be able to
• classify and describe the use of forecasting models (L3)
• model the use of regression forecasting with casual variables (L5)
• identify the appropriate forecasting model for a given data (L5)
• explain the use of monte carlo simulation for forecasting and identify the involved risk (L2)

Unit V

Learning Outcomes
After the completion of this unit, the student will be able to
• formulate decision problems (L2)
• list the decision strategies with and without probabilities (L1)
• use the decision trees for analysis (L4)
• describe the value of information, utility and its use in decision making (L4)

Textbook(s):

Course Outcomes
Upon successful completion of the course, the student will be able to
• define the scope, process and advantages of business analytics (L1)
• explain the modeling and problem solving skills in business analytics (L2)
• describe the organization and management of business analytics (L3)
• utilize the forecasting models and techniques used in analytics (L4)
• enumerate and utilize the formulation and decision strategies (L2)
Optimization problems arise in all walks of human activity—particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real-life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

Course Objectives
- to impart knowledge on developing mathematical formulation for linear programming and transportation problem
- to familiarize the student in the construction of the required activities in an efficient manner to complete it on or before a specified time limit and at the minimum cost.
- to expose the development of mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.
- to illustrate PERT and CPM techniques for planning and implementing projects.
- To impart the knowledge of formulating and analysis of real life problems using advanced tools and techniques for resource optimization
- to provide frameworks for analyzing waiting lines using advanced queuing theory concepts

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

Learning Outcomes
After completing this unit, the student will be able to
- identify and develop operational research models from the verbal description of the real system. [L4]
- understand the classification systems of effective Inventory control models [L2]

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

Learning Outcomes
After completing this unit, the student will be able to
- translate a real-world problem, given in words, into a mathematical formulation. [L2]
- utilize the mathematical tools that are needed to solve optimization problems. [L2]

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

Learning Outcomes
After completing this unit, the student will be able to
- describe the need and origin of the optimization methods [L2]
• classify optimization problems to suitably choose the method needed to solve the particular type of problem\[L3\]

Unit IV 8L
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Learning Outcomes

After completing this unit, the student will be able to
• choose linear programming problems to suitably choose the method needed to solve the particular type of problem\[L1\]
• identify industrial problems involved in inventory, MRP and scheduling\[L2\]

Unit V 8L
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Learning Outcomes

After completing this unit, the student will be able to
• identify the values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs in a real decision problem\[L2\]
• Apply the models to incorporate rational decision-making process in real life situations.\[L3\]
• Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.. \[L3\]

Text Book(s):

Course Outcomes

After the successful completion of the course, the students will be able to:
• Understand the basic concepts of different advanced models of operations research and their applications. (L2)
• Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. (L4)
• Apply the models to incorporate rational decision-making process in real life situations. (L4)
• Analyze various modeling alternatives & select appropriate modeling techniques for a given situation. (L3)
• Validate output from model to check feasibility of implementations. (L5)
• Create innovative modeling frameworks for a given situation. (L6)
• Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. (L3)
This course will equip the student with the expertise to mathematically model engineering projects and use effective methods and techniques to plan and execute engineering activities.

Course Objectives
- to introduce the basic principles of strategic cost management and the related terminology
- to familiarize the project planning and execution process involving technical/nontechnical activities
- to acquaint the student with detailed engineering activities and their cost management analysis
- to impart the knowledge of cost analysis and profit planning of engineering projects
- to familiarize the quantitative techniques for optimization of budget allocation

Unit I

Learning Outcomes
- describe the cost concepts in decision making(L2)
- define the various costs involved in the cost management process(L2)
- list the objectives of cost control(L2)
- identify the different fields of a database for operational control(L2)

Unit II
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.

Learning Outcomes
- define the meaning of a project and list the different types(L2)
- identify the measures to manage cost overruns(L2)
- describe the various stages of project execution from conception to commissioning(L2)
- plan the proper order of technical/nontechnical activities as part of project execution(L2)

Unit III
Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Learning Outcomes
- identify the different clearance norms required in the pre-project execution phase(L2)
• describe the hierarchy of project team and identify the role of each member
• list the different contents of project contracts
• present the project cost control and planning through bar charts, network diagrams etc

Unit IV  
8L

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the cost behavior and profit planning
• distinguish between marginal costing and absorption costing
• analyze the variance of standard costing
• analyze the pricing strategies in project costing
• identify the quality measures satisfying the appropriate constraints

Unit V  
10L
Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Learning Outcomes
After the completion of this unit, the student will be able to
• define and compare the different budgeting strategies
• model the cost management as a linear programming problem
• measure the divisional profitability and decide the appropriate pricing

Textbook(s):

References:

Course Outcomes
After the successful completion of the course, the students will be able to
• list the basic principles of strategic cost management and define the related terminology
• plan the project execution process involving technical/nontechnical activities
• describe the detailed engineering activities and their cost management analysis
• carry out the cost analysis and profit planning of engineering projects
• utilize quantitative techniques for optimization of budget allocation
Each student is required to submit a report of first part of project work i.e. about the problem definition, literature review and methodology to be adopted including experiments and tests to be performed on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester end.
Each student is required to submit a detailed project report about the work on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time. The candidate shall present/publish one paper in national/international conference/seminar/journal of repute. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.