GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^+ Grade

REGULATIONS AND SYLLABUS

OF

M.Tech. Data Sciences

(w.e.f. 2019-20 admitted batch)

Vision and Mission of University

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with high sense of discipline and social relevance in a serene and invigorating environment.

Vision and Mission of Department

Vision

Excel in computer science and engineering education with international standards for global employment and research.

Mission

- *Create an excellent academic ambience that promotes innovation and research.*
- *Impart quality education through well designed curriculum experiential learning in tune with the changing needs of the industry.*
- *Collaborate with world class academic institutions and software industries for mutual benefit.*
- *Produce competent and socially committed graduates having creative skills and ethical values.*

Program Educational Objectives of M. Tech. Computer Science and Engineering are:

- PEO1: Apply the knowledge gained in the areas of research and development
- PEO2: Develop and use IT tools for the benefit of society
- PEO3: Work effectively as part of a team with strong moral and ethical values

Program Educational Objectives of M. Tech. Data Science are:

- PEO1: Develop competent professionals who can develop novel techniques and tools for data analysis
- PEO2: Enhance their technical skills to be easily absorbed in industry
- PEO3: Produce highly skilled engineers who can work for a sustainable society

Program Educational Objectives of M. Tech. Cyber Forensics and Information Security are:

- PEO1: Develop highly secure and scalable algorithms to provide better security among the various software used.
- PEO2: Promote leadership abilities along with team work for a just and secure technical society
- PEO3: Engage in lifelong learning

Program Outcomes:

At the end of the program a student is expected to have:

1. An understanding of the theoretical foundations and the limits of computing.
2. An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.
3. An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society.
4. Understanding and ability to use advanced computing techniques and tools.
5. An ability to undertake original research at the cutting edge of computer science & its related areas.
6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.
7. An understanding of professional and ethical responsibility.
8. An ability to communicate effectively with a wide range of audience.
9. An ability to learn independently and engage in life-long learning.
10. An understanding of the impact of IT related solutions in an economic, social and environment context.

Program Specific Outcomes:

Upon successful completion of the program the students should be able to:

1. identify, formulate and provide efficient solutions to higher engineering problems.
2. design and develop software/hardware solutions for multidisciplinary and transdisciplinary problems.
3. handle research problems.

M.Tech in Data Science(DS)

REGULATIONS

(w.e.f. 2019-20 admitted batch)

1. ADMISSION

Admission into M.Tech. in Data Science 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:

- Score obtained in GAT (PG), if conducted.
- Performance in Qualifying Examination /Interview.
- CandidateswithvalidGATEscoreshallbeexemptedfromappearingforGAT(PG).

2.3The 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
- Cafeteria approach
- Learning at their own pace
- Interdisciplinary learning

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 THEPROGRAM

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 Practical per week.

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%and74%ongenuinegroundsandonpaymentofprescribedfee.

8. EVALUATION

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

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 is 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

S.No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
1	Theory Courses	40	Continuous Evaluation	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. ii) Ten (10) marks for Quizzes, Assignments and Presentations. Sixty (60) marks for Semester-end examinations
		60	Semester-end Examination	
	Total	100		

2	Practical Courses	100	Continuous Evaluation	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. ii) Ten (10) marks for case studies. 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 lab teacher.
3	Technical Seminar (II Semester)	100	Continuous Evaluation	Through five periodic seminars of 20 marks each
4	Project Work (III Semester)	100	Continuous Evaluation	i) Forty (40) marks for periodic assessment on originality, innovation, sincerity and progress of the work, assessed by the project supervisor. 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 Evaluation	i) Twenty (20) marks for periodic assessment on originality innovation, sincerity and progress of the work, assessed by the project supervisor. 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.
		50	Semester-end Examination	Fifty (50) marks for final project report and viva-voce examination assessed by external examiners.
	Total	100		

6	Audit Courses	100	Continuous Evaluation	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

**Panel of Examiners shall be appointed by the concerned Head of the Department*

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGEEVALUATION

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 SPECIALEXAMINATIONS

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 Studies (BoS).

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

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

Table 2: Grades and Grade Points

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 securingaGPAof5.0foraPassinthesemester.

13.GRADE POINTAVERAGE

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

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

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 Table3.

Table 3: CGPA required for Award of Class

Class	CGPA Required
First Class with Distinction	$\geq$ 8.0*
First Class	$\geq$ 6.5
Second Class	$\geq$ 5.5
Pass Class	> 5.0

* 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 OFTHE 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 study period.

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

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

a) Registered and successfully completed all the courses and project works.

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

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

Notwithstanding 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

S.no.	Course Code	Course Title	Category	L	T	P	C	Remarks
1	19ECS701	Advanced Data Structures	PC	3	0	0	3	Common to DS/CSE/CFIS
2	19EMA110	Statistical Modeling	BS	3	0	0	3	
3	19ECS705	Algorithms and Analysis	PC	3	0	0	3	Common to DS/CSE/CFIS
4	19ECS7XX	Program Elective I	PE	2	0	2	3	
5	19ECS7XX	Program Elective II	PE	2	0	2	3	
6	19EMC741	Research Methodology And IPR	MC	2	0	0	2	
7	19ECS721	Advanced Data Structures Laboratory	PC	0	0	4	2	Common to DS/CSE/CFIS
8	19ECS727	Data Science and Machine Learning Laboratory	PC	0	0	4	2	Common to DS/CSE
9	19EAC7XX	Audit Course I	AC	2	0	0	0	
							Total Credits: 21	

Semester II

S.no.	Course Code	Course Title	Category	L	T	P	C	Remarks
1	19ECS702	Soft Computing	PC	3	0	0	3	Common to DS/CSE
2	19ECS7XX	Program Elective III	PE	2	0	2	3	
3	19ECS7XX	Program Elective IV	PE	2	0	2	3	
4	19ECS7XX	Program Elective V	PE	2	0	2	3	
5	19EOE7XX	Open Elective	OE	3	0	0	3	
6	19ECS730	Deep Learning and Data Analytics Laboratory	PC	0	0	4	2	Common to DS/CSE
7	19ECS722	Soft Computing Laboratory	PC	0	0	4	2	Common to DS/CSE
8	19ECS792	Technical Paper Writing	PW	0	0	4	2	Common to DS/CSE/CFIS
9	19EAC7XX	Audit Course II	AC	2	0	0	0	
							Total Credits: 21	

Semester III

S.no.	Course Code	Course Title	Category	L	T	P	C	Remarks
1	19ECS891	Project Work I	PW	0	0	26	13	
							Total Credits: 13	

Semester IV

S.no.	Course Code	Course Title	Category	L	T	P	C	Remarks
1	19ECS892	Project Work II	PW	0	0	26	13	
							Total Credits: 13	

Number of Credits

Semester	I	II	III	IV	**Total**
Credits	21	21	13	13	**68**

Program Elective I

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19ECS741	Machine Learning	PE	2	0	2	3	Common to DS/CSE/CFIS
2	19ECS753	Data Warehousing and Mining	PE	2	0	2	3	Common to DS/CSE
3	19ECS776	Cloud Computing	PE	2	0	2	3	Common to DS/CSE

Program Elective II

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19ECS751	Data Preparation and Analysis	PE	2	0	2	3	Common to DS/CSE
2	19ECS781	Internet of Things	PE	2	0	2	3	Common to DS/CSE
3	19ECS747	Data Science	PE	2	0	2	3	Common to DS/CSE
4	19ECS763	Recommender Systems	PE	2	0	2	3	
5	19ECS777	Agile Software Development	PE	2	0	2	3	Common to DS/CSE/CFIS

Program Elective III

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19ECS765	Data Visualization	PE	2	0	2	3	Common to DS/CSE
2	19ECS767	Big Data Analytics	PE	2	0	2	3	Common to DS/CSE
3	19ECS769	Data Storage Technologies and Networks	PE	2	0	2	3	Common to DS/CSE
4	19ECS779	Cyber security	PE	2	0	2	3	Common to DS/CSE

Program Elective IV

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19ECS771	Web Analytics and Development	PE	2	0	2	3	Common to DS/CSE
2	19ECS750	GPU Computing	PE	2	0	2	3	Common to DS/CSE
3	19ECS773	Deep Learning	PE	2	0	2	3	Common to DS/CSE

Program Elective V

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19ECS774	Social Network Analysis	PE	2	0	2	3	Common to DS/CSE
2	19ECS772	Data Security and Access Control	PE	2	0	2	3	Common to DS/CSE/CFIS
3	19ECS775	Natural Language Processing	PE	2	0	2	3	Common to DS/CSE
4	19ECS785	Block chain Technology	PE	2	0	2	3	Common to DS/CFIS
5	19ECS783	Software Project Management	PE	2	0	2	3	Common to DS/CSE

AUDIT COURSE I and II

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19EAC741	English for Research Paper Writing	AC	2	0	0	0	Common to All
2	19EAC742	Disaster Management	AC	2	0	0	0	Common to All
3	19EAC744	Value Education	AC	2	0	0	0	Common to All
4	19EAC745	Constitution of India	AC	2	0	0	0	Common to All
5	19EAC746	Pedagogy Studies	AC	2	0	0	0	Common to All
6	19EAC747	Stress Management by Yoga	AC	2	0	0	0	Common to All
7	19EAC748	Personality Development through life Enlightenment Skills	AC	2	0	0	0	Common to All
8	19EAC750	Developing Soft Skills and Personality	AC	2	0	0	0	Common to All

OPEN ELECTIVE

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19EOE742	Business Analytics	OE	3	0	0	3	Common to All
2	19EOE746	Operations Research	OE	3	0	0	3	Common to All
3	19EOE748	Cost Management of Engineering Projects	OE	3	0	0	3	Common to All

19ECS701: ADVANCED DATA STRUCTURES

L	T	P	C
3	0	0	3

This course provide 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.
Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

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**

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

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 **8L**

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

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 **8L**

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm,The Knuth- Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence
Problem (LCS), Applying Dynamic Programming to the LCS Problem.

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 **8L**

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)

Text Book(s):

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 3rd Edition, Pearson, 2014. (PYTHON)
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2014.

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)

19EMA110 : STATISTICAL MODELING

L	T	P	C
3	0	0	3

Course Objectives

- To familiarize the students with the foundations of statistical modeling techniques.
- To sensitize the students will obtain knowledge about the basic concepts of nonparametric statistical inference.
- To learn how to perform hypothesis testing for population proportion by the p-value approach
- To distinguish ARIMA terms from simultaneously exploring an ACF and PACF
- To import, review, manipulate and summarize data-sets in R.

UNIT I **9 L**

Linear Statistical Models, Estimation and Sufficient Statistic:

Simple linear regression & correlation, multiple regression & multiple correlation, Analysis of variance (one way, two way with as well as without interaction) , **Estimation**: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation, **Sufficient Statistic**: Concept & examples, complete sufficiency, their application in estimation.

Learning Outcomes:

At the end of this unit, the student will be able to

- use the equation of a linear function to model a data set (L3)
- apply their knowledge of linear model to solve real world problems in comparing two measurement data (L3)
- approximate the value of a population parameter on the basis of a sample statistic (L4)
- learn a formal definition of sufficiency (L5)
- learn how to apply the Factorization Theorem to identify a sufficient statistic (L5)

UNIT II **9 L**

Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing (single proportion and mean, double proportions and Means for Large Samples, t-test, F-test and Chi-Square tests for Small samples).

Learning Outcomes:

At the end of this unit, the student will be able to

- understand how to develop Null and Alternative Hypotheses (L3)
- understand Type I and Type II Errors (L3)
- learn how to perform hypothesis testing for population proportion by the p-value approach(L4)
- use confidence interval to draw conclusion about two-sided test(L5).

UNIT III **8 L**

Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test. Tolerance region.

Learning Outcomes:

At the end of this unit, the student will be able to

- find the differences among parametric, nonparametric and semi-parametric inferences (L2)
- learn nonparametric procedures for analyzing real data (L4)
- perform and interpret the Mann Whitney U Test, Run test, Kolmogorov-Smirnov test, Spearman's and Kendall's test (L3)
- identify the appropriate nonparametric hypothesis testing procedure based on type of outcome variable and number of samples (L4)

UNIT IV **8 L**

Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify and interpret a non-seasonal ARIMA model(L4)
- distinguish ARIMA terms from simultaneously exploring an ACF and PACF(L5)
- test that all residual autocorrelations are zero(L4)
- convert ARIMA models to infinite order Moving Average models(L4)
- forecast with ARIMA models(L5)

UNIT V **8 L**

R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R.

Learning Outcomes:

- At the end of this unit, the student will be able to
- motivate for learning a programming language (L3)

- access online resources for R and import new function packages into the R workspace (L4)
- import, review, manipulate and summarize data-sets in R (L4)
- explore data-sets to create testable hypotheses and identify appropriate statistical tests using R (L5) create and edit visualizations with R (L4)

Text Book(s):

1. Probability and Statistics for Engineers (4th Edition), I.R. Miller, J.E. Freund and R. Johnson.
2. Fundamentals of Statistics (Vol. I & Vol. II), A. Goon, M. Gupta and B.Dasgupta.
3. The Analysis of Time Series: An Introduction, Chris Chatfield.
4. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, 5/e, Wiley, 2015.
5. Chris Chatfield, The Analysis of Time Series: Texts in Statistical Science, 6/e, Chapman & Hall/CRC, 2016.
6. Garrett Grolemund, Hands-On Programming with R: write your own functions and simulations, Hadley Wickham, 2014.
7. Jared P. Lander, R for EveryOne: Advanced Analytics and Graphics, 2/e, Addison Wesley Data and Analytics Series, 2017

Reference Book(s):

1. Introduction to Linear Regression Analysis, D.C. Montgomery &E.Peck
2. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill& D.C. Boes.
3. Applied Regression Analysis, N. Draper & H. Smith
4. Hands-on Programming with R,- Garrett Grolemund
5. R for Everyone: Advanced Analytics and Graphics, Jared P. Lander

Data Source:

www.rbi.org.in

Course Learning Outcomes:

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

- use the equation of a linear function to model a data set (L3)
- understand how to develop Null and Alternative Hypotheses (L3)
- find the differences among parametric and nonparametric inferences (L2)
- identify and interpret a non-seasonal ARIMA model(L4)
- import, review, manipulate and summarize data-sets in R (L4)

19ECS705: ALGORITHMS AND ANALASYS

L T P C

3 0 0 3

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 **9 L**

Sorting: Review of various sorting algorithms, topological sorting

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

Learning Outcomes

After completion of this Unit the student will be able to

- 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 **9 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:

After completion of this Unit the student will be able to

- 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 **8 L**

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond- Karp maximum-flow algorithm.

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

Learning Outcomes:

After completion of this Unit the student will be able to

- 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 **8 L**

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

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base- representation and modulo-representation. Application: Interpolation problem.

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 **8 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):

1. Dr. Basant Agarwal and Benjamin Baka, “Hands-on Data Structures and Algorithms with Python”, Packt, 2/e, 2018.
2. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms", Tata Mcgraw Hill
3. Publishers.
4. Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithms", Pearson
5. Education.
6. Kleinberg and Tardos, "Algorithm Design", Pearson Education.
7. E-book
8. Bhupendra Singh Mandloi,” Design And Analysis of Algorithms”,2018.
9. R. Pannerselvam, “Design And Analysis of Algorithm”, PHI Learning Pvt. Ltd., 2/e, 2016.

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)

19EMC741: RESEARCH METHODOLOGY AND IPR

L T P C

2 0 0 2

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

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. (L3)
- identify the research gaps from literature review. (L1)
- describe the ethical principles to be following during research process and authorship

- define the terminology and list the methods to avoid being accused of plagiarism. (L1)
- list the different types of research misconduct. (L1)

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 . (L2)
- choose a particular research contribution for patenting or journal publication. (L1)
- define the terminology related to citation, citation index, h-index etc.(L1)

Unit IV **5L**

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Learning Outcomes:

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

- describe the codes and standards in building intellectual property rights. (L3)
- list the subject, importance and requirements for of patentability. (L1)
- explain the process of patenting and commercialization in academia. (L3)
- enumerate the procedure for application preparation, filing and grant of Patents. (L2)
- define the terminology related to citation, citation index, h-index etc.(L1)

Unit V **8L**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **New Developments in IPR**: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Outcomes:

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

- explain the scope of patent rights. (L3)
- 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.(L2)

Text Book(s):

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for Science and engineering students", Tata Mcgraw Hill India, 2013.
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2/e, Prentice Hall of India, 2013.
3. Vinayak Bairagi, Mousami v. Munot, "Research Methodology: A Practical and Scientific Approach", CRC press, 2019.
4. Dolores Modic, Nadja Damij, "Towards Intellectual Property Rights Management: Back-office and Front-Office Perspectives ", Palgrave macmillan, 2018.

Reference Book(s):

1. Halbert, "Resisting Intellectual Property", Taylor and Francis Limited, 2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand Publishers, 2008

Course Outcomes:

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

- define the meaning, sources, approaches for research problems. (L2)
- explain the guidelines for carrying out effective literature review and identify research gaps. (L4)
- describe effective guidelines for preparing technical reports, research publications, presentations and research proposals. (L5)
- describe the codes, standards and process of obtaining intellectual property rights. (L5)
- enumerate the new developments of IPR in engineering systems. (L6)

19ECS721: ADVANCED DATA STRUCTURES LABORATORY

L	T	P	C
0	0	4	2

1. Develop programsfor
    a. HeapSort
    b. MergeSort
    c. Quick sort by taking random element aspivot
    d. Selection
2. Program to perform insertion, deletion and search operations on thefollowing:
    a. Single Linked List b. Doubly Linked List c. Circular Linked List
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.

19ECS727: DATA SCIENCE AND MACHINE LEARNING LABORATORY

L T P C

0 0 4 2

1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib,Scikit
2. Perform Data exploration and preprocessing inPython
3. Implement regularised Linearregression
4. Implement Naive Bayes classifier for dataset stored as CSVfile.
5. Implement regularized logistic regression
6. Build models using different Ensemblingtechniques
7. Build models using Decisiontrees
8. Build model using SVM with differentkernels
9. Implement K-NN algorithm to classify adataset.
10. Build model to perform Clustering using K-means after applying PCA and determining the value of K using Elbowmethod.

19ECS741: MACHINE LEARNING

L T P C

2 0 2 3

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 **9L**

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 **9L**

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 **8L**

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 **8L**

Modeling Sequence/Time-Series Data, Deep Learning (Deep generative models, Deep Boltzmar Machines, Deep auto-encoders, Applications of Deep Networks) and Feature Representatic 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 **8L**

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):

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2017(corrected copy)
3. Jiawei Han, Micheline Kamber, Jian Pei , Data Mining: Concepts and Techniques, 3/e, Morgan Kaufmann, 2011.(2016 modified copy)

4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.(2016)

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)

19ECS753: DATA WAREHOUSING AND MINING

L T P C

2 0 2 3

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

- 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 **9L**

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 **9L**

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 **8L**

Mining 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 **8L**

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 **8L**

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)

Text Book(s):

1. Vipin Kumar, Pang-Ning Tan, Michael Steinbach, Introduction to Data Mining, pearson india education services, 2016.
2. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, 2012 3rd edition, 2016 kindle edition.
3. G Dong, J Pei, Sequence Data Mining, Springer, 2007.

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)

19ECS776: CLOUD COMPUTING

L T P C

2 0 2 3

This course will help the students to get familiar with Cloud Computing benefits, technology mechanisms, platforms and state-of-the-art security issues in Cloud Computing fundamental issues, technologies, applications and implementations.

Course Objectives

- To understand the descriptions of common benefits and challenges, services and the virtualization of resources
- To evaluate the specialized technology mechanisms including scaling, load balancing and storage.
- To implement modern-day cloud computing platforms and innovations including data centers and descriptions of common cloud security
- Fundamentals of cloud computing interoperability issues and case study examples.
- To understand the fundamental cloud enterprise architectural models.

Unit I **9L**

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

Learning Outcomes:

After completion of this unit the student will be able to

- Define the cloud benefits, challenges. (L1)
- Name the cloud computing services (L1)
- Classify the Virtualization of resources(L2)

Unit II **9L**

Scaling in the Cloud, Capacity Planning, Load Balancing, File System and Storage,

Learning Outcomes:

After completion of this unit the student will be able to

- List the various Scaling in the cloud (L1)
- Illustrate the various capacity planning components (L2)
- Apply the load balancer and storage. (L3)

Unit III **8L**

Multi-tenant Software, Data in Cloud, Database Technology, Content Delivery Network, Security Reference Model, Security Issues, Privacy and Compliance Issues

Learning Outcomes:

After completion of this unit the student will be able to

- List the various cloud enabling technologies (L1)
- Illustrate the various technologies and components (L2)
- Select the security and privacy issues (L3)

Unit IV **8L**

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

Learning Outcomes:

After completion of this unit the student will be able to

- Compare the various portability and interoperability issues (L2)
- Build the cloud management model. (L3)
- Compare the popular services. (L4)

Unit V **8L**

Enterprise architecture and SOA, Enterprise Software, Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Learning Outcomes:

After completion of this unit the student will be able to

- Categorize the enterprise environments.(L4)
- Distinguish between the enterprise environments. (L4)
- Evaluate the enterprise cloud computing.(L5)

Text Book(s):

1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.
2. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.
3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, "Distributed and Cloud Computing From Parallel Processing to the Internet of Things", Elsevier, 2012.

Course Outcomes:

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

- define the basic concepts related to benefits, services and resource virtualization (L1)
- demonstrate the set of technology mechanisms with cloud computing.(L2)
- identify the building blocks of cloud computing platforms and cloud security issues (L3)
- evaluate the specific interoperability issues and examples (L4)
- elaborate the cloud Enterprise architecture models(L4)

19ECS751: DATA PREPARATION AND ANALYSIS

L T P C

2 0 2 3

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 **8 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)

Text Book(s):

1. Glenn J. Myatt, Making sense of Data I: A practical Guide to Exploratory Data Analysis and Data Mining, 1/e,2/e, A John Wiley & Sons, Inc., Publication, 2014.
2. Ben Fry, Visualizing Data: Exploring and Explaining Data with the pre processing Environment, O'REILLY MEDIA,2018.

3. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung: Time Series Analysis: Forecasting and Control, 5/e,Wiley publications,2015.
4. Tamraparni Dasu, Exploratory Data Mining and Data Cleaning, A John Wiley & Sons, Inc, 2003.(no updated edition)

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)

19ECS781: INTERNET OF THINGS

L T P C

2 0 2 3

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols and APIs used in IoT.

Course Objectives

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

UNIT I **9 L**

Overview of IoT: The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?, Design Principles for Connected Devices, Calm and Ambient Technology, Privacy, Keeping Secrets, Whose Data Is It Anyway?, Web Thinking for Connected Devices, Small Pieces, Loosely Joined, First-Class Citizens On The Internet, Graceful Degradation, Affordances.

Learning Outcomes:

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

- explain IoT architecture(L2)
- interpret the design principles that govern connected devices(L2)
- summarize the roles of various organizations for IoT(L2)

UNIT II **9 L**

Embedded Devices - I: Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, Developing on the Arduino, Some Notes on the Hardware, Openness.

Learning Outcomes:

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

- explain the basics of microcontrollers(L2)
- outline the architecture of Arduino(L2)
- develop simple applications using Arduino(L3)

UNIT III **8 L**

Embedded Devices - II: Raspberry Pi , Cases and Extension Boards, Developing on the Raspberry Pi, Some Notes on the Hardware, Openness, Other notable platforms, Mobile phones and tablets, Plug

Computing: Always-on Internet of Things.

Learning Outcomes:

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

- outline the architecture of Raspberry Pi(L2)
- develop simple applications using Raspberry Pi(L3)
- select a platform for a particular embedded computing application(L3)

UNIT IV **8 L**

Communication in the IoT: Internet Principles, Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports, An Example: HTTP Ports, Other Common Ports, Application Layer Protocols- HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.

Learning Outcomes:

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

- interpret different protocols and compare them(L2)
- select which protocol can be used for a specific application(L3)
- Utilize the Internet communication protocols for IoT applications(L3)

UNIT V **8 L**

Prototyping Online Components: Getting Started with an API, Mashing Up APIs, Scraping, Legalities, Writing a New API, Clockodillo, Security, Implementing the API, Using Curl to Test, Going Further, ReaLTime Reactions, Polling, Comet, Other Protocols, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol.

Learning Outcomes:

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

- select IoT APIs for an application(L3)
- design and develop a solution for a given application using APIs(L6)
- test for errors in the application(L4)
- judge the security issues in Real time applications.(L5)

Text Book(s):

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. ArshdeepBahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.
3. Pethuru Raj, Anupama C. Raman, The Internet of Things, Enabling technologies and use cases –CRC Press 2017.

Web Sources

https://www.arduino.cc/

https://www.raspberrypi.org/

Course Outcomes:

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

- choose the sensors and actuators for an IoT application(L1)
- select protocols for a specific IoT application(L2)
- utilize the cloud platform and APIs for IoT application(L3)
- experiment with embedded boards for creating IoT prototypes(L3)
- design a solution for a given IoT application(L6)

19ECS747: DATA SCIENCE

L T P C

2 0 2 3

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 **9 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 **9 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 **8 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 **8 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 **8 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)

Text Books(s):

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline. O'Reilly, 2013.
2. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v 2.1, Cambridge University Press, 2014.

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 navie bayesian (L3)
- apply coding techniques to data for securing the data (L4)

19ECS763: RECOMMENDER SYSTEMS

L T P C

2 0 2 3

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 **9 L**

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 **9 L**

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 **8 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 **8 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 **8 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)

Text Book(s):

1. Jannach D., Zanker M., Fel Fering A., Recommender Systems: An Introduction, 1/e, Cambridge University Press, 2011.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, 1/e, Springer, 2016.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer, 2011.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems for Learning, Springer, 2013.

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.

19ECS777: AGILE SOFTWARE DEVELOPMENT

L T P C

2 0 2 3

In software development, agile software development practices are highly effective when deployed in a collaborative, people-centered organizational culture. Students will learn agile development principles and techniques covering the entire software development process from problem conception through development, testing and deployment

Course Objectives

- To understand the agile concept and its importance in software development
- To acquire complete knowledge on Xtreme programming
- To know complete modeling of agile process on XP environment.
- To assess and predict the future development potentiality linked with agile policies.
- To apply the agile knowledge to RUP, and FDD and to extend it to other integrated tools.

UNIT I **9 L**

Introduction: The Agile manifesto, Agile methods, XP: Extreme Programming, DSDM, SCRUM, feature- Driven Development, modelling misconceptions, agile modelling, tools of misconceptions, updating agile models.

Learning Outcomes:

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

- What is Agile?(L1)
- Classify different agile methods for software development(L2)
- Describe the origins and motivations of the Agile Manifesto(L3)
- Analyze what scrum methodology is?(L4)
- Construct different agile models(L6)

UNIT II **9 L**

Extreme Programming: Introduction, core XP values, the twelve XP practices, about extreme programming, planning XP projects, test first coding, making pair programming work.

Learning Outcomes:

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

- Define core XP values(L1)
- Explain the twelve XP practices(L2)
- Identify different XP projects(L4)
- Justify extreme programming(L5)
- Construct test first coding and pair programming(L6)

UNIT III **8 L**

Agile Modelling and XP: Introduction, the fit, common practices, modelling specific practices, XP objections to agile modelling, agile modelling and planning XP projects, XP implementation phase.

Learning Outcomes:

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

- How Agile Modeling enables developers to develop customized software(L1)
- Illustrate common practices and specific practices(L3)
- Apply XP objections to agile modeling(L4)
- Distinguish agile modelling and planning XP projects(L5)
- Create XP implementation phase(L6)

UNIT IV **8 L**

Feature-Driven Development: Introduction, incremental software development, Regaining Control,The motivation behind FDD, planning an iterative project, architecture centric, FDD and XP.

Learning Outcomes:

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

- Define Feature-Driven Development(L1)
- Demonstrate incremental software development(L2)
- Apply regaining control techniques(L3)
- Appraise the motivation behind FDD(L5)
- Modify iterative project and architecture centric(L6)

UNIT V **8 L**

Agile Methods with RUP and PRINCE2 and Tools and Obstacles: Agile modeling and RUP, FDD and RUP, agile methods and prince2, tools to help with agile development, Eclipse, An agile IDE, obstacles to agile software development, management intransigence, the failed project syndrome, contractual difficulties, familiarity with agility.

Learning Outcomes:

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

- Recall agile modelling and RUP, FDD(L1)
- Explain prince2, tools and obstacles to agile software development(L2)
- Identify tools to help with agile development(L3)
- Estimate the failed project syndrome and contractual difficulties(L4)
- Construct Agile methods with RUP and PRINCE2(L5)

Text Book(s):

1. John hunt, Agile software construction,1/e, springer ,2005

2. Craig Larman, Agile and Iterative Development: a manager's guide , Addison-Wesley [Pearson Education] – 2004.
3. Pearson, Robert C. Martin, Juli , James Shore, Chromatic 2013, The Art of Agile Development, O'Reilly Media.
4. Llisabeth Hendrickson, Agile Testing, Quality Tree Software Inc 2008.

Course Outcomes:

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

- use agile methods in various development environments
- apply Xtreme programming in XP projects confidently.
- design and model agile methods in XP environments.
- develop abilities on Future Driven Development with iterative projects visualize applications with RUP and PRINCE2 like tools by agile methods

19ECS702: SOFT COMPUTING

L T P C

3 0 0 3

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 **9L**

Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Learning Outcomes:

After completion of this Unit the student will be able to

- define soft computing and neural network(L1)
- illustrate the evolution of the field of soft computing(L1)
- explain the basics of machine learning(L2)

Unit II **9L**

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Learning Outcomes:

After completion of this Unit the student will be able to

- name what are fuzzy sets, fuzzy operations and relations(L1)
- define fuzzy reasoning and fuzzy inference systems(L1)
- illustrate fuzzy expert systems and decision making using fuzzy logic (L2)

Unit III **8 L**

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 **8 L**

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

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 **8 L**

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):

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing®, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications®, PrenticeHall, 1995.

3. MATLAB ToolkitManual.
4. Saroj Kaushik, Sunita Tiwari, Soft computing: Fundamentals, Techniques and applications, Mc Graw Hill Education, 2018.
5. Snehashish Chakraverty, Deepti Moyi Sahoo, Nisha Rani Mahato, Concepts of Soft Computing: Fuzzy and ANN with Programming, Springer, 2019.
6. Samir Roy, Udit Chakraborty, Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms, Pearson, 2013

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 COMPUTINGLABORATORY

L	T	P	C
0	0	4	2

1. Tutorial on Tensor flow
2. Tutorial on keras
3. Implement Union, Intersection, complement and difference operations on Fuzzy sets.
4. Create Fuzzy relation by Cartesian product of any two Fuzzy sets and perform Max-Min composition of any two Fuzzy relations.
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.
9. Build classification model using Mini Batch gradient and Stochastic Gradient techniques.
10. Implement Genetic algorithm.

19ECS730: DEEP LEARNING AND DATA ANALYTICS LABORATORY

L T P C

0 0 4 2

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

19ECS792: TECHNICAL SEMINAR

L	T	P	C
0	0	4	2

Each student shall survey a technical topic related to a chosen specialization and prepare/submit a report in a specified format. 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.

19ECS765: DATA VISUALIZATION

L T P C

2 0 2 3

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 whilerepresenting 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 **9 L**

Introduction: What Is Visualization? , History of Visualization Relationship between Visualization and Other Fields, The Visualization Process Pseudocode Conventions, The Scatterplot and The Role of the User.

Data Foundations Types of Data, Structure within and between Records, Data Preprocessing.

Human Perception and Information Processing: What Is Perception? Physiology, Perceptual Processing, Perception in Visualization, Metrics Visualization Foundations 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 **9L**

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.

Visualization Techniques for Time-Oriented Data Introduction, Definitions: Characterizing Time-Oriented Data, Visualizing Time-Oriented Data, Time Bench: A Data Model and Software Library for Visual Analytics of Time-Oriented Data

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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 **8 L**

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.

Text and Document Visualization Introduction ,Levels of Text Representations ,The Vector Space Model ,Single Document Visualizations ,Document Collection Visualizations , Extended Text Visualizations.

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 **8 L**

Interaction Concepts: Interaction Operators, Interaction Operands and Spaces, A Unified Framework.

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 **8 L**

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

Research Directions in Visualization: Issues of Data Issues of Cognition, Perception, and Reasoning, Issues of System Design, Issues of Evaluation, Issues of Hardware 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)

Text Book(s):

1. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters,Ltd,2015.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, 1/e, Springer, 2016.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer, 2015.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems for Learning, Springer, 2013. (no update)

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

L T P C

2 0 2 3

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 **9 L**

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 9 **L**

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 **8 L**

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 **8 L**

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 **8 L**

Hbase, data model and implementations, Hbase clients, Hbase examples,praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients,Hadoop integration. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation,HiveQL queries.

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).

Text Book(s):

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2014.
3. Tom White, "Hadoop: The Definitive Guide", 3/e,4/e O'Reilly, 2015.

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).

19ECS769: DATA STORAGE TECHNOLOGIES AND NETWORKS

LT P C

2 0 2 3

The course is designed to enable the student to define about various data storage technologies and networks like storage media e.t.c. 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 **9 L**

Storage Media and Technologies – Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.

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 **9 L**

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 **8 L**

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 **8 L**

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 **8 L**

Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids. Storage QoS–Performance, Reliability, and Security issues, storage appliances.

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)

Text Book(s):

1. The Complete Guide to Data Storage Technologies for Network-centric Computing, Computer Technology Research Corporation, 1998.
2. Nigel Poulton, Data Storage Networking: Real World Skills for the Comptia Storage, Sybex, Wiley,

2015

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)

19ECS779: CYBER SECURITY

L T P C

2 0 2 3

This course enables the students to gain knowledge on various Cybercrimes. The course briefs the students regarding the Indian IT Act, Global perspective of Cybercrimes, Cyber stalking, cyber cafe, key loggers, DoS attacks, crimes on mobile, wireless devices, etc. The knowledge gained in this course can be applied to identify, classify, estimate the criminal plans of the attackers and predict the web threats and security implications.

Course Objectives

- introduce the fundamentals of Cybercrime and its legal perspectives with respect to India.
- acquaint the student with various types of attacks and Cyber offenses
- make the student aware of crimes related to wireless devices
- familiarize the student with tools and other possible vulnerabilities that assist in performing crimes and of the consequences of Cybercrimes.

UNIT I **9 L**

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Learning Outcomes:

The students will be able to

- classify the types of Cybercrimes(L4)
- outline the Indian stance and Acts towards Cybercrime(L2)
- compare the Indian perspective to Global perspective(L4)

UNIT II **9 L**

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Learning Outcomes:

The students will be able to

- interpret how attacks are formulated(L2)
- explain the concepts of Cyber stalking and Cyber cafe(L2)
- infer how Botnets and cloud computing provide base for cultivating Cybercrime(L2)

UNIT III **8 L**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices,

Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Learning Outcomes:

The students will be able to

- interpret how cybercrimes were escalated with the advent of mobile and wireless devices(L5)
- evaluate the security challenges(L5)
- design counter measures to limit the possibilities of crime(L6)

UNIT IV **8 L**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Learning Outcomes:

The students will be able to

- list various tools and methods that assist attackers in performing the Cybercrime(L1)
- analyze how password cracking is done(L4)
- distinguish between Viruses and Worms and Trojan Horses(L4)

UNIT V **8 L**

Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Learning Outcomes:

The students will be able to

- identify the issues related to IPR and threats to organizations(L3)
- assess the requirements to promote Security and Privacy(L5)
- predict the security challenges to organizations(L6)

Text Book(s):

1. Nina Godbole and Sunil Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1/e, Wiley INDIA, 2011.
2. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, 1/e, CRC Press, 2011.

3. Chwan-Hwa(John) Wu,J.DavidIrwin, Introduction to Cyber Security, 1/e, CRC Press T&F Group, 2013.

Course Outcomes:

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

- explain the types of Cybercrimes happening all around(L3)
- select tools and practices that boost up the crime rate(L5)
- demonstrate the vulnerabilities of Botnets and cloud to(L2)
- demonstrate the contribution of key loggers, password crackers, viruses and worms towards enabling the possibilities of Cybercrime(L2)
- assess the seriousness of the security problems faced by the organizations(L5)

19ECS771: WEB ANALYTICS AND DEVELOPMENT

L T P C

2 0 2 3

Web Analytics is the measurement, collection, analysis, and reporting of Internet data for purposes of understanding and optimizing Web usage. Web Analytic 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 click stream 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 **9L**

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 **9L**

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 click stream 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 **8L**

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 **8L**

Making Connection: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity

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 **8L**

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)

Text Book(s):

1. Derek Hansen, Ben Shneiderman, Marc A. Smith, Itai Himelboim, Analyzing Social Media Networks with NodeXL: Insights from a Connected World, 2/e, MK,2020.

2 AvinashKaushik, Web Analytics 2.0: The Art of Online Accountability, Wiley Publishers, 2009.
3. Easley, D., Kleinberg, J., Networks, Crowds, and Markets: Reasoning About a Highly Connected World. New York: Cambridge University Press, 2010. http://www.cs.cornell.edu/home/kleinber/networks-book/
4. Kim Ann King, The Complete Guide to B2B Marketing: New Tactics, Tools and Techniques to Complete in the Digital Economy, Paul Boger, 2015.

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 click stream data collection techniques, their impact on metrics, and their inherent limitations;.(L3)
- develop an optimization strategy following best practices for a client to implement to help increase their ranking.(L3)
- construct the random graphs by using the tools(L3)
- analyze the Key Analytic Metrics to Monitor the Average Time on Site/Page, Bounce/Exit Rates, etc.(L4)

19ECS750: GPU COMPUTING

L T P C

2 0 2 3

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 **9L**

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 **9L**

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 **8L**

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 **8L**

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 **8L**

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 B. Kirk, Wen-mei W.Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 3/e, Mk, 2017
2. Shane Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, Morgan Kaufman, 2012
3. Aditi Majumder, M. Gopi, Introduction to Visual Computing: Core Concepts in Computer Vision, Graphics, and Image Processing, CRC Press, 2018.
4. Bertil Schmidt, Jorge Gonzalez-Dominguez, Christian Hundt, Moritz Schlarb, Parallel Programming: Concepts and Practice, MK, 2018.

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).

19ECS773: DEEP LEARNING

L T P C

2 0 2 3

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 **9L**

Introduction: Feed forward neural networks (FFNN). Gradient descent and the back propagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Regularization. Dropout.

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 **9L**

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 **8L**

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 **8L**

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 **8L**

Applications of Deep Learning: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, and video to text with LSTM models.

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):

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.
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).

19ECS774: SOCIAL NETWORK ANALYSIS

L T P C

2 0 2 3

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 **9L**

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 **9L**

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:

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

- analyze relational data (L2).
- construct preparation of relational data (L2).
- develop GraphTheory (L2).

- demonstrate the usage of Egocentric and socio centric (L2).

Unit III **8L**

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 **8L**

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).

Text Book(s):

1. John Scott, Social Network Analysis, 3/e, SAGE Publications, 2017
2. Matthew A. Russell and Mikhail Klassen, Mining the Social Web, 3/e, O'Reilly, 2019.
3. Charles Kadushin, Understanding Social Networks: Theories, Concepts, and Findings,

Oxford University Press, 2012.

4. Maksim Tsvetovat, Alexander Kouznetsov, Social Network Analysis for Startups, O'Reilly, 2014.

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).

19ECS772: DATA SECURITY AND ACCESS CONTROL

L T P C

2 0 2 3

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 **9L**

Introduction to Access Control, Purpose and fundamentals of access control, brief history. Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary AccessControl(DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List andLimitations.

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 **9L**

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'sintrigity 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 andDAC.

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 **8L**

Smart Card based Information Security, Smart card 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 **8 L**

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)

Text Book(s):

1. David F. Ferraiolo, D. Richard Kuhn, RamaswamyChandramouli, Role Based Access Control, Artech House, 2003.(2007 is the latest one)
2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial.

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

L T P C

2 0 2 3

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 **9L**

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 **9L**

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**

Context Free Grammars for English Syntax, Sentence- Level Constructions, Parsing – Top-down – Early Parsing, feature Structures – Probabilistic Context-Free Grammars

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 **8L**

Discourse -Reference Resolution - Text Coherence - Discourse Structure – Coherence, Machine Translation -Transfer Metaphor–Interlingua- Statistical Approaches

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 **8L**

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)

Text Book(s):

1. Daniel Jurafsky, James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2/e, Prentice Hall, 2008.
2. C. Manning, H. Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA, 1999.
3. Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019.
4. EBook: Le Deng, Yang Liu, Deep Learning in Natural Language Processing, Springer, 2018.
5. Jalaj Thanaki, Python Natural Language Processing: Explore NLP with machine Learning and deep

learning Techniques, Packt, 2017.

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)

19ECS785: BLOCK CHAIN TECHNOLOGY

L T P C

2 0 2 3

To really be aware of what is special about Bitcoin, we need to understand how it works at a technical level. Bitcoin truly is a new technology and we can only get so far by explaining it through simple analogies to past technologies. Cryptography is a deep academic research field utilizing many advanced mathematical techniques that are notoriously subtle and complicated to understand. Fortunately, Bitcoin only relies on a handful of relatively simple and well-known cryptographic constructions. Here specifically we will study cryptographic hashes and digital signatures, two primitives that prove to be very useful for building cryptocurrencies and Bitcoin mining Strategies.

Course Objectives

- Gain knowledge on BlockChain Fundamentals and Working Principle
- Understand the basic concept of Cryptographic Hash Functions, Hash Pointers
- Learn Elliptic Curve Digital Signature Algorithm.
- Get an insight into the working of the Bitcoin network, wallet, Bitcoin mining and distributed consensus for reliability.
- Gain knowledge about Bitcoin storage, Transaction and Usage
- Be familiar with Bitcoin Mining Hardware, Pools, strategies and basics of Anonymity.

UNIT I **9 L**

Block Chain Fundamentals: Tracing Blockchain's Origin, Revolutionizing the Traditional Business Network, How Blockchain Works, What Makes a Blockchain Suitable for Business?

Introduction to Cryptography: Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree.

Learning Outcomes:

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

- Learn Blockchain Fundamentals and Working Principle.
- Apply Cryptographic Hash Functions.
- Implement Merkle Tree

UNIT II **9 L**

Digital Signatures: Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency.

Learning Outcomes:

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

- Implement Elliptic Curve Digital Signature Algorithm.
- Learn Simple Crypto currency like GoofyCoin, ScroogeCoin.

UNIT III **8 L**

Centralization vs. Decentralization, Distributed Consensus, Consensus without identity using a block chain, Incentives and proof of work.

Mechanics of Bitcoin: Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network.

Learning Outcomes:

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

- Work on Bitcoin network, wallet
- Learn Bitcoin mining and distributed consensus for reliability
- Use Bitcoin Transaction and applications

UNIT IV **8 L**

Storage of and Usage of Bitcoins: Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Learning Outcomes:

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

- Learn Types of Bitcoin Storage
- Use Bitcoin Payment Services and Currency Exchange Markets.
- Able to do mining job in Bitcoin transaction.

UNIT V **8 L**

Bitcoin Mining: The Task of Bitcoin miners, Mining Hardware, Mining pools, Mining incentives and strategies.

Bitcoin and Anonymity: Anonymity Basics, Mixing, Zerocoin and Zerocash

Learning Outcomes:

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

- Learn Mining Hardware and Pools
- Design Bitcoin Mining strategies

Text Book(s):

1. Manav Gupta, BlockChain for dummies, 2nd IBM Limited Edition, Published by John Wiley & Sons, Inc, 2018.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, 2016.
3 Melanie Swan ,Blockchain: Blueprint for a New Economy, O'Reilly Media, 1/e, 2015.
4. Andreas M. Antonopoulos, Mastering Bitcoin: Programming the Open Block chain, O'Reilly Media, 2/e, 2017.

Course Outcomes:

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

- learn Blockchain Fundamentals and Working Principle.
- apply Cryptographic Hash Functions, Hash Pointers.
- implement Elliptic Curve Digital Signature Algorithm.
- work on Bitcoin network, wallet, Bitcoin mining and distributed consensus for reliability.
- use Bitcoin Transaction, Payment Services and Exchange Market Services.
- design Bitcoin Mining Hardware, Pools and strategies.

19ECS783: SOFTWARE PROJECT MANAGEMENT

L T P C

2 0 2 3

This course provide an overall idea of management skills in the area of handling projects. This course helps to solve the problems occurred during the lifecycle of project. Learn about different tools of project management to solve the problems.

Course Objectives:

- To highlight the importance of software project management.
- To discuss various processes in Software Project Management.
- To provide tools and techniques for project monitoring.
- To expose different project management life cycles.

Unit I **9L**

Fundamentals Of Project Management: Defining a project- Sequence of Activities – Complex Activities – A Business focused definition - Understanding the Scope Triangle - Managing the Creeps- Importance of Classifying Projects - Fundamentals of Project Management - Introducing Project Management Life Cycles - Choosing the Best-Fit PMLC Model.

Learning Outcomes:

After completion of this unit the student will be able to

- define different activities in order (L1)
- understand the working of lifecycles of project management (L2)

Unit II **9L**

Project Management: Process Groups: Defining the Five Process Groups - Nine Knowledge Areas - Mapping Knowledge Areas to Process Groups - Using Tools, Templates, and Processes to Scope a Project - Managing Client Expectations.

Learning Outcomes

After completion of this unit the student will be able to

- understand the importance of process groups (L2)
- grouping of mapping areas to process (L2)

Unit III **8L**

TPM Project: Using Tools, Templates, and Processes to Plan a Project - Application Software Packages- Project Planning Tools – Planning and Conducting Joint Project - Building the WBS - Estimating - Constructing the Project Network Diagram - Effective Project Proposal - Launch a TPM Project- Monitor and Control a TPM Project.

Learning Outcomes:

After completion of this unit the student will be able to

- choose the appropriate tools to manage the project(L3)
- sketch the work breakdown structure and project network (L3)

Unit IV **8L**

Establishing Project Management Life Cycle: Understanding the Complexity/Uncertainty - Traditional Project Management- Incremental Project Management Life Cycle - Agile Project Management - Iterative Project Management Life Cycle- Adaptive Project Management Life Cycle – Adapting and Integrating the APM Toolkit.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the complexity/uncertainty (L3)
- categorize the different life cycles of management (L4)

Unit V **8L**

Building An Effective Project Management: Establishing and Managing a Project Portfolio Management Process - The Project Portfolio Management Life Cycle - Establishing and Managing a Continuous Process Improvement Program - Defining Process and Practice Maturity - Using Process Improvement Tools, Templates and Processes.

Learning Outcomes:

After completion of this unit the student will be able to

- establishing and managing a continuous process improvement program(L4)
- work on tools (L5)

Text Book(s):

1. Robert K. Wysocki, "Effective Project Management – Traditional, Agile, Extreme", 6th Edition, Wiley Publication, 2011.
2. Robert K. Wysocki, "Effective Software Project Management", 3rd Edition, Wiley Publication, 2010.

Course Outcomes:

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

- design a project management plan using different project management life cycles (L1)
- find a suitable project management life cycle model for effective project execution (L2)
- working of different life cycles of management (L3)
- apply the tools on monitoring and control the total project management (L3)

19EAC741: ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

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 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 **5L**

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 **5L**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

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):

1. Goldbort R, Writing for Science, Yale University Press, 2006
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM, Highman, 1998.

References:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

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).

19EAC742: DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

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 **5L**

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 **5L**

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

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 **6L**

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 **6L**

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 **6L**

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

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):

1. R. Nishith, Singh A.K., Disaster Management in India: Perspectives, issues and strategies, New Royal Book Company., 2008.
2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep and Deep Publication, 2007.

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

L	T	P	C
2	0	0	0

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 **7L**

Values and self-development –social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

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 **7L**

Importance of cultivation of values. Sense of duty. Devotion, self-reliance. Confidence, concentration. Truthfulness, cleanliness. Honesty, humanity. Power of faith, national unity. Patriotism, love for nature, discipline.

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 **7L**

Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Learning Outcomes

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

- describe the benefits of positivie 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 **7L**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

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):

1. Chakroborty S.K., “Values and ethics for organizations: Theory and Practice”, Oxford University Press, 1998.

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)

19EAC745: CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

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 **5L**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble, Salient Features

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 **5L**

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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 **6L**

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**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

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**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

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.
3. M. P. Jain, Indian Constitution Law, 7/e, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 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)

19EAC746: PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

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 **5L**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

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 **5L**

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 **6L**

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school

curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

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 **6L**

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 **6L**

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):

1. Ackers J, Hardman F, Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261, 2001
2. Agrawal M, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004.
3. Akyeampong K, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID., 2003.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282., 2013.
5. Alexander RJ, Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell., 2001.
6. Chavan M, Read India: A mass scale, rapid, 'Learning to Read' campaign., 2003.

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)

19EAC747: STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

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 **9L**

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 **9L**

Yam and Niyam.

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, 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, astheya etc(L2)
- explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life(L3)

Unit III **9L**

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)

19EAC748: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

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 **9L**

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 **9L**

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 **9L**

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

L	T	P	C
3	0	0	0

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 **8L**

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 **8L**

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

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.

5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

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)

19EOE742: BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

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**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview

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**

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

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 **10L**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

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 **8L**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

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):

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications Pearson FT Press, 2014.
2. James Evans, Business Analytics, Pearson Education, 2013.

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)

19EOE746: OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

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 **8L**

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 **8L**

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 **8L**

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):

1. H.A. Taha, Operations Research, An Introduction, Prentice Hall of India, 2008
2. H.M. Wagner, Principles of Operations Research, Prentice Hall of India, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, 2008

4. Hitler Libermann Operations Research: McGraw Hill Publishers, 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

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)

19EOE748: COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
3	0	0	3

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 **8L**

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational
control; Provision of data for Decision-Making.

Learning Outcomes

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

- 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 **8L**

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

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

- 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 **8L**

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

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

- 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(L2)
- list the different contents of project contracts(L2)
- present the project cost control and planning through bar charts, network diagrams etc(L2)

Unit IV **8L**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Learning Outcomes

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

- describe the cost behavior and profit planning(L2)
- distinguish between marginal costing and absorption costing(L2)
- analyze the variance of standard costing(L2)
- analyze the pricing strategies in project costing(L2)
- identify the quality measures satisfying the appropriate constraints(L2)

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(L2)
- model the cost management as a linear programming problem(L2)
- measure the divisional profitability and decide the appropriate pricing(L2)

Textbook(s):

1. Charles T. Horngren, ,Srikant M. DatarGeorge Foster, Cost Accounting A Managerial Emphasis, Prentice .Hall of India, New Delhi, 2006

References:

1. Charles T. Horngren, George Foster, Advanced Management Accounting, Greenwood Publishing, 2001.
2. Robert S Kaplan, Anthony A. Alkinson, Management & Cost Accounting, 1998.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, Wheeler Publisher, 2004.
4. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book, 2006.

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(L1)
- plan the project execution process involving technical/nontechnical activities(L4)
- describe the detailed engineering activities and their cost management analysis(L2)
- carry out the cost analysis and profit planning of engineering projects(L5)
- utilize quantitative techniques for optimization of budget allocation(L6)

19ECS891: PROJECT WORK I

L	T	P	C
0	0	26	13

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.

19ECS892: PROJECT WORK II

L	T	P	C
0	0	26	13

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.