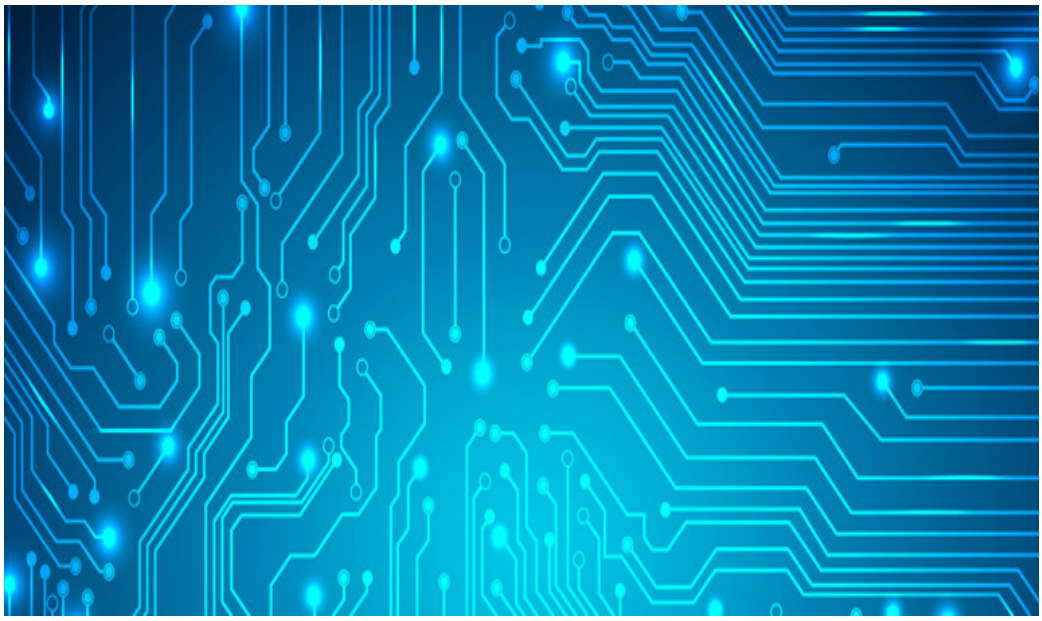
University Of Kerala

Learning Outcomes-based Curriculum Framework (LOCF)

Post-Graduate Programme



M.Sc. Computer Science

Regulations, Curriculum Framework and Syllabus

(Affiliated Colleges Syllabus effective from 2021 Admission Onwards)

UNIVERSITY OF KERALA

2021

SCHEME AND SYLLABUS OF M.Sc. COMPUTER SCIENCE

(2021 ADMISSION ONWARDS)

A. Objectives

1. To develop an interest in the candidates towards a career in academics and research, and toenable them with sufficient knowledge to become a competent academician.
2. To equip the students with adequate exposure and skills to empower them to catch adeserving position in the software industry.
3. To develop an interest in promoting the use of Computer Science for the positive development of our society and the environment.
4. To enable the students to contest for regional/national/international level competitive examinations.

B. Duration:

The duration of the course is four semesters in 2 years.

C. Eligibility

Candidates for admission to M. Sc. Programme in Computer Science should have passed:

(i) A Degree course with minimum three years duration after 10+2 with not less than 50% marks or 2 CGPA[S] out of 4 in Computer Science/Computer Application/Electronics /Mathematics / Statistics as main or an equivalent Degree recognized by the University of Kerala for the purpose.

(ii) Any Science degree with minimum three years duration after 10+2 with not less than 50% marks or 2 CGPA[S] out of 4 with Computer Science/Computer Application as one of the main/subsidiary/core subject or an equivalent Degree recognized by the University of Kerala for the purpose.

The candidate shall meet all other requirements in the prospectus published by the University fromtime to time.

D. Assessment

Assessment will be done in two components: Continuous Assessment (CA) and End-Semester Assessment (ESA).

(i) Continuous Assessment (CA)

Theory Courses: In addition to classroom lectures, students shall be assigned to application problems, classroom presentations, group activities, etc. Case studies/industry visits may also be organized. At least two tests shall be conducted for each course. Short viva may be carried out to assess assignnments.

CA Mark for Theory Courses (Total: 25)

Attendance	5
Test	10
Assignment & Activities	10

Lab Courses: Each Lab course shall be completed under the supervision of a faculty member. **The students shall undertake a case study for each practical course.** The case study can be done as a team of 2 members if necessary**.** The practical record includes both lab exercises and a case study report.

CA Mark for Lab Courses (Total: 25)

Attendance	5	Lab performance	5
Internal Lab Test	5	Case Study	5
Record	5		

Seminar:

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the M. Sc Computer Science Programme. They should get the paper approved by the Faculty member in charge of the seminar and shall present it in the class.

CA Mark for Seminar (Total: 50)

Presentation & Defense	24
Report	16
Topic & Content of Seminar	10

Major Project (Phase I & II):

Major project work shall be done individually by each student under the guidance of a faculty member from the department. **Major Project will be carried out in two phases. Phase – I in third semester and Phase – II in Fourth Semester.**

An internal assessment team consisting of at least three members, chaired by the Head of Department or a senior faculty member shall be constituted at the college every year by the end of the second semester. The project guide of the candidate can be one of the members of the team.

The Project proposals and synopsis submission shall be done at the beginning of the third semester

itself. It is advisable to select the project topic and area keeping the following objectives in mind:

(i) The project work shall give enough opportunity for the students to apply some of the skills and knowledge earned through the theory courses.
(ii) The student shall get an exposure in developing industry type applications/utility software for computer systems or mobile devices/in studying and analyzing theoretical concepts and presenting a comparative analysis of state-of-the-art techniques/in developing new or improved algorithms/in the use of soft computing techniques in selected area/discipline.

If the student chooses to do the project in an organization other than the college, the department shall ensure the following:

1. A qualified person supervises the project. The External Supervisor shall be a post graduate in either Science/Applied Science/Engineering branches. He/She shall have at least three years of experience in running/managing/implementing/supervising such projects. A declaration shall be obtained in this regard from that person, and shall be kept by the Department.
2. An attendance statement and a performance feedback shall be obtained from the External supervisor. The student has to present periodic reports and attend for evaluation process before the internal assessment team at the College as per the schedule.

CA Mark for Major Project Phase - I (Total: 25)

Literature Survey	5
Interim Report	5
Methodology / Design	10
Presentation	5

CA Mark for Major Project Phase - II (Total: 100)

Study Phase activities & Report: 20 marks			
Methodology/Design	20 Marks	Implementation	20 marks
Results & Findings	20 marks	Presentation	20 marks

ii. End Semester Assessment (ESA)

The University will conduct the end-semester Assessment for all courses. A student with 75% attendance in a course is eligible to attend the University examination.

Theory Courses: (Total: 75)

The question paper consists of two parts:

Part A (27 marks). Nine compulsory questions, of 3 mark each.
Part B (48 marks). Students must answer one out of two questions from each module. Each question carries eight marks.

Lab Courses: (Total: 75)

Lab examinations shall be conducted in each college by two examiners appointed by the University, of which one shall be from other colleges. The External Examiner will finalize the marks in consultation with the internal examiner. The questions for the examination shall be prepared before each examination and approved by the board of examiners. A candidate shall be asked to answer one out of two questions given to him.

The marks will be distributed as follows. **(Total: 75)**

Description of procedure: 10 marks [The procedure/algorithm/flow chart/pseudo code for solving the problem(s) shall be explained in the answer sheet.] ***Preparation of program: 15 marks*** ***Logic &Output : 20 marks.*** *20 marks shall be distributed as follows:* *(i) 15 marks for the correct output of the given problem.* *(ii) 5 marks for completing the modifications suggested by the examiner(s) in the given questions during the examination hours.* [The program/code shall work for all cases of the given problem. Different test cases and answers shall be written in the answer sheet. ***Viva: 15 marks.*** Viva shall be on the problem domain, based on the programming tool used, from the area of study for solving the problem/from the theory concepts related to the area. ***Case study Report and Viva : 15 marks***

Major Project Phase - I (Total: 75)

Major Project (Phase I) shall be evaluated by an examiner appointed by the University. A report of the project shall be submitted to the examiner at the time of examination.

ESA for Major Project (Phase I)			
Report of the work	15 marks	Methodology / Implementation	25 marks
Viva - Voce	10 marks	Presentation	25 marks

Major Project Phase - II (Total: 150)

Major Project Phase - II shall be evaluated at the examination centers by a panel of two examiners appointed by the university, one of which shall be from other colleges. The project report shall be finalized after the internal Assessment. The candidates shall present the findings/output of their work before the examiners during the examination hours. The examiners will conduct a viva voce also.

ESA for Major Project (Phase II)			
Report of the work	25 marks	Methodology /Design	40 marks
Findings/Implementation Viva Voce	25marks 20 marks	Presentation	40 marks

Comprehensive Viva (Total: 100)

It is mandatory that the Comprehensive Viva shall be conducted by separate examiners other than Project Evaluation. The viva will be carried out by a panel of two examiners appointed by the University, of which one shall be from outside the college. Though the viva shall be based on the entire syllabus contents, the candidates may be given an opportunity to opt a set of subjects, not less than 40% of the programme. However, the candidate, in any case, shall not be asked to write answers to the questions given by the examiners.

E. Question Paper Pattern:

The maximum mark for the theory examinations will be 75 and the time duration will be 3 hours. The question paper shall contain two parts; Part-A and Part-B.

Part-A shall be for 27 marks and shall contain 9 compulsory short answer questions. Each question carries 3 marks. Atleast one question from each module.

Part B shall be for 48 marks and shall contain 12 questions, 2 questions from each module out of which the student has to answer 1 question from each module. Each question carries 8 marks.

F. Pass Requirements:

For each subject(including practical), a student should get a minimum of 40% marks in the university examinations and 50% aggregate for the CA and ESA together for all theory and practical courses except Major Project. For Major Project and Comprehensive viva-voce in the 4^{th} semester each student should get a minimum of 50% for the university examination and 50% aggregate for the CA and ESA together. Classification of passed candidates will be as per the University norms.

PROGRAMME OUTCOMES (PO) for M. Sc Computer Science Programme

	PROGRAMME OUTCOMES (PO)
PO1	To develop an interest in the candidates towards a career in academics and research, and to enable them with sufficient knowledge to become a competent academician
PO2	To apply knowledge of mathematical, scientific, and computer science to evaluate, analyze, synthesize, model and integrate technologies to develop new computer system for applied engineering systems.
PO3	To equip the students with adequate exposure and skills to empower them to catch a deserving position in the software industry.
PO4	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO5	To develop an interest in promoting the use of Computer Science for the positive development of our society and the environment
PO6	Recognize the need for and develop the ability to engage in continuous learning as a Computing professional.
PO7	Create, identify and apply appropriate techniques, resources, and modern computing tools to complex computing activities.
PO8	To enable the students to contest for regional/national/international level competitive examinations.

Programme Specific Outcomes

The students on completion of M.Sc (Computer Science) Programme will be able to:

PSO1	**Communicate computer science concepts, designs, and solutions effectively and professionally**
PSO2	Apply knowledge of computing to produce effective designs and solutions for specific problems
PSO3	Use of software development tools, software systems, and modern computing platforms to solve real life problems
PSO4	Investigate research gaps, analyze and carry out research in the specialized/emerging areas
PSO5	Apply knowledge of recent computing technologies, skills and current tools of computer science
PSO 6	Utilize skills and knowledge for computing practice with commitment on social, ethical, cyber and legal values

G. CURRICULUM FRAMEWORK

Semester I		Credits	L	T	P	CA	ESA	Total
CS 511	Mathematical Foundations of Computer Science	4	4	1		25	75	100
CS 512	Distributed Operating Systems	3	4			25	75	100
CS 513	Data Structures & Algorithms	4	4	1		25	75	100
CS 514	Computer Graphics & Image Processing	4	4	1		25	75	100
CS 515	Data Structures using Python Lab	2	-		3	25	75	100
CS 516	Computer Graphics & Image Processing Lab	2	-		3	25	75	100
	Total	**19**	**16**	**3**	**6**			**600**

Semester II		Credits	L	T	P	CA	ESA	Total
CS521	Database Management Systems	4	4	1	-	25	75	100
CS522	Computer Networks & Security	4	4	1	-	25	75	100
CS523	Software Engineering	4	4	1	-	25	75	100
CS524	Elective I	3	4		-	25	75	100
CS525	Network Programming in Java Lab	2	-		3	25	75	100
CS526	DBMS & Data Mining Lab	2	-		3	25	75	100
	Total	**19**	**16**	**3**	**6**			**600**

Semester III		Credits	L	T	P	CA	ESA	Total
CS531	Automata Theory & Compiler Design	4	4	1	-	25	75	100
CS532	Big Data Analytics	4	4	1	-	25	75	100
CS533	Artificial Intelligence	4	4	1	-	25	75	100
CS534	Elective II	3	4		-	25	75	100
CS535	Major Project (Phase I)	2	-	-	3	25	75	100
CS536	Seminar	1				50	-	50
CS537	Data Analytics Lab	2		-	3	25	75	100
	Total	**20**	**16**	**3**	**6**			**650**

Semester IV		Credits	L	T	P	CA	ESA	Total
CS541	Research Methodology & Report Writing	4	3	1		25	75	100
CS542	Elective III	3	3			25	75	100
CS543	Major Project (Phase II)	6			18	100	150	250
CS544	Comprehensive Viva	3					100	100
	Total	**16**	**6**	**1**	**18**			**550**

Elective Courses		Credits
Elective I		
CS 524 A	Cyber Forensics & Cyber Laws	3
CS 524 B	Cloud Computing Technologies	3
CS 524 C	Natural Language Processing	3
Elective II		
CS 534 A	Soft Computing	3
CS 534 B	Social Network Analysis	3
CS 534 C	Bioinformatics	3
Elective III		
CS 542 A	Advanced Learning Techniques	3
CS 542 B	Optimization Techniques	3
CS 542 C	Computer Vision	3

SEMESTER I	COURSE CODE : CS 511	CREDIT :4

MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

COURSE OUTCOMES

CO1	Solve problems on Sets, functions and relations
CO2	Describe Linear Algebra and its applications
CO3	Analyzing Mathematical logic and Boolean algebra
CO4	Solve problems of Probability
CO5	Apply Algebraic Structures on various problems
CO6	Evaluating Graph Theory

COURSE CONTENTS

Module I Fundamentals: Sets and subsets, operation on sets, Inclusion Exclusion principle, pigeonhole principle, sequence, product sets and partitions Relations, Matrix representation of relations, classification of relations ,N-ary relations, equivalence relation, Functions , Permutation Functions ,Growth of functions, Partially ordered sets, Lattices.

Module II Introduction to linear Algebra :Matrix, basic terms in matrix, operation on matrices, types of matrix, transpose of matrix, symmetric and skew symmetric matrix, inverse of matrix,rank of a matrix, Gauss Jordan method, Cramers rule

Module III Finite Boolean Algebra, Mathematic logic, statements and notations, connectives, Normal forms, PCNF, PDNF, The theory of inference for calculus, inference theory, predicate calculus

Module IV Graph theory, Basic concepts of graph theory, Graph terminology and Special types of graph, representation of graph, graph isomorphism, planar and non-planar graphs, Euler paths and circuits, Hamiltonian paths and circuits, Trees spanning tree, theorems on trees.

Module V Algebraic structures, semigroups, Monoids, groups, subgroups, symmetric groups,Group homomorphism and isomorphism,cosets and Lagrange's theorem, normal subgroups, permutation of group, Theorems on Group, Burnsides theorem.

Module VI Probability, Axioms of probability, conditional probability, General aspects, Random variables, Scatter diagram, Sample, uniform distribution, Basic rules of probability

References:

- Bernard Kolan c, Busby & Sharon Ross, Discrete Mathematical Structures[PHI]
- J.P.Tremblay&R.Manohar, Discrete Mathematical Structures with Application tocomputer science[TataMcGraw-Hill]
- C.J.Liu, Elements of Discrete Mathematics , MGH
- Johnsonbaugh, Discrete Mathematics, Pearson Ecducation,2007
- Grassmann,Logic and DisctereMathermatics: A Computer Science Perspective,Person Education,2007
- Higher Engineering Mathematics, Dr.B.S.Grewal
- Advanced Engineering Mathematics 9th Edition , Erwin Kreyszig

SEMESTER I	COURSE CODE : CS 512	CREDIT : 3

DISTRIBUTED OPERATING SYSTEMS

COURSE OUTCOMES

CO1	Describe the principles and concept of Distributed Systems and Distributed Operating Systems.
CO2	Identify the challenges and opportunities faced by Distributed Operating Systems.
CO3	Discuss the middleware technologies that support distributed applications such as RPC, RMI and object based middleware
CO4	Analyze different shared memory architectures
CO5	Identify the issues involved in studying process and resource management
CO6	Explain about the file organization and management in distributed systems.
CO7	Identify the security challenges and control measures in Distributed Operating Systems

COURSE CONTENTS

Module I : Introduction to Distributed Computing System - Distributed Computing Models- Distributed Operating System - Issues in Designing a Distributed Operating System -Distributed Computing Environment (DCE). Computer Networks: Networks Types – LAN Technologies - WAN Technologies - Internetworking - ATM Technology.

Module II: Distributed communication – Issues, Message Passing –remote procedural call – stream oriented communication - Synchronization - Buffering - Multi datagram Messages – Encoding and Decoding of Message Data - Process Addressing - Failure Handling - Group Communication.

Module III : Distributed Shared Memory: General Architecture of DSM Systems - Design and Implementation: Issues of DSM - Granularity - Structure of Shared Memory Space – Consistency Models - Replacement Strategy - Thrashing - Heterogeneous DSM. Transaction and concurrency control in Distributed OS.

Module IV: Resource Management in Distributed OS – resource, task assignment, distributed load balancing, load estimation, process transfer, and state information exchange policy. Synchronization: Clock Synchronization - Event Ordering - Mutual Exclusion -Deadlock - Election Algorithms.

Module V: Distributed File Systems: Desirable Features of a Good Distributed File System – File Models - File Accessing Models - File Caching Schemes- File Replication - Fault Tolerance - Atomic Transactions - Design Principles.

Module VI: Distributed Object based System - DOO Architecture, DOO Process, DOO Communication, and Synchronization in Object Based Systems. Security in DOS: information system security and policy, trust management, access control and cryptography.

REFERENCES:

- Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education, Inc., 2007.
- George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design, Addison Wesley/Pearson Education, 2012.
- Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
- Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA,
- Pradeep K Sinha, "Distributed Operating Systems: Concepts and design", PHI, 2007.

SEMESTER I	COURSE CODE : CS 513	CREDIT :4

DATA STRUCTURES & ALGORITHMS

COURSE OUTCOMES

CO1	Recognize the basic programming concepts in Python
CO2	Practice the data types supported by Python
CO3	Examine the different classifications of data Structures
CO4	Compare the implementation of different data structures
CO5	Interpret the pseudo code representation of algorithms
CO6	Design and implement the different algorithms

COURSE CONTENT

Module I Python: Introduction, Features, Data Types, Control Structures, Collections, Functions, Modules

Module II: Classes and Objects, Packages, Exception Handling, File Handling, Introduction to GUI Programming

Module III: Data Structures: Introduction, Classifications; Searching: Linear Search, Pattern Search; Sorting: Insertion Sort, Selection Sort; Stacks and Queues: Operations, Applications; Linked Lists: Singly, Doubly, Circularly Lists

Module IV: Trees: Operations, BST, AVL Trees, Red-Black Trees; Graphs: Representation, Operations; File Structures: Concepts and organization, Sequential file, Indexed sequential files, Direct files;

Module V: Algorithm, Pseudo Code Representation, Performance analysis, Asymptotic Notation; Randomized Algorithms : Primality Testing; Divide and Conquer: Merge Sort; Greedy Method: Tree vertex Splitting

Module VI: Back Tracking: Sum of subsets, Graph Coloring; Dynamic Programming: All Pairs Shortest Paths, 0/1 knapsack; NP Hard and NP Complete : Hamiltonian cycle, Travelling Salesman Problem

Case Study : Development of any of the algorithm using an appropriate data structure in Python

References

Text books

1. Dr Jeeva Jose, Taming PYTHON By Programming, Khana Publications
2. Seymour Lipschutz, Data Structures Schaum's Outlines
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein,"Introduction to Algorithms", MIT Press
4. E. Horowitz, S. Sahni and S. Rajasekaran, 1999, Computer Algorithms, Galgotia, New Delhi.
5. Jain, Hemant, Problem Solving in Data Structures & Algorithm
6. Anany Levitin, Introduction to Design and Analysis of Algorithms, Pearson

Additional and Web –Resources

1. Rance D. Necaise , Data Structures and Algorithms Using Python, John Wiley and Sons – PDF
2. hhttps://www.geeksforgeeks.org/fundamentals-of-algorithms/
3. https://www.geeksforgeeks.org/data-structur
4. https://www.tutorialspoint.com/python_data_structure

SEMESTER I	COURSE CODE: CS 514	CREDIT : 4

COMPUTER GRAPHICS AND IMAGE PROCESSING

COURSE OUTCOMES

CO1	Explain the display technologies including LED, LCD, OLED, Plasma Panel
CO2	Illustrate Bresenham's Ellipse Drawing Algorithm
CO3	Solve 3D transformation problems including rotation, translation and scalin
CO4	Recognize OpenGL command syntax
CO5	List the sequence of operations of the OpenGL rendering pipeline
CO6	Identify the steps in creating animation sequence
CO7	Implement computer graphics programs in Open GL
CO8	Implement basic image processing programs in python
CO9	Illustrate the working of algorithms for processing digital images
CO10	Perform Histogram Equalization

COURSE CONTENT

Module I: Introduction to Computer Graphics- Raster Scan and Random Scan- Display Devices – LCD, LED, Plasma Display Panel- OLED Bresenhams's Line Drawing Algorithm- Mid point Ellipse drawing algorithm. Window-to-Viewport Transformation

Module II: 3D Transformations- Translation- Rotation- Scaling- Bezier Curves, Splines, Visible Surface Detection- Depth Buffer Method- Depth Sorting Method - Fractals- Sierpenski Gasket - Animation- Design of Animation Sequences

Module III: Graphics Programming : Primitives in OpenGL -Advantages of Open GL- Installing OpenGL- Input and Interaction in OpenGL- Call back functions- Keyboard Interaction- Open GL libraries – GLU, GLUT

Module IV: OpenGL Rendering Pipeline- Structure of an OpenGL program - Basic Transformations in OPENGL- Creating animations in OpenGL- Writing OpenGL programs

Module V: Image Processing – Digital Image representation - Types of Images- Sampling and Quantization - Steps in Digital Image Processing - Applications of Image Processing, Intensity transformation Functions

Module VI: Piecewise Linear Transformation Functions - Spatial Filtering- Histogram Processing, Histogram Equalization- Image enhancement using Arithmetic operations- Median Filter – Image Averaging

LEARNING RESOURCES

http://glprogramming.com/red/index.html

REFERENCES

1. Donald D. Hearn, M Pauline Baker, Warren Carithers, " Computer Graphics with Open GL ", PHI, 4th Ed., 2010.
2. Dave Shreiner, "OpenGL Programming Guide: The Official Guide to Learning OpenGL, Versions 3.0 and 3.1", Addison Wesley, 7th Ed., 2009
3. Steven Harrington, Computer graphics: A Programming approach, McGraw Hill, 2nd Ed.1987
4. James D. Foley, Andries van Dam, Steven K. Feiner and John F. Hughes, "Computer Graphics: Principles and Practice in C", Addison Wesley, 2nd Ed., 1995.
5. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 4th Ed., Pearson, March 2017.
6. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 1st Ed., 1988.
7. Azriel Rosenfield, Avinash C. Kak, "Digital Picture Processing", Morgan Kaufmann, 2nd Ed., 1982.
8. Bernd Jahne, "Digital Image Processing", Springer, 6th Ed., 2005.

SEMESTER I	COURSE CODE : CS 515	CREDIT : 2

DATA STRUCTURES USING PYTHON LAB

COURSE OUTCOMES

CO1	Illustrate various data representation techniques in the real world
CO2	Implement linear and non-linear data structures
CO3	Formulate various algorithms based on their time and space complexity
CO4	Develop real-time applications using suitable data structure
CO5	Design suitable data structure to solve various computing problems

COURSE CONTENT

Lab experiments related with the following should be implemented in this course.

1. SEARCHING TECHNIQUES

Write Python programs for implementing the following searching techniques.

1. Linear search
2. Binary search

2. SORTING TECHNIQUES

Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.

1. Bubble sort
2. Insertion sort
3. Selection sort
4. Quick sort
5. Merge sort

3. IMPLEMENTATION OF STACK AND QUEUE

Write Python programs to

a. Design and implement Stack and its operations using List.
b. Design and implement Queue and its operations using List.

4. APPLICATIONS OF STACK

Write Python programs for the following:

a. Uses Stack operations to convert infix expression into postfix expression.
b. Uses Stack operations for evaluating the postfix expression.

5. IMPLEMENTATION OF SINGLY LINKED LIST

Write Python programs for the following operations on Singly Linked List.

(i) Creation (ii) insertion (iii) deletion (iv) traversal

6. IMPLEMENTATION OF CIRCULAR SINGLY LINKED LIST

Write Python programs for the following operations on Circular Linked List.
(i) Creation (ii) insertion (iii) deletion (iv) traversal

7. IMPLEMENTATION OF DOUBLY LINKED LIST

Write Python programs for the following:
Uses functions to perform the following operations on Doubly Linked List.

(i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.

8. IMPLEMENTATION OF STACK USING LINKED LIST

Write a Python program to implement Stack using linked list.

9. IMPLEMENTATION OF QUEUE USING LINKED LIST

Write a Python program to implement Linear Queue using linked list.

10. GRAPH TRAVERSAL TECHNIQUES

Write Python programs to implement the following graph traversal algorithms:
a. Depth first search.
b. Breadth first search.

11. IMPLEMENTATION OF BINARY SEARCH TREE

Write a Python program to perform the following:
a. Create a binary search tree.
b. Traverse the above binary search tree recursively in pre-order, post-order and in-order.
c. Count the number of nodes in the binary search tree.

References

Data Structures and Algorithms Using Python (PDF) Rance D. Necaise

Web Resources

- https://www.iare.ac.in/sites/default/files/lab1/IARE_DS_Lab_Manual_0.pdf
- http://home.ustc.edu.cn/~huang83/ds/Data%20Structures%20and%20Algorithms%20Using%20Python.pdf

SEMESTER I	COURSE CODE: CS516	CREDIT: 2

COMPUTER GRAPHICS & IMAGE PROCESSING LAB

COURSE OUTCOMES

CO1	Implement Computer graphics programs using Open GL
CO2	Implement basic image processing algorithms in Python
CO3	Write programs for 3D transformations of image
CO4	Write program for histogram equalization
CO5	Design Animation Sequences for a given problem

COURSE CONTENT

Lab programs related with the following should be implemented in this course.

1. Implement Computer Graphics programs in Open GL
    - Write a program for displaying a triangle red in color
    - Display a static picture of a torus and the coordinate system axes.
    - Display a Sierpenski2D Gasket. (Use GL_points)
    - Perform 3D Rotation, Translation and Scaling of a Cube
    - Create an animation the sun and earth from the point of view of a comet.
    - Create an animation for bouncing balls.
2. Implement Image Processing programs in Python
    - Reading and displaying an image
    - Display the three channels of a color image
    - Arithmetic Operations – Image Addition, Image Subtraction in Images
    - Perform rotation, translation and scaling in images.
    - Perform image enhancement technique- Histogram Equalization
    - Implement Median filter for Noise Removal

References

1. https://cs.lmu.edu/~ray/notes/openglexamples/ accessed on 16.02.2021
2. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 4th Ed., Pearson, March 2017.

SEMESTER II	COURSE CODE : CS 521	CREDIT : 4

DATA BASE MANAGEMENT SYSTEMS

COURSE OUTCOMES

CO1	Explore relational database and various Normal forms and ER diagrams
CO2	Explain SQL and PL/SQL
CO3	Discuss various concepts of object oriented database
CO4	Identify the various kinds of data and pattern used in data mining.
CO5	Illustrate various algorithms used in data warehousing
CO6	Classify various cluster methods used in data mining and warehousing.

COURSE CONTENT

MODULE1: Relational Database:-Introduction-purpose of database systems, views of data– data abstraction, instances and schemas, data independence, data models Database languages-DDL, DML, transaction management, storage management, database administrator, database users. Relational data model- relational model concepts , keys, integrity constraints- domain constraints, key constraints, entity integrity constraints.

MODULE II: Normalization- types of Normal Forms-ER diagrams programs **with SQL(Basic query statements) and PL-SQL** - Developing stored procedures,-Creation, Statement blocks, Conditional execution, Repeated execution, Triggers- Creating triggers, Cursors – types of cursors.

Module III : Object Oriented Database Management Systems (OODBMS) - concepts, limitation of relational model, need for OODBMS, composite objects, issues in OODBMSs, advantages and limitations of OODBMS, object model, object definition language ,object query language..

Module IV :Introduction to Data Mining. Different kinds of data and patterns that are mined.Applications, Major Issues. Data Objects and Attribute Types, KDD Process , Data Pre-processing, Data cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.AssociationRule-Apriori Algorithm.

Module V : Basic concepts of Data Warehousing. Data warehousing modelling : Data cube and OLAP, OLTP, Data cube Technology. Classification, Decision Tree Induction, Bayes classification, Rule based classification, classification by back propagation

Module VI: Cluster Analysis: Partitioning methods, Hierarchical methods. Outlier–Outlier detection techniques . Advanced Techniques, Web Mining, Text mining, Spatial and Temporal Mining. Data mining and society, Data mining software.

Text Books

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan," Database System Concepts", McGraw Hill Education, 6th Edition, 2011.
2. 3. Guy Harrison, "Next Generation Databases: NoSQL, NewSQL, and Big Data", Apress, 1st Edition, 14 December 2015.
3. Ramon A. Mata-toledo and Pauline K. Cushman, Fundamentals of Relational Data Bases, SchaumOutlines, Tata McGraw Hill
4. Thomas Connolly and Carolyn Begg - Database systems, 4th edition – Pearson Education, 2009
5. M. Tamer Ozsu and PatrickValduriez, Principles of Distributed Database Systems; Pearson Education Asia ISBN: 81-7808-375-2
6. Sunitha Tiwari & Neha Chaudary, Data Mining and Warehousing, Dhanpat Rai & Co.
7. Data Mining : Concepts and Techniques , 3rd ed., J Han, M Kember, J Pei, Morgan Kaufman
8. Zaki Mohammed J., Meira Wagner, Data mining and analysis, Cabridge University Presss, 2014.

Web References:

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https://nptel.ac.in/courses/106/105/106105174/
https://nptel.ac.in/courses/106/106/106106093/

SEMESTER II	COURSE CODE : CS 522	CREDIT : 4

COMPUTER NETWORKS & SECURITY

COURSE OBJECTIVES

CO1	Describe the basics of Networks and Reference models
CO2	Analyze security issues in network, transport and application layers and outline appropriate security protocols
CO3	Discuss the fundamental concepts of Information Security & Cryptography
CO4	Analyze different classical encryption techniques
CO5	Identify the mathematical concepts for different cryptographic algorithms
CO6	Introduce fundamental concepts of authentication algorithms
CO7	Identify different authentication and digital signature schemes

COURSE CONTENTS

Module I Introduction to Data Communication: Components of Data Communication, Networks, Protocols and Standards, , Data and signals,, Inter connecting devices – Repeater, Hub, Switch, Bridge, Router, Gateways - Transmission Media -Copper wires, fibre optics, Radio transmission, microwave, Satellite. Switching - circuit, packet, message.

Module II Network Models- Layering, packets, Layered PDUs, ISO-OSI model, TCP/IP model Comparison. Functions of Data Link Layer ,Flow control – stop and wait, sliding window, Multiple Access Protocols - pure- slotted ALOHA, CSMA, CSMA/CD.- Network Layer functions- Routing (Distance Vector and Link State Routing)- Internet Protocol (IPv4 and IPv6)- Functions and services of Transport Layer – TCP.UDP –Application Layer sservices

Module III Concepts of Security: Introduction, The Need for Security, Security Approaches, Principles of Security, Types of Attacks, Classical Symmetric Cipher Models- Substitution techniques- Transposition techniques – Steganography- Block Cipher principles- Block Cipher modes of operations -Data Encryption Standard(DES)- AES.

Module IV Public key Cryptography: - Principles of Public key Cryptography Systems, Number theory- Euler's Totient Function, Extended Euclid's Algorithm, Modular arithmetic. RSA algorithm -Diffie-Hellman Key Exchange, El Gamal Cryptography

Module V Message Authentication and Hash Functions : Authentication & Hash functions- Message Authentication Codes , SHA , HMAC , Security of Hash functions and MACs- Digital signature-Digital signature standards, Kerberos

Module VI Security at various Layers: Email Security – PGP,S/MIME ,IP Security – IPSec , Web Security – Secure Socket Layer & Transport Layer Security , Intrusion Detection System , Malicious Software - Firewalls

Text Books:

1. Tanenbaum, 'Computer-networks' 4th-edition"
2. Behrouz A Forouzan,' Data Communication and Computer networks', 4th ed, McGraw Hill
3. Achyut S Godbole, 'Data communications and network's, McGraw-Hill, Second
4. Behrouz A. Forouzan, 'Cryptography and Network Security', Tata McGraw-Hill. 2010
5. William Stallings, 'Cryptography and Network Security', Pearson Education, 2014

References:

1. B. Schneier , Applied Cryptography, Protocols, Algorithms, and Source Code in C, 2 nd Edn, Wiley, 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, PHI, 2002

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- https://nptel.ac.in/courses/106/105/106105183/
- https://nptel.ac.in/courses/106/105/106105031/
- http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf
- http://www.cs.vsb.cz/ochodkova/courses/kpb/cryptography-and-network-security_-principles-and-practice-7th-global-edition.pdf

SEMESTER II	COURSE CODE : CS 523	CREDIT : 4

SOFTWARE ENGINEERING

COURSE OBJECTIVES

CO1	Apply the principles of the engineering processes ins software development
CO2	Demonstrate software project management activities such as planning,scheduling and Estimation
CO3	Model the requirements for the software projects
CO4	Design and Test the requirements of the software projects
CO5	Design patterns and object oriented modelling for software projects
CO6	Implement the software development processes activities from requirements to validation and verification
CO7	Apply version control for software

COURSE CONTENTS

Module 1: Introduction to Software Engineering: Characteristics of Software. Project planning phase: objectives and scope of the software system, empirical estimation models, COCOMO, staffing and personnel planning. Software Engineering models: Predictive software engineering models, model approaches, predictive and adaptive waterfall, waterfall with feedback (Sashimi), incremental waterfall, V model; Prototyping and prototyping models. Software requirements specification, Eliciting Software requirements, Requirements modeling, Requirements documentation. Use cases and User stories.

Module II: Software Design: Cohesion and Coupling Function oriented design: Overview of SA/SD Methodology, Developing the DFD model of a system, Structured Design, User Interface design: Characteristics of a good user interface, Types of user interfaces

Module III: Object Oriented Modeling and Design using UML-bject state and properties, Behavior, Methods, Messages, Object Oriented system development life cycle. Benefits of OOMethodologyFactional view(models):, Use case diagram ,Activity diagram , Static structural view (Models) Behavioral (Dynamic structural view):,State diagram, Interaction diagrams:,Approaches for developing dynamic systems:, Architectural view:.Reuse: Libraries, Frame works components and Patterns.

Module IV: Design Patterns: Basic concepts of Design patterns, How to select a design pattern, Creational patterns, Structural patterns, Behavioural patterns. Concept of Anti-patterns. Concepts of Agile Development methodology; Scrum Framework.

Module V: Software Testing: Software testing principles, Program inspections and walkthroughs, Program reviews;Unit Testing frameworks, The xUnit Architecture.Assertions, Custom Assertions, single condition tests, testing for expected errors, Abstract test. Blackbox testing: Equivalence class testing, Boundary value testing, Decision table testing, Pairwise testing, State transition testing, Use-case testing; White box testing: control flow testing, Data

flow testing. Testing automation: Defect life cycle; Regression testing, Testing automation; Testing non-functional requirements.

Module VI Software Configuration Management: Using version control, Managing dependencies and software configuration, Managing build and deployment environments. Continuous Integration: Prerequisites for continuous integration, Essential practices. Continuous Delivery: Principles of Software delivery, Introduction and concepts. Build and deployment automation,

Text Books

1. Philip A. Laplante, What Every Engineer Should Know about Software Engineering, CRC Press
2. Murali Chemuturi, Mastering Software Quality Assurance: Best Practices, Tools and Technique for Software Developers, J Ross Publishing
3. Erich Gamma et. al., Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley
4. Alistair Cockburn and Robert Cecil Martin, Agile Software Development: The Cooperative Game (2ndedition), Addition Wesley
5. Ken Schwaber , Agile Software Development with Scrum, Pearson
6. Lisa Crispin, Agile Testing: A Practical Guide for Testers and Agile Teams, Adison Wesley
7. Glenford J. Myers, et. al., The Art of Software Testing, Wiley
8. Lee Copeland, A Practitioner's Guide to Software Test Design, Artech House Publishers
9. Jez Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation,Pearson Education
10. Roger Pressman, Software Engineering: A Practitioner‟s Approach, 7th Edition, McGraw-Hill, 2010.
11. Ian Sommerville, Software Engineering, 9th Edition, Addision Wesley, 2016.
12. Pankaj Jalote, A Concise Introduction to Software Engineering, Springer, 2008.
13. William E. Lewis, Software Testing and Continuous Quality Improvement, Third Edition,Auerbach Publications, 2008

SEMESTER II	COURSE CODE : CS524 A	CREDIT : 3

COMPUTER FORENSICS AND CYBER LAWS

COURSE OUTCOMES

CO1	Discuss the importance of a systematic procedure for investigation of data.
CO2	Evaluate the use of computer forensics tools used in data analysis
CO3	Describe the nature and scope of cyber-crime.
CO4	Discuss Cyber crime investigation procedures
CO5	Discuss IT Act 2000, IPR, Copy right**.**
CO6	Explain the tools used in digital Forensics

COURSE CONTENT

Module I. Computer Forensics Fundamentals -Introduction to Computer Forensics-Types of Computer Forensics Systems- Preparing for computer investigations, Vendor and Computer Forensics Services-Computer Forensics Evidence and Capture- Data Recovery- Duplication and Preservation of Digital Evidence-Digital Investigation. Understanding data recovery workstations and software, conducting an investigation, completing the case, requirements for forensic lab certification, determining the physical requirements for a computer forensics lab.

Module II .Introduction to Digital Forensics - Forensic Software and Hardware - Analysis and Advanced Tools - Forensic Technology and Practices - Forensic Ballistics and Photography - Face, Iris and Fingerprint Recognition - Audio Video Analysis.

Module III: Introduction and Overview of Cyber Crime - Nature and Scope of Cyber Crime - Categories of Cyber Crime - Property Cyber Crime. **Cyber crime issues**- Unauthorized Access to Computers - Computer Intrusions - White collar Crimes - Viruses and Malicious Code - Internet Hacking and Cracking - Virus Attacks – Software Piracy.

Module IV :Introduction to Cyber Crime Investigation - Investigation Tools – Discovery - Digital Evidence Collection - Evidence Preservation - E-Mail Investigation – Tracking - IP Tracking - E-Mail Recovery - Search and Seizure of Computers - Recovering Deleted Evidences - Password Cracking.

Module V. Introduction to cyber Law: Evolution of the IT Act, Genesis and Necessity, Salient features of the IT Act, 2000, various authorities under IT Act and their powers. Penalties & Offences, Cyber Space Jurisdiction (a) Jurisdiction issues under IT Act, 2000. (b) Traditional principals of Jurisdiction (c) Extra terrestrial Jurisdiction (d) Case Laws on Cyber Space Jurisdiction.

Module V1 E-Commerce and Laws in India (a)E – Commerce; Issues and provisions in Indian Law (b) E – Governance; concept and practicality in India (c) E – Contracts and its validity in India. **Intellectual Property Rights**, Domain Names and Trademark Disputes (a) Concept of Trademarks / in Internet Era (b) Cyber Squatting(c) Copyright in Computer Programmes (d) Concept of Patent Right (i) Relevant Provisions of Patent Act 1970

References:

Text Books

1. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.
2. Kevin Mandia, Chris Prosise, Matt Pepe, ―Incident Response and Computer Forensics ―Tata McGraw -Hill, New Delhi, 2006.
3. John R. Vacca , 'Computer Forensics-Computer Crime Scene Investigation' , CHARLES RIVER MEDIA, INC.Boston, Massachusetts
4. F.Enfinger and C.Steuart B.Nelson,A.Phillips,' Guide to Computer Forensics And Investigations '
5. Raghu Santanam, M. Sethumadhavan, Mohit Virendra ,'Cyber Security, Cyber Crime and Cyber Forensics: Applications and Perspectives' , Information Science Reference.
6. Pfleeger , Charles P. and Shari L, 'Security in Computing' Upper Saddle River, NJ Prentice Hall.
7. PavanDuggal , ' Cyberlaw – The Indian Perspective ' Saakshar Law Publications.
8. Murugan S Cyber Forensics
9. Darren R. HayesA Practical Guide to Digital Forensics Investigations.

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https://www.cs.nmt.edu/~df/lectures.html

https://www.classcentral.com/course/swayam-information-security-and-cyber-forensics-23006

SEMESTER II	COURSE CODE: CS524B	CREDIT: 3

CLOUD COMPUTING TECHNOLOGIES

COURSE OUTCOMES

CO1	Describe cloud service models
CO2	Discuss the architecture of Clouds
CO3	Explain about virtualization in clouds
CO4	Describe web services and applications
CO5	Describe the need of security mechanisms in cloud
CO6	Analyze different cloud tools
CO7	Identify the Future trends of Clouds

COURSE CONTENT

Module I: Foundation: Cloud Computing Basics, Its Characteristics, Pros & Cons, Technologies, Seven-Step Model, Public and Private Cloud, Cloud Infrastructure, Cloud Service and deployment Models.

Module II: Architectures: Cloud Life Cycle Model, Role of Cloud Modelling and Architectures, Reference Model, Cloud Industry Standard, Logical Architectures, Developing Holistic Cloud Computing Reference Model, Basic Principles, Model for federated Cloud Computing, Cloud Eco system model, Cloud Governance, **Virtualization:** Types, Architectures and softwares, Virtual Clustering and its pitfalls.

Module III: Virtualization in Grid and Cloud, Anatomy of Cloud Infrastructure, CPU virtualization, Network and Storage Virtualization, **Data Storage:** Enterprise data storage, Data storage Management, File Systems, Data Stores, Grid Oriented Storage (GOS), CDMI, Data Intensive Technologies for Cloud Computing, Distributed Data Storage, Applications Utilising Cloud Storage. Value of Cloud Computing, Legal Implications

Module IV: Web Services, Infrastructure Services, On-Demand Computing, Web Application Framework, Cloud Type and Services, SaaS, PaaS, IaaS, STaaS, DaaS, INaaS, Cloud Service development tool, Risks in cloud computing, Risk Management, Cloud Impact, Enterprises wide risk management, Types of Risks, Current State, Content level Security, Confidentiality, Integrity and Availability, Security Authorization and challenges, Software requirements and testing.

Module V: SOA Introduction, SOA Communication, Operation, Components of Cloud and SOA, SOA and Cloud, Tools for building Cloud, Programming in Cloud, Cloud Mashups, Cloud Tools: VMWARE, EUCALYPTUS, CLOUDSIM, OPENNEBULA, NIMBUS, Microsoft Cloud Services, Google Cloud Applications.

Module VI: Amazon web components and services, Elastic Compute Cloud (EC2), Amazon Storage System and database services, Cloud Based Solutions, Cloud Computing Services, Future trends of cloud computing, Mobile Cloud computing, Automatic Cloud Engine, Multimedia Cloud, Energy awareness, Jungle Computing.

LEARNING RESOURCES

Text books

- Cloud Computing, A practical approach for learning and implementation, A.Srinivasan&J.Suresh, Pearson, 2017
- Cloud computing a practical approach - Anthony T.Velte Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
- Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

References

- Cloud Computing (Principles and Paradigms), Edited by RajkumarBuyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

SEMESTER:II	COURSE CODE :CS 524C	CREDIT:3

NATURAL LANGUAGE PROCESSING

COURSE OUTCOMES

CO1	Demonstrate the NLP- Text & Speech understanding system
CO2	Apply the n-gram & Language models in various NLP applications
CO3	Identify the different models for computational Morphological analysis
CO4	Apply and generalize the different types of Parts-of- speech tagging
CO5	Apply and execute the statistical parsing & probabilistic theory
CO6	Generalize the grammar formalisms & tree banks of syntactical parsing
CO7	Recall the Phonetics & Phonology in speech forms
CO8	Generalize the knowledge representation system in Language processing
CO9	Predicate the ambiguity & solutions of different methods
CO10	Describe the place and manner of articulation in speech processing
CO11	Evaluate the recall & F-score method in speech processing
CO12	Implement the Finite State Model for morphological processing
CO13	Criticize the Named Entity Recognition & relation extraction methods
CO14	Execute the probability model for speech processing

COURSE CONTENT:

Module I: Introduction-Natural Language Processing: Natural Language Understanding and Generation. Levels of Analysis: Phonetics, Phonology, Morphology,Syntax, Semantics, and pragmatics.NLP Task, Applications, and Issues.Machine Learning and NLP: The role of machine learning. Probability Basics–Information theory-Estimating parameters and smoothing- Evaluating language models.

Module II: Speech Processing: Graphical Modelsfor Sequence Labeling in NLP, Consonants (place and manner of articulation) and Vowels;Phonology: ASR, Speech Synthesis, Hidden Markov Model and Viterbi, Precision, Recall,F-score, Map. Speech technology and Speech understanding. Feature extraction. Introduction to PRAAT.

Module III: Morphology: Root & Stem, affixes. Inflectional and Derivational Morphology.Linguistic essentials– Lexical,Morphology, syntax. Finite State Transducers. Part of speech Tagging- Tag set - Rule-Based Part of Speech Tagging -Markov Models- Hidden Markov Models– Statical tagger. Transformationbased Models - Maximum Entropy Models. Conditional Random Fields.

Module IV: Syntax parsing: Grammar formalisms and tree banks- Parsing with Context Free

Grammars- Features and Unification. Parsing: Top-down and Bottom-Up, Statistical parsing andprobabilistic CFGs (PCFGs)-Lexicalized PCFGs. Word net, Lexicography, wordnet similarity. Regular expression, Word tokenization. Stop word removal, Stemming, Lemmatization.

Module V: Semantic analysis- Representing Meaning – Semantic Analysis – Lexicalsemantics– ambiguity: Word sense disambiguation- Supervised– Dictionary based andUnsupervised Approaches - Compositional semantics - Semantic Role Labeling andSemantic Parsing – Pragmatics - Discourse Analysis.

Module VI: Applications - Named Entity Recognition (NER) and relation extraction- IE usingsequence labeling-Machine Translation (MT) - Basic issues in MT-Statistical translationwordalignment- phrase-based translation. Tools for Machine Translation: NLTK, textblob, Python-, Gensim, Scikit-learn Question Answering, Text Summarization,Corpus Design: Collocations -n-gram Language Models.

REFERENCES:

1. Jacob Eisenstein, Introduction to Natural Language Processing, 2019.
2. Dash, Niladri Sekhar Corpus Linguistics and Language Technology, New Delhi:Mittal Publications 2005.
3. Dan Jurafsky and James H. Martin, Speech and Language Processing (3rd ed.draft), Draft chapters in progress, October 16, 2019.
4. Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python.Steven 2016.
5. James Allen, Natural Language Understanding (2nd Edition) 2nd Edition- 2017.
6. Ruslan Mitkov, The Oxford Handbook of Computational Linguistics, OxfordUniversity Press 2003.
7. Philipp Koehn , Statistical Machine Translation, 2016.
8. Daniel Jurafsky and James H. Martin: 2000, Speech and Language Processing:An Introduction to Natural Language Processing, Computational Linguistics, andSpeech Recognition. Prentice-Hall.
9. Geoffrey Sampson and Diana McCarthy: 2004. Corpus Linguistics: Readings in a Widening Discipline. Continuum Press.

SEMESTER:II	COURSE CODE: CS 525	CREDIT:2

NETWORK PROGRAMMING IN JAVA LAB

COURSE OBJECTIVES

CO1	Develop a basic knowledge of programming constructs
CO2	Explore basic knowledge of networking
CO3	Analyze socket programming with Java
CO4	Develop socket programs and client server applications
CO5	Apply socket programming running over Proxy Server

COURSE CONTENT

LIST OF EXPERIMENTS

1. Experiments familiarizing basic programming constructs: defining class, using input output, control structures.
2. Experiments to practice overloading, overriding
3. Experiments to practice multithreading
4. Learn RMI
5. Basic socket programming with Java,
6. Client server communication
7. Writing multicast client and server
8. Develop socket programs and client server applications for TCP and UDP
9. Build Java socket programs for HTTP, FTP, SMTP, POP3
10. Build Java socket programs running over Proxy server

SEMESTER:II	COURSE CODE: CS526	CREDIT:2

DBMS & DATA MINING LAB

COURSE OUTCOMES

CO1	Describe various kinds of tools in DBMS.
CO2	Analyze the mining techniques for realistic data, and also to conceptualize Data Mining and the need for pre-processing
CO3	Develop the algorithms used for various types of Data Mining Problem
CO4	Construct algorithms to solve data mining problems using WEKA tool
CO5	Demonstrate the classification and clusters Techniques in large datasets.
CO6	Build an ability to add mining algorithms as a component to the existing tools.

COURSE CONTENT

LIST OF EXPERIMENTS

- **Database Management System**

1. SQL statements for creating, listing, dropping, checking, updating tables.
2. Record manipulation using insert, delete, and update.
3. Experiments on the use of keys.
4. Queries with expressions.
5. Queries on aggregation, grouping.
6. Queries with substring comparison and ordering.
7. Queries to find values on different conditions and constraints.
8. Nested queries
9. Renaming attributes and joined tables
10. Experiments on other features covered in the course CS2021

Data Mining Experiments

1. Creation of a Data Warehouse.
2. Apriori Algorithm.
3. FP-Growth Algorithm.
4. K-means clustering.
5. One Hierarchical clustering algorithm.
6. Bayesian Classification.
7. Decision Tree.
8. Support Vector Machines.
9. Applications of classification for web mining.
10. Case Study on Text Mining.

TEXT BOOKS

1. ORACLE PL/SQL Programming – Scott Urman BPB Publications.
2. Data Mining: Concepts and Techniques (The Morgan Kaufmann Series in Data Management Systems) -- by Jiawei Han, MichelineKamber;
3. Insight into Data Mining – Theory and Practice - K.P.Soman, ShyamDiwakar, V.Ajay, PHI, 2006.
4. Database Management Systems : Raghu Ramakrishnan
5. Oracle 9i The Complete Reference – Kevin Loney, George Koch - Oracle Press

SEMESTER III	COURSE CODE : CS531	CREDIT : 4

AUTOMATA THEORY & COMPILER DESIGN

COURSE OUTCOMES

CO1	Evaluate concepts in automata theory and theory of computation.
CO2	Formulate grammars and recognizers for different formal languages
CO3	Prepare Finite Automata, NFA, Push Down Automata
CO4	Explain Turing Machines and types of Turing Machines
CO5	Analyze the lexical, syntactic and semantic structures of language features
CO6	Explore the techniques for intermediate code representation and machine code optimization

COURSE CONTENT

Module I :Automata Theory: Concepts of Automata Theory-Formal Language and Regular Expressions**,** Chomsky Hierarchy of Grammar , Regular Grammar, Finite Automata – DFA, NFA, Conversion of regular expression to NFA, NFA to DFA. Finite Automata with Epsilon Transitions, Eliminating Epsilon Transition, FAs & Regular Expressions, Minimization of DFA, FA with outputs

Module II :Context Free grammars : CFG , Parse Trees ,Derivation, Ambiguity in Grammar , Removal of Left Recursion , Left Factoring , Push Down Automata-Languages , Equivalence of PDA's and CFG's , Deterministic Pushdown Automata,

Module III: Turing Machines: Transition Diagrams for Turing Machines, Language of a Turing Machine Turing Machines and Halting, Multitape Turing Machines, Equivalence of OneTape and Multitape TM's, Undecidable Problems about Turing Machines

Module IV : Compiler : Phases of Compiler **,**role of Lexical Analyzer, specification & recognition of Tokens using Regular Expressions, Syntax Analysis: Parsing ,Top-Down Parsing: Recursive Descent parsing, Predictive parsing, LL(1) Grammars. Bottom-Up Parsing: Shift Reduce parsing LR , SLR , CLR & LALR parsers, Compiler Construction Tools

Module V: Syntax Directed Translation: Dependency Graphs, S-Attributed & L-Attributed Definition, Type Checking, Intermediate Code Generation: Intermediate code Representations, DAGs ,Three-Address code, Quadruples, Triples, SSA

Module VI: Code Generation: Issues in Design of Code generator, Static & Stack Allocation Basic Blocks & Flow Graphs, Optimization of Basic blocks, Simple Code Generator, Code Optimization: Principal sources of optimization, Peephole Optimization.

Text Books:

1. Aho, Ullman, Ravi Sethi , 'Compilers Principles, Techniques and Tools' , Pearson Education.
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman ,' Introduction to automata theory, languages and computation'
3. Sipser ' Introduction to Theory of computation ' ,2nd Edition, Thomson.

Reference Text Books:

1. Andrew W.Appel, 'Modern Compiler Construction in C ', Cambridge University Press.
2. LOUDEN, ' Compiler Construction , Principles & Practice' , Thomson.

Web Resources:

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https://nptel.ac.in/courses/106/103/106103070/

https://nptel.ac.in/courses/106/106/106106049/

https://nptel.ac.in/courses/111/103/111103016/

https://nptel.ac.in/courses/106/108/106108113/

https://nptel.ac.in/courses/106/108/106108052/

SEMESTER : III	COURCE CODE :532	CREDIT :4

BIG DATA ANALYTICS

COURSE OUTCOMES

CO1	Familiarize the fundamentals of Bigdata and Data Analysis
CO2	Discover Stream Computing, Analytics and Frameworks
CO3	Discuss the fundamentals of RDF and Querying the Semantic Web
CO4	Explain the concepts of HDFS and MapReduce framework
CO5	Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop administration
CO6	Recognize the role of Business Intelligence, Visualization in decision making

COURSE CONTENT

Module I Big Data – Definition, Characteristics, Features – Big Data Applications -Structure of Big Data- Evolution of analytic scalability - Analytic innovation .Modern Data Analytic Tools. Characteristics of big data analytics, Need of big data analytics,Classification ofanalytics, Challenges to big data analytics, Importance of big data analytics.

Module II Mining data streams: Introduction To Streams Concepts – Stream Data Model andArchitecture - Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream –HDFS concepts– MapReduceExecution, Algorithms using MapReduce,.Introduction to Big Data Platforms.

Module III Hadoop foundation for analytics:Features, Key advantage andVersions ofHadoop, Essential of Hadoop ecosystems, RDBMS versus Hadoop, Keyaspects andComponents of Hadoop, Hadoop architectures.HadoopMapReduce .Introduction to MapReduce, Processingdata withHadoop using MapReduce.

Module IV Developing a Map Reduce Application-How MapReduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle andSort – Task execution - Map Reduce Types and Formats- Map Reduce Features-

Module V Predictive Analytics- Simple linear regression- Multiple linear regression- Interpretation. InternalsIntroduction to Big Data Streaming Platforms for Fast Data-Introduction to Big Data StreamingSystems-Big Data Pipelines for Real-Time computing.

Module VI Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services .Introduction to Big Data Storage Platforms for Large Scale Data Storage.Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation.

TEXT BOOKS

1. Seema Acharya and SubhashiniChellappan, “Big Data and Analytics”, Wiley IndiaPvt. Ltd, 2016.
2. Big data now –O”Reilly
3. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier, 2007
4. Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351
5. Anil Maheshwari, “Data Analytics”, 1st Edition, McGraw Hill Education, 2017. ISBN-13: 978-9352604180

REFERENCE TEXTS:

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman “Big Data” by Wiley Publications, 2014.
2. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
3. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics forEnterprise Class Hadoop and Streaming Data”, McGraw Hill, 2011.
4. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007
5. Pete Warden, Big Data Glossary, O’Reilly, 2011

SEMESTER III	COURSE CODE : CS 533	CREDIT : 4

ARTIFICIAL INTELLIGENCE

COURSE OUTCOMES

CO1	Investigate the applications of artificial intelligence
CO2	Explain about learning systems and its application scope
CO3	Illustrate knowledge representation and its structures
CO4	Define machine learning
CO5	Compare different quantification methods of classification
CO6	Differentiate different clustering techniques and algorithms
CO7	Implement Support Vector Machine algorithm and its variants

COURSE CONTENT

Module I: Knowledge Representation and Reasoning- Knowledge Management, Types of Knowledge, Knowledge representation, Knowledge base. - Knowledge Representation Structures - First Order logic, Unification algorithm, Frames, Conceptual Dependency, Scripts, Semantic network.

Module II: Types of reasoning, Non-monotonic reasoning, reasoning with Fuzzy logic, Rule Based reasoning, Case Based reasoning, Model based reasoning systems. – Bayes' rule, Bayesian networks, probabilistic inference, sample applications.

Module III: Machine Learning, Types of learning, Learning of Input/ Output Function, history and timelines of machine learning, Aspects of machine learning, Machine Learning Applications and examples, intelligent agents

Module IV: Quantification of classification - Threshold Fixing, ROC Graphics, ROC formulation. Supervised learning model - Prediction system, Training, testing and validation datasets, cross validation. Supervised learning model - Bias-variance trade-off, classification problems.

Module V: Unsupervised learning model - clustering, data compression, PCA. Clustering - k-Means clustering, Fuzzy clustering, hierarchical clustering Agglomerative and Divisive Clustering, Hierarchical Agglomerative Clustering, Cluster similarity.

Module VI: Support Vector Machines- Margins, Learning a maximum hyperplane, Kernel functions, Linear SVM, Non-linear SVM, Applications of SVM. Decision Trees - Decision tree construction, types of decision trees. Decision tree algorithms - C4.5 algorithms, CART, random forest.

Text Books

1. C. Bishop - “Pattern Recognition and Machine Learning”, Springer, 2007.
2. Vinod Chandra S S, Anand H S - “Machine Learning: A Practitioners Approach”, Prentice Hall of India, New Delhi, 2020
3. Vinod Chandra S S, Anand H S- "Artificial Intelligence and Machine Learning", Prentice Hall of India, New Delhi, 2014

SEMESTER III	COURSE CODE : CS 534 A	CREDIT : 3

SOFT COMPUTING TECHNIQUES

COURSE OUTCOMES

CO1	Learn Fuzzy logic and its applications
CO2	Discuss the basic concepts of artificial neural networks and its applications
CO3	Describe about Swarm models and its self-organisation
CO4	Understanding of nature inspired algorithms
CO5	Solve single-objective optimization problems using GAs
CO6	Solve multi-objective optimization problems using Evolutionary algorithms.
CO7	Apply Soft computing techniques to solve problems in various application domains.
CO8	Classify Single and multi-objective Optimization techniques

COURSE CONTENT

MODULEi: Introduction to Soft Computing: Concept of computing systems - "Soft" computing versus"Hard" computing - Characteristics of Soft computing - Some applications of Soft computingtechniques.

MODULE II: Fuzzy logic: Introduction to Fuzzy logic - Fuzzy sets and membership functions – Operationson Fuzzy sets - Fuzzy relations, rules, propositions, implications and inferences – Defuzzification techniques - Fuzzy logic controller design - Some applications of Fuzzy logic.

MODULEIII: Artificial Neural Networks: Biological neurons and its working - Simulation of biological neurons to problem solving - Different ANNs architectures - Training techniques for ANNs -Applications of ANNs to solve some real life problems.

MODULEIV: Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organisation, swarm and evolutionary algorithms. Optimisation problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

MODULE V: Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilisticsearch techniques - Basic GA framework and different GA architectures - GA operators:Encoding, Crossover, Selection, Mutation, etc. - Solving single-objective optimization problemsusing Gas.

MODULE VI: Multi-objective Optimization Problem Solving: Concept of multi-objective optimizationproblems (MOOPs) and issues of solving them - Multi-Objective Evolutionary Algorithm(MOEA) - Non-Pareto approaches to solve MOOPs - Pareto-based approaches to solve MOOPs -Some applications with MOEAs.

References

- Melanie Mitchell: An Introduction to Genetic Algorithms, MIT Press, 1st edition, 1998.
- Nikola K. Kasabov: Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, 1st edition, MIT Press, 1996.
- S. N. Sivanandam and S. N. Deepa: Principles of Soft Computing, Wiley, 3rd edition, 2018.
- Randy L. Haupt and Sue Ellen Haupt: Practical Genetic Algorithms, Wiley, 2nd edition, 2004.
- Simon Haykin: Neural Networks and Learning Machines, Pearson, 3rd edition, 2009.
- Vinod Chandra S S, Anand H S - "Artificial Intelligence: Principles and Applications", Prentice Hall of India, New Delhi, 2020
- Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioners Approach", Prentice Hall of India, New Delhi, 2020.
- J.-S. R. Jang, C.-T. Sun, and E. Mizutani: Neuro Fuzzy and Soft Computing, Pearson Education India, 1st edition, 2015.

SEMESTER III	COURSE CODE: CS 534 B	CREDITS 3

SOCIAL NETWORK ANALYSIS

COURSE OUTCOMES

CO1	Identify the different components of a web social network that can be used for analyzing and mining
CO2	Represent knowledge using ontology
CO3	Predict human behaviour in social web and related communities
CO4	Visualize social networks
CO5	Develop semantic web related applications

COURSE CONTENT

Module I : Introduction: Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

ModuleII: Knowledge representation on the semantic Web: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language.

Module III: Modelling, Aggregating social network data : State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

Module IV: Evolution in Social networks-framework-Challenges of social network streams- □ Models and Algorithms for Social influence Analysis □ Influence Related Statistics □ Social Similarity and Influence

Module V: Link prediction in social networks-Feature based link prediction-Bayesian probabilistic models - Probabilistic Relational Models - Text Mining in Social Networks Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

Module VI: Visualization and applications of Social networks: Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

Text books

1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011
3. Borko Furht, Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

References

1. Maksim Tsvetovat, Alexander Kouznetsov ,"Social Network Analysis for start-ups:finding connections on the social web", Shroff/O'Reilly

2. Pearson," Network Analysis ",Revised Third Edition, Pearson Education

SEMESTER III	COURSE CODE : CS 534 C	CREDIT :3

BIOINFORMATICS

COURSE OUTCOMES

CO1	Acquire basic knowledge in Life science
CO2	Obtain detailed knowledge about Bioinformatics
CO3	Appreciate the design of biological databases to hold enormous data
CO4	Implement algorithms used for sequence analysis
CO5	Demonstrate the use tools in bioinformatics
CO6	Identify how computer science is closely associated with Biology

COURSE CONTENT

Module I: Introduction to life Science **:** Characteristics of life, Levels of biological Organization, cell as basic unit of life, cell theory, structure of Prokaryotic cell and Eukaryotic cell, Primary and secondary structure of DNA, Chargaff's Rules, Different forms of DNA, RNA, structural organization of DNA, Central Dogma of Molecular Biology, Gene and genetic information

Module II: Bioinformatics: Introduction, History of Bioinformatics, Definition of Bioinformatics, Bioinformatics versus Computational Biology, Goals of Bioinformatics analysis, Bioinformatics technical tool box, Biological data, File format, conversion of file format, Data retrieval system, Genome browsers, Branches of Bioinformatics

Module III: Biological Sequences: Analyzing DNA sequence, IUPAC code for DNA sequence, ORF, palindromes in DNA sequence, RNA sequence analysis; FASTA format. Sequence analysis: DNA sequence, RNA sequence, Protein sequence; Sequence alignment : classifications, Scoring Matrices – PAM, BLOSUM, Pairwise Alignment Method (DOT PLOT method) and Multiple Alignment

Module IV: Biological Databases: Types of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, GenBank, DDBJ; Secondary nucleotide databases, Protein sequence databases-SwissProt/ TrEMBL, Protein structure databases- Protein Data Bank

Module IV: Bioinformatics Tools: ORFFinder, Sequence comparison Tools – BLAST, FASTA; Prediction Tools – GENSCAN, SNP; Visualization Tools – RasMol, PyMol, SWISS-PDBViewer; Phylogenetic Tools – Mega, ClustalW, CADD Tools : GOLD, Auto Dock

Module VI: Human Genome Project, Importance of Perl language in Bioinformatics, Applications of Bioinformatics in Biodiversity, Human Genetics, Gene Therapy, Agriculture, Computer-Aided Drug Design, DNA Fingerprinting

References

Text books

1. P S Verma, V K Agarwal, Cell Biology, enetics, Molecular Biology, Evolution and Ecology, S. Chand Publications.
2. S C Rastogi, N Mendiratta, P Rastogi, Bioinformatics Methods and Applications, PHI
3. Jin Xiong, Essential Bioinformatics, Cambridge University Press
4. Jean-Michel Claverie, Cedric Notredame, Bioinformatics: A Beginner's Guide, Wiley, 2006
5. Dr. K Mani & N Vijayaraj, Bioinformatics: A practical approach, Aparna Publications

Additional and Web -Resources

1. https://nptel.ac.in/courses/102/106/102106065
2. http://www.cs.ukzn.ac.za/~hughm/bio/docs/IntroToBioinfAlgorithms.pdf

SEMESTER III	COURSE CODE : CS 535	CREDIT : 2

MAJOR PROJECT PHASE- I

COURSE OBJECTIVES:

The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real-life problems related to industry or current research. The project work can be a design project/experimental project and/or computer simulation project on any of the topics related to the field of Computer Science.

The project work is chosen / allotted individually on different topics. Work of each student shall be supervised by one or more faculty members of the department. The students shall be encouraged to do their project work in the College itself. If found essential, they may be permitted to carry out their major project outside the College.

The student is required to undertake the major project phase-1 during the third semester and the same is continued in the 4th semester (Phase 2).

In Major Project Phase-I, the students are expected to select an emerging research area in the field of Computer Science. After conducting a detailed literature survey, they should compare, analyze research works done and review recent developments in the area and prepare an initial design of the work to be carried out as Major Project. It is mandatory that the students should refer to National and International Journals and conference proceedings while selecting a topic for their Project. Emphasis should be given to introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work carried out on the Project topic in Phase I.

Phase-1 consist of preliminary work, two reviews of the work and the submission of a preliminary report. First review would highlight the topic, objectives, preliminary report and scope of the work. Second review evaluates the progress of the work, methodology /design and expected results which is to be completed in the 4th semester?

COURSE OUTCOMES:

The students need to do the following activities:

1. The student shall submit a proposal for different projects before the internal assessment team. The team shall select and finalize one of the proposals. However if all proposals are not acceptable, he may be asked to submit new/modified proposals. The candidate shall prepare and submit a synopsis of the accepted proposal. A record of the accepted synopsis of each candidate shall be maintained in the department.

2. A detailed study of the requirements and feasibility of the proposed work shall be conducted by the candidate with the help of the project guide. A study phase report shall be presented before the assessment team within one month from the beginning of project work during the first review. The design of proposed work shall be completed and

presented before the assessment team for the second review. The design shall be finalized with suggested corrections/updates.

3. A short presentation explaining the proposed work and expected experimental results shall also be made during second review. The Project Report shall be finalized only after the internal presentation after correcting/updating the document based on the comments from internal assessment team.

Students should submit a copy of Phase-I Project report covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the Project. The candidate should present the current status of the Project work and the assessment will be made on the basis of the work and the presentation, by a panel of internal examiners in which one will be the internal guide. The examiners should give their suggestions to the students so that it should be incorporated in the Phase–II of the Project.

SEMESTER III	COURSE CODE : CS 536	CREDIT : 1

SEMINAR

COURSE OBJECTIVES:

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the M. Sc. Computer Science programme / recent trends in the field of Computer Science. He / she shall select the topic based on the references from National or International journals of repute. They should get the paper approved by the Programme Co-Ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar.

COURSE OUTCOMES:

The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

SEMESTER III	COURSE CODE : CS 537	CREDIT : 2

DATA ANALYTICS LAB

COURSE OUTCOMES

CO1	Describe the installation of Hadoop
CO2	Implement some programs in Hadoop
CO3	Implement fewMap Reduce programs
CO4	Install and Run Hive
CO5	Data analytics using Apache Spark

COURSE CONTENTS

LIST OF EXPERIMENTS

1. Installation of Hadoop.

2. Use web based tools to monitor your Hadoop setup.

3. Implement the following file management tasks in Hadoop:
   Adding files and directories • Retrieving files • Deleting files

4. Benchmark and stress test an Apache Hadoop cluster
Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
Find the number of occurrence of each word appearing in the input file(s)

5. Performing a MapReduce Job for word search count (look for specific keywords in a file)
Stop word elimination problem:
- Input: o A large textual file containing one sentence per line o A small file containing a set of stop words (One stop word per line)
- Output: o A textual file containing the same sentences of the large input file without the words appearing in the small file.

6. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.
7. Find average, max and min temperature for each year in NCDC data set?
   Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.
8. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

9. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.
10. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

References

1. Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization by DT Editorial Services

Web Resources

- https://www.coursera.org/learn/big-data-
- https://www.ee.columbia.edu/~cylin/course/bigdata/

SEMESTER IV	COURSE CODE : CS 541	CREDIT : 4

RESEARCH METHODOLOGY & REPORT WRITING

COURSE OUTCOMES

CO1	Introduce concepts in research methodology and technical writing
CO2	Overview of research process
CO3	Introduction of concepts statistical data analysis and use of statistical functions in R language
CO4	Importance of publishing the results of research
CO5	Underline Ethics in research.
CO6	Outline formats and styles for research publications
CO7	Creation of article, book, report, slides using LaTeX

COURSE CONTENT

Module I : Research: Definitions, Objectives and types of research: Motivation; Research Methods, Significance of Research, overall processes involved in research, Defining and formulating the research problem, Literature review - need, importance and various sources for literature searching and information gathering. Identifying gap areas from literature review, formation of research hypothesis, Research Design, The Scientific Method- Observation-Questions- Hypothesis- Experimentation, Criteria of good research.

Module II : Statistics for research: Data, information and system model, Missing frequencies, Frequency Distribution, Cumulative Frequency Distribution, Graphical Representation of data, Types of data analysis-(Descriptive and inferential concepts only), Measures of Central Tendency, dispersion, measures of symmetry, kurtosis, Linear Correlation and Linear Regression Analysis, Types of correlation, Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient.

Module III: Introduction to R, data types and control structures in R, Reading data files (with different formats) in R. Overview of statistical functions in R Language –rnorm, mean, avg, median, var, sd, scale, sort, rank, quantile, aov, cor, lm, coefficients, confint, summary, plotting functions - hist, plot, curve and boxplot.

Module IV: Critical Communication-Presenting and publishing research work- seminar, workshop, symposium, conference. Types, need and significance of Technical writing, in computer science research. Reporting and thesis writing – writing a proposal, Structure and components of scientific reports - Types of report – Technical reports and thesis– Different steps in preparation of report – Layout – Illustrations and tables - Bibliography, Mechanics of writing research report, referencing and footnotes, Referencing styles.

Module V: : Technical writing in Latex: LaTeX compilation, formatting, writing books as chapters, designing header and footer, designing chapters and sections, creating lists, tables, inserting images, setting labels and reference, index, list of figures and tables, math formulae, hyperlinks, bookmarks, bibliography

Module VI : . LaTeX Classes: article, book, report, slides, IEE Tran; Publishing research papers:- Structure of a research paper, awareness on paper publication formats-IEEE Tran, Impact factor, h, hb, g indices, research repositories- WoS & Scopus; DOI, Ethics in research, Intellectual property rights, Patents, Plagiarism and Plagiarism checking tools.

Assignment: Create a sample research paper, slides or a book using Latex (any one)

Reference:

Text Books:

- Kothari, C.R., Research Methodology: Methods and Techniques. New Age International. Publishers
- Mr. Ranjit Chitale., Statistical and Quantative Methods
- S.P.Gupta, Statistical Methods., Sultan Chand, NewDelhi
- Kottwiz, LaTEX for Beginners.
- Kopka., A guide to Latex.

Web Resources:

- https://nptel.ac.in/courses/121/106/121106007/
- http://web.mit.edu/rsi/www/pdfs/new-latex.pdf
- https://cran.r-project.org/web/packages/HSAUR/vignettes/Ch_introduction_to_R.pdf
- http://www.countbio.com/web_pages/left_object/R_for_biology/R_fundamentals/curve_to_function_R.html
- https://nptel.ac.in/courses/109/106/109106137/

SEMESTER IV	COURSE CODE : CS 542 A	CREDIT : 3

ADVANCED LEARNING TECHNIQUES

COURSE OUTCOMES:

CO1	Explain about fuzzy systems and Fuzzy Logic with examples. (Understand)
CO2	Use fuzzy set theory for solving problems.(Apply)
CO3	Apply Neuro-fuzzy concepts in developing an intelligent system. (Apply)
CO4	Illustrate the working of GANs
CO5	Implement KNN, ensemble and adaBoost classifiers for Machine learning. (Apply)
CO6	Compare different ANN networks and working structure. (Analyze)
CO7	Compare different Deep architectures and their learning models. (Analyze)

COURSE CONTENT

MODULE I: Introduction to Fuzzy Logic - Fuzzy neural systems, Fuzzy logic and fuzzy set, Fuzzy control, Defining fuzzy operations, Fuzzy reasoning, De-fuzzification techniques, Fuzzy Inference Systems- ANFIS, Types of Neuro-fuzzy Systems, Applications and advantages of Fuzzy systems.

MODULE II: Nearest neighborhood - Distance measure, Hamming distance, Euclidean distance, City Block Distance, Square distance, KNN algorithm, Nearest Neighborhood applications- Expectation Maximization, EM algorithm, Features of EM

MODULE III: Ensemble classifier, Types of ensemble methods, Simple ensemble models, Advanced ensemble models, AdaBoost, Bayes Optimal classifier, Bayesian model averaging, Gradient boosting

MODULE IV: ANN basics, Types of networks, Perceptron, RBF networks, Self-organising maps, Adaptive Resonance theory, Recurrent neural network, Hopfield networks, Boltzmann machines, Probabilistic neural network

MODULE V: Deep learning - Convolutional neural networks – Transfer learning- Deep architecture -Recurrent and Recursive networks, Bidirectional RNNs, Deep Recurrent Networks, LSTM. Deep Belief networks, Deep reinforcement learning, Applications of deep learning.

MODULE VI: Generative Networks: Auto encoders, Generative Models, GANs framework, GANs application, Variation auto encoders – Applications

References

- Aggarwal Charu – “Neural Networks and Deep Learning”, Springer, 2015.
- AurélienGéron’s, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly Media, Inc.,2017.
- Ian Goodfellow, YoshuaBengio, Aaron Courville – “Deep Learning”, MIT Press, 2016.
- Mike Krebbs - "Deep Learning with Python", CreateSpace Independent Publishing Platform, 2018.
- Vinod Chandra S S, Anand H S - “Machine Learning: A Practitioners Approach”, Prentice Hall of India, New Delhi, 2020.

SEMESTER IV	COURSE CODE : CS 542 B	CREDIT : 3

OPTIMIZATION TECHNIQUES

COURSE OUTCOMES

CO1	Acquire awareness about ability to apply theoretical knowledge of Mathematics and Computational Science to model and solve real time problems
CO2	Describe operations Research Introduction, limitations and solutions,Overview of Transportation problem, Applications and solutions
CO3	Identify the importance of optimization of industrial process management, Awareness about Assignment problem, limitations and solutions
CO4	Outline Game theory- systematic quantitative approach for deciding the best strategy in competitive situations.
CO5	Outline network theory concepts, CPM and PERT – How they minimise production delays, interruptions and conflicts
CO6	Outline queuing theory- How it helps users make informed business decisions on how to build efficient and cost-effective workflow systems
CO7	Outline Poisson distribution- tool used in probability theory statistics

COURSE CONTENT

Module I: Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research**.**Modeling in Operations Research -Solution methods for O.R- Methodology of O.R Linear Programming Problem-Formulation-Graphical method-Simplex method Artificial variables, big-M method, two-phase method, degeneracy and unbounded solutions.Concept of Duality: Formulation of dual LPP, Duality theorem, advantages of duality, Dual simplex algorithm,-Big M method-Two phase method.

Module II: Transportation Problem-Formulation, Solution, Unbalanced Transportation Problem, Methods to find initial basic feasible solution-Northwest corner rule-Matrix minima method, least cost method, Vogel's Approximation method. Solving TP -MODI method – Degeneracy in TP-Maximization in TP.

Module III: Assignment Problem- Hungarian method of assignment-Maximization in assignment problem. Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Travelling salesman problem and crew assignment problem.

Module IV: Games Theory- Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 x 2 games

Module V: Network Models- Definition, Shortest Route problem, Maximum flow problem. CPM & PERT: Network representation, Critical Path Computations

Module VI: Queuing Theory-Elements of a queuing system-Kendall's notation-Operating characteristics-Poisson process. Exponential distribution - mean and variance - Birth and death process. Queuing models based on Poisson process-Single server models with finite and infinite capacity-Multi server models with finite and infinite capacity.

References:
Text books

- P. K. Gupta and D. S. Hira, "Operations Research", S. Chand & Co.
- Sharma J.K., Mathematical models in operations research, TMH.
- Thaha H.A, Operations Research, Pearson.
- Winston, Operations Research Applications and Algorithms, Cengage.
- L. R Potti, Operations Research.
- Kanthi Swaroop, P.K Guptha, ManMohan, Operations Research
- Operations Research: Principles And Practice, A. Ravindran, Don T. Phillips, James J. Solberg

SEMESTER IV	COURSE CODE : CS 542 C	CREDIT : 3

COMPUTER VISION

COURSE OUTCOMES

CO1	Describe basic principles of computer vision
CO2	Develop understanding of the basic image operations
CO3	Explain image feature detection and matching
CO4	Explore basic theory of edge detection
CO5	Analyze Principal Component Analysis & Motion Estimation
CO6	Develop skills in the design and implementation of computer vision

COURSE CONTENT

Module 1: Introduction: What is computer vision, applications of Computer vision, Color space: RGB, HSV, basic image operations, white balancing, Binocular imaging systems, Image sampling and quantization, Image Histogram, QR Code.

Module II: Extracting information from images, Image Filters: Point operators, Linear filtering, neighborhood operators, Noise and noise removal, Median Filters, mode filters, dilation and erosion in binary images, morphology in grayscale images. Thresholding, local thresholding, region-growing methods.

Module III: Feature detection and matching: Interest points and corners, local image features, Hough transform. Medial representations, Multi resolution analysis, seamless cloning, image in painting.

Module IV: Edge Detection: Basic theory of edge detection, edge properties, edge detection techniques, edge thinning. Image Segmentation- Active contours, Split and merge. Object detection, Face recognition, Category recognition

Module V: Shape correspondence and shape matching, Principal Component Analysis, Human pose estimation, Motion estimation in video, object tracking, Instance recognition

Module VI: Open CV: Installation and setup, Basic image operations, mathematical operations on images, bitwise operations, image annotations, QR Code detection, using mouse, Video I/O, implementing morphological operations, Filtering, skin smoothing.

References:

1. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer
2. Python: Tools and Algorithms for Analyzing Images, Jan Erik Solem, O'reilly
3. Learning Open CV, Adrian keihler, O'RElly
4. Learning OpenCV 4 Computer Vision with Python 3, Joe Minichino and Joseph Howse, Packt.
5. Opencv.org.

SEMESTER IV	COURSE CODE : CS 543	CREDIT : 6

MAJOR PROJECT PHASE II

Main project phase-II is a continuation of project phase-I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work. Second review would be a pre -submission presentation before the internal assessment committee to assess the quality and quantum of the work done.

It is encouraged to prepare at least one technical paper for possible publication in journals or conferences. The project report (and the technical paper(s)) shall be prepared without any plagiarized content and with adequate citations, in the standard format specified by the University.

Guidelines for doing M. Sc. Project work (No. Ac.AII/1/48/2019)

1. Each student should do an independent original research work as a part of their project work. The nature of the work can be theoretical, experimental, simulation etc. This should not be mere duplication of previous reports. Submission of same work by more than one student is not allowed. It will be the responsibility of respective supervisors and Head of Department to ensure non duplication and plagiarism of any sort. Further the head of the department and respective guides should inform the students about the implications of plagiarism as per the UGC guideline.
2. The text of the report should be written as Normal Body Text Font size: 12, Times New Roman, Double Spacing, and justified. Paragraph Heading Font Size: 14, Times New Roman, Underlined, Left Aligned. Chapter Heading Font Size: 20, Times New Roman, Centre Aligned. The project report should not be more than 60 pages.
3. The thesis should contain an **Introduction Chapter**: which should give an introduction to the scientific problem and should provide clear motivation required to carry out the project work.
4. **Materials / Methods**: In this chapter the student should clearly mention the Materials / Methods / Characterization technique / Theoretical Background / Mathematical tools / Software etc. which are used to carry out the project work .They may also mention the institution where the work / experiment has been carried out.
5. **Results and Discussion:** In this chapter students should describe the results obtained. Also a detailed discussion of the results should be included followed by Conclusion and Future scope.
6. Brief abstract < 500 words should be included
7. Proper scales and units should be given for all graphs
8. **References**: References should be cited in the text and a uniform format should be used for all references.
9. Figures and tables should have proper caption and continuous numbering in each chapter. Figures taken from the internet /books etc. should be properly acknowledged

SEMESTER IV	COURSE CODE : CS 544	CREDIT : 3

COMPREHENSIVE VIVA

It is mandatory that the Comprehensive Viva shall be conducted by separate examiners than that for Project Evaluation. The viva will be carried out by a panel of two examiners appointed by the University, of which one shall be from outside the college. Though the viva shall be based on the entire syllabus contents, the candidates may be given an opportunity to opt a set of subjects, not less than 40% of the programme. However, the candidate, in any case, shall not be asked to write answers to the questions given by the examiners.