MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous Programmes
Bachelor of Engineering

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SYLLABUS

VII Semester & VIII Semester

(FOURTH YEAR)

Academic Year 2023-2024

VISION

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns.

MISSION

- Impart world class engineering education to produce technically competent engineers.
- Provide facilities and expertise in advanced computer technology to promote research.
- Enhance Industry readiness and entrepreneurial abilities through innovative skills
- Nurture ethical values and social responsibilities

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1 : Graduates will be efficient software developers in diverse fields and will be successful professionals and/or pursue higher studies.

PEO 2 : Graduates will be capable to adapt to new computing technology for professional excellence and Research and will belifelong learners.

PEO 3 : Graduates will work productively exhibiting ethical qualities forthe betterment of society.

PEO 4 : Graduates will possess leadership qualities, work harmoniously in a team with effective communication skills

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, andan engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, andengineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information toprovide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering andmanagement principles and apply these to one's own work, as a member and leader in a team, to manageprojects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon graduation, students with a degree B.E. in Computer Science & Engineering will be able to:

PSO – 1: To make the students industry ready by facilitating them with software tools in recent technologies

PSO – 2: To develop IT based solutions for problems in diverse domains

Scheme & Syllabus for IV Year

Semester VII							
Course Category	**Course Code**	**Course Title**	**Hours**			**Credits**	**Contact Hours**
			L	T	P		
PC-25	20CS701	Machine Learning	4	0	0	4	4
PROJ-2	20CS702	Mini Project	0	0	4	2	4
PC-26	20CS703	Network Security and CyberLaw	4	0	0	4	4
PC-27	20CS704	Cloud Computing	3	0	0	3	3
PC-28	20CS705	Machine Learning Laboratory	0	0	2	1	2
PC-29	20CS706	Networks Laboratory	0	0	2	1	2
PE-2	20CS75X	Elective - II	3	0	0	3	3
PE-3	20CS76Y	Elective - III	3	0	0	3	3
OE-3	20OECSXX	Open Elective - II	3	0	0	3	3
OE-4	20SW02	SWAYAM- II (Mandate Audit Course)	3	0	0	0	3
		Total	23	0	8	24	31

Elective – II			**Elective – III**		
Sl. No.	**Course Code**	**Course Title**	**Sl. No.**	**Course Code**	**Course Title**
1	20CS751	Artificial Intelligence	1	20CS761	Internet of Things
2	20CS752	Advanced DBMS	2	20CS762	Advanced Computer Architecture
3	20CS753	Digital Image Processing	3	20CS763	Software Testing
4	20CS754	Big Data Analytics	4	20CS764	Software Architecture

Open Electives		
Sl. No.	**Course Code**	**Course Title**
1.	20OECS71	Introduction to Python Programming
2.	20OECS72	IoT and its Applications
3.	20OECS73	Big Data Analytics
4.	20OECS74	Web Technology

VIII Semester							
Course Category	**Course Code**	**Course Title**	**Hours**			**Total Credits**	**Contact Hours**
			L	T	P		
SR	20CS801	Seminar on Advanced Topics	0	0	2	1	2
PROJ-3	20CS802	Project Work	0	0	40	9	40
IN	20CS803	Internship (Four Weeks)	0	0	25	2	25
PE-4	20CS88X	Elective –IV	3	0	0	3	3
		Total	**3**	**0**	**67**	**15**	**70**

Elective -IV		
Sl. No.	**Course Code**	**Course Title**
1.	20CS881	C# Programming and .NET
2.	20CS882	Advanced Algorithms
3.	20CS883	Operations Research
4.	20CS884	Principles of Compiler Design
5.	20CS885	Storage Area Networks
6.	20CS886	Mobile Communications

Course Title	MACHINE LEARNING		
Course Code	20CS701	L-T-P-C	(4-0-0) 4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: To apply the techniques of machine learning for real time projects.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop a good understanding of fundamental principles of machine learning	1,2,3	-
2.	Formulation of a Machine Learning problem	1,2,4	-
3.	Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering	2,3,4	-
4.	Evaluate the performance of various machine learning algorithms on various data sets of a domain.	4,5	1

MODULE - 1	13 Hrs

Introduction: What Is Machine Learning? Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning.
Learning Problems and Concept Learning: Well Posed learning problems, Designing a Learning systems, Concept Learning Tasks, Search, Find-S, Version Spaces and Candidate Elimination Algorithm.
Self Study: Reinforcement Learning.

MODULE – 2	13 Hrs

Dimensionality Reduction: Introduction, Subset Selection, Principal Component Analysis, Singular Value Decomposition and Matrix Factorization.
Supervised Learning: Decision Tree learning, Representation, Algorithm, Issues in decision tree learning.
Self Study: Linear Discriminant Analysis.

MODULE - 3	12 Hrs

Supervised Learning: Support Vector Machine, K-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions.
Artificial Neural Networks: Neural Network Representation, Problems for Neural Network learning, Perceptron's, Multilayer Networks and Back Propagation Algorithms.
Self Study : Adaline Madaline.

MODULE – 4	12 Hrs

Unsupervised Learning: Introduction, Hierarchical Clustering, k-Means Clustering.
Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Naïve Bayes classifier, Bayesian belief networks, EM algorithm.
Self Learning: Problems on Hierarchical Clustering.

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (INDIAN EDITION), 2013.
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Ed., PHI Learning Pvt. Ltd., 2013

Reference Books:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer; 1st edition, 2001
3. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006
4. Yegnanaravana B. Artificial Neural Netwroks PHI Learning Pvt., Ltd.

Course Title	MINI PROJECT		
Course Code	20CS702	L-T-P-C	(0-0-4)2
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks		

Course Objective: Identify, analyze and formulate problem statement for project work with systematic and comprehensive approach.

Course Outcomes (COs) : Upon completion of course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify a real-world problem and provide feasible solution as a team.	1,2,3,9,10	-
2.	Conduct experimental analysis of data to ensure conformance to technical specifications and user requirements as a team.	1,3,5,4,9	1,2
3.	Present the project work as a team.	9,10	-
4.	Document the project in phases of software development cycle.	8,9,10,11,12	-

Course Contents:

- A team of **TWO** students must develop the mini project. However, during the evaluation, each student must demonstrate the project individually.
- The team may implement a mini project of their choice. However, the project topic selected should broadly be in the area of Engineering.
- The team must submit a **Brief Project Report** (25 to 30 Pages) at the end which must include the following:
  - Introduction
  - Requirements
  - Software Development Process Model Adopted
  - Analysis and Design Models
  - Implementation
  - Testing

Evaluation Pattern:

Sl. No	Evaluation Phase	Marks
1	Phase -1	15
2	Phase -2	15
3	Phase -3	20
	Total	**50**

Detailed Rubrics for Phase I, Phase II and Phase III

Project Phase I Evaluation Rubrics (15 Marks)

	Parameter	Good	Average	Poor	Score (15)
A	**Identification of Problem statement**	Detailed explanation and purpose of the project	Average explanation and purpose of the project	Minimal explanation of the purpose ofthe project	
	(3)	(3)	(2)	(1)	
B	**Literature Review**	Demonstrate superior use of research by referring 10 or more papers indexed in IEEE/springer/ ACM/ Scopus SCI indexed journals.	Demonstrate superior use of research by referring 5 or more papers indexed in IEEE/springer/ACM/ Scopus SCI indexed journals.	Demonstrate the use of research by referring less than 5 papers with or without proper indexing.	
	(4)	(4)	(2-3)	(1)	
C	**Objectives and Scope of the Proposed Work**	All objectives of the proposedwork are well defined; Scope to implement considering the societal issues are also well defined	Incomplete justification to the objectives and scope proposed	Objectives of the proposed work are either not identified or not defined	
	(4)	(4)	(2-3)	(1)	
D	**Synopsis Report and Presentation**	Presentation ofthe Synopsis according to the specified format	Presentation of the Synopsis with corrections suggested by evaluation panel.	Presentation of the synopsis with resubmission	
	(4)	(4)	(2-3)	(1)	

Project Phase II Evaluation Rubrics

	Parameter	Good	Average	Poor	Score(15)
A	**Incorporation of suggestions from Phase 1**	Changes are made to problem statement as permodification suggested during phase 1 and new innovations are added.	Few changes are made to problem statement as per the Modifications suggested during evaluation.	Suggestions givenduring phase I evaluation are not incorporated.	
	(2)	(2)	(1)	(0)	
B	**Design**	Design of system according to appropriate architectural model adhering to the SRS.	Partially incorporated the design but clearly able to demonstrate the design.	Does not match with the SRS. Incorrect design of modules.	
	(5)	(4-5)	(3)	(1-2)	
C	**ModernTool**	Implementation is efficient using latest tools and technology	Partial implementation but not modularized the code.	Not started implementing the code.	
	(2)	(2)	(1)	(0)	
D	**Work Progress**	50% of the Objectives achieved	25% of the Objectives achieved as per time frame	Less than 25% objectives achieved as per timeframe	
	(3)	(3)	(02)	(01)	
E	**Presentation**	Contents of Presentations are arranged, Proper eye contact with audience and clear voice with goodspoken Language.	Presentations are not satisfactory and average demonstration.	Contents of presentations are not appropriate and poor delivery of presentation.	
	(3)	(3)	(2)	(1)	

Project Phase III Evaluation Rubrics

	Parameter	Good	Average	Poor	Score(20)
A	**Presentation on Complete Implementation**	Contents of Presentations are appropriate and well arranged, Proper eye contact with audience andclear voice with good spoken Language.	Presentations are not satisfactoryand average demonstration.	Contents of presentations are not appropriate and poor delivery ofpresentation.	
	(5)	(5)	(3- 4)	(2-1)	
B	**Demonstration of project output/ Implementation**	Demonstrates all the defined objectives as per schedule.	Demonstrat esfew of the defined objectives.	Demonstrates very few defined objectives.	
	(5)	(5)	(3-4)	(2-1)	
C	**Testing**	Project developed is tested thoroughly for all test cases.	Project developed is tested for few test cases.	Project developed isnot tested thoroughly for all test cases.	
	(2)	(2)	(1)	(0)	
D	**Project Report**	Project report is according to the specified format.	Project report is according to thespecified format but has some mistakes.	Project report is not prepared according to the specified format.	
	(5)	(4-5)	(3)	(2-1)	
E	**Paper Presented**	Presented in international Conference journals with top indexing / project proposals	Presented in journals, conferences in UGC/SCOPUS	Paper Presented	
	(3)	(3)	(2)	(1)	

Semester End Examination

Evaluation committee consists of panel of examiners containing external as well as internal evaluators. This evaluation is carried out for 50 marks.

Sl. No	Performance Indicators		Marks Allotted
1.	**Project Execution**	Project Specification	5
		Progress	5
2.	**Methodology/ Result Analysis**	System Design	5
		System Implementation	5
		System Testing	5
3.	**Project Report and Presentation**	Organization and Clarity	5
		Technical Content	5
		Conclusion and Future work	5
4.	**Final Presentation**		10
Total Marks			**50**

Rubrics for Semester End Exam	
Marks	**Overall criteria**
48-50	Project is reaching professional standards.
40-47	Project is excellent and may contain publishable material. Presentation is excellent.
35-39	Project and presentation are very good. All design aims are met.
30-34	Project and presentation are good. Most design aims are met.
25-29	Minimum core of design aims has been met. Presentation is satisfactory.
20-24	Design aims and implementation are met partially. Presentation is moderate.
0-20	Most design aims are not met and implementation does not work. Presentation is not satisfactory.

Course Title	NETWORK SECURITY AND CYBER LAW		
Course Code	20CS703	L-T-P-C	(4-0-0) 4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: Students will be able to apply cryptography techniques on malicious networks and cyber law, IPR, IT Act.

Course Outcomes (COs): Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Perceive the various types of Security attacks and Ciphers	1,12	-
2.	Develop the Traditional and Modern Block Ciphers	2,3	-
3.	Analyze the Symmetric and Asymmetric key Cryptography Algorithms	4,6	-
4.	Apply Security Protocols at upper layers of networking system.	3,5	-
5.	Assess the new strategies and regulations of Cyber law and IT act	6,8	-

Course Contents:

MODULE – 1	13 Hrs

Introduction: Security goals, Cryptographic attacks, Services and Mechanisms, Techniques for security goals implementation, **Mathematics of cryptography**: Integer Arithmetic, The Extended Euclidean Algorithm; **Traditional Symmetric-Key Ciphers:** Symmetric-Key Ciphers**,** Categories of traditional ciphers, stream and block ciphers.

Self Study Component (Not included in SEE): Modular Arithmetic, Matrices and Linear Congruence.

MODULE – 2	13 Hrs

Introduction to Modern Symmetric-Key Ciphers: Modern block ciphers, Components of modern block ciphers, Two classes of Product Ciphers, Attacks designed for block ciphers.; **Data Encryption Standard**: History and Data Encryption Standard, DES Structure, DES Analysis, Security of DES, Multiple DES-Conventional Encryption Algorithm, The CAST Block Cipher, Blowfish, IDEA

Self Study Component (Not included in SEE):: Mathematics of Symmetric-Key cryptography: Field and GF (2n) Fields.

MODULE – 3	12 Hrs

Advanced Encryption Algorithm: History and Advanced Encryption Algorithm, Transformation used by AES; **Asymmetric Key cryptography:** Difference between symmetric cryptography and asymmetric Key cryptography Cryptosystem, RSA cryptosystem, Rabin Cryptosystem ; **Security at the Application Layer:** E-mail System, Pretty Good Privacy(PGP), **Security at the Transport Layer:** Security Services at Transport layer, SSL Architecture.

Self Study Component (Not included in SEE): Mathematics of Asymmetric-Key cryptography: Primes, Primality testing, Factorization, Chinese Remainder Theorem.

MODULE – 4	12 Hrs

Security and Cyber Law: INTRODUCTION: Cyberspace , Cyber security, Cyber security Policy, Cyber Crime, Nature of Threat , Enabling People, Mission and Vision of Cyber security Program, OBJECTIVES : Emerging Trends of Cyber Law, Create Awareness, Areas of Development, International Network on Cyber security; **Intellectual Property Rights**: Types of Intellectual Property Rights, Advantages of Intellectual Property Rights, Intellectual Property Rights in India, Intellectual Property in Cyber Space;

The information Technology Act - IT act aim and objectives, Scope of the act, Major Concepts, Important provisions, Attribution, acknowledgement, and dispatch of electronic records, Secure electronic records and secure digital signatures, Regulation of certifying authorities: Digital Signature certificates, Duties of Subscribers, Penalties and adjudication.
Text Books: 1. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security" Third edition published by McGraw Hill Education-2017. 2. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition
Reference Books: 1. Hans Delfs, Helmut Knebl, "Introduction to Cryptography: Principles and Applications", Springer 2. Neal Koblitz, "Number theory and cryptography", Springer, 2007. 3. William Stallings: Cryptography and Network Security, Fifth Edition, Pearson Education-2013
MOOCs: 1. http://nptel.ac.in/courses/106105031/ 2. https://www.edx.org/learn/cybersecurit 3. https://www.tutorialspoint.com/information_security_cyber_law/index.htm

Course Title	CLOUD COMPUTING		
Course Code	20CS704	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to find out cloud computing service models and applications.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Unveil history and leverage elements of cloud computing	1,2	-
2.	Recognize the different virtualization techniques, architecture and types of clouds	3,4	-
3.	Determine the cloud platforms and get exposed to new challenges for various organizations	4,7	-
4.	Integrate new standards for access management, security and privacy at different levels of cloud services	6,8	-
5.	Develop and deploy an application for cloud platform	2,3,5	1

Course Contents:

MODULE – 1	10 Hrs

Introduction: Cloud computing at a glance, historical developments, building cloud computing environments, computing platforms and technologies. **Principles of parallel and Distributed computing:** Eras of computing, parallel vs. Distributed computing, elements of parallel computing, elements of distributed computing, technologies for distributed computing.

MODULE – 2	10 Hrs

Virtualization: Introduction, characteristics of virtualized environments, Taxonomy of virtualization techniques, virtualization and cloud computing, pros and cons of virtualization technology.
Cloud Computing architecture: Introduction, Cloud reference model, types of clouds, economics of thecloud, open challenge**s.**

MODULE – 3	10 Hrs

Cloud platforms in industry: Amazon Web Services, Google AppEngine, Microsoft Azure.
Advanced topics in cloud computing: Energy efficiency in clouds, Market based management of clouds,Federated clouds/Inter clouds, Third party cloud services.

MODULE – 4	10 Hrs

Infrastructure security, IAM: Infrastructure security: network level, host level, application level**, Identity and Access management**: trust boundaries and IAM, why IAM? IAM challenges, IAM definitions, IAM architecture and practices, getting ready for cloud, IAM standards and protocols for cloud services, IAM practices in the cloud, cloud authorization management;
Security management in the cloud: security management standards, security management in the cloud, availability management, Saas, Paas. Iaas availability management, access control, security vulnerability, patch and configuration management. **Privacy:** What is privacy?, what is data life cycle?, what are the key privacy concerns in cloud?, who is responsible for protecting privacy?

Text Books:

1. Mastering Cloud Computing, McGraw Hill publication, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi
2. Cloud security and privacy an enterprise perspective on risks and compliances,2013, Tin Mather, Subra Kumarswamy, Shahed Latif

Reference Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescue, first edition, MK publishers.
2. Cloud Computing- A practical approach, McGraw Hill publication, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter.

MOOCs:

1. https://www.youtube.com/watch?v=Eg4AAGCE7X4
2. https://www.coursera.org/learn/cloud-computing
3. https://www.edx.org/course/introduction-cloud-computing-microsoft-cloud200x

Course Title	MACHINE LEARNING LABORATORY		
Course Code	20CS705	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours/Week	2
SEE	50 Marks	Total Hours	28

Course Objective: Provide fundamental elements of Machine Learning algorithms and its applications.

Course Outcomes(COs): Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design and implement Machine Learning concepts and algorithms	2,3,4,5	1
2.	Implement and document Machine Learning programs	10	-

Course Contents:

Practice Programs

1. Write a program to compute distance between two points taking input from the user. (Pythagorean Theorem)
2. Write a program that takes two numbers as command line arguments and prints its sum.
3. Write a Program for checking whether the given number is an even number or not.
4. Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4,..., 1/10.
5. Write a program to count the numbers of characters in the string and store them in a dictionary data structure.
6. Write a program to count frequency of characters in a given file. Use character frequency to tell whether the given file is a Python program file, C program file or a text file?
7. Find mean, median and mode for the given set of numbers in a list.
8. Write function to compute GCD, LCM of two numbers.
9. Write a program that defines a matrix and prints the same.

Exercise Programs

1. Implement and demonstrate the **FIND-S algorithm** for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm** to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the **Back propagation algorithm** and test the same using appropriate data sets.
5. Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a . CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart/ lung patients using standard disease Data Set.
8. Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using ***k*-Means algorithm**. Compare the results of these two algorithms and comment on the quality of clustering.
9. Write a program to implement ***k*-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions
10. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Activity:

1. Write a program to demonstrate the working of PCA.
2. Write a program to demonstrate the working of the SVD.
3. Write a program to demonstrate the working of the LDA.
4. Write a program to demonstrate the working of the SVM. Use an appropriate data set for building the SVM and apply this knowledge to classify a new sample.
5. Write a program to demonstrate the working of the Hierarchical Clustering. Use an appropriate data set for building the Hierarchical Clustering and apply this knowledge to cluster a new sample.

Course Title	NETWORKS LABORATORY		
Course Code	20CS706	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28

Course Objective: Students will be able to develop and analyze the various network topologies and protocols using a Network simulator.

Course Outcomes (COs) : Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design and implement various networking algorithms, socket programming, protocols and local area network using network simulator.	1,2,3,5	1
2.	Documentation of implemented networking concepts.	10	-

Course Contents:

Practice Programs

1. Write and execute a program for error detecting code using CRC-CCITT (16- bits).
2. Write and execute a C/C++ program for hamming code.
3. Simulate a three nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
4. Simulate a three nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets sent with different types of traffic.

Exercise Programs

1. Write and execute a program for distance vector algorithm to find the suitable path for transmission between sender and receiver.
2. Write and execute a program to find 16-bit and 32-bit checksum Fletcher and Adler checksum methods.
3. Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
4. Suppose Alice wants her friends to encrypt email messages before sending them to her. Write a program to help her friends to encrypt and decrypt the data. (RSA algorithm).
5. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
6. Simulate a four node point-to-point network with the links connected as follows: n0 – n2, n1 – n2 and n2 – n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/ UDP.
7. Simulate the transmission of ping messages over a network topology consisting of 6 nodes.
8. Simulate an Ethernet LAN using n nodes, change error rate and data rate and compare throughput.
9. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
10. Simulate simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.

Course Title	ARTIFICIAL INTELLIGENCE		
Course Code	20CS751	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply the concepts of Artificial Intelligence to construct knowledge-based.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe different types of Artificial Intelligence agents, search strategies.	1	-
2.	Analyze different search strategies for a given problem.	2	-
3.	Design simple knowledge-based systems using first-order logic.	2	-
4.	Analyze different learning techniques.	3	-

Course Contents:

MODULE – 1	10 Hrs

Introduction: What is AI? Intelligent Agents: Agents and environment; Good behavior: The Concept of Rationality; The nature of environment; The structure of agents. Problem-solving: Problem-solving agents. Example problems; Searching for solution; Uninformed search strategies: Breadth-first search, Uniform-cost search.

MODULE – 2	10 Hrs

Uninformed search strategies: Depth-first search, Depth-limited search, Iterative deepening depth first search, Bidirectional search, Comparing uninformed search strategies; Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Optimality of A*, Memory-bounded heuristic search; Heuristic functions; Local Search Algorithms and Optimization Problems: Hill-climbing search, Simulated annealing, Local beam search, Genetic algorithms.

MODULE – 3	10 Hrs

On-line search agents and unknown Environments: Online search problems, Online search agents, online local search, learning in online search, Logical Agents: Knowledge-based agents; The Wumpus world; First-Order Logic: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic, Knowledge engineering in first-order logic.

MODULE – 4	10 Hrs

Learning from Examples: Forms of Learning; supervised learning; Learning decision trees; Practical Machine Learning. Statistical and Reinforcement learning: Statistical learning, maximum likelihood parameter learning, Bayesian parameter, learning, passive reinforcement learning, active reinforcementlearning.

Text Book:

1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.

Reference Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015.
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.

MOOCs:

1. https://www.coursera.org/courses?query=artificial%20intelligence
2. https://onlinecourses.nptel.ac.in/noc21_cs42/preview

Course Title	ADVANCED DATABASE MANAGEMENT SYSTEM		
Course Code	20CS752	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: To build database management systems using advanced techniques.

Course Outcomes (COs) : Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the role of database management system	1,2	-
2.	Recognize the different types of file structure and storage architecture	1,2	-
3.	Analyze and use emerging technologies to build the database	2,5	-
4.	Design, develop and implement mid-scale relational Databases, Object-Relational Databases and distributed databases for an application domain	2,5	-

Course Contents:

MODULE – 1	10 Hrs

Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations.

Object and Object-Relational Databases:

Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.

MODULE – 2	10 Hrs

Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files) , Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.

Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalog Management.

MODULE – 3	10 Hrs

NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document- Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Basedor Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.

Big Data Technologies Based on MapReduce and Hadoop: What is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion.

MODULE – 4	10 Hrs

Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, approaches to Other Data Mining Problems, Applications of Data Mining, Commercial DataMining Tools.

Overview of Data Warehousing and OLAP: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modeling for Data Warehouses, Building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.

Text Books:

1. Fundamentals of Database systems, Elmasri and Navathe, Pearson Education, 7th Edition.
2. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke ,McGraw –Hill, 3rd Edition , 2013.

Reference Book:

1. Database System concepts , Abraham Silberschatz , Henry F. Korth, S. Sudarshan McGraw –Hill, 3rd Edition , 2013

Course Title	DIGITAL IMAGE PROCESSING		
Course Code	20CS753	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective : To study the image fundamentals and mathematical transforms necessary for image processing along with image enhancement, restoration, compression and segmentation techniques

Course Outcomes (COs) : Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the basic principles of Digital image processing	1,2	-
2.	Elucidate mathematical modeling of filtering and image restoration	2,3,5	-
3.	Apply concepts of Digital image processing using coloring model	2,3,4,5	-
4.	Analyze image processing algorithms	2,9,10,11	1
5.	Develop image processing application for real time problems	5,9,11	2

Course Contents:

MODULE – 1	10 Hrs

Introduction: Basic concepts, Examples of fields that use Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System. **Digital Image Fundamentals:** Elements of visual perception. Image sensing and acquisition: Image sampling and quantization: Basic concepts in sampling and quantization, Representing digital images, Spatial and Intensity resolutions, some basic relationships between pixels: An Introduction to the Mathematical tools used in digital image processing.

MODULE – 2	10 Hrs

Intensity Transformations and Spatial Filtering: Background: The basics of intensity transformations and spatial filtering, Some basic intensity transformation functions, Histogram Processing. Fundamentalsof spatial filtering: The mechanics of spatial filtering, Spatial correlation and convolution. **ImageRestoration:** A model of the image restoration/degradation process. Noise Models: Spatial and Frequency properties of Noise.

MODULE – 3	10 Hrs

Image Restoration: Some important noise probability density functions, Periodic noise, Estimation of noise parameters, Restoration in the presence of Noise only- Spatial Filtering, Mean Filters. **Color Image Processing:** Color fundamentals, Color models: The RGB color model. **Image Compression: Fundamentals:** Coding redundancy, Spatial and Temporal redundancy, Irrelevant information, Measuring image information, Fidelity Criteria**.**

MODULE – 4	10 Hrs

Image Compression: Some basic compression methods: Arithmetic coding, LZW coding, Bit_Plane coding, Digital image watermarking. **Image Segmentation :** Fundamentals, Point, Line, and Edge Detection, Background, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection: The Image Gradient and its Properties, Gradient Operators, Combining the Gradient with

Thresholding, Thresholding: Foundation, The Basics of Intensity Thresholding, The Role of Noise in Image Thresholding, The Role of Illumination and Reflectance in Image Thresholding.

Text Book:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", 4th Edition, Pearson publications,2018

Reference Books:

1. A.K. Jain, "Fundamentals of Digital Image Processing", Pearson2nd Edition, 2018.
2. B. Chanda , Dutta Majumdeer, "Digital Image Processing and Analysis", Prentice-Hall of India Pvt.Ltd., 2nd Edition, 2011.
3. "Introduction to Digital Image Processing with Matlab", Rafael C. Gonzales, Richard E. Woods, Steven L.Eddins, Mcgraw Higher Ed, 2nd Edition, 2010.

MOOC:

1. http://nptel.ac.in/courses/106105032

Course Title	BIG DATA ANALYTICS		
Course Code	20CS754	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Describe big data features on Hadoop platform.

Course Outcomes (COs) : Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply basic Concepts of Big data Analytics	1,3	1
2.	Identify open-source technologies for big data	3	1
3.	Illustrate the processing of big data	3,5	-
4.	Describe the building blocks of Hadoop	1,2	1
5.	Use big data tools and techniques	4,5	1

Course Contents:

MODULE – 1	10 Hrs

Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization.

Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.

MODULE – 2	10 Hrs

Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines.

Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.

MODULE – 3	10 Hrs

Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels.

Map-Reduce and the New Software Stack 1: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.

MODULE – 4	10 Hrs

Map-Reduce and the New Software Stack 2, Communication Cost Models: Algorithms Using Map- Reduce for Matrix multiplication, Relational Algebra operations, Workflow Systems. Recursive Extensions to Map-Reduce, **Communication Cost Models**: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate.

Mining Data Streams, Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream , Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.
2. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC

1. https://nptel.ac.in/courses/106/104/106104189

Course Title	INTERNET OF THINGS		
Course Code	20CS761	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Explore the interconnection and integration of the physical world and design IOT applications.

Course Outcomes (COs) : Upon the completion of the course the students will be able to

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze the impact and challenges posed by IoT networks and compare IoT architectures	1,2	-
2.	Identify smart objects, connectivity and IoT Access Technologies	1,2	-
3.	Appraise the role of IoT protocols for efficient network communication	2,3	-
4.	Adopt Raspberry Pi interface to develop IoT modules	2,3	2
5.	Employ security structures for IoT systems	1,3	-

Course Contents:

MODULE - 1	10 Hrs

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and OT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack.

MODULE – 2	10 Hrs

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, **Connecting Smart Objects:** Communications Criteria, IoT Access Technologies – IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e

MODULE – 3	10 Hrs

IoT Access Technologies – IEEE 1901.2a, IEEE 802.11ah, LoRaWAN

IP as the IoT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances.

Application Protocols for IoT: The Transport Layer

MODULE – 4	10 Hrs

Application Protocols for IoT: IoT Application Transport Methods.

IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, Exploring the RaspberryPi Board; Operating System setup on RaspberryPi, RaspberryPi commands, Programming RaspberryPi with Python.

Securing IoT: A Brief History of OT Security, Common Challenges in OT Security, Formal Risk Analysis Structures: OCTAVE and FAIR

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2. Srinivasa K G, Siddesh G M Hanumantha Raju R "Internet of Things", CENGAGE Leaning India, 2017.

Reference Books:

1. Internet of Things - A Hands on Approach**,** Arshdeep Bahga and Vijay Madisetti UniversitiesPress, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.

MOOCs:

1. https://www.edx.org/course/introduction-to-the-internet-of-things-iot
2. http://nptel.ac.in/noc/individual_course.php?id=noc17-cs22

Course Code	ADVANCED COMPUTER ARCHITECTURE		
Course Code	**20CS762**	**L-T-P-C**	**(3-0-0)3**
Exam Hrs.	**3**	**Hours / Week**	**3**
SEE	**50**	**Total Hours**	**40**

Course Objective: To analyze the design techniques of parallelism in computer architecture.

Course Outcomes (COs) : At the end of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Illustrate the organization of computer systems and Parallelism in it.	1,2	-
2.	Exploit and analyze instruction-level parallelism	1,2,3	-
3.	Explicate the memory architecture in multiprocessor systems and its performance issues	1,2	-
4.	Portray the need for multi-core architectures	1	-

Course Contents:

MODULE – 1	10 Hrs

Fundamentals of Computer Design: Introduction; Classes of computers; Define Computer Architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Quantitative Principles of computer design. **Pipelining:** Introduction; Pipeline hazards- structural hazard, data hazard; A simple implementation of MIPS; Basic pipeline for MIPS; What makes pipelining hard to implement?

MODULE – 2	10 Hrs

Instruction –Level Parallelism: ILP: Concepts and challenges; Basic Compiler Techniques for exposing ILP; Overcoming Data hazards with Dynamic scheduling; Hardware-based speculation; Exploiting ILP using multiple issues and static scheduling; Exploiting ILP using dynamic scheduling; multiple issue and speculation; Advanced Techniques for instruction delivery and Speculation.

MODULE – 3	10 Hrs

Multiprocessors and Thread –Level Parallelism: Introduction; Symmetric shared-memory architectures; Performance of symmetric shared–memory multiprocessors; Distributed shared memory anddirectory-based coherence. **Review of Memory Hierarchy:** Introduction; Cache performance; Six basic Cache Optimizations.

MODULE – 4	10 Hrs

Introduction to Multicore Architecture: Motivation, Parallel Computing Platforms, Understanding Performance. System Overview of Threading: Defining threads, System View of threads, what happens when a thread is created? **Threading on Intel Multi-core Processors**: Hardware based Threading, Hyper-threading Technology, Multi-CORE Processors, Multiple Processor Interaction.

Text Books:

1. John L. Hennessey and David A. Patterson: Computer Architecture, A Quantitative Approach, 5th Edition, Elsevier, 2013.
2. Shameen Akhter and Jason Roberts, Multi -CORE Programming Increasing Performance through software Multi-Threading, Intel Press, 2006.

Reference Books:

1. Kai Hwang: Advanced Computer Architecture Parallelism, Scalability, Programmability, Tata Mc Grawhill, 2003.
2. David E. Culler, Jaswinder Pal Singh, Anoop Gupta: Parallel Computer Architecture, A Hardware /Software Approach, Morgan Kaufman, 1999.

MOOCs:

1. http://www.nptelvideos.in/2012/11/computer-architecture.html
2. https://onlinecourses.nptel.ac.in/noc21_cs47
3. https://nptel.ac.in/courses/106/103/106103206/

Course Title	SOFTWARE TESTING		
Course Code	20CS763	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Apply the concepts in software testing including software testing objective, process, criteria, strategies and methods.

Course Outcomes (COs) : Upon the completion of the course the students will be able to :

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore fundamentals of testing software products	1,9	-
2.	Analyze software testing strategies	2,3	1
3.	Deploy suitable test generation techniques	3,11	-
4.	Illustrate various coverage criteria	1,3	-
5.	Design criteria for final certification of the software product	1,11	-

Course Contents:

MODULE – 1	10 Hrs

Basics of Software Testing - 1: Human Errors and Testing; Software Quality; Requirements, Behaviorand Correctness; Correctness versus Reliability; Testing and Debugging; Test Metrics.
Basics of Software Testing – 2: Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test-generation Strategies, Static Testing. Model-Based Testing and Model Checking; Control-Flow Graph; Types of Testing; The Saturation Effect.

MODULE – 2	10 Hrs

Test Generation from Requirements – 1: Introduction; The Test-Selection Problem; Equivalence Partitioning; Boundary Value Analysis; Category-Partition Method.
Test Generation from Requirements –2: Cause-Effect Graphing, Test Generation from Predicates.

MODULE – 3	10 Hrs

Structural Testing: Overview; Statement testing; Branch testing; Condition testing, Path testing;Procedure call testing; Comparing structural testing criteria; The infeasibility problem.
Dependence, Data Flow Models, and Data Flow Testing: Definition-Use pairs; Data flow analysis;Classic analyses; From execution to conservative flow analysis; Data flow analysis with arrays and pointers; Inter-procedural analysis; Overview of data flow testing; Definition-Use associations; Data flow testing criteria; Data flow coverage with complex structures; The infeasibility problem.

MODULE – 4	10 Hrs

Test Case Selection and Adequacy, Test Execution: Overview; Test specification and cases; Adequacy criteria; Comparing criteria; Overview of test execution; From test case specification to test cases; Scaffolding; Generic versus specific scaffolding; Test oracles; Self-checks as oracles; Capture and replay. **Process:** Test and analysis activities within a software process: The quality process; Planning and monitoring; Quality goals; Dependability properties; Analysis; Testing; Improving the process; Organizational factors. Integration and component-based software testing: Overview; Integration testing strategies; Testing components and assemblies. System, Acceptance and Regression Testing:

Overview; System testing; Acceptance testing; Usability; Regression testing; Regression test selection techniques; Test case prioritization and selective execution.
Text Books: 1. Aditya P Mathur: Foundations of Software Testing, 2nd Edition, Pearson Education, 2014 (Chapters 1 excluding 1.15, 1.16, 1.17, 2, 6). 2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, John Wiley & Sons, 2008 (Chapters 4, 6, 9, 12, 13, 17, 21, 22).
Reference Books: 1. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, 2nd Edition, Pearson, 2007. 2. Ron Patton: Software Testing, 2nd edition, Pearson, 2004.
MOOC: 1. http://nptel.ac.in/courses/106105150

Course Title	SOFTWARE ARCHITECTURE		
Course Code	20CS764	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Provide students with the principles and concepts of applying various design patterns in designing a wide variety of software system.

Course Outcomes (COs) : Upon the completion of the course the students will be able to :

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the significance of software architecture.	1,2	-
2.	Apply quality attributes to create an architecture for the given application.	2,3	-
3.	Analyze the architectural pattern and build the system from components.	2,3	-
4.	Create documentation relevant to the chosen architecture.	1,10	-

Course Contents:

MODULE – 1	10 Hrs

What Is Software Architecture? : What Software Architecture Is and What It Isn't; Architectural Structures and Views; Architectural Patterns; What Makes a "Good" Architecture? **Why Is Software Architecture Important?** Inhibiting or Enabling a System's Quality Attributes; Reasoning About and Managing Change ; Predicting System Qualities; Enhancing Communication among Stakeholders; Carrying Early Design Decisions ; Defining Constraints on an Implementation; Influencing the Organizational Structure ; Enabling Evolutionary Prototyping Improving Cost and Schedule Estimates ; Supplying a Transferable, Reusable Model; Allowing Incorporation of Independently Developed Components; Restricting the Vocabulary of Design Alternatives; Providing a Basis for Training; **The Many Contexts of Software Architecture:** Architecture in a Technical Context, Architecture in a Project Life-Cycle Context, Architecture in a Business Context, Architecture in a Professional Context, Stakeholders, How Is Architecture Influenced?, What Do Architectures Influence?, **Quality Attributes Understanding Quality Attributes;** Architecture and Requirements ; Functionality; Quality Attribute ; Considerations ; Specifying Quality Attribute; Requirements ; Achieving Quality Attributes through Tactics, Guiding Quality Design Decisions.

MODULE – 2	10 Hrs

Availability: Availability General Scenario; Tactics for Availability; **Modifiability:** Modifiability General Scenario; Tactics for Modifiability **Performance:** Performance General Scenario; Tactics for Performance; **Security:** Security General Scenario; Tactics for Security ; **Architectural Patterns – 1:** Introduction; from mud to structure: Layers, Pipes and Filters.

MODULE – 3	10 Hrs

Architectural Patterns – 2: Distributed Systems: Broker; Interactive Systems.
Architectural Patterns – 3: Presentation-Abstraction-Control; Adaptable Systems: Microkernel;

MODULE – 4	10 Hrs

Some Design Patterns: Structural decomposition: Whole – Part; Organization of work: Master – Slave; Access Control: Proxy.

Designing and Documenting Software Architectures: Design Strategy; The Attribute-Driven Design Method; The Steps of ADD; Uses and Audiences for Architecture; Documentation; Notations for Architecture; Documentation; Views; Choosing the Views; Combining Views; Building the Documentation Package; Documenting Behavior; Architecture Documentation and Quality Attributes; Documenting Architectures That Change Faster Than You Can Document Them.

Text Books:

1. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, 3rd Edition, Addison-Wesley, 2013.
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: Pattern-Oriented Software Architecture, A System of Patterns, Volume 1, John Wiley and Sons, 2009.

Reference Books:

1. Mary Shaw and David Garlan: Software Architecture- Perspectives on an Emerging Discipline, PHI, 2008.
2. E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns- Elements of Reusable Object-Oriented Software, Addison-Wesley, 1995.

MOOCs:

1. http://www.hillside.net/patterns
2. http://www.nptel.ac.in/syllabus/106104027
3. https://www.mooc-list.com/course/software-architecture-coursera

Course Title	INTRODUCTION TO PYTHON PROGRAMMING		
Course Code	**20OECS71**	**L-T-P-C**	**(3-0-0)3**
Exam Hrs.	**3**	**Hours / Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**

Course Objective: Acquire the basics of Python programming, design and implement programs using Python language.

Course Outcomes (COs) : Upon Completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Comprehend the basics of python programming.	1	-
2.	Identify appropriate programming constructs to solve the given problem.	2	1
3.	Apply python knowledge in real time applications.	3,5	1
4.	Explore file structures and its applications	1	-

Course Contents:

MODULE – 1	10 Hrs

Hello, Python: Installing Python, Simple program using Python, Expressions and Values, Variables and Computer Memory, error detection, Multiple line statements, **Designing and using functions**: functions provided by Python, Tracing function calls in memory model, Omitting return statement. **Working with Text:** Creating Strings of Characters, Using Special Characters in Strings, Creating a Multiline String, Printing Information, Getting Information from the Keyboard.

MODULE – 2	10 Hrs

Making Choices: A Boolean Type, Choosing Statements to Execute, Nested If Statements , Remembering the Results of a Boolean Expression Evaluation , **A Modular Approach to Program Organization:** Importing Modules, Defining Your Own Modules, Testing Code Semi automatically Grouping Functions **Using Methods:** Modules, Classes, and Methods , Calling Methods the Object Oriented Way, Exploring String Methods, Underscores.

MODULE – 3	10 Hrs

Storing Collections of Data Using Lists: Storing and Accessing Data in Lists, modifying Lists, Operations on Lists, Slicing Lists, Aliasing, List Methods, Working with a List of Lists**. Repeating Code Using Loops:** Processing Items in a List, Processing Characters in Strings, Looping Over a Range of Numbers, Processing Lists Using Indices, Nesting Loops in Loops, Looping Until a Condition Is Reached, Repetition Based on User Input, Controlling Loops Using Break and Continue.

MODULE – 4	10 Hrs

Reading and Writing Files: Kinds of files, opening a File, Techniques for Reading Files, Files over the Internet, Writing Files, and Writing Algorithms That Use the File-Reading Techniques, Multiline Records. **Storing Data Using Other Collection Types**: Storing Data Using Sets, Storing Data Using Tuples, Storing Data Using Dictionaries, inverting a Dictionary, Using the In Operator on Tuples, Sets, and Dictionaries, Comparing Collections.

Text Books:

1. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
2. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey, Jeffrey Elkner, 2012

Reference Books:

1. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr.
2. Exploring Python, Timothy A. Budd, McGraw Hill Education.
3. Python for Informatics: Exploring Information, Charles Severance.
4. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication.

MOOCs:

1. https://nptel.ac.in/courses/106106212
2. https://nptel.ac.in/courses/106106145

Course Title	IOT AND ITS APPLICATIONS		
Course Code	20OECS72	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Explore the interconnection and integration of the physical world and design IOT applications.

Course Outcomes (COs) : Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze the impact and challenges posed by IoT networks and compare IoT architectures	1,2	-
2.	Identify smart objects, connectivity and IoT Access Technologies	1,2	-
3.	Appraise the role of IoT protocols for efficient network communication and Security in IoT network	2,3	-
4.	Adopt Raspberry Pi interface to develop IoT modules	2,3	2
5.	Employ security structures for IoT systems	1,3	-

Course Contents:

MODULE – 1	10 Hrs

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack.

MODULE – 2	10 Hrs

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, **Connecting Smart Objects:** Communications Criteria, IoT Access Technologies.

MODULE – 3	10 Hrs

IP as the IoT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances. **Application Protocols for IoT:** The Transport Layer, IoT Application Transport Methods.

MODULE – 4	10 Hrs

IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, Exploring the RaspberryPi Board; Operating System setup on RaspberryPi, RaspberryPi commands, Programming RaspberryPi with Python. **Securing IoT:** A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743).
2. Srinivasa K G, Siddesh G M Hanumantha Raju R "Internet of Things",CENGAGE Leaning India, 2017.

Reference Books:

1. Internet of Things - A Hands on Approach**,** Arshdeep Bahga and Vijay Madisetti Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.

MOOCs:

1. https://www.edx.org/course/introduction-to-the-internet-of-things-iot
2. http://nptel.ac.in/noc/individual_course.php?id=noc17-cs22

Course Title	BIG DATA ANALYTICS		
Course Code	20OECS73	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Describe big data features on Hadoop platform.

Course Outcomes (COs) : Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply basic Concepts of Big data Analytics	1,3	1
2.	Identify open-source technologies for big data	3	1
3.	Illustrate the processing of big data	3,5	-
4.	Describe the building blocks of Hadoop	1,2	1
5.	Use big data tools and techniques	4,5	1

Course Contents:

MODULE – 1	10 Hrs

Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation,Monetization.

Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.

MODULE – 2	10 Hrs

Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines.

Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.

MODULE – 3	10 Hrs

Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance,Integrating Big Data with MDM, Evolving Maturity Levels.

Map-Reduce and the New Software Stack 1: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping byKey, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.

MODULE – 4	10 Hrs

Map-Reduce and the New Software Stack 2, Communication Cost Models: Algorithms Using Map-Reduce for Matrix multiplication, Relational Algebra operations, Workflow Systems. Recursive Extensions to Map-Reduce, **Communication Cost Models**: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate.

Mining Data Streams, Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream , Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.
2. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC:

1. https://nptel.ac.in/courses/106/104/106104189

Course Title	WEB TECHNOLOGY		
Course Code	20OECS74	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Create web pages with client side and server-side scripting.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge of HTML and CSS in designing webpage	1	2
2.	Develop dynamic web pages using JavaScript	3	2
3.	Develop client-side script to design webpage	3	2
4.	Design server-side script using PHP and MySQL	3,5	2

Course Contents:

MODULE – 1	10 Hrs

Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

MODULE – 2	10 Hrs

HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

MODULE – 3	10 Hrs

JavaScript and HTML Documents: The JavaScript execution environment; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The navigator object.
Dynamic Documents with JavaScript: Introduction to dynamic documents; Element positioning; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor.

MODULE – 4	10 Hrs

XML: Introduction; Syntax; Document structure; Namespaces, XML schemas, Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets.
PHP: Origins and uses of PHP; Overview of PHP; General syntactic characteristics; Primitives, operations and expressions; Output; Control statements; Arrays; Functions; Pattern matching; Form handling; Files; Cookies; Session tracking; Database Access using PHP and MySQL.

Text Books:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India, 2016.
2. Robert W. Sebesta: Programming the World Wide Web, 8th Edition, Pearson Education, 2014.

Reference Books:

1. Deitel H.M. and Deitel P.J., "Internet and World Wide Web How to program", Pearson International, 2012, 4th Edition.
2. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson, 2015.
3. SRD Group: Internet Technology and Web Design, Tata McGraw Hill Publishing Ltd, 2011.

MOOCs:

1. https://www.mooc-list.com/course/programming-and-web-beginners-coursera
2. http://nptel.ac.in/courses/117105080/3
3. https://www.coursera.org/specializations/web-design
4. http://www.w3c.org

Course Title	SEMINAR ON ADVANCED TOPICS		
Course Code	20CS801	L-T-P-C	(0-0-2)1
Exam Hrs.	3	Hours / Week	2
CIE	100 Marks	Total Hours	28

Course Objective: To read, understand and present a technical paper.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Organize a detailed literature survey and build a document with respect to technical publications	9,10	-
2.	Effective presentation and improve soft skills	10,12	-

Evaluation parameters:

Sl. No.	Guidelines	Marks
1.	Quality of the selected paper and synopsis	10
2.	Presentation Slides	20
3.	Oral presentation	30
4.	Report	25
5.	Viva-Voce	15
	Total	100

Rubrics:

Criteria	Satisfactory	Good	Excellent
Quality of the selected paper/ Literature Review (10)	Mentions only thework done. (0-3)	Describes previous and related work. (4-5)	Concisely describesthe recent trends. (6-10)
Presentation Slides (20)	Some problems in sequencing. (Lacksclear transitions ; incomplete or emphasis given to less important information) (0-5)	Most information presented in logical sequence. (Clear introduction; adequate background). (6-12)	Presented in logical Sequence. (Introduction, background, context; key points and conclusions are clear and well developed). (13-25)
Oral Presentation (CommunicationSkills) (30)	Difficult to hear; occasional eye contact; some mumbling, little or no expression;	Most of audience can hear presentation; eye contact most of the time; clear	Entire audience can hear presentation; maintains eye contact with audience; clear, Expressive voice;
Report (15)	According to the specified format but some mistakes. In-sufficient references and citations. All key concepts are not explained (0-10).	According to the specified format; references and citations are appropriate but not mentioned. (11-20)	According to the specified format; references and citations are appropriate and well mentioned; complete explanation of the key concepts (21-30).
Viva-Voce(15)	Does not answer. (0)	Competently defends by providing very helpful answers. (1-10)	Masterfully defends by providing clear and insightful answers to questions (11-15).

Course Title	PROJECT WORK			
Course Code	20CS802		L-T-P-C	(0-0-40)9
Exam Hours	3		Hours / Week	40
SEE	50 Marks		Total Hours	40

Course Objective: Develop technical skills, communication skills, managerial skills and team work.

Course Outcomes (COs) : Upon completion of the course, students shall be able to:

COs	Statement	Mapping to PO's	Mapping to PSO's
1.	Identify one's need for further knowledge and continuously develop one's own competencies.	1,12	1,2
2.	Illustrate data analysis within given constraints and independently analyze the problem statements.	1,2,4,9	2
3.	Demonstrate the complexity of problems within the technical area and implement relevant work.	1,3,4,5	1,2
4.	Document and present the work.	1,6,7,10	-

Phase – 1 (Synopsis Evaluation)

During phase 1, the students will survey different research and journal papers to prepare the synopsis for their project proposal. This will be evaluated for **15** marks by the project committee.

Planning:

Performance Indicators	Level 0	Level 1	Level 2	Level 3
Planning	No evidence of planning.	Little planning or fore thought.	Moderate planning	Professional level of planning and time management.
Marks Allocated	**0**	**1-2**	**3-4**	**5**
			Total Marks	**5**

Survey :

Indicator	Level 0	Level 1	Level 2	Level 3
Literature Survey	No evidence of Survey	Insufficient survey	Moderate survey	Survey done sufficiently
Marks allocated	**0**	**1-2**	**3-4**	**5**
			Total Marks	**5**

Synopsis Writing and Presentation:

Indicator	Level 0	Level 1	Level 2
Synopsis Writing	Synopsis idea not clear	Synopsis with problem statement to be refined.	Complete Synopsis and presentation.
Marks allocated	**0**	**1-3**	**4-5**
		Total Marks	**5**

Phase – 2 (Mid-Term Evaluation)

Mid-term progress evaluation for **15** marks.

Progress :

Progress Indicator	System requirement specification	Initial system development	System analysis specification & user interface specification	Employ appropriate analytical tools and/or software engineering techniques.	Oral presentation
Marks allocated	**0-2**	**0-3**	**0-5**	**0-2**	**0-3**
				Total Marks	**15**

Phase – 3(Final Evaluation)

The students will prepare a prototype of the proposed work. The team must submit a brief report (25 to 30 Pages) at the end of the semester. Final Evaluation for **20** marks will be done by the committee headed by the project coordinator in consultation with HOD.

Project demonstration :

Progress Indicator	Design and Implementation	Demonstration	Report writing	Oral presentation
Marks allocated	**0-5**	**0-5**	**0-5**	**0-5**
			Total Marks	**20**

Course Title	INTERNSHIP		
Course Code	20CS803	L-T-P-C	(0-0-25)2
Exam Hrs.	3	Hours / Week	25
CIE	100 Marks	Total Hours	16

Course Objective: To expose to a particular job and a profession or industry.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore career alternatives prior to graduation.	12	-
2.	Integrate theory and practice.	5	1
3.	Develop work habits and attitudes necessary for job success	9,10,12	-
4.	Prepare and present the project work	9,10,11	-

Rubrics:

Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (20M)	Apply domain knowledge for design and development of allissues (20M)	Apply domain knowledge for design and development of most issues (15M)	Apply domain knowledge for design and development of specific issues (10M)	Unable to apply complete domain knowledge for design and development issues (5M)
Ability to develop /implement the solutions with appropriate techniques, resources and contemporarytools (20M)	Able to develop/implement all the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/implement most of the solutions with appropriate techniques, resources and contemporary tools (15M)	Able to develop/implement specific solutions with appropriate techniques, resources and contemporary tools (10M)	Not confident to develop/implement solutions with appropriate techniques, resources and contemporary tools (5M)
Ability to work independently andin collaboration / multidisciplinary environment. (20M)	Able to work independently andin a collaboration/multid isciplinary environment. (20M)	Able to work independently with minimal guidance and ina collaboration/multidisciplinary environment. (15 M)	Able to work independently with more guidance and ina collaboration/multidisciplinary environment. (10M)	Unable to work independently without guide support and in a collaboration/multidisciplinary environment. (5M)
Ability to allocate time effectively and manage to complete the workallotted within appropriate time. (15M)	Able to allocate time effectively andcomplete all the work allotted withinappropriate time. (15M)	Able to allocate time effectively and complete most of the work allotted within appropriate time. (10M)	Able to allocate timeeffectively and manage to completethe work allotted (5M)	Unable to use time effectively and complete the work allotted.(3M)
		Able to		

Ability to exhibit integrity and ethical behaviour while carrying out the internship and for the preparationof internship report. (15M)	Able to effectively exhibit integrity andethical behaviour while carrying out the internship and for the preparation of internship report. (15M)	moderately exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (10M)	Able to partially exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (6M)	Unable to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (3M)
Ability to demonstrate effective oral andwritten communication skills (10M)	Able to demonstrate effective oral and written communication skills (10M)	Able to demonstrate oral and written communication skills moderately. (7M)	Able to demonstrate oral and written communication skillsminimally. (5M)	Unable to demonstrate effective verbal and written communication skills (2M)

Course Title	C# PROGRAMMING AND .NET		
Course Code	20CS881	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to develop various console and windows applications.

Course Outcomes(COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop programs that use reusability properties and namespaces.	3	-
2.	Design applications using classes, methods, interfaces and inheritance techniques and manage exceptions.	1, 3	-
3.	Create delegates, packages and manage database.	2, 3	-
4.	Demonstrate windows application system and build their own applications	3	1

Course Contents:

MODULE – 1	10 Hrs

Overview of C#: Introduction , A Simple C# Program, Namespaces , Adding Comments, Main Returning a Value, Using Aliases for Namespace Classes, Passing String Objects to WriteLine Method, Command Line Arguments, Main with a Class, Providing Interactive Input, Using Mathematical Functions, Multiple Main Methods, Compile Time Errors. **Literals, Variables and Data Types:** Introduction, Literals , Variables , Data Types , Value Types Reference Types, Declaration of Variables , Initialization of Variables , Default Values ,Constant Variables , Scope of Variables , Boxing and Unboxing. **Operators and Expressions :** Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators , Special Operators ,Arithmetic Expressions, Evaluation of Expressions ,Precedence of Arithmetic Operators, Type Conversions ,Operator Precedence and Associatively. Mathematical Functions. **Decision Making and Branching:** Introduction, Decision Making with if Statement, Simple if Statement, The if... else Statement, Nesting of if... else Statements, The else if Ladder, The Switch Statement The? : Operator. **Decision Making and Looping:** Introduction, The while Statement The do Statement, The for Statement, The foreach Statement. **Methods in C#:**Introduction, Declaring Methods, The Main Method, Invoking Methods, Nesting of Methods, Method Parameters, Pass by Value, Pass by Reference, The Output Parameters, Variable Argument Lists, Methods Overloading. **Handling Arrays:** One-Dimensional Arrays, Creating an Array, Two- Dimensional Arrays, Variable- Size Arrays, the System. Array Class. **Manipulating Strings** : Creating Strings, String Methods, Inserting Strings, Comparing Strings, Finding Substrings, Mutable Strings, Arrays of Strings

MODULE – 2	10 Hrs

Classes and Objects : Introduction, Basic principles of OOP, Defining a Class, Adding Variables and Methods, Member Access Modifiers, Creating Objects, Accessing Class members, Constructors, Overloaded Constructors, Static Members, Static Constructors, Private Constructors, Copy Constructors, Destructors, Member Initialization. **Inheritance and Polymorphism:** Introduction, Classical Inheritance, Containment Inheritance, Defining a Subclass, Visibility Control, Defining Subclass Constructors, Multilevel Inheritance, Hierarchical Inheritance, Overriding Methods, Hiding Methods, Abstract Classes, Abstract Methods, Sealed Classes: Preventing Inheritance, Sealed Methods, The this reference, Nesting of Classes, Constant Members, Read-only Members, Properties, Indexers. Polymorphism, **Interface:** Multiple Inheritance, Multiple Inheritance: Introduction, Defining an Interface, Extending an Interface, Implementing Interfaces, Interfaces and Inheritance, Explicit Interface Implementation, Abstract Class and Interfaces.

Operator Overloading: Introduction, Over loadable Operators, Need for Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Comparison Operators **Delegates and Events:** Introduction, Delegates, Delegate Declaration, Delegate Methods, Delegate Instantiation, Delegate Invocation, Using Delegates, Multicast Delegates, Events. **Managing Errors and Exceptions**: Introduction, What is Debugging? Types of Errors, Exceptions, Syntax of Exception Handling Code, Multiple Catch statements, The Exception Hierarchy, General Catch Handler, Using Finally statement, Nested Try Blocks, Throwing our Own Exceptions, Checked and Unchecked Operators, Using Exceptions for Debugging.

MODULE – 3	**10 Hrs**

Understanding. NET: The C# Environment: Building a Better Window (Introducing Windows Forms): Overview of the System. Windows. Forms Namespace, Working with the Windows Forms Types, The Role of the Application Class ,The Anatomy of a Form, The Functionality of the Control Class, The Functionality of the Form Class, Building Windows Applications with Visual Studio 2005, Working with MenuStrips and ContextMenuStrips, Working with StatusStrips.

Programming with Windows Forms Controls: The World of Windows Forms Controls, Adding Controls to Forms by and, Adding Controls to Forms Using Visual Studio 2005, Working with the Basic Controls, Configuring the Tab Order, Setting the Form's Default Input Button, Working with More Exotic Controls, Building Custom Windows Forms Controls, Testing the CarControl Type, Building a Custom CarControl Form Host.

MODULE – 4	**10 Hrs**

Data Access with ADO.NET: A High-Level Definition of ADO.NET, Understanding, DO.NET Data Providers, Additional ADO.NET Namespaces, The System. Data Types, Abstracting Data Providers Using Interfaces, Increasing Flexibility Using Application ,Configuration Files, The .NET 2.0 Provider Factory Model, The <connectionStrings> Element Installing the Cars Database, Understanding the Connected Layer of ADO.NET, Working with Data Readers, Modifying Tables Using Command Objects, Working with Parameterized Command Objects, Executing a Stored Procedure Using DbCommand, Asynchronous Data Access Under .NET 2.0,Understanding the Disconnected Layer of ADO.NET.

ASP. NET Web Pages and Web Controls: The Role of HTTP, Understanding Web Applications and Web Servers, The Role of HTML, The Role of Client-Side Scripting, Submitting the Form Data (GET and POST), Building a Classic ASP Page, Problems with Classic ASP, The ASP.NET 2.0 Namespaces, The ASP.NET Web Page Code Model, Details of an ASP.NET Website Directory Structure, The ASP.NET 2.0 Page Compilation Cycle, The Inheritance Chain of the Page Type, Interacting with the Incoming HTTP Request, Interacting with the Outgoing HTTP Response, The Life Cycle of an ASP.NET Web Page, Understanding the Nature of Web Controls

Text Books :

1. Andrew Troelsen , "Pro C# and the .NET 3, Special edition, A Press, 2012
2. E. Balagurusamy," Programming in C# A Primer", 3rd edition, TMH, 2010.

Reference Book:

1. Tom Archer: Inside C#, WP Publishers, 2001.

MOOCs:

1. https://www.udemy.com/course/c-net-for-beginners/
2. https://www.udemy.com/course/aspnet-webforms/

Course Title	ADVANCED ALGORITHMS		
Course Code	20CS882	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students should be capable of designing algorithms using suitable algorithm design method and mathematically analyze it.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Determine the asymptotic complexity of algorithms including solving of recurrence relations.	1, 2	-
2.	Explain advanced data structures.	1, 3	-
3.	Apply the dynamic programming concept, greedy approach, and the graph algorithms for problem solving.	2	-
4.	Develop algorithm for a given real life problem.	1,2	1

Course Contents:

MODULE – 1	10 Hrs

Growth Functions: Asymptotic notations, standard notations and common functions, Summations: summations formulas and properties, bounding summations, recurrences: the substitution method, iteration method, master method.

Hash tables: Direct- address tables, hash tables, hash functions, open addressing. **Amortized analysis:** The aggregate method, the accounting method, the potential method, dynamic tables

MODULE – 2	10 Hrs

Definitions of B-trees, basic operations on B-trees, deleting a key from B-tree, Binomial heaps: binomial trees and binomial heaps, operations on binomial heaps, Fibonacci heaps: structure of Fibonacci heaps, mergeble-heap operations, decreasing a key and deleting a node, bounding the maximum degree

MODULE – 3	10 Hrs

Sorting Networks: Comparison networks, the zero-one principle, a Bitonic sorting network, a merging network, a sorting network, Arithmetic circuits: combinational circuits, addition circuits, multiplication circuits.

String matching: The naïve-string algorithm, the rabin-karp algorithm, string matching with finite automata, the Knuth morris-Pratt algorithm.

MODULE – 4	10 Hrs

NP-Completeness :Polynomial time, polynomial-time verification, NP-Completeness and reducibility

Approximation Algorithm: The vertex-cover algorithm, the travelling salesman problem, the set-covering problem, the subnet-sum problem.

Text Book :

1. Thomas H Coreman, Charles E Leiseron, Ronald Rivest, "Introduction to Algorithms", PHI India 2000, Chapters(2,3,4,12,18,19,20,21,28,29.1 to 29.3,34.1 to 34.4,36,37)

Course Title	OPERATIONS RESEARCH		
Course Code	20CS883	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Solve optimization problems using various methods

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop mathematical model for a given problem.	1	-
2.	Apply techniques of Operations Research.	2	-
3.	Solve prediction and estimation problems.	1, 2	-
4.	Expose to the significance of various scientific tools.	5	-

Course Contents:

MODULE – 1	10 Hrs

Introduction : Introduction: The origin, nature and impact of OR; Overview of the Operations Research Modeling Approach: Defining the Problem and Gathering Data; Formulating a Mathematical Model; Deriving Solutions from the Model; Testing the Model; Preparing to Apply the Model; Implementation

Linear Programming – 1 : Prototype example; The Linear Programming (LP) Model, Assumptions of LP, Additional Examples

MODULE – 2	10 Hrs

Simplex Method - 1 : The Essence of the Simplex Method; Setting up the Simplex Method; The **Algebra** of the Simplex Method; The Simplex Method in Tabular Form; Tie Breaking in the Simplex Method

Simplex Method – 2 : Adapting to other Model Forms; Post Optimality Analysis, Computer implementation

MODULE – 3	10 Hrs

Revised Simplex Methods : Foundations of the Simplex Method, The revised simplex method, A Fundamental Insight

Duality Theory: The Essence of Duality Theory; Economic Interpretation of Duality. Primal-Dual **Relationships**, Adapting to other primal forms, The role of duality in sensitive analysis; The essence of sensitivity analysis; Applying sensitivity analysis, The dual simplex method ; Parametric linear programming; The upper bound technique.

MODULE – 4	10 Hrs

Transportation Model :

Definition of the Transportation Model, Nontraditional Transportation Models, The Transportation Algorithm. **Assignment Model and Network Models :** The Assignment Model, CPM and PERT

Text Books :

1. Frederick S. Hillier and Gerald J. Lieberman, "Introduction to Operations Research", Tata McGrawHill, 9th Edition, 2012. (Chapters: 1.1 to 1.3, 2, 3.1 to 3.3, 4.1 to 4.7, 5, 6.1 to 6.7, 7.1)
2. Hamdy A Taha, "Operations Research: An Introduction", Prentice Hall India, 8th Edition, 2005.(Chapters: 5, 6.4)

Reference Book:

1. Wayne L. Winston, "Operations Research Applications and Algorithms", Thomson Course Technology, 4th Edition 2003

Course Title	PRINCIPLES OF COMPILER DESIGN		
Course Code	20CS884	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: To provide students with the knowledge and abilities to design and implement compilers.

Course Outcomes(COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design syntax directed translation schemes for a given context free grammar	1	-
2.	Explain various memory management issues while designing a compiler	1	-
3.	Construct the intermediate code representations for a given simple programming constructs	1	-
4.	Apply the optimization techniques to have a better code for code generation	1	-

Course Contents:

MODULE – 1	10 Hrs

Syntax-Directed Translation : Syntax Directed definitions, Evaluation order for SDD's, Applications of Syntax- Directed translation, Syntax Directed Translation Schemes, Implementing L-attributes SDD's;

MODULE – 2	10 Hrs

Run time environment: Storage Organization, Stack Allocation Space, Access to Non-Local Data onthe stack, Heap Management, Introduction to Garbage Collection. **Intermediate Code Generation :** introduction, Variants of Syntax trees,

MODULE – 3	10 Hrs

Intermediate Code Generation (Contd.): Three Address code, Types and Declarations; translation of expression, Type Checking, Control flow, Back patching. Switch statements; Intermediate Code for Procedures.

MODULE – 4	10 Hrs

Code Generation: Issues in the design of code generation, the target language, Address in target code. Basic blocks and flow graphs, Optimization of basic blocks, A simple code generator, Peephole Optimization

Text Book :

1. Alfred V Aho, Ravi Sethi, Jeffrey D Ullman, "Compilers- Principles, Techniques and Tools", 2nd Edition , Addison-Wesley, 2013

Reference Books:

1. Fischer, C. N. and LeBlanc, R. J., "Crafting a compiler with C", Benjamin Cummings, 2003.
2. Bennet, J.P., "Introduction to Compiler Techniques", 2nd Edition, TMH, 2003
3. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", Prentice Hall of India, 2001

Course Title	STORAGE AREA NETWORKS		
Course Code	20CS885	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Analyze various Storage Area Networks.

Course Outcomes(COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate different RAID levels.	1,2	-
2.	Analyze the components of Storage Area Network (SAN).	1,2	2
3.	Explore Storage Area Network.	2	2
4.	Demonstrate Network Attached Storage.	1,2	2

Course Contents:

MODULE – 1 **10 Hrs**

Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages, Case study: Replacing a server with Storage Networks, Architecture of Intelligent Disk Subsystems, Hard disks and Internal I/O Channels.

Intelligent Disk Subsystem: JBOD, Storage virtualization using RAID, different RAID levels; Caching: Acceleration of Hard Disk Access; Instant copies, Remote mirroring, LUN masking, Availability of disk subsystems.

MODULE – 2 **10 Hrs**

I/O Technique: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel **Protocol** Stack-links, ports, topologies, FC-0,FC-1,FC-2,FC-3, link services, FC-4.

Fiber channel SAN, Network Attached Storage: Fiber Channel SAN-point-to-point topology, fabric **topology**, arbitrated loop topology, hardware components, IP Storage-IP storage standards: iscsi, iFCP, Mfcp, FCIP. The NAS hardware Architecture, The NAS Software Architecture, Network connectivity.

MODULE – 3 **10 Hrs**

File System: Local File Systems; Network file Systems and file servers: basic principle, NAS, **performance** bottle necks, acceleration of network file systems, case study-DAFS; Shared Disk file systems; Comparison: NAS, fiber Channel SAN and iSCSI SAN.

Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.

MODULE – 4 **10 Hrs**

SAN Architecture and Hardware devices: Creating a Network for storage-The network part, The software `-fabric OS services, The connectivity part- connecting server, connecting the storage, SAN Hardware devices- The fiber channel switch, Host Bus adaptors. **Software Components of SAN:** The switch's operating system, Device Drivers, The Supporting components.

Text Books :

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Second Edition Wiley India, 2009
2. Robert Spalding: Storage Networks, The Complete Reference, Tata McGraw Hill, 2003. (Ch. 9, 13, 14, 15)

Reference Book:

1. Richard Barker and Paul Massiglia: Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs, John Wiley India, 2002

MOOC:

1. https://onlinecourses.nptel.ac.in/noc18_cs50/preview

Course Title	MOBILE COMMUNICATIONS		
Course Code	20CS886	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: To apply knowledge of Mobile Communications and Technologies in real timeapplications.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the applications, marketing and reference model of Mobilecommunication system.	6,12	-
2.	Classify the different types of transmissions, medium access controltechniques and satellite Systems.	1,2	-
3.	Differentiate and analyze the mobile networks and Other Networks.	1,3	-
4.	Analyze the process involved in Mobile IP and DHCP Server.	1,2	-
5.	Design the Protocols for mobile networks and file systems.	3,4	-

Course Contents:

MODULE – 1 **10 Hrs**

Introduction to Mobile Communications: Applications, History of Wireless Communication, A Market for Mobile Communications, Some open research Topics, A simplified reference model.
Wireless Transmission: Frequencies for Radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Cellular Systems.

MODULE – 2 **10 Hrs**

Medium Access Control: Motivation for a specialized MAC, TDMA, CDMA, Comparison of S/T/F/CDMA. **Satellite Systems:** History, Applications, Basics, Routing, Localizations, Handover; **Broadcast Systems:** Overview, Cyclical Repetition of data, DAB, DVB, Convergence of Broadcasting and Mobile communications.

MODULE – 3 **10 Hrs**

Wireless LAN: Infrared versus radio transmission, Infrastructure and Adhoc Network, IEEE-802.11-System Architecture and Protocol Architecture.
Mobile Network Layer: Mobile IP: Goals, assumptions and requirements, Entities and terminology, IP packet delivery, Agent discovery, Registration, Tunnelling and encapsulation, Optimizations; Dynamic host configuration protocol

MODULE – 4 **10 Hrs**

Mobile ad-hoc networks: Routing, Destination sequence distance vector, Dynamic source routing, Alternative metrics , Overview ad-hoc routing protocols

Mobile Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, Performance enhancing proxies; Support for Mobility: File Systems, i-mode.

Text Book:

1. Jochen Schiller, Mobile communications, Pearson Education, 2nd edition

Reference Books:

1. Asoke K. Talkukder, Roopa R Yavagal: Mobile Computing – Technology, Applications and Service Creation, Tata McGraw Hill, 2012
2. Reza B'Far: Mobile Computing Principles – Designing and Developing Mobile Applications with UML and XML, 5th Edition, Cambridge University press, 2013