RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

Academic year 2023 – 2024

COMPUTER SCIENCE AND ENGINEERING

V & VI SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 11 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^+' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 67% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 78th rank among 1314 top Engineering Institutions & 23rd Rank for School of Architecture in India for the year 2023.

About the Department

Year of Establishment	1984
Names of the Programmes offered	UG: B.E. in Computer Science and Engineering PG: M.Tech. in Computer Science and Engineering PG: M.Tech. in Computer Networks and Engineering Ph.D M.Sc.(Engg.) by Research

The Department of Computer Science and Engineering (CSE) has eminent emeritus professors, 15 faculties with the doctorate degree and 15 pursuing the doctoral studies. The faculty has been publishing research papers in refereed journals and in conference proceedings. The department also conducts vocational courses and proficiency courses on fundamental and new programming languages and computer science concepts. These courses are conducted beyond college hours'/summer semester by the faculty of the department. Some of the faculty are involved in institutional level activities and actively involved in interdisciplinary research activities. The department has state of the art laboratories like SAP, IBM Centre of Excellence and CUDA learning center. Technical seminars, workshops and hackathons are conducted regularly for UG & PG students. The department encourages the students to conduct and participate in extra- curricular/sports activities. The alumni network is very active and regular meeting are conducted by the department. The department is accredited by Nation Board of Accreditation (NBA). The department has MoUs with leading IT Industries like NVIDIA, SAP, IBM and HP. The department conducts subjects with more of hands- on sessions and encourages students to take up MOOC based online courses in NPTEL, IITBombayX, Coursera, Udacity and edX.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs.

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization.
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations.
3. Establishing innovative skills development, techno-entrepreneurial activities, and consultancy for socio-economic needs.

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned.

VISION OF THE DEPARTMENT

To build a strong learning and research environment in the field of Computer Science and Engineering that promotes innovation towards betterment of the society.

MISSION OF THE DEPARTMENT

1. To produce Computer Science graduates who, trained in design and implementation of computational systems through competitive curriculum and research in collaboration with industry and research organizations.
2. To educate students in technology competencies by providing professionally committed faculty and staff.
3. To inculcate strong ethical values, leadership abilities and research capabilities in the minds of students so as to work towards the progress of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

A B.E (Computer Science & Engineering) graduate of Ramaiah Institute of Technology should, within three to five years of graduation

PEO1 Pursue a successful career in the field of Computer Science & Engineering or a related field utilizing his/her education and contribute to the profession as an excellent employee, or as an entrepreneur.

PEO2 Be aware of the developments in the field of Computer Science & Engineering continuously enhance their knowledge informally or by pursuing graduate studies.

PEO3 Be able to work effectively in multidisciplinary and multicultural environments and be responsible members and leaders of their communities.

PROGRAM OUTCOMES (POs):

The Outcomes of the Bachelor of engineering in Computer Science & Engineering Programme are as follows:

Engineering Graduates must be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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 to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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):

PSO1: Understand the principles, architecture and organization of computers, embedded systems, and computer networks.

PSO2: Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems that include both hardware and software

PSO3: Apply software design and development practices to develop software applications in emerging areas such as IoT, Data Analytics, Social Networks, Cloud and High-Performance Computing.

Semester wise Credit Breakdown for B.E Degree Curriculum

Batch 2021-25

Course Category \ Semester	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	09	11	--	--	--	--	--	--	20
Humanities, Social Sciences and Management (HSMC)	02	--	01	01	03	03	--	--	10
Ability Enhancement Course (AEC)	01	01	01	01	01	--	03	--	08
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	11	05	04	--	43
Integrated Professional Core Course (IPCC)	--	--	03	03	03	--	04	--	13
Professional Elective Courses (PEC)	--	--	--	--	03	06	03	--	12
Institutional Open Elective Courses (IOE)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	02	--	02	--	05	09
Mini Project / Project Work (PW)	--	--	--	--	--	03	03	09	15
Non Credit Mandatory Courses (NCMC)	--	--	Yes	--	Yes	--	--	--	--
Total Credits	20	20	21	22	21	22	20	14	160

SCHEME OF TEACHING

V SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	CS51	Software Engineering and Modelling	CSE	PCC	3	0	0	3	3
2	CS52	Artificial Intelligence and Machine Learning	CSE	IPCC	2	0	1	3	4
3	CS53	Database Systems	CSE	PCC	2	1	0	3	4
4	CS54	Operating Systems	CSE	PCC	3	0	0	3	3
5	CSE55x	Program Elective Course – 1	CSE	PEC	3	0	0	3	3
6	CSL56	Database Laboratory	CSE	PCC	0	0	1	1	2
7	CSL57	Advanced Java Programming Laboratory	CSE	PCC	0	0	1	1	2
8	AL58	Research Methodology & Intellectual property rights	CSE	HSMC	3	0	0	3	3
9	AEC510	Ability Enhancement Course - V	Any Department	AEC	1	0	0	1	1
				Total				**21**	**26**
10	HS59	Environmental Studies *	Civil	NCMC	0	0	0	0	1

V Semester-List of Courses for Program Elective Course-1

SI. No	Course Code	Course Name	Credits				Contact Hours/ Week
			L	T	P	Total	
1.	CSE551	Secure Programming	2	0	1	3	4
2.	CSE552	Computer Graphics and Virtual Reality	2	0	1	3	4
3.	CSE553	Operation Research	2	1	0	3	4
4.	CSE554	Advanced Algorithms	2	1	0	3	4
5.	CSE555	Cryptography and Network Security	3	0	0	3	3

SCHEME OF TEACHING

VI SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AL61	Management & Entrepreneurship	CSE	HSMC	3	0	0	3	3
2	CS62	Compiler Design	CSE	PCC	2	1	0	3	4
3	CSE63x	Program Elective Course – 2	CSE	PEC	3	0	0	3	3
4	CSE64x	Program Elective Course – 3	CSE	PEC	3	0	0	3	3
5	CSL65	Web Technologies Laboratory	CSE	PCC	0	0	1	1	2
6	CSL66	Unix System Programming Laboratory	CSE	PCC	0	0	1	1	2
7	CSOE0x*	Institutional Open Elective - 1	Any Department	IOE	3	0	0	3	3
8	CSP67	Mini Project	CSE	PW	0	0	3	3	-
9	INT68	Innovation/Societal/ Entrepreneurship based Internship	Any Department	INT	0	0	2	2	-
Total								**22**	**20**

VI Semester-List of Courses for Programme Elective Course-2

Sl. No	Course Code	Course Name	Credits				Contact Hours/ Week
			L	T	P	Total	
1.	CSE631	Introduction to Deep Learning	2	0	1	3	4
2.	CSE632	Software Defined Networks	2	1	0	3	4
3.	CSE633	Linux Kernel Programming	3	0	0	3	3
4.	CSE634	Information Retrieval	2	0	1	3	4
5.	CSE635	Block chain and Distributed App Development	3	0	0	3	3

VI Semester-List of Courses for Programme Elective Course-3

Sl. No	Course Code	Course Name	Credits				Contact Hours/ Week
			L	T	P	Total	
1.	CSE641	Introduction to Devops	3	0	0	3	3
2.	CSE642	Wireless Sensor Networks	2	1	0	3	4
3.	CSE643	Natural Language Processing	3	0	0	3	3
4.	CSE644	Advanced DBMS	3	0	0	3	3
5.	CSE645	Cyber Physical systems	3	0	0	3	3

List of Open Elective Courses

Sl. No	Course code	Course Name
1.	CSOE02	Mobile application Development
2.	CSOE04	Web Technologies
3.	CSOE05	Object Oriented Programming with C++
4.	CSOE07	Programming in Java
5.	CSOE09	Introduction to Artificial Intelligence and Machine Learning
6.	CSOE10	Introduction to Big Data Analytics

Note: The above list of courses shall be offered during 6^{th} and 7^{th} semester for the students of branches other than CSE and ISE

SOFTWARE ENGINEERING AND MODELLING	
Course Code: CS51	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Annapurna P Patil/ Dr. Shilpa Chaudri	

Course Contents

Unit I

The Software Process - Process Models: A Generic Process Model, defining a Framework Activity, identifying a Task Set, Process Assessment and Improvement, Prescriptive Process Models.**Agility and Process:** What Is Agility? Agility and the Cost of Change, What Is an Agile Process? Agility Principles, The Politics of Agile Development, Scrum-Scrum Teams and Artifacts, Sprint Planning Meeting, Daily Scrum Meeting, Sprint Review Meeting, Sprint Retrospective; Other Agile Frameworks-The XP Framework, Kanban, DevOps **Homan aspects of Software Engineering:** Characteristics of a Software Engineer, The Psychology of Software Engineering, The Software Team, Team Structures. The Impact of Social Media, Global Teams

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Comparative analysis of software process models on the real-time case study application

Unit II

Principles that guide practice: Core Principles Principles That Guide Practice, That Guide Each Framework Activity. **Understanding Requirements:** Requirements Engineering, Establishing the Groundwork, Requirements Gathering, Developing Use Cases, Building the Analysis. **Requirement Modeling-A Recommended Approach:** Requirements Analysis, Scenario-Based Modeling, Class-Based Modeling, Functional Modeling, Behavioral Modeling

- Pedagogy /Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Analysis of the real-time case study application

Unit III

Design Concepts: Design Within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model. **Architectural Design -** Software Architecture, Agility and Architecture, Architectural Considerations, Architectural Decisions, Architectural Design, Alternative Architectural Designs. **Component-level Design -** What Is a Component? Class-Based Components, Conducting Component-Level Design, Component Refactoring. **User Experienced Design** - User Experience Design Elements, The Golden Rules, User Interface Analysis and Design, User Experience Analysis, User Experience Design, User Interface Design, Design Evaluation, Usability and Accessibility, Conventional Software UX and Mobility

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: High level and low level design of the analysed real-time case study application

Unit IV

Software Testing- Component Level -A Strategic Approach to Software Testing, Planning and Recordkeeping, Test-Case Design, White-Box Testing, Black-Box Testing, Object-Oriented Testing. **Software Testing -Integration Level** - Software Testing Fundamentals, Integration Testing, Artificial Intelligence and Regression Testing, Integration Testing in the OO Context, Validation Testing, Testing Patterns. **Specialized testing for mobility -** Mobile Testing Guidelines, The Testing Strategies, User Experience Testing Issues, Web Application Testing, Web Testing Strategies, Internationalization, Security Testing, Performance Testing, Real-Time Testing, Testing AI Systems, Testing Virtual Environments, Testing Documentation and Help Facilities. **Quality Concepts :** What Is Quality? Software Quality, The Software Quality Dilemma Achieving Software Quality

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Designing test cases as per the requirement specification of the real-time case study application

Unit V

Reviews - Cost Impact of Software Defects, Defect Amplification and Removal, Review Metrics and Their Use, Criteria for Types of Reviews, Informal Reviews, Formal Technical Reviews, Postmortem Evaluations, Agile Reviews. **Software Security Engineering** - Why Software Security Information Is Important? Security Life-Cycle Models, Secure Development Life-Cycle Activities, Security Requirements Engineering, Misuse and Abuse Cases and Attack Patterns, Security Risk Analysis, Threat Modeling, Prioritization, and Mitigation, Attack Surface, Secure Coding, Measurement, Security Process Improvement and Maturity Models. **Software Metrics and Analytics -** Software Measurement, Software Analytics, Product Metrics, Metrics for Testing, Metrics for Maintenance, Process and Project Metrics, Software Measurement, Metrics for Software Quality, Establishing Software Metrics Programs. **Software Process Improvement -** What Is SPI? The SPI Process, The CMMI, Other SPI Frameworks, SPI Return on Investment, SPI Trends

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Review of the analysis and design of the real-time case study application

Textbooks:

1. Pressman, Roger S. Software Engineering: A Practitioner‟s Approach, 2020, 9th Edition, McGraw-Hill. ISBN 978-1-260-54800-6
2. Krief, Mikael. Learning DevOps, 2019, 1st Edition, 2019, Packt Publishing Ltd. ISBN 9781838642730
3. Sommerville, Ian. Software Engineering, 2011, 9th Edition, Pearson Education. ISBN 9780137035151

Reference books:

1. Verona, Joakim, Practical DevOps, 2016, 1st Edition, Packt Publishing Ltd. ISBN 9781785882876.
2. Blaha, Michael, and James Rumbaugh. Object-Oriented Modeling and Design with UML, 2004, 2nd Edition, Pearson Education, ISBN 9780130159205.

Course Outcomes (COs):

At the end of the course, the students should be able to:

1. Identify the various components of the software development lifecycle, taking into account key process models and addressing the debate between prescriptive and agile process philosophies. (PO-1,4,6,7,8,9,11. PSO-2, 3)
2. Examine the software requirement using different modelling techniques. (PO-12,3,3,6,7,8,9,11, PSO-2, 3)
3. Apply design principles and concepts to create component and architectural models with systematic user interfaces. (PO,2,3,4,6,7,8,9,11, PSO-2,3)
4. Create test cases using the testing techniques and strategies. (PO-2, 3, 4, 5, 6,9,11, PSO-2, 3)
5. Apply the review approach and security engineering approach to identify quality characteristics and achieve them. (P0-1,4,5,6,7,8,9,11, PSO-2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Report of High level and low level design of the analysed real-time case study application	10	CO1, CO2 and CO3
Presentation of Review of the analysis and design of the real-time case study application	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in First Evaluation +Marks scored in Second Evaluation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 and CO5

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	
Course Code: CS52	**Credits: 2:0:1**
Prerequisite: Knowledge of Algorithms, Elementary Discrete Mathematics and Probability theory	**Contact Hours: 28L+14P**
Course Coordinator: Dr.Annapurna P Patil & Dr.Sangeetha V	

Course Contents

Unit I

Introduction: What is AI? Foundation and History of Artificial Intelligence. **Intelligent Agents**: Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. **Problem-solving by search:** Problem Solving Agents, Example Problems, Searching for Solution, Uniformed Search Strategies, Informed Search Strategies, Heuristic Functions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Informed and Uninformed Search techniques

Unit II

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, reasoning patterns in propositional Logic, Agents Based on Propositional Logic**. First-Order Logic:** Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic. **Inference in First-order Logic**: Propositional vs. First-Order Inference, Unification and Lifting, forward chaining, Backward chaining, Resolution.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Problems on FOL, Forward Chaining, Backward Chaining, Resolution

Unit III

Introduction to Machine Learning: What is Machine Learning, Key Terminology, Key tasks of machine learning, well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. **Concept Learning:** Introduction, A Concept Learning Task, Concept Learning as Search, Find-S, Version Spaces and the Candidate-Elimination Algorithm. **Decision Tree** - Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Issues in Decision Tree Learning.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Find S algorithm, Candidate-Elimination Algorithm, ID3 Algorithm.

Unit IV

Artificial Neural Networks - Introduction, Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer Networks and the Backpropagation algorithm. **Bayesian Learning** - Introduction, Bayes theorem, Naive Bayes Classifier, The EM Algorithm.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Naïve Bayes Classifier, Backpropagation algorithm, K-means algorithm, EM Algorithm

Unit V

Instance Based Learning - Introduction, k-nearest neighbor learning, Locally Weighted Regression, radial basis function, Case-based reasoning. **Genetic Algorithms** – Representing hypotheses, Genetic Operators, Fitness Function and Selection, An Illustrative Example. **Reinforcement Learning** – Introduction, The Learning Task, Q Learning.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement k-nearest neighbor learning, Genetic algorithm, reinforcement learning techniques

Text Books:

1. Stuart J Russel and Peter Norvig: "Artificial Intelligence - A Modern Approach", 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair: "Artificial Intelligence", 3rd Edition, Tata McGraw hill, 2011.
2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
3. Peter Harrington. "Machine learning in action", Shelter Island, NY: Manning Publications Co, 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2016.

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Identify the modern view of Artificial Intelligence and the problem solving techniques. (PO-1,2,3,4,5, PSO-2,3)
2. Apply the knowledge representation and Inference techniques to solve real world problems using the agent Philosophy. (PO-1,2,3,4,5, PSO-2,3)
3. Demonstrate proficiency in applying scientific method to models of machine learning (PO-1,2,3,4,5, PSO-2,3)
4. Analyze the concept of Artificial neural networks and Bayes classifier for problem solving (PO-1,2,3,4,5, PSO-2,3)
5. Examine the different applications of Instance Based Learning, Reinforcement Learning and genetic algorithm with their societal impact. (PO-1,2,3,4,5, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Lab program Implementation	10	CO1, CO2, CO3
Case study solving & Presentation with report	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Lab Component +Case Study presentation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 and CO5

DATABASE SYSTEMS	
Course Code: CS53	**Credits: 2:1:0**
Prerequisite: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

Unit I

Introduction: Characteristics of Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of using DBMS approach, Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client-Server Architectures for DBMS, Classification of Database Management Systems, **Entity-Relationship Model:** Using High-level Conceptual Data Models for Database Design, A Sample Database Application, Entity types, Entity sets Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints Weak Entity Types.ER Design for COMPANY Database,

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Design an ER schema for a database application

UNIT II

Relational Model and Constraints Relational Model Concepts, Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint violations. **Relational Algebra:** Unary Relational Operations, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations. Examples of Queries in Relational Algebra. Relational Database Design Using ER- to-Relational Mapping

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Unary and Binary Operations using Relational Algebra.

UNIT III

Introduction to SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Scheme Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, INSERT, DELETE and UPDAT Statements in SQL, Specifying Constraints as Assertions and Triggers, Views(Virtual Tables) in SQL ,**Introduction to SQL Programming Techniques:** Database programming Issues and Techniques, Embedded SQL. Database Programming with Function Calls: SQL and JDBC

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implementation of Database Applications using SQL and Programming Techniques.

UNIT IV

Functional Dependencies and Normalization: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of second Database Systems and third Normal Forms, Boyce Codd Normal Forms, **Relational Database Design:** Properties of Relational Decompositions**,** Algorithms for Relational Database Schema Design. Multivalued Dependencies and Fourth Normal Form. Join Dependencies and Fifth Normal Form.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Functional Dependencies and Normalization Techniques.

UNIT V

Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules based on Serializability. **Concurrency Control Techniques:** Two-Phase Locking Techniques for concurrency Control, Concurrency Control based on Timestamp Ordering, Multi-version Concurrency Control Techniques. Database Recovery Techniques and Algorithms.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Transaction Processing Algorithms and Techniques.

Text Books:

1. Elmasri and Navathe: Fundamentals of Database Systems, 7th Edition, Pearson, 2016.
2. Silberschatz, Korth and Sudharshan: Data base System Concepts, 6th Edition, Tata McGraw Hill, 2011.
3. C.J. Date, A. Kannan, S. Swamynatham: An Introduction to Database Systems, 8th Edition, Pearson education, 2009.

Reference Book:

1. "Database Management Systems" by Raghu Ramakrishnan, Johanners Gehrke, Second Edition. McGraw-Hill Education

Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/106105175

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Design Entity-Relationship Diagrams to represent simple Database Applications and Interpret Advantages of Database Systems (PO-2, 3, 4, 5, PSO-2)
2. Construct Relational Algebraic Expressions for Queries using the Concepts of Relational Database theory and convert to ER to Relational Model (PO-1, 2, 4, PSO-2)
3. Formulate using SQL Solutions to a broad range of Query and Data update problems (PO-2,3,4,5, PSO-2)
4. Apply Normalization to Improve Database Design (PO-1, 2, PSO-2)

5. Interpret the basic Issues of Transaction Processing, Concurrency Control and Recovery Techniques (PO-3, PO-4, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 and CO3
Quiz –II/Project Implementation	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 and CO5

OPERATING SYSTEM	
Course Code: CS54	**Credits: 3:0:0**
Prerequisite: Computer Organization	**Contact Hours: 42L**
Course Coordinator: Chandrika Prasad	

Course Contents

Unit I

Introduction to Operating Systems- What operating systems do, Operating System operations, Process management, Memory management, Storage management, Protection and security**. System Structures-** Operating System Services, System calls, Operating System design and implementation, Operating System structure, Virtual machines**.**

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit II

Process Management - Process concept, Process scheduling, Operations on processes, Inter-process communication. **Process Scheduling**- Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-Processor scheduling. **Process Synchronization-** Background, The Critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit III

Deadlocks- System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance**. Memory Management Strategies-** Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation. **Virtual Memory Management-** Background, Demand paging, Page replacement.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit IV

File System- File concept, Access methods, Directory structure, Protection. **Implementing File System-** File system structure, File system implementation, Directory implementation, Allocation methods, Free space management, Disk scheduling algorithms.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit V

Dockers-Docker Basics and Architecture, what is containerization, how are containers different from physical machines and VMs, Docker evolution and architecture, Developments in Docker world, Docker tooling, Basic Docker commands. **Docker Networking-** Introduction, Types of Docker networks, Using Networks, Identifying container networks, **Docker Volumes-**Managing data in Docker containers with volumes, Volume file systems and basic Docker image file systems,

Creating and managing volumes.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 9th edition, Wiley-India, 2012.

Reference Books:

1. William Stallings: Operating systems Internals and Design Principles | Ninth Edition, Pearson Education, 2018
2. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Operating systems: Three easy pieces, URL : http://pages.cs.wisc.edu/~remzi/OSTEP/
3. James Turnbull: The Docker Book: Containerization is the new virtualization Kindle Edition, Kindle Edition, 2014

Link (e-Resources): URL: https://docs.docker.com/

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Describe operating system operations and operating system structures (PO-1, 2, PSO-2).
2. Implement various scheduling algorithms and concurrency control techniques to provide co-ordination among threads and processes (PO-1, 2, 3, 4, PSO-2).
3. Examine various methods for handling deadlocks and memory management techniques (PO-1, 2, 3, 4, PSO-2).
4. Demonstrate different directory structure, file allocation methods and disk scheduling algorithms used for managing the disk (PO-1,2,3, PSO-2)
5. Illustrate Dockers techniques for various networking and file system applications (PO1, 2, 3, 4,5,9,10,12, PSO-2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3 and CO4
Uploading Project on Cloud	10	CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Quiz + Project Implementation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 and CO5

SECURE PROGRAMMING	
Course Code: CSE551	**Credits: 2:0:1**
Prerequisite: C Programming	**Contact Hours: 28L+14P**
Course Coordinator: Dr. Shilpa Chaudri	

Course Contents

Unit I

The Software Security Problem - security features, static analysis in the big picture, classifying vulnerabilities, Introduction to Static Analysis - capabilities and limitations, solving problems, success criteria, analyzing source vsanalyzing compiled code

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit II

Performing code review, adding security review on an existing development process, static analysis metrics, Security analysis internals - building model, analysis algorithms, rules, reporting results

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit III

Handling inputs - what and how to validate, preventing met character vulnerabilities, introduction to buffer overflow, strings, integers, runtime protection.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit IV

Handling errors with return codes, managing exceptions, preventing resource leaks, logging and debugging

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit V

Code/Command Injection, (No) SQL Code Injection, Cross-Site Request Forgery (CSRF), Cross-Site Scripting (XSS), Open Redirection, File Inclusion / Directory Traversal, Clickjacking, Session-Hijacking, Information Disclosure, Authentification, Denial of Service, Middleware, and Third-Party Software

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Text Books:

1. Chess, B and West, J, Secure Programming with Static Analysis, Addison-Wesley, 2007
2. Frank Hissen "Secure Programming of Web Applications", 2019
3. TamaghnaBasu Secure Programming with Python – 31 January 2017
4. McGraw, G., Viega, J. (2011). Building Secure Software: How to Avoid Security Problems the Right Way. Addison-Wesley.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Identify the software security problems solved by the static analysis from programmer's perspectives (PO-1,2,3,PSO -1,3)
2. Examine security review process considering metrics based on output of static analysis for integrating static analysis as part of the software development process (PO-1,2,3, PSO -1,3)
3. Deal with many forms and flavors of untrustworthy input and corresponding pervasive security problems that impact the software regardless of its functionality PO-1,2,3, PSO -1,3)
4. Demonstrate error handling and recovery as part of security problem using general approached to logging and debugging (PO-1,2,3, PSO -1,3)
5. Analyze security concerns that affect web development applications (PO-1,2,3, PSO -1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 and CO3
Quiz –II/Project Implementation	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

COMPUTER GRAPHICS AND VIRTUAL REALITY	
Course Code: CSE552	**Credits: 2:0:1**
Prerequisite: Data Structures	**Contact Hours: 28L+14L**
Course Coordinator: Dr. Jayalakshmi D S	

Course Contents

Unit I

Introduction: Applications of computer graphics, A graphics system, Images: Physical and synthetic, Imaging Systems, The synthetic camera model, The programmer's interface, Graphics architectures, Programmable Pipelines.

Graphics Programming: Programming two-dimensional applications, OpenGL application programming interface, Primitives and attributes, color, viewing, control functions, the gasket program, polygons and recursions, the three dimensional gasket, adding interactions, menus.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implementation of primitives with different color

Unit II

Geometric Objects and Transformations: Frames in OpenGL, Modeling a Colored Cube, Affine Transformations, Rotation, Translation and Scaling, Transformation in Homogeneous Coordinates, Concatenation of Transformations, OpenGL Transformation Matrices.

From Vertices to Fragments: Basic Implementation Strategies, Four major tasks, Clipping, Line-segment clipping.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos
- Lab Component / Practical Topics: Implementation of different transformations and line clipping

Unit III

Polygon clipping, Clipping of other primitives. Clipping in three dimensions, Rasterization, Bresenham's algorithm, Polygon Rasterization, Hidden-surface removal

Lighting and Shading: Light and Matter, Light sources, The Phong reflection model, Polygon shading, Light sources in OpenGL, Specifying lighting parameters, Implementing a lighting model

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos
- Lab Component / Practical Topics: Implement polygon clipping, lighting and shading

Unit IV

Viewing: Classical and computer viewing, Viewing with a Computer, Positioning of the camera, Parallel Projections, Perspective projections, Perspective Projections with OpenGL, Perspective projection matrices.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos
- Lab Component / Practical Topics: Demonstration of Projection Types.

Unit V

Introduction to virtual reality: Classical components and design of a VR system, important factors in a VR system, types, advantages, VR input devices, graphics display interfaces, sound display and interface, haptic feedback, graphical rendering pipeline. applications of VR.

Object Modelling and Computer Architecture for Virtual reality: Modelling techniques in VR, PC graphics architecture and accelerators, distributed VR environment, Programming through VRML.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos
- Lab Component / Practical Topics: Demonstration of VRML

Laboratory Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Drawing basic shapes using openGL primitives
2.	2D and 3D Sierpinski Gasket
3.	Interaction using mouse and keyboard
4.	Menu based program
5.	Line-segment clipping
6.	Brenham's line drawing algorithm
7.	Transformation of primitives
8.	Draw Color cube and allow the user to move the camera suitably to experiment with perspective viewing
9.	Double Buffering
10.	Lighting and shading
11.	VRML demonstration
12.	VRML based exercises

Text Books:

1. Edward Angel and Dave Shreiner: Interactive Computer Graphics - A Top-Down Approach with Shader-based OpenGL, 7th Edition, Pearson Education, 2014.
2. Rajesh K Maurya, Computer Graphics with Virtual Reality Systems, Second Edition, Wiley, 2014.

Reference Books:

1. Donald Hearn and Pauline Baker: Computer Graphics with OpenGL, 3rd Edition, Pearson Education, 2011.
2. F.S. Hill Jr.: Computer Graphics Using OpenGL, 3rd Edition, Pearson Education, 2009.
3. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes: Computer Graphics, 2nd Edition, Pearson Education, 2011

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Illustrate the concepts of graphics system architecture and OpenGL programming (PO-1, 2, 5,12 PSO-2)
2. Apply the geometrical transformations used in interactive computer graphics in different coordinate systems. (PO-1,2, 5,12 PSO-2)
3. Implement the different algorithms for clipping and rasterization of lines and polygons, and for hidden surface removal. (PO-1, 2, 5,12 PSO-2)
4. Demonstrate the geometrical transformations used in viewing and projection. (PO-1, 2, 5,12 PSO-2)
5. Appraise the hardware and software used in Virtual Reality Systems. (PO-2,3 PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Practical lab record	10	CO1,CO2, CO3, CO4 and CO5
Practical test	10	CO1,CO2, CO3, CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Practical Lab Record +Marks scored in Practical Test		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

OPERATION RESEARCH	
Course Code: CSE553	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 42L**
Course Coordinator: Veena G S	

Course Contents

Unit I

Introduction, Linear Programming – 1: Introduction: The origin, nature and impact of OR; Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation. **Introduction to Linear Programming**: Prototype example; the linear programming (LP) model.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit II

LP – 2, Simplex Method: Assumptions of LP; Additional examples. The essence of the simplex method; Setting up the simplex method; Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Adapting to other model forms; Post optimality analysis; Computer implementation Foundation of the simplex method. **Duality Theory:** The revised simplex method, a fundamental insight. The essence of duality theory; Economic interpretation of duality, Primal dual relationship; Adapting to other primal forms.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit III

Duality Theory and Sensitivity Analysis, Other Algorithms for LP: 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.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit IV

Transportation and Assignment Problems: The transportation problem: A streamlined simplex method for the transportation problem; The assignment problem; A special algorithm for the assignment problem.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit V

Game Theory, Decision Analysis: Game Theory: The formulation of two persons, zero sum games; Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure; Solving by linear programming, Extensions. **Decision Analysis:** A prototype example; Decision making without experimentation; Decision making with experimentation; Decision trees. **Metaheuristics:** The nature of Metaheuristics, Tabu Search, Simulated Annealing, Genetic Algorithms.

- Pedagogy: Chalk and talk, Power point presentation, Videos

Text Books:

1. Frederick S. Hillier and Gerald J. Lieberman: Introduction to Operations Research: Concepts and Cases, 8th Edition, Tata McGraw Hill, 2005. (Chapters: 1, 2, 3.1 to 3.4, 4.1 to 4.8, 5, 6.1 to 6.7, 7.1 to 7.3, 8, 13, 14, 15.1 to 15.4).

Reference Books:

1. Wayne L. Winston: Operations Research Applications and Algorithms, 4th Edition, Cengage Learning, 2003.
2. Hamdy A Taha: Operations Research: An Introduction, 8th Edition, Pearson Education, 2007.

Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=WIWhQpR-CjY

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Determine optimal strategy using appropriate techniques and the concepts of LPP and formulations. (PO-1,2, PSO-2)
2. Construct problems under simplex methods and its types. (PO-1,2, PSO-2)
3. Identify problems under duality and justify them. (PO-3,5,7, PSO-2)
4. Solve assignment and transportation problems. (PO-4, PSO-2)
5. Model competitive game theory and decision-making problems. (PO-4,11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2 and CO3
Quiz -II	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

ADVANCED ALGORITHMS	
Course Code: CSE554	**Credits: 2:1:0**
Prerequisite: Design and Analysis of Algorithms	**Contact Hours: 28L+14T**
Course Coordinator: Dr Sangeetha J / Mamatha A	

Course Contents

Unit I

Characterizing Running Times: O-notation, Ω-notation, and Θ-notation, Asymptotic notations: formal definitions, Standard notations and common functions. **Recurrences and Solution of Recurrence equations** :The Substitution method, The recurrence – tree method, The master method. **Amortized Analysis**: Aggregate, Accounting and Potential Methods. (T1: Chapter 3,4.3 to 4.5, 16.1 to 16.3)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://nptel.ac.in/courses/106105164
  https://nptel.ac.in/courses/106104019

Unit II

Graph Algorithms: Bellman-Ford Algorithm, Single source shortest paths in a DAG, Johnson's Algorithm for sparse graphs, Maximum bipartite matching (T1: Chapter 22.1, 22.2, 23.3, 24.3) **Trees:** B-trees, Red- Black trees. (T1 : Chapter 13,18). **Hashing:** General Idea, Hash Function, Separate Chaining, Hash Table without Linked Lists, Rehashing, Extendible hashing.(T2 : Chapter 5.1 to 5.5, 5.9)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link: https://nptel.ac.in/courses/106105164,
  https://nptel.ac.in/courses/106104019

Unit III

Number – Theoretic Algorithms: Elementary notations, GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem. (T1: Chapter 31.1 to 31.7) **Priority Queues (Heaps):** Binary Heap, Applications of Priority Queues, d-Heaps, Leftist Heaps, Skew Heaps (T2: Chapter 6.3 to 6.7)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link: https://nptel.ac.in/courses/106105164
  https://nptel.ac.in/courses/106104019

Unit IV

String Matching Algorithms: Naïve string matching, Rabin – Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm (T1: Chapter 32.1 to 32.4)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link : https://nptel.ac.in/courses/106104019

Unit V

Algorithmic Puzzles: Magic Square, n-queens problem, Glove Selection, Ferrying Soldiers, Jigsaw Puzzle Assembly, A Stack of Fake Coins, Maximum Sum Descent, Hats of Two Colors, Pluses and Minuses, Searching for a Pattern, Locker Doors, Palindrome Counting, Inverting a Coin Triangle, Sorting 5 in 7. (T3- Mentioned Puzzles)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Problems on Recurrences Solving using Substitution and recurrence tree method
2.	Problems on Recurrences Solving using master method
3.	Problems on Bellman-Ford Algorithm, Single source shortest paths in a DAG
4.	Problems on Johnson's Algorithm for sparse graphs, Maximum bipartite matching
5.	Problems on B-Trees
6.	Problems on Red Black Trees
7.	Problems on Hashing
8.	Problems on Chinese remainder theorem
9.	Problems on RSA
10.	Problems on Rabin – Karp algorithm
11.	Problems on String matching with finite automata
12.	Problems on Knuth-Morris-Pratt algorithm
13.	Problems on Algorithmic Puzzles
14.	Revision

Text Books:

1. **T H Cormen, C E Leiserson, R L Rivest and C Stein**: Introduction to Algorithms, 4/e, PHI, 2022.
2. **Mark Allen Weiss**: Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson Education, 2014.
3. **AnanyLevitin and Maria Levitin:** Algorithmic Puzzle, Oxford University Press, 2011.

Reference Books:

1. **Ellis Horowitz, SartajSahni, S Rajasekharan**: Fundamentals of Computer Algorithms, University Press, 2007.
2. **Alfred V Aho, John E Hopcroft, J D Ullman:** The Design and Analysis of Computer Algorithms, Pearson Education, 2011.

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Devise recurrence relations and amortized cost of various operations. (PO- 1,2,4, PSO- 1,2)
2. Illustrate graph algorithms such as Bellman-Ford, Shortest path, and bipartite matching, B-trees, Red-Black trees and hashing techniques. (PO- 1,2,3, PSO-1,2)
3. Identify the methods for solving modular linear equations, Chinese remainder theorem and RSA cryptosystem, Describe the types of heaps such as Binary Heap, d-heaps, Leftist and skew heaps. (PO-1,6,9,10, PSO-1,2)
4. Assess the string-matching algorithms such as Rabin – Karp and Knuth- Morris-Pratt algorithm. (PO-1,2,3,6,9,10, PSO-1,2)
5. Create mathematical models, objective functions and constraints to solve algorithmic puzzles. (PO-1,2,4,9,10,12, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study/ Implementation and Analysis of Real World Algorithms/Applications	20	CO1, CO2, CO3, CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study/Demonstration		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

CRYPTOGRAPHY AND NETWORK SECURITY	
Course Code: CSE555	**Credits: 3:0:0**
Prerequisite: Computer Networks and Data Communication	**Contact Hours: 42L**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction: Security Goals, Attacks, Services and Mechanism, Techniques. **Mathematics of Cryptography:** Integer Arithmetic, Modular Arithmetic, Matrices, Linear Congruence.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Demonstrate different Cryptographic Attack forms, Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool.

Unit II

Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transpositional Ciphers, Stream and Block Ciphers. **Data Encryption Standard (DES):** Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implementation of Substitution and Transposition techniques, DES algorithm using any programming language

Unit III

Advanced Encryption Standard: Introduction, Transformations, Key Expansion, The AES Ciphers, Examples, Analysis of AES. **Asymmetric Key Cryptography:** Introduction, RSA Cryptosystem, Rabin Cryptosystem, Elgamal Cryptosystem.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implementation of AES algorithm, RSA algorithm, Elgamal and Rabin Cyrptosystem

Unit IV

Message authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes. **Digital signatures:** Digital Signatures, NIST Digital Signature Algorithm. **Key management and distribution:** Distribution of public keys, X.509 certificates.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement the Digital Signature Scheme and Demonstration of Authenticatio mechanisms.

Unit V

User Authentication: Kerberos. **Transport Level security:** Web Security Considerations, Secure Sockets Layer, Transport level Security, HTTPS. **Electronic Mail security:** S/MIME, Pretty Good Privacy

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Demonstrate intrusion detection system using any tool eg. Snort or any other s/w.

Text Books:

1. **Behrouz A. Forouzan, Debdeep Mukhopadhyay** - Cryptography and Network Security, Tata McGraw-Hill, 3rd Edition, 2015
2. **William Stallings** - Cryptography and Network Security, Pearson Education, 7th Edition, 2018

Reference Books:

1. **Bernard Menezes**: Cryptography, Network Security and Cyber Laws , Cengage Learning, First edition, 2018.
2. **Atul Kahate**: Cryptography and Network Security", 4th Edition, Tata McGraw Hill, 2019.
3. **William Stallings**: Network Security Essentials: Applications and Standards by, 6th edition, Pearson Education, 2018.

Video Lectures (e-Resources):

- https://a.impartus.com/ilc/#/course/2582489/1205

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Identify security goals, attacks, services and mechanism techniques. (PO-1,8,9,10,11,12, PSO-2).
2. Apply Symmetric Cryptographic techniques depending on the need and security threat perception (PO- 1,2,3,5,6,8,9,10,111,12, PSO-2).
3. Illustrate the Symmetric and Asymmetric algorithms. (PO-1,2,3,5,6,8,9,10,11,12, PSO-2).
4. Summarize the fundamentals of Key Management and Distribution (PO- 1,3,5,6,8,9,10,11,12, PSO-1,2).
5. Appraise the need for authentication and protocols at Transport and application layer. (PO- 5,6,8,9,10,11,12, PSO-1).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study/Demonstrate Network scanning tools	10	CO1, CO2 and CO3
Implementation of Cryptographic Techniques	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Implementation of Cryptographic Techniques		
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4 and CO5

DATABASE LABORATORY	
Course Code: CSL56	**Credits: 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

1. Introduction to Entity-Relationship (ER) Model
2. Design an Entity-Relationship (ER) Model and Mapping to Relational Model
3. Introduction SQL Databases: Oracle/ MySQL
4. Implement SQL Queries using DDL, DML and DCL Statements
5. Build an Applications in Oracle DB using simple and Complex Quires
6. Build an Application in Oracle DB using Triggersand Views
7. Introduction NoSQL Databases: Mongo DB
8. Implement NoSQL Queries using CRUD Operations.
9. Building Modern Applications in Mongo DB using NoSQL.
10. Building a Database application for a particular case study using Visual Basic/Java Script in visual studio/Eclipse Tool.

Text Books:

1. "Database Management Systems" by RaghRamakrishnan, JohannersGehrke, Second Edition. McGraw-HillEducation.
2. "Fundamentals of Database Systems" by RamezElmasri, Shamkant B. bNavathe, Fifth Edition, Pearson Publications.
3. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, sixth Edition, McGraw Hill Education.

Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/106105175
2. https://erdplus.com/

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Demonstrate the Core MongoDB Operations (PO-2, PSO-1,2)
2. Design an Oracle DB Application Using SQL DDL statements, DML statements and Queries (PO-1,3, PSO-1,2)
3. Develop a Real Time Database Application Using IDE/Tools of student's choice (PO-1, 3, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	20	CO1, CO2 and CO3
Regularity/ Continuous assessment	20	CO1, CO2 and CO3
Average of the two CIE will be taken for 30 marks		
Other Components		
Online Certificate/ Project Implementation	10	CO1, CO2 and CO3
The Final CIE out of 50 Marks = CIE TEST+ Continuous assessment Project Implementation		
Semester End Examination (SEE)		
Course End Examination	50	CO1, CO2 and CO3

ADVANCED JAVA PROGRAMMING LABORATORY	
Course Code: CSL57	**Credits: 0:0:1**
Prerequisite: Java Programming	**Contact Hours: 14P**
Course Coordinator: Dr. J Geetha	

Course Contents

1. JDBC Connectivity
2. JDBC Statement Objects
3. JDBC Result Sets
4. Transaction Processing
5. Servlet Life Cycle
6. doGet and doPost Methods
7. Servlet with JDBC
8. Cookies and Session management using Servlet
9. JSP Elements
10. JSP Custom Tags
11. Request Dispatcher
12. JSP using JDBC
13. Cookies and Session management using JSP
14. Java Beans and Socket Programming

Text Books:

1. Herbert Schildt: Java the Complete Reference, 8th Edition, Tata McGraw Hill, 2013.
2. Y. Daniel Liang: Introduction to JAVA Programming, 7th Edition, Pearson Education, 2012.
3. Jim Keogh: J2EE The Complete Reference, first edition, Tata McGraw Hill, 2011.
4. Ivan Bayross, Sharanam Shah, Cyntiha Bayross and Vishali Shah, Java EE 5 for
5. Beginners, SPD (Sharoff Publishers & Distributors Pvt. Ltd.), 2nd edition August 2008.

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Develop java programs to query the database and perform DDL and DML operations. (PO-2, 3, 5, 9 PSO-3)
2. Design dynamic web application using Servlets. (PO-2, 3, 4,5,9 PSO- 3)
3. Develop the dynamic data driven web pages using JSP. (PO-2, 3,4, 5,9 PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	10	CO1, CO2 and CO3
Internal Test-II(CIE-II)	10	CO1, CO2 and CO3
CIE=CIEI+CIEII		
Other Components		
Continuous Assessment and quiz/Debugging	30	CO1, CO2 and CO3
The Final CIE out of 50 Marks = CIE TEST+ Continuous assessment		
Semester End Examination (SEE)	50	CO1, CO2 and CO3

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	
Course Code: AL58	**Credits: 3:0:0**
Prerequisite: NIL	**Contact Hours: 42L**
Course Coordinator: -	

Course Contents

Unit I

Research Methodology:

Introduction: Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct. Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Conceptualizing Research, Critical and Creative Reading. **Citations:** Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge flow through Citations, Acknowledgments, and Attributions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit II

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis, Experimental and Control Groups, Treatments.**Experimental Designs:** Introduction to Randomised Block Design, Complete Randomised Design, Latin Square Design, and Factorial Design.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit III

Method of Data Collection: Primary and Secondary Data Collection.

Sampling Design: Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design.**Data Analysis:** Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors, Level of Significance. Procedure for Hypothesis Testing: Mean, Variance, Proportions. Chi-square Test, Analysis of Variance (One Way ANOVA), and Covariance (ANOCOVA)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit IV

Intellectual Property Rights

Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. TRIPS Agreement, Patent Cooperation Treaty (PCT). **Patents:** Brief history of Patents-Indian and Global Scenario, Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for

Obtaining a Patent. Non Patentable Inventions. Rights Conferred to a Patentee, Basmati Rice Patent Case.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Unit V

Design: What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design. **Trademarks:** Essentials of a Trademark, Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements, Types of Reliefs, Case Studies. **Copyrights:** Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights, Case studies

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Text Books:

1. C. R Kothari, Gourav Garg, Research Methodology – Methods and Techniques. New Age International Publishers.
2. Dr. B L Wadehra – Law relating to Intellectual property. Universal Law Publishing Co.
3. Dipankar Deb, Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.

Reference Books:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Possess the knowledge of research and conduct a literature review**.** (PO-8, PO-10, PO-12)
2. Apply the knowledge of research design and design of experiments. (PO-4, PO-8, PO 10, PO-12)
3. Analyse data collection methods, analysis, and sampling design. (PO-4, PO-8, PO-10, PO-12)
4. Understand the global and Indian scenarios of patents and patent applications. (PO-8, PO-10, PO-12)
5. Acquire the requirements of registration and infringements related to trademarks, copyrights, and designs. (PO-8, PO-10, PO-12)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcome attained**
Internal test - 1	30	CO1, CO2 and CO3
Internal test - 2	30	CO4 and CO5
The average of the two internal tests will be taken for 30 marks		
Other Components		
Assignment	10	CO1 and CO2
Quiz	10	CO3, CO4 and CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4 and CO5

ABILITY ENHANCEMENT COURSE - V	
Course Code: AEC510	**Credits: 1:0:0**
Prerequisite: Nil	**Contact Hours: 14L**
Course Coordinator: Any Department	

Ability Enhancement Courses (AEC) are the generic skill courses which are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights and the law.

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.

ENVIRONMENTAL STUDIES	
Course Code: HS59	**Credits: 0:0:0**
Prerequisite: -	**Contact Hours: 14L**
Course Coordinator: -	

Course Content

Unit I

Environment, Ecology and Biodiversity

Definition, scope, and importance. Multidisciplinary nature of Environmental studies. Food chain and food web. Energy flow and material cycling in the ecosystem. Biodiversity and threats to biodiversity. Concept of sustainable development: Definition, objectives, and applications.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos, Models
- Link: https://youtu.be/I_bnGkviWOU
  https://youtu.be/Ar04qG1P8Es

Unit II

Natural resources

Forest resources: Ecological importance of forests. Water resources: Global water resources distribution. Mineral resources: Environmental effects of extracting and processing Mineral resources. Food resources: Effects of modern agriculture. Land resources: Soil erosion and Desertification.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos
- Link: https://youtu.be/vsXv3anIBSU
  https://youtu.be/1rOVPqaUyv8

Unit III

Energy sources

Growing energy needs. Conventional and non-conventional / Renewable and Non-renewable energy sources. Bio Energy-Ethanol and Bio mass energy. Energy of the future – Hydrogen fuel cells and Nuclear energy. Environmental Impact Assessment (EIA): Definition, Objectives and benefits. Step by step procedure of conducting EIA.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Animations, Models
- Link: https://youtu.be/mh51mAUexK4
  https://youtu.be/XS-eXqppf_w

Unit IV

Environmental pollution

Definition, Causes, Effects and control measures of Water pollution, Air pollution and Soil/ land pollution. Management of Municipal Solid Waste and treatment methods of municipal solid waste.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos
- Link: https://youtu.be/NRoFvz8Ugeo
  https://youtu.be/DAQapF-F4Vw

Unit V

Environmental protection

Global warming and Climate change, Acid rain, Ozone layer depletion. Salient features of Environmental Protection Act, Air & Water Acts. Functions of Central and State Pollution Control Boards.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos, Open source softwares
- Link: https://youtu.be/iV-BvYwl4Y8
  https://youtu.be/BYqLRGawoH0

Text Books:

1. Dr. S M Prakash – Environmental Studies, Elite Publishers, 2007.

Reference Books:

1. P. Venugopala Rao – Principles of Environmental Science & Engineering Prentice Hall of India, 1st edition, 2006.

Web links and video Lectures (e- Resources):

1. https://youtu.be/I_bnGkviWOU
2. https://youtu.be/vsXv3anIBSU
3. https://youtu.be/mh51mAUexK4
4. https://youtu.be/NRoFvz8Ugeo
5. https://youtu.be/iV-BvYwl4Y8

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Describe the importance of environmental studies, sustainable development and biodiversity (PO-1, 7)
2. Explain the importance and conservation of impacts of natural resources (PO-1, 7)
3. Distinguish the energy sources and identify the alternative energy sources for sustainable development (PO-1, 7)
4. Identify the causes, effects and control measures of pollution in developmental activities (PO-1, 7)
5. Outline the current environmental issues and the role of the agencies for environmental protection (PO-1, 7)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2 and CO3
Internal Test-II	30	CO4 and CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Assignment – MCQ, Objectives	10	CO1 and CO2
Assignment – Quiz, Group presentation	10	CO3 and CO4
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4 and CO5

VI Semester

MANAGEMENT & ENTREPRENEURSHIP	
Course Code: AL61	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. M Rajesh / Dr. Siddharthakar	

Course Contents

Unit I

Introduction to Management: Definition of Management, Its nature and purpose, Contributions of F.W. Taylor and Henry Fayol to management theory, Functions of managers.

Planning: Types of plans, Steps in planning, the planning process, Management by Objectives (MBO).

Organizing: The nature and purpose of organizing, Formal and informal organization. Organization levels and Span of management, Principle of span of management, the structure and process of organizing

- Pedagogy: Chalk board, power point presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_mg33/preview
  https://www.digimat.in/nptel/courses/video/110107150/L01.html

Unit II

Staffing: Situational factors affecting staffing.

Leading: Human factors in managing, definition of leadership, Ingredients of leadership.

Controlling: Basic control process, Critical control points and standards, Control as a feedback system, Feed forward control, Requirements for effective controls.

- Pedagogy: Chalk board, power point presentations
- Links: https://nptel.ac.in/courses/110107150

Unit III

Introduction to Entrepreneurship: The Foundations of Entrepreneurship: What is an Entrepreneurship? The benefits of Entrepreneurship, The potential drawbacks of Entrepreneurship; Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation and Entrepreneurship, Creative Thinking, Barriers to Creativity

- Pedagogy: Chalk board, power point presentations
- Links:https://www.youtube.com/watch?v=Hgj_kRrvbhQ&list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb

Unit IV

The Entrepreneurial Journey: Crafting a Business Plan: The benefits of creating a business plan, the elements of a business plan; Forms of Business Ownership and Buying an Existing Business: Sole proprietorships and partnership.

- Pedagogy: Chalk board, power point presentations

- Links:https://www.youtube.com/watch?v=Tzzfd6168jk&list=PLyqSpQzTE6M8EGZbmNUuUM7Vh2GkdbB1R

Unit V

Launching the Business: Franchising and the Entrepreneur: Types of Franchising, the benefits of buying a Franchise; E-Commerce and the Entrepreneur: Factors to consider before launching into E-commerce, Ten Myths of E-Commerce.

- **Pedagogy:** Chalk board, power point presentations
- **Links:**https://www.youtube.com/watch?v=5RMqxtMwejM&list=PLyqSpQzTE6M9zMKj_PSm81k9U8NjaVJkR

Text Books:

1. Harold Koontz, H. Weihrich, and A.R. Aryasri, Principles of Management, Tata McGraw-Hill, New Delhi, 2004.
2. Essentials of Entrepreneurship and Small Business Management – Norman Scarborough & Jeffrey Cornwall (Pearson, 2016)

References Books:

1. Innovation & Entrepreneurship – Peter Drucker (Harper, 2006)
2. Entrepreneurship: The Art, Science, and Process for Success – Charles Bamford & Garry Bruton (McGraw-Hill, 2015)
3. Managent and Enterpreneuship-NVR Naidu, T Krishna Rao, I.K. International Publishing House Pvt. Ltd.@ 2008
4. Poornima M Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2006.

Course Outcomes (COs):

1. Plan and organize for the manpower in the given type of organization (PO: 6,9,11)
2. Use staffing Leading and controlling function for the given organization. (PO: 6,8,9,10)
3. Understand the fundamentals of entrepreneurship with the goal of fulfilling the requirements of the industries and holding the responsibilities towards the society. (PO-6,7,8)
4. Design a basic business plan by considering case studies and show the involvement of ownership in Business. (PO-3,7,8,11)
5. Start a new small business with the help of E-Commerce and the current available technologies. (PO-5,11)

COMPILER DESIGN	
Course Code: CS62	**Credits: 2:1:0**
Prerequisite: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Parkavi. A	

Course Contents

Unit I

Introduction: The Structure of Compilers, **Lexical analysis:** The Role of Lexical Analyzer, Input Buffering, Specifications of Tokens, And Recognition of Tokens.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit II

Parsing: Top-down Parsing, Bottom-up Parsing, LR Parsing: SLR parser, Canonical parser, LALR parser.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit III

Syntax-Directed Definitions: Evaluation order for SDDs, Applications of Syntax-directed translation, Syntax-directed translation schemes.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit IV

Intermediate Code Generation: Variants of syntax trees, Three-address code, Types and declarations, Translation of expressions, Type checking, Control flow, Switch statements, Intermediate code for procedures.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit V

Code Generation: Issues in the design of Code Generator, The Target language, Addresses in the target code, Basic blocks and Flow graphs, Optimization of basic blocks, A Simple Code Generator.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Text Books:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman: Compilers- Principles, Techniques and Tools, 2nd Edition, Pearson education, 2012.

Reference Books:

1. Kenneth C Louden: Compiler Construction - Principles & Practice, First Edition, Brooks/Cole, CENGAGE learning, 1997.
2. Andrew W Appel: Modern Compiler Implementation in C, First Edition, Cambridge University Press, 2010.

Course Outcomes (COs):

At the end of the course students should be able to:

1. Construct lexical analyzer to recognize inputs using patterns.(PO1,2,4, PSO-1)
2. Devise different types of syntax analyzers using grammars. (PO1,2,4, PSO-1,2)
3. Illustrate syntax-directed translation schemes for grammars. (PO1,3,4,9, PSO-1)
4. Formulate intermediate code generators for programming statements. (PO1,4, PSO-1)
5. Develop assembly language code for the given optimized intermediate codes. (PO1,2,3,4,5, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Literature study & Technical paper writing/Practical assignment & Report	20	CO1, CO2, CO3,CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Literature study and technical paper writing /coding		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

WEB TECHNOLOGIES LABORATORY	
Course Code: CSL65	**Credits: 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. J Geetha	

Course Contents

There shall be a minimum of 2 exercises conducted on each of the following topics:

1. HTML5
2. Advanced CSS
3. Java Script
4. Advanced java Script
5. Inheritance In java Script
6. Scopes and Closures
7. Develop a Server side programming using java Script : Node.Js
8. Implement CRUD Operation using MongoDB and Node.Js
9. Develop a Client Side Application using React
10. Implement MERN Stack.

Reference Books:

1. Web Application Design and Implementation: Apache 2, PHP5, MySQL, JavaScript, and Linux/UNIX Steven A. Gabarro, December 2006, ©2007, Wiley-IEEE Computer Society Press.
2. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" September 2016 3. KrasimirTsonev, "Node.js by Example Paperback", May 2015.
3. Web link for Angular4.0: https://angular.io/
4. Web link for Node.js : https://nodejs.org/en/
5. Web link for MongoDB: https://www.mongodb.com

Course Outcomes (COs):

At the end of the course students should be able to:

1. Develop web pages with various media contents using HTML5. (PO-1,2,3,PSO-2)
2. Create a robust Client side validation with java script. (PO- 1,2,3,PSO-3)
3. Design dynamic data-driven Web sites using Node.js(PO- 1,2,3,5-PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Lab Test-I	10	CO1, CO2 and CO3
Lab Test-II	10	CO1, CO2 and CO3
Weekly Evaluation-Lab Record/project Implementation	30	CO1, CO2 and CO3
The Final CIE out of 50 Marks = Marks of weekly evaluation &Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)	50	CO1, CO2 and CO3

UNIX SYSTEM PROGRAMMING	
Course Code: CSL66	**Credits: 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Chandrika Prasad	

Course Contents

Sl. No.	Topics Covered
	Part A
1.	Basic file I/O functions
2.	Programs on file operations: file descriptor, open(), read(), write(),append()
3.	Properties of a file: File Types, File access permission and File links.
4.	Record locking
5.	Process: Concepts, creation, fork(), vfork()
6.	Process termination.
7.	Process execution
8.	Process coordination
9.	Daemon process characteristics
10.	Programs on daemon processes

Note: Each Lab Session is of two hours duration/week

Text Books:

1. W. Richard Stevens: Advanced Programming in the UNIX Environment, Third Edition, Pearson education, 2011.
2. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman: Compilers- Principles, Techniques and Tools, 2nd Edition, Addison-Wesley, 2007.

Reference Books:

1. Kenneth C Louden: Compiler Construction - Principles & Practice, Brooks/Cole, CENGAGE learning, 1997.
2. Andrew W Appel: Modern Compiler Implementation in C, Cambridge University Press, 1999.
3. Terrence Chan: UNIX System Programming Using C++, First edition, Prentice Hall India, 2011.
4. Kay A Robbins and Steve Robbins: Unix Systems Programming, First Edition, Pearson Education, 2009.
5. Marc J. Rochkind: Advanced UNIX Programming, 2nd Edition, Pearson Education, 2009.

Course Outcomes (COs):

At the end of the course students should be able to:

1. Demonstrate various file I/O operations using system calls. (PO-1,2,4, PSO- 2,3)
2. Implement unix system calls to create and execute the processes (PO-1,2,4, PSO- 2,3)

3. Understand the process coordination in unix and background processes (PO-1,2,4, PSO- 2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Lab Test-I	10	CO1, CO2 and CO3
Lab Test-II	10	CO1, CO2 and CO3
Weekly Evaluation-Lab Record	30	CO1, CO2 and CO3
The Final CIE out of 50 Marks = Marks of weekly evaluation &Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C)	50	CO1, CO2 and CO3

INTRODUCTION TO DEEP LEARNING	
Course Code: CSE631	**Credits: 2:0:1**
Prerequisite: Machine Learning	**Contact Hours: 28+14P**
Course Coordinator: Dr J Sangeetha / Dr S Rajarajeswari	

Course Contents

Unit I

Introduction: What is a Neural Network?, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures. **Rosenblatt's Perceptron:** Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

- Pedagogy /Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit II

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Back Propagation and Differentiation.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit III

Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Dropout, Adversarial Training. **Optimization for Training Deep Models:** Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions. Cliffs and Exploding Gradients, Basic Algorithms, Algorithms with Adaptive Learning Rates (Text Book 2 - Chapter 7 and Chapter 8)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit IV

Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit V

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Text Books:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Reference Books:

1. Neural Networks and Deep Learning by Michael Nielsen
   http://neuralnetworksanddeeplearning.com/

Video Lectures (e-Resources):

1. https://a.impartus.com/ilc

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Illustrate the concepts and applications of neural networks and deep learning. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
2. Illustrate various types of learning work and its applications. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
3. Illustrate the Regularization and Optimization for Deep learning. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
4. Apply deep feed forward networks and convolutional to solve practical problems. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
5. Demonstrate recurrent, recursive nets function and practical problems can be mapped to these functions. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study	10	CO1, CO2, CO3, CO4 and CO5
Report	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Report		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 and CO5

SOFTWARE DEFINED NETWORKS	
Course Code: CSE632	**Credits: 2:1:0**
Prerequisite: Data Communication Basics	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Shilpa Chaudri / Manjula L	

Course Contents

Unit I

How SDN Works - Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller- SDN controller core modules, SDN controller interfaces, Existing controller implementations, potential issues with the SDN Controller, SDN Applications, Alternate SDN Methods – SDN via APIs, Benefits and Limitations of SDN via APIs, SDN via hypervisor based overlay networks. **The Open Flow Specification** – Open Flow Overview – The Open Flow switch, The Open Flow Controller, The Open Flow protocol, The Controller-switch secure channel

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Installing Mininet on Ubuntu and windows
  Creating topologies in mininet

Unit II

Open Flow 1.0 and Open Flow Basics, Open Flow 1.1 Additions, Open Flow 1.2 Additions, Open Flow 1.3 Additions, Open Flow Limitations. Open flow 1.4 additions – Bundles, Eviction and vacancy events, enhanced support for multiple controller, optical port support, and flow table synchronization. OpenFlow 1.5 Additions -Enhanced L4–L7 Support, Pipeline Processing Enhancements, Egress Tables, Fitness for Carrier Use, Bundle Enhancements, Enhanced Support for Multiple Controllers, Enhanced Support for Tunnels, Enhancements to Flow Entry Statistics

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Using wireshark to see the contents of the open flow packets
  Using MiniEdit, Mininet's graphical user interface

Unit III

SDN Controllers- Introduction, General Concepts,VMware, Nicira, OpenFlow-Related, Mininet, NOX/POX, Trema, Ryu, Big Switch Networks/Floodlight, Layer 3 Centric, L3VPN, Path Computation Element Server, Plexxi, Plexxi Affinity, Cisco OnePK, Relationship to the Idealized SDN Framework.

Building an SDN Framework- Introduction, The Juniper SDN Framework, IETF SDN Framework(s), SDN(P), ABNO, Open Daylight Controller/Framework, API, High Availability and State Storage, Analytics, Policy

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Introduction to RYU Controller
  Implementing REST APIs

Unit IV

The Journey to Network Functions Virtualization (NFV) Era – NFV Architectural framework- Need for a framework, ETSI framework for NFV, understanding the ETSI framework, A closer look at ETSI's NFV framework, NFV framework summary, Benefits of NFV- Hardware flexibility, faster service life cycle, scalability and elasticity, leveraging existing tools, rapid development and vendor independence, validation of new solutions, amorphous service offering, operational efficiency and agility. **Virtualization of Network Functions**: Designing NFV Networks –NFV Design considerations, NFV transformation challenges, Virtualization of Network Infrastructure and Services – NFV for Routing infrastructure, virtualization of network security, virtualization of mobile communication networks

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Group Table implementation to perform specific actions on packets
  Collecting packet Statistics from OpenFlow switch

Unit V

Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring - Introduction, Bandwidth Calendaring, Base Topology and Fundamental Concepts, OpenFlow and PCE Topologies, Example Configuration, OpenFlow Provisioned Example, Enhancing the Controller, Overlay Example Using PCE Provisioning, Expanding Your Reach: Barbarians at the Gate, Big Data and Application Hyper-Virtualization for Instant CSPF, Expanding Topology. **Use Cases for Data Center Overlays, Big Data, and Network Function Virtualization-** Introduction, Data Center Orchestration, Creating Tenant and Virtual Machine State, Forwarding State, Data-Driven Learning, Control-Plane Signaling, Scaling and Performance Considerations,Puppet (DevOps Solution), Network Function Virtualization - NFV in Mobility, Optimized Big Data

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Identifying different roles of Multicontrollers

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Installing Mininet on Ubuntu and windows
2.	Creating topologies in mininet
3.	Using wireshark to see the contents of the open flow packets
4.	Using MiniEdit, Mininet's graphical user interface
5.	Executing hub behaviour using pox controller
6.	Running a webserver in mininet
7.	Introduction to RYU Controller
8.	Implementing REST APIs
9.	Group Table implementation to perform specific actions on packets
10.	Collecting packet Statistics from OpenFlow switch
11.	Using Meter Tables to implement QoS
12.	Adding multiple actions for a flow using Flow Manager
13.	Discovering underlying Network Topology

Session No.	Topics Covered
14.	Identifying different role of Multicontrollers

Text Books:

1. Paul Goransson, Chuck Black, Timothy Culver: Software Defined Networks A Comprehensive Approach, Second Edition, Elsevier, 2014.
2. Thomas D.Nadeau & Ken Gray: SDN Software Defined Networks O'Reilly publishers, First edition, 2013.

Reference Books:

1. Chayapathi, Rajendra, Syed F. Hassan, and Paresh Shah. Network Functions Virtualization (NFV) with a Touch of SDN: Netw Fun Vir (NFV ePub_1. Addison-Wesley Professional, 2016.

Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=CaukSKg_sI0
- https://www.youtube.com/watch?v=l3E-C1j-SJg
- https://nptel.ac.in/courses/106106243

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Identify the fundamental characteristics of SDN. (PO1,3,4)
2. Compare the various OpenFlow specifications. (PO1,3,4)
3. Illustrate implementation of SDN controllers and building of SDN framework. (PO1,3,4)
4. Examine the NFV framework and Virtualization of Network Functions. (PO1,3,4)
5. Illustrate use of SDN and NFV for bandwidth scheduling, data center orchestration and Network Access Control. (PO1,3,4,5)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	C03, CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2 and CO3
Quiz -II	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

LINUX KERNEL PROGRAMMING	
Course Code: CSE633	**Credits: 3:0:0**
Prerequisite:	**Contact Hours: 42L**
Course Coordinator: Dr. Shilpa S Chaudhari	

Course Contents

Unit I

Introduction to the Linux Kernel- Obtaining the Kernel Source, The Kernel Source Tree, Building the Kernel. Debugging - Getting Started, Bugs in the Kernel, Debugging by Printing, Oops, Kernel Debugging Options. **Process Management** – process descriptor and task structure, process creation, The Linux Implementation of Threads, process termination.

Unit II

Process Scheduling – Multitasking, Linux's Process Scheduler, Policy, Linux scheduling algorithm, The Linux Scheduling Implementation, Preemption and Context Switching, Real-Time Scheduling Policies, Scheduler-Related System Calls. **System Call implementation** - Communicating with the Kernel, APIs, POSIX, and the C Library, Syscalls, System Call Handler, System Call Context.

Unit III

Kernel Data Structures - What Data Structure to Use, When, **Interrupt Handlers** - Top Halves Versus Bottom Halves, Registering an Interrupt Handler. **Bottom Halves** - softirq, tasklets, Work Queues.**Timer**- Jiffies, Hardware Clocks and Timers, The Timer Interrupt Handler.

Unit IV

Memory Management – Pages, Zones, Getting Pages, kmalloc, vmalloc, slab layer, **The Process Address Space-** Address Spaces, memory descriptor. **The Page Cache**- Approaches to Caching, The Linux Page Cache.

Unit V

The Virtual Filesystem - Common Filesystem Interface, Filesystem Abstraction Layer, Unix Filesystems, VFS Objects and Their Data Structures, The Superblock Object, Superblock Operations, The Inode Object, Inode Operations, The Dentry Object, Dentry Operations, The File Object, File Operations.**Devices and Modules** - Device Types, modules, The Device Model, sysfs

Reference Books:

1. BILLIMORIA, Kaiwan N. Linux Kernel Programming: A comprehensive guide to kernel internals, writing kernel modules, and kernel synchronization. Packt Publishing Ltd, 2021.
2. BHARADWAJ, Raghu. Mastering Linux Kernel Development: A kernel developer's reference manual. Packt Publishing Ltd, 2017.
3. Robert Love, Linux kernel development, 3rd edition, 2010.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Examine the kernel components for building kernel image from kernel source (PO-1,2,3)
2. Implement kernel process and CPU scheduling to observe the process management (PO-1,2,3)
3. Design the interrupt handler considering kernel synchronization (PO-1,2,3)
4. Demonstrate memory management at kernel level (PO-1,2,3)
5. Apply device driver as kernel module (PO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1,CO2 and CO3
Quiz –II/Project Implementation	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

INFORMATION RETRIEVAL	
Course Code: CSE634	**Credits: 2:0:1**
Prerequisite: NIL	**Contact Hours: 28L+14P**
Course Coordinator: Dr. J Sangeetha / Dr. D S Jayalakshmi	

Course Contents

Unit I

Introduction: Overview, History of IR, Text Operations: Document preprocessing, Document Clustering, Text Compression, Indexing: Inverted files. **Mathematics for IR:** Set Theory, Mathematical Logic, Probability and Linear algebra, Classic IR Models: Boolean Model, Vector space model: tf-idf weighing. **Probabilistic Model. Language models for IR:** The language model and the query likelihood model.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit II

Evaluation Measures: Precision, Recall, Alternative Measures. **Reference Collections:** TREC, Relevance Feedback and Query Expansion. **Text Classification:** The text classification problem, Flat clustering: Clustering in information retrieval, Problem Statement, Hierarchical clustering: Hierarchical agglomerative clustering, Single-link and Complete-link clustering.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit III

String matching algorithms: Knuth Morris Pratt and Rabin Karp, Stemming algorithm: Porter, Map reduce algorithms: tf- idf calculation and indexing. **Classification:** Naive Bayes algorithm, Clustering: k-means algorithm. Machine learning Algorithms: Machine- learned scoring, Result ranking by machine learning.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit IV

Web search basics: web characteristics, Architecture of web search engine. **Web Crawling and Indexing:** Overview, Crawling, Distributing Indexes, and Connectivity Servers. **Link analysis:** Web as a graph, Page Rank, Hubs and Authorities. Information Retrieval

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit V

XML Retrieval: Basic XML Concepts, Challenges in XML retrieval, a vector space model for XML retrieval. **Introduction to Semantic Web**: Purpose, Semantic Web Stack, RDF, RDFS, Ontology, Web ontology language (OWL) and ontology tools.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Text Books:

1. Ricardo Baeza-Yates, BerthierRibeiro-Neto: Modern Information Retrieval, Pearson Education, 1999.
2. Introduction to Information Retrieval. C.D. Manning, P. Raghavan, H. Schütze. Cambridge UP, 2008.

Reference Books:

1. William B Frakes, Ricardo Baeza Yates: Information Retrieval Data Structures and Algorithms, PH PTR, 1992.
2. David A Grossman, OphirFrieder: Information Retrieval Algorithms and Heuristics, 2e, Springer, 2004
3. Mathematics for Classical Information Retrieval: Roots and Applications: Dariush Alimohammadi,
4. http://www.dcc.fc.up.pt/~zp/aulas/1213/pde/geral/bibliografia/MIT. Press. A. Semantic. Web.Primer.eBook-TLFeBOOK.pdf

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Describe text operations and various information retrieval models. (PO-1,2, PSO-2)
2. Evaluate an IR system using various evaluation measures. (PO-1,2,4, PSO- 2)
3. Apply various algorithms such as string matching, map reduce, classification and clustering. (PO-1,2,3,4,5, PSO-3)
4. Design web search engine, web crawling and link analysis techniques. (PO- 1,2, 3,4, PSO-3).
5. Explain XML Retrieval and various semantic web technologies. (PO-1, 3, 5, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study	10	CO1, CO2, CO3, CO4 and CO5
Report	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Reports		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

BLOCKCHAIN ESSENTIALS & DAPPS	
Course Code: CSE635	**Credits: 3:0:0**
Prerequisite: NIL	**Contact Hours: 42L**
Course Coordinator: Dr. Prakavi A	

Course Contents

Unit I

Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit II

Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization.

Cryptographic primitives : Symmetric cryptography , Asymmetric cryptography , Public and private keys Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD),Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA**)**.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit III

Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block , The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit IV

Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain , Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network Hands-on: Clients and wallets -Geth

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit V

Hyperledger: Reference architecture Requirements Fabric: Hyperledger Fabric ,Fabric architecture, Membership services, Blockchain services, Components of the Fabric, Sawtooth lake: PoET, Transaction families, Consensus in Sawtooth, Development environment, Corda: Architecture, State objects, Transactions Consensus ,Flows ,Components , Nodes, Permissioning service ,Network map service, Notary service ,Oracle service Transactions, Vaults, CorDapp .

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Text Book:

1. Imran Bashir. "Mastring Block Chain", Packt

Reference Books:

1. Mastering Bitcoin: Programming the Open Blockchain Paperback – 2017. By Andreas M. O'rielly.

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Illustrate the Blockchain terminologies with its applications. (PO-1,2,3; PSO-1,2)
2. Analyse the working principles of Blockchain. (PO-1,2,3,6; PSO-1,2,3)
3. Comprehend the principles & methodologies used in Bitcoin and able to deploy smart contract. (PO-1,2,3; PSO-1,2)
4. Create Ethereum Network, Wallets, Nodes, Smart contract & Dapps (PO-1,2,3,4,5,6; PSO-1,2)
5. Develop Blockchain Based Application Architecture using Hyperledger(PO-1,2,3,4,5,6; PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
NPTEL Certification	20	CO1, CO2, CO3 ,CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ NPTEL Certification		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 and CO5

INTRODUCTION TO DEVOPS	
Course Code: CSE641	**Credits: 3:0:0**
Prerequisite: Introduction to DevOps	**Contact Hours: 42L**
Course Coordinator: Dr. J Geetha	

Course Contents

Unit I

DevOps and Infrastructure as Code: DevOps Culture and Practices: Getting started with DevOps, Implementing CI/CD and continuous deployment, Understanding IaC practices. Using Ansible for Configuring IaaS Infrastructure: Installing Ansible, Creating an inventory for targeting Ansible hosts, writing the first playbook, Executing Ansible, Protecting data with Ansible Vault, Using a dynamic inventory for Azure infrastructure. Optimizing Infrastructure Deployment with Packer: An overview of Packer, Creating Packer templates for Azure VMs with scripts, Using Ansible in a Packer template, Executing Packer, Using a Packer image with Terraform.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit II

DevOps CI/CD Pipeline: Managing Your Source Code with Git: Overviewing Git and its command lines, Understanding the Git process and GitFlow pattern. Continuous Integration and Continuous Delivery: The CI/CD principles, using a package manager, Using Jenkins, Using Azure Pipelines, Using GitLab CI.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit III

Containerized Applications with Docker and Kubernetes : Containerizing Your Application with Docker: Installing Docker, Creating a Dockerfile, Building and running a container on a local machine, Pushing an image to Docker Hub, Deploying a container to ACI with a CI/CD pipeline. Managing Containers Effectively with Kubernetes: Installing Kubernetes, First example of Kubernetes application deployment, Using HELM as a package manager, Using AKS, Creating a CI/CD pipeline for Kubernetes with Azure Pipelines

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit IV

Testing Your Application (5 Lectures)

Testing Your Application: Testing APIs with Postman: Creating a Postman collection with requests, Using environments and variables to dynamize requests, Writing Postman tests, Executing Postman request tests locally, Understanding the Newman concept, Preparing Postman collections for Newman, Running the Newman command line, Integration of Newman in the CI/CD pipeline process. Static Code Analysis with SonarQube: Exploring SonarQube, Installing SonarQube, Real-time analysis with SonarLint, Executing SonarQube in continuous integration. Security and Performance Tests: Applying web security and penetration testing with ZAP, Running performance tests with Postman.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit V

Taking DevOps Further (6 Lectures)

Taking DevOps Further: Security in the DevOps Process with DevSecOps: Testing Azure infrastructure compliance with Chef InSpec, Using the Secure DevOps Kit for Azure, Preserving data with HashiCorp's Vault. Reducing Deployment Downtime: Reducing deployment downtime with Terraform, Understanding blue-green deployment concepts and patterns, Applying blue-green deployments on Azure. DevOps for Open Source Projects: Storing the source code in GitHub, Contributing using pull requests, Managing the changelog and release notes, Sharing binaries in GitHub releases, Using Travis CI for continuous integration, Getting started with GitHub Actions, Analyzing code with SonarCloud, Detecting security vulnerabilities with WhiteSource Bolt. DevOps Best Practices.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Text Books:

1. Learning DevOps: Mikael Krief, October 2019, Packt Publishing Ltd, ISBN: 978-1-83864-273-0.

Reference Books:

1. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Jez Humble and David Farley, 2010, Addison-Wesley Professional, ISBN: 9780321670250.
2. The DevOPS Handbook: How to Create World, Gene Kim & Jez Humble, 2016, It Revolution Press, ISBN: 9781942788003
3. The Phoenix Project: A Novel about It, Devops, and Helping Your Business Win, George Spafford & Gene Kim, 2018, It Revolution Press, ISBN: 9781942788294
4. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, Jennifer Davi & Ryn Daniels, 2016, O'Reilly Media.

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Demonstrate the DevOps culture by illustrating applications cloud infrastructure and configuration management with Ansible. (PO-2, 3, 5, 9, PSO-3)
2. Apply the DevOps pipeline process starting with continuous integration and continuous deployment principles. (PO-2, 3, 5, 9, PSO-3)
3. Demonstrate how to create and run a container from a Docker file and deploy a complex application on Kubernetes. (PO-2, 3, 5, 9, PSO-3)
4. Illustrate the different ways to test APIs with Postman, static code analysis with SonarQube and perform security and performance tests. (PO-2, 3, 5, 9, PSO-3)
5. Apply security in the DevOps process with DevSecOps and related best practices. (PO-2, 3, 5, 9, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Devops Tools Implementation	20	CO1, CO2, CO3, CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study/Demonstration		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

WIRELESS SENSOR NETWORKS	
Course Code: CSE642	**Credits: 2:1:0**
Prerequisite: Data Communication Basics	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Shilpa Chaudri / Manjula L	

Course Contents

Unit I

What are Wireless Sensor Networks? WSN, Sample Applications around the world, Types of WSN (Textbook 1- Chapter 1.1,1.2.1.3) **Anatomy of Sensor Node**: Hardware components, Power Consumption, Operating System and Concepts, Communication Stack (Textbook 1- Chapter 2.1,2.2,2.3,2.5)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Learn MATLAB usage

Unit II

Physical layer: Physical layer technologies, Overview of RF Wireless communication, modulation, Wireless channels effects. (Textbook 2- Chapter 4.1,4.2,4.4,4.5) **Medium Access Control:** Challenges of MAC, CSMA Mechanism, Contention Based and Reservation based Medium Access, Hybrid Medium Access (Textbook 2- Chapter 5.1,5.2,5.3,5.4,5.5)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Simulate Simple WSN scenario using MATLAB.

Unit III

Radio Communications: Radio Waves(modulation/Demodulation), properties of wireless communication, Medium Access protocols. (Textbook 1- Chapter 3.1,3.2,3.3) **Link Management**: Wireless links introduction, Properties, Error Control, Naming and addressing, Link estimation protocols, and Topology Control. (Textbook 1- Chapter 4.1-4.6)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Study Parameters for building WSN

Unit IV

Multi-hop Communication: Routing Basics, Routing Metrics, Routing Protocols. (Textbook 1- Chapter 5.1-5.3)

Data Aggregation and Clustering: Clustering Techniques, In-Network Processing and Data Aggregation, Comprehensive Sampling. (Textbook 1- Chapter 6.1-6.3)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Routing Metrics evaluation in WSN using MATLAB

Unit V

Sensing Techniques: Types of the sensor, Sensing coverage, High-level sensor, Special case: Human as a sensor, Actuators. (Textbook 1- Chapter 9.1-9.5)

Designing and Deploying WSN Applications: Early WSN deployments, General Problems, General testing and validation, Requirement analysis, Top-down design Process, Bottom-up Implementation Process. (Textbook 1- Chapter 10.1-10.6)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Detection of bad nodes using MATLAB

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Demonstration of different WSN Applications
2.	Study different OS associated with WSN
3.	Analyse communication stack and compare with other standards
4.	Associate Modulation and demodulation techniques with real time applications.
5.	Implement different CSMA Protocols
6.	Use MATLAB and simulate basics WSN environment
7.	Analyze the Radio waves applications
8.	Analyze Different topologies applicable in WSN
9.	Data Bucket Size in WSN
10.	Analyse routing metrics w.r.t WSN
11.	SVM training
12.	WSN with ACO code
13.	Detection of bad nodes in WSN
14.	Training SVM model

Text Books:

1. Anna Forster: Introduction to Wireless Sensor Networks, IEEE Press, Wiley Publisher, 2016.
2. Ian F. Akyildiz, Mehmet Can Vuran, Wireless Sensor Networks, Wiley Publishers, 2010.

Reference Books:

1. Kazem Sohraby, Daniel Minoli, TaiebZnati :" Wireless Sensor Networks: Technology, Protocols, and Applications", Willey -Interscience ,2007
2. Rastko R. Selmic, Vir V. Phoha, Abdul Serwadda :" Wireless Sensor Networks: Security, Coverage, and Localization", Springer,2016
3. Philip John Sallis: "Wireless Sensor Networks: Insights and Innovations" , Intechopen,2017

Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105160/
- https://nptel.ac.in/courses/117104118
- https://www.google.com/search?q=wsn+simulation+in+matlab+simple+example+program&ei=4Oo8ZIXhFZmfseMPkdq30Aw&oq=wsn+simulation+in+matlab+simple+exmpke&gs_lcp=Cgxnd3Mtd2l6LXNlcnAQAxgCMgcIIRCgARAKMgcIIRCgARAKMgcIIRCgARAKOgoIABBHENYEELADOgYIABAWEB46CAgAEIoFEIYDOgUIIRCgAToICCEQFhAeEB06B

AghEBVKBAhBGABQkQZYjT5g0FBoAnABeACAAaoCiAGtD5IBBjEuMTIuMpgBAKABAcgBCMABAQ&sclient=gws-wiz-serp#fpstate=ive&vld=cid:288f9605,vid:C5gOEydRqFA

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios (PO-1,8,9,10,11,12, PSO-2).
2. To study different protocols at various layers and its differences with traditional protocols. (PO- 1,2,3,5,6,8,9,10,111,12, PSO-2).
3. To study the design consideration of communication and link management. (PO-1,3,5,6,8,9,10,11,12, PSO-1,2).
4. Analyze the need of clustering and aggregation. (PO- 5,6,8,9,10,11,12, PSO-1).
5. Study anatomy of sensors and deployment in real time. (PO-1,2,3,5,6,8,9,10,11,12, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	C03, CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2 and CO3
Quiz -II	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

NATURAL LANGUAGE PROCESSING	
Course Code: CSE643	**Credits: 3:0:0**
Prerequisite: Theory of Computation	**Contact Hours: 42L**
Course Coordinator: Dr. Jayalakshmi D S/ Chandrika Prasad	

Course Contents

Unit I

Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms; Language, Thought, and Understanding; The State of the Art and The Near-Term Future; Regular Expressions and Automata; Morphology and Finite-State Transducers: Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

Unit II

N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; **Word Classes and Part-of-Speech Tagging:** Part-of- Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging;
Context-Free Grammars for English: Constituency, Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit III

Parsing with Context-Free Grammars: The Earley Algorithm; Features and Unification: Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints; Lexicalized and Probabilistic Parsing: Probabilistic Context-Free Grammars, Problems with PCFGs.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit IV

Representing Meaning: First Order Predicate Calculus, Some Linguistically Relevant Concepts, Related Representational Approaches, Alternative Approaches to Meaning;**Semantic Analysis:** Syntax-Driven Semantic Analysis, Attachments for a Fragment of English; Lexical Semantics: Relations Among Lexemes and Their Senses, WordNet: A Database of Lexical Relations, The Internal Structure of Words.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Unit V

Discourse: Reference Resolution, Text Coherence, Discourse Structure; **Generation**: Introduction to Language Generation, An Architecture for Generation; **Machine Translation**: Language Similarities and Differences, The Transfer Metaphor.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

Text Books:

1. **Daniel Jurafsky and James H Martin -** Speech and Language, Prentice Hall, 2nd Edition, 2008.

Reference Books:

1. **Tanveer Siddiqui, U.S. Tiwary-** Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Video Lectures (e-Resources):

1. NPTEL Course by IIT Kharagpurhttps://nptel.ac.in/courses/106105158

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Interpret how speech and language technology relies on formal models to capture knowledge, and language processing deals with subparts of words (morphology).(PO- 1,5,11, PSO-2)
2. Illustrate the way N-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories. (PO-2,3,11,PSO-2)
3. Describe feature structures and unification operation which is used to combine them, and probabilistic parsing to capture more syntactic information. (PO-2,11,PSO-2)
4. Demonstrate the gap from language to common sense Knowledge (semantic processing), and meanings associated with lexical items. (PO- 1,3,5,11, PSO-2)
5. Illustrate natural language outputs construction from non-linguistic inputs and machine translation framework approaches. (PO-1,11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2 and CO3
Case Study	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

ADVANCED DBMS	
Course Code: CSE644	**Credits: 3:0:0**
Prerequisite: DBMS Concepts	**Contact Hours: 42L**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

Unit I

Overview of Database Models: Database models: Flat data model, Entity relationship model, Relation model, Record base model, Network model, Hierarchical model, Object oriented data model, Object relation model, Semi structured model, Associative model, Context data model, graph data model. **The Enhanced Entity-Relationship (EER) Model:** Subclasses, Super classes, and Inheritance, Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization Hierarchies, Modeling of UNION Types Using Categories, A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Design an EER schema for a database application

Unit II

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Multiple-Key access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Index Definition in SQL.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Operations on B/B^+ Tree using Java or Python Programming

Unit III

Query Processing and Optimization: Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions Query Optimization: Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Techniques used for Evaluation of Expressions and Join / Sort Operations.

Unit IV

Parallel Databases: I/O Parallelism, Inter-query Parallelism, Intra-query Parallelism, Intra-operation Parallelism, Interoperation Parallelism, Query Optimization, Design of Parallel Systems, Parallelism on Multi-Core Processors **Distributed Databases:** Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of I/O Parallelism in parallel databases using Partitioning Techniques and Commit Protocol for distributed Transactions.

Unit V

Enhanced Data Models for Advanced Applications: Active Database Concepts and Triggers: Generalized Model for Active Databases and Oracle Triggers, Design and Implementation Issues for Active Databases. Temporal Database Concepts: Time representation, Calendars and Time Dimensions, Incorporating Time in Relational Databases using Tuple Versioning. Spatial Database Concepts: Introduction, Spatial Data Types and Models. Multimedia Database Concepts

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Triggers in active databases and Time in Relational databases.

Text Books:

1. "Database System Concepts" by Abraham Silberschatz , Henry F. Korth, sixth Edition McGraw Hill Education.
2. "Fundamentals of Database Systems" by Ramez Elmasri, Shamkant B. Navathe, Fifth Edition, Pearson Publications.

References:

1. "Database Management Systems" by Raghu Ramakrishnan, Johanners Gehrke, Second Edition. McGraw-Hill Education

Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=aZjYr87r1b8

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Describe different Database Models and Apply EER Model to Design Databases (PO-1,2,3 PSO-1,2)
2. Discuss the concepts of Indexing and Hashing as applied to Data Storage and Query Processing (PO- 1,2,3, PSO- 1, 2)
3. Explain how Queries are Processed and Optimized (PO- 1,2, 3, PSO- 1, 2)
4. Describe the Processing of the Queries in Distributed and Parallel Databases. (PO- 1, 2,3 PSO- 1)
5. Understand Enhanced Data models for advanced Applications like Active Databases, Temporal Databases, Spatial Databases and Multimedia Databases. (PO- 1,2,3, PSO- 1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 and CO3
Quiz –II/Project Implementation	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

CYBER PHYSICAL SYSTEMS	
Course Code: CSE645	**Credits: 3:0:0**
Prerequisite: Microprocessors and Microcontrollers	**Contact Hours: 42L**
Course Coordinator: Dr. Dayananda R B and Prof. Veena G S	

Course Contents

Unit I

Introduction: Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Design an EER schema for a database application

Unit II

CPS Platform components: CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Embedded systems and networks Types of Processors, Parallelism

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Operations on B/B^+ Tree using Java or Python Programming

Unit III

Feedback control systems- Analysis and verification techniques, temporal logic, and model checking- Invariants and Temporal Logic Invariants, Linear Temporal Logic. Reachability Analysis and Model Checking: Open and Closed Systems Reachability Analysis. straction in Model Checking, Model Checking Liveness Properties

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Techniques used for Evaluation of Expressions and Join / Sort Operations.

Unit IV

Security of Cyber-Physical Systems: Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of I/O Parallelism in parallel databases using Partitioning Techniques and Commit Protocol for distributed Transactions.

Unit V

CPS Application: Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber-Physical Systems, WSN based Cyber-Physical Systems, Smart Cities.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Triggers in active databases and Time in Relational databases.

Text Books:

1. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber- Physical Systems Approach, Second Edition, http://LeeSeshia.org, ISBN 978-1-312-42740-2, 2015.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.

References:

1. Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley, 2017
2. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015
3. Fei Hu, "Cyber-Physical Systems", CRC Press 2013

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Apply Embedded system concepts to solve real word problems.
2. Present solution to automated systems to make life easier.
3. Apply concepts of embedded systems and microcontroller to enhance existing systems.
4. Ability to develop concepts, logics towards solving a unknown problem in research and industry.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 and CO3
Quiz –II/Project Implementation	10	CO4 and CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

MOBILE APPLICATION DEVELOPMENT	
Course Code: CSOE02	Credits: 3:0:0
Prerequisite: Java Programming	Contact Hours: 42L
Course Coordinator: Pradeep Kumar D	

Course Contents

Unit I

Build your first app: Introduction to Android, Create Your First Android App, Layouts, Views and Resources, Text and Scrolling Views, Resources to Help You Learn. **Activities:** Understanding Activities and Intents, the Activity Lifecycle and Managing State, Activities and Implicit Intents. **Testing, debugging, and using support libraries:** The Android Studio Debugger, Testing your App, The Android Support Library. (Lesson 1, 2 and 3)

Unit II

User interaction: User Input Controls, Menus, Screen Navigation, Recycler View. **Delightful user experience:** Drawables, Styles, and Themes, Material Design, Providing Resources for Adaptive Layouts. **Testing your UI:** Testing the User Interface. (Lesson 4, 5 and 6)

Unit III

Background Tasks: Async Task and Async Task Loader, Connect to the Internet, Broadcast Receivers, Services. **Triggering, scheduling and optimizing background tasks:** Notifications, Scheduling Alarms, Transferring Data Efficiently. (Lesson 7 and 8)

Unit IV

Preferences and Settings: Storing Data, Shared Preferences, App Settings. **Storing data using SQLite:** SQLite Primer, SQLite Database. **Sharing data with content providers:** Share Data Through Content Providers. (Lesson 9, 10 and 11)

Unit V

Permissions, Performance and Security: Permissions, Performance and Security. **Firebase and AdMob:** Firebase and AdMob. **Publish:** Publish. (Lesson 13, 14 and 15)

Text Books:

1. Google Developer Training, "Android Developer Fundamentals Course Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android- developer fundamentals-course-concepts/details (Download pdf file from the above link).

Reference Books:

1. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015.
3. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
4. Anubhav Pradhan, Anil V Deshpande, “Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Understand the android OS and fundamental concepts in android programming.
2. Demonstrate various components, layouts and views in creating android applications.
3. Design applications to save, or store, data using SQLite and Content Providers.
4. Demonstrate the working of long running tasks in the background using Services.
5. Demonstrates how to write applications using location based services and to publish the android applications.

WEB TECHNOLOGY	
Course Code: CSOE04	**Credits: 3:0:0**
Prerequisite: Basics of Programming	**Contact Hours: 42L**
Course Coordinator: Dr. Geetha J	

Course Contents

Unit I

Fundamentals: A Brief Introduction to the Internet, The World Wide Web Web, Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol, Security, The Web Programmers Toolbox. **Introduction to XHTML:** Origins and Purposes of HTML and XHTML, Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists

Unit II

Introduction to XHTML: Tables, Forms, Frames, Syntactic Differences between HTML and XHTML

Cascading Style Sheets: Introduction, Levels of Style Sheets, Style Specification Formats, Selector Formats, Property Value Forms, Font Properties, List Properties, Color, Alignment of Text, The Box Model, Background Images, The span and div Tags

Unit III

The Basics of JavaScript: Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics, Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, Constructors, Pattern Matching Using Regular Expressions, Errors in Scripts, JavaScript and HTML Documents, The JavaScript Execution Environment, The Document Object Model, Element Access in JavaScript, Events and Event Handling, The DOM 2 Event Model, The navigator Object, DOM Tree Traversal and Modification.

Unit IV

Dynamic Documents with JavaScript: Introduction, Positioning Elements, Moving Elements, Element Visibility, Changing Colors and Fonts, Dynamic Content, Stacking Elements, Locating the Mouse Cursor, Reacting to a Mouse Click, Slow Movement of Elements, Dragging and Dropping Elements

Introduction to 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

Unit V

Database Access through the Web:

Relational Databases: An Introduction to the Structured Query Language, Architectures for Database Access, The MySQL Database System, Database Access with PHP and MySQL, **NoSQL**

Databases: An Introduction, Basics of MongoDB, CRUD Operations, Database Access with PHP and MongoDB.

Text Books:

1. Robert W Sebesta: Programming The World Wide Web, 4th Edition, Pearson Education 2008
2. Steve Perry: Learn to Build Web Applications with PHP, MySQL and JavaScript, O'Reilly Publications, 2017
3. Brad Dayley: NoSQL with MongoDB in 24 Hours, Sams Teach Yourself, Pearson Education; First edition, 2015

Reference Books/websites:

1. M. Deitel, P.J. Deitel, A. B. Goldberg: Internet & World Wide Web How to program, 4th Edition, Pearson education, 2011.
2. Chris Bates: Web Programming Building Internet Applications, 3rd Edition, Wiley India, 2011.
3. Web Link for PHP: https://www.php.net/
4. Web Link for MySQL: https://www.mysql.com/
5. Web link for MongoDB: https://www.mongodb.com/

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Explain different components and technologies of World Wide Web as a platform.
2. Apply the concepts of HTML and CSS in designing web pages.
3. Apply the JavaScript concepts in designing dynamic web pages.
4. Demonstrate the uses of PHP as a server side scripting language.
5. Demonstrate the concepts of Database connectivity in web applications for both Structured and NoSQL databases

OBJECT ORIENTED PROGRAMMING WITH C++	
Course Code: CSOE05	**Credits: 3:0:0**
Prerequisite: C Programming	**Contact Hours: 42L**
Course Coordinator: Dr. Dayananda R B	

Course Contents

Unit I

Beginning with C++ and its features: What is C++?, Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, operator overloading and control structures in C++

Unit II

Functions, classes and Objects: Functions, Inline function, function overloading, friend and virtual functions, Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects, members, pointers to members and member functions

Unit III

Constructors, Destructors and Operator overloading: Constructors, Multiple constructors in a class, Copy constructor, Dynamic constructor, Destructors, Defining operator overloading, Overloading Unary and binary operators, Manipulation of strings using operators.

Unit IV

Inheritance, Pointers, Virtual Functions, Polymorphism: Derived Classes, Single, multilevel, multiple inheritance, Pointers to objects and derived classes, this pointer, Virtual and pure virtual functions

Unit V

Streams and Working with files:C++ streams and stream classes, formatted and unformatted I/O operations, Output with manipulators, Classes for file stream operations, opening and closing a file, EOF

Text Book:

1. Object Oriented Programming with C++, E. Balaguruswamy, TMH, 6th Edition, 2013.

Reference Book:

1. Object Oriented Programming using C++, Robert Lafore, Galgotia publication 2010

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Explain the basics of Object Oriented Programming concepts.
2. Apply the object initialization and destroy concept using constructors and destructors.
3. Apply the concept of polymorphism to implement compile time polymorphism in programs by using overloading methods and operators.
4. Use the concept of inheritance to reduce the length of code and evaluate the usefulness. Apply the concept of run time polymorphism by using virtual functions, overriding functions and abstract class in programs.
5. Use I/O operations and file streams in programs.

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	
Course Code: CSOE05	**Credits: 3:0:0**
Prerequisite: Knowledge of any advanced programming language, Algorithms and Data structures, Elementary Discrete Mathematics or similar.	**Contact Hours: 42L**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction: What is AI? Foundation and History of Artificial Intelligence.

Intelligent Agents: Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents.

Problem-solving by search: Problem Solving Agents, Example Problems, Searching for Solution, Uniformed Search Strategies, Informed Search Strategies, Heuristic Functions. (Chapter 1, 2, 3 of Text Book 1)

Unit II

Introduction to Machine Learning: What is Machine Learning, Key Terminology, Key tasks of machine learning, Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning.

Decision Tree - Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Issues in Decision Tree Learning. (Chapter 1and 3 of Text Book 2)

Unit III

Artificial Neural Networks - Introduction, Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer Networks and the Backpropagation algorithm.

Bayesian Learning - Introduction, Bayes theorem, Naive Bayes Classifier, The EM Algorithm. (Chapter 4 and 6 of Text Book 2)

Unit IV

Instance Based Learning - Introduction, k-nearest neighbor learning, Locally Weighted Regression, radial basis function, Case-based reasoning

Genetic Algorithms – Representing hypotheses, Genetic Operators, Fitness Function and Selection, An Illustrative Example.

Reinforcement Learning – Introduction, The Learning Task (Chapter 8, 9 and 13 of Text Book 2)

Unit V

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction. **Natural Language Communication:** Phrase, Structure Grammars,

Syntactic Analysis, Augmented Grammars and Semantic Interpretation, Machine translation, Speech recognition. (Chapter 22, 23 of Text Book 1)

Text Books:

1. Stuart J Russel and Peter Norvig: "Artificial Intelligence - A Modern Approach", 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair: "Artificial Intelligence", 3rd Edition, Tata McGraw hill, 2011.
2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
3. Peter Harrington. "Machine learning in action", Shelter Island, NY: Manning Publications Co, 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2016.

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Identify the modern view of artificial intelligence and its applications based on agent Philosophy. (PO-1,2,3,4,5,PSO-1,2)
2. Demonstrate the fundamental understanding of machine learning techniques, Concept learning and Decision tree. (PO-1,2,3,5,7,8,9,10,12,PSO-1,2)
3. Analyze neural networks and Bayes classifier for problem solving (PO-1,2,3,5,7,8,9,10,12, PSO-1,2)
4. Illustrate and implement Instance based learning, Reinforcement learning and Genetic Algorithm for optimization of engineering problems (PO-1,2,3,4,5,PSO-1,2)
5. Apply the concept of Natural Language Processing in building intelligent systems through machine translation and speech recognition. (PO-1,2,3,4,5,PSO-1,2)

INTRODUCTION TO BIG DATA ANALYTICS	
Course Code: CSOE10	**Credits: 3:0:0**
Prerequisite:	**Contact Hours: 42L**
Course Coordinator: Dr. Ganeshayya I Shidaganti	

Course Contents

Unit I

UNDERSTANDING BIG DATA: What is big data – why big data –.Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

Unit II

NOSQL DATA MANAGEMENT: Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schema less databases – materialized views – distribution models – shading — version – map reduce – partitioning and combining – composing map-reduce calculations.

Unit III

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

Unit IV

MAPREDUCE APPLICATIONS: MapReduce workflows – unit tests with MRUnit – test data and local tests– anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

Unit V

HADOOP RELATED TOOLS: Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Cassandra – Cassandra data model – Cassandra examples – Cassandra clients – Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

Reference Books:

1. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
4. Alan Gates, "Programming Pig", O'Reilley, 2011

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Describe the Role and Importance of Big Data in various Business Context
2. Describe the Aggregate Data Models and Distribution Models in managing the Big Data Storage.
3. Discuss the Architecture and Features of Hadoop Distributed File System (HDFS) for handling Big Data.
4. Discuss the Map Reduce Fundamentals and Workflows for handling Big Data.
5. Interpret on various Hadoop related Tools and explore the Operations for Analyzing Big data Applications.

PROGRAMMING IN JAVA	
Course Code: CSOE07	**Credits: 3:0:0**
Prerequisite:-	**Contact Hours: 42L**
Course Coordinator: Dr. J Geetha	

Course Contents

Unit I

Introduction to Java Programming: Java Buzzwords, Overview of Java Datatypes, Variables, arrays, Control statements. Java Programming Fundamentals: Object-Oriented Programming, the Three OOP Principles, Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods

Unit II

Java Programming Fundamentals: Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Introducing Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes

Unit III

Inheritance, Packages & Interfaces: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Packages, Access Protection, Importing Packages, Interfaces, String and String Buffer Handling.

Unit IV

Exception Handling: Exception-Handling Fundamentals, Exception Classes, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch clauses, Nested try Statements, throw, throws, finally. Multithreaded Programming: Java Thread Classes, The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Suspending, Resuming and Stopping Threads.

Unit V

Event Handling, Introducing Swing: Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model, Adapter Classes, Inner Classes. Swing: Introducing Swing. Lambda Expressions: Fundamentals, Block Lambda expressions, Passing Lambda Expressions as Argument, Lambda Expressions and Exceptions, Method References.

Text Book:

1. The Complete Reference - Java, Herbert Schildt 10th Edition, 2017, TMH Publications, ISBN: 9789387432291.

Reference Book:

1. Head First Java, Kathy Sierra and Bert Bates, 2nd Edition, 2014, Oreilly Publication, ISBN: 9788173666.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Examine the fundamental elements of object model and identify classes and objects for object oriented programming.
2. Explore the OOP principles and basic constructs of Java language.
3. Develop java programs using inheritance, interfaces and packages.
4. Explore the exception handling mechanism and thread synchronization.
5. Design the GUI application using swings and handle the interactions.

Mini Project	
Course Code: CSP67	**Credits: 0:0:3**
Prerequisite: Nil	**Contact Hours:**
Course Coordinator: Chandrika Prasad	

Guidelines:

As a part of Mini Project, students must carry out the following activities:

1. Students should form a group to carry out their project. The minimum group size is 3 and maximum group size is 4.
2. The groups will be attached to one Internal Guide by the Department.
3. Students can carry out their project in-house once guide approves the topic.
4. Identify the problem statement based on the current state of Art and trends in the area of interest.
5. Based on the survey, identify the project requirements and do feasibility study.
6. Identify and draw a system level architecture by showing subsystems and their input/output need.
7. Implement the programs using step by step for each module.
8. Integrate and examine the implementation and test the project scope and the requirements.
9. Prepare the demonstration of the Project documents and the presentation.
10. The evaluation is based on presentation and report.

Assessment:

- CIE - Minimum 2 reviews of the project + any other relevant components (for 50 Marks)
- SEE - Project Demonstration + any other component as decided by Internal Examination (for 50 Marks)
- The evaluation will be done by the internal guide and a co-examiner twice during the semester.
    - Mid-semester evaluation: Students must do a group presentation and produce documents of system requirements, and system design (during 6th week).
    - Final Evaluation: At the End of the semester students must do a group presentation, demonstrate the project work and submit the complete report. (During 13th week).

Course Outcomes (COs):

At the end of the course, student should be able to

1. Formulate a real world problem and its requirements. (PO-1,2,3,4,6,11,12, PSO-1,2,3)
2. Develop a design document for a set of requirements. (PO-1,2,3,4,5,11,12, PSO-1,2,3)
3. Test and validate the conformance of the developed prototype against the original requirements of the problem. (PO-1,2,3,4,5,11,12, PSO-1,2,3)
4. Appraise the Contribution of an individual or in a team in development of the project. (PO-8,9,11,12, PSO-1,2,3)
5. Develop effective communication skills for presentation of project related activities (PO-8,9, 10, 11,12, PSO-1,2,3)

INNOVATION/SOCIETAL/ENTREPRENEURSHIP BASED INTERNSHIP	
Course Code: INT68	**Credits: 0:0:2**
Prerequisite: Nil	**Contact Hours: -**
Course Coordinator: Mr. Pradeep Kumar D	

Course Contents

Students enrolled in the Computer Science Programme are mandated to undergo a training program in a relevant industry, research institution, or start up for a minimum duration of four weeks, scheduled after the 4th semester or during the 5th semester. The internship program is designed to focus on fostering innovation, societal contributions, or the development of entrepreneurial skills in students. Following the completion of the internship, students are required to submit a comprehensive report adhering to the format specified by the Industrial Training Committee within the department. The evaluation of students will be conducted by the Industrial Training Committee based on predefined rubrics communicated to students by the committee.

Course Outcomes (COs):

At the end of the course, student should be able to:

1. Understand how the Computer Science and Engineering industry operates, get awareness of the latest advancements in the field, and combine theoretical knowledge with real-world applications in computing processes. (PO-2,4,7,11,12, PSO-1,2,3)
2. Develop communication proficiency to collaborate effectively within interdisciplinary teams. (PO-9, 10, PSO-1,2,3)
3. Realize his/her professional and ethical responsibility. (PO-6, 7, 8, PSO-1,2,3)