LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING - (DATA SCIENCE)
SCHEME OF INSTRUCTIONS & EXAMINATION [LR-21]
(W.e.f Academic Year 2024-25) (Revised)
B.E. VII-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course											
1	**U21CS701**	PCC	Distributed Systems	3	-	-	3	40	60	3	3
2	U21CD701	PCC	Data Handling and Data Visualization	3	-	-	3	40	60	3	3
3	-	PEC	Professional Elective III	3	-	-	3	40	60	3	3
4	-	PEC	Professional Elective IV	3	-	-	3	40	60	3	3
5	-	OEC	Open Elective-III	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
7	**U21CS7L1**	PCC	Distributed Systems Lab	-	-	3	3	25	50	3	1.5
8	U21CD7L1	PCC	Data Handling and Data Visualization Lab	-	-	3	3	25	50	3	1.5
Skill Development Course											
9	U21CD7P1	PROJ	Mini project	-	-	6	6	50	-	3	3
Total				**15**	**0**	**6**	**24**	**290**	**460**	**--**	**21**

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L: Lecture *(Hrs/Wk/Sem)* **T:** Tutorial *(Hrs/Wk/Sem)* ***P*:** Practical **D:** Drawing *(Hrs/Wk/Sem)*

CIE: Continuous Internal Evaluation **SEE:** Semester End Examination **BSC**: Basic Science Course
ESC: Engineering Science Course **PCC:** Program core course
HSMC: Humanities & Social Sciences Including Management Course

CD: CSE-Data Science **AM:**AI&ML
PCC: Program Core Course **PEC:** Professional Elective Course **OEC:** Open Elective Course
PROJ: Project **MB:** ManagementStudies

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

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SCHEME OF INSTRUCTIONS & EXAMINATION [LR-21]
(W.e.f Academic Year 2024-25) (Revised)
B.E. VIII-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	U21CD801	PCC	Natural Language Processing	3	-	-	3	40	60	3	3
2	-	PEC	Professional Elective V	3	-	-	3	40	60	3	3
3	-	OEC	Open Elective IV	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
4	U21CD8L1	PCC	Cloud Computing Lab	-	-	3	3	50	50	-	2
Project											
5	U21CD8P1	PROJ	Major Project	-	-	16	16	50	150	--	8
Total				**9**	**-**	**20**	**29**	**220**	**380**	**--**	**19**

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L: Lecture *(Hrs/Wk/Sem)* **T:** Tutorial *(Hrs/Wk/Sem)* ***P*:** Practical **D:** Drawing *(Hrs/Wk/Sem)*

CIE: Continuous Internal Evaluation **SEE:** Semester End Examination
PCC: Program core course

CD: CSE-Data Science **PCC:** Program Core Course
PEC: Professional Elective Course **OEC:** Open Elective Course
PROJ: Project

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

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SCHEME OF INSTRUCTIONS& EXAMINATION[LR-21]
PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/ Week	Maximum Marks CIE	Maximum Marks SEE	Duration in	
Theory Course											
1	U21CD504	PEC 1	Graph Theory	3	-	-	3	40	60	3	3
	U21CD505		Computer Networks	3	-	-	3	40	60	3	3
	U21CD506		Automata Languages and Computation theory	3	-	-	3	40	60	3	3
	U21CD507		Web Technologies	3	-	-	3	40	60	3	3
					-	-					
2	U21CD603	PEC 2	Block Chain Technology	3	-	-	3	40	60	3	3
	U21CD604		Network Security and Cryptography	3	-	-	3	40	60	3	3
	U21CD605		Statistical Simulation and data Analysis	3	-	-	3	40	60	3	3
	U21CD606		Software Engineering	3	-	-	3	40	60	3	3
					-	-					
3	U21CD702	PEC 3	Information Storage and Management	3	-	-	3	40	60	3	3
	U21CD703		Cloud Computing	3	-	-	3	40	60	3	3
	U21CD704		Business Intelligence and Analytics	3	-	-	3	40	60	3	3
	U21CD705		Software Testing Methodologies	3	-	-	3	40	60	3	3
					-	-					
4	U21CD706	PEC 4	Basics of Soft Computing Techniques	3	-	-	3	40	60	3	3
	U21CD707		Semantic Web Social Networks	3	-	-	3	40	60	3	3
	U21CD708		web and social media analytics	3	-	-	3	40	60	3	3
	U21CD709		Software Project Management	3	-	-	3	40	60	3	3
					-	-					
5	U21CD802	PEC 5	Optimization Techniques	3	-	-	3	40	60	3	3
	U21CD803		Internet Of Things	3	-	-	3	40	60	3	3
	U21CD804		Cognitive Science and Analytics	3	-	-	3	40	60	3	3
	U21CD805		Secure Software Design and Enterprise Computing	3	-	-	3	40	60	3	3

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SCHEME OF INSTRUCTIONS& EXAMINATION[LR-21]
PROFESSIONALELECTIVES

S.No.	PE-I	PE-II	PE-III	PE-IV	PE-V
1	Graph Theory	Block Chain Technology	Information Storage and Management	Basics of Soft Computing Techniques	Optimization Techniques
2	Computer Networks	Network Security and Cryptography	Cloud Computing	Semantic Web Social Networks	Internet Of Things
3	Automata Languages and Computation theory	Statistical Simulation and data analysis	Business Intelligence and Analytics	Web and Social Media Analytics	Cognitive Science and Analytics
4	Web Technologies	Software Engineering	Software Testing Methodologies	Software Project Management	Secure Software Design and Enterprise Computing

LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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SCHEME OF INSTRUCTIONS& EXAMINATION[LR-23]
(w.e.fAcademic Year 2023-24)
OPEN ELECTIVE COURSES OFFERED

S. No.	Course Code	Category	Course Title
1	U21EE508	OEC 1	Non-Conventional Energy Systems
	U21EE509		Energy Conservation and Management
	U21CS508		Data Base Management Systems**
	U21IT506		Data Structures**
	U21ME509		Basics of Mechanical Engineering
	U21ME510		Modern Manufacturing Processes
	U21CE510		Disaster Preparedness and Management
	U21CE511		Civil Engineering Principles and Practices
	U21EC507		Principles of Electronic Communication
	U21EC508		Semi-Conductor Devices
	U21MB502		Managerial Communication
	U21MB503		Managerial Science and Theory
	U21SH501		History of Science & Technology
	U21SH502		Economic Policies in India

S. No.	Course Code	Category	Course Title
2	U21EE608	OEC 2	Fundamental of Power Electronics
	U21EE609		Electrical Installation and Safety
	U21CS607		Java Programming**
	U21CD603		Data Ethics**
	U21IT606		Operating Systems**
	U21ME608		Basics Of 3-D Printing
	U21ME609		Optimization Methods for Engineers
	U21CE607		Construction Materials
	U21CE608		Engineering Geology
	U21EC607		Principles of Data Communication and Network
	U21EC608		Embedded Systems
	U21MB602		Total Quality Management
	U21MB603		Innovation Management
	U21SH601		Indian Music System
	U21SH602		Introduction to Art and Aesthetics

*Note:**Subject is not offered to the students of cse and allied branches*

S. No.	Course Code	Category	Course Title
3	U21EE711	OEC 3	Introduction to Electrical Vehicles
	U21EE712		Design estimation and Costing of Electrical Systems
	U21CS711		Data Sciences
	U21IT705		Basics of Artificial Intelligence
	U21ME711		Renewable Energy Resources
	U21ME712		Cooling of Electronic Components
	U21CE711		Environmental Systems
	U21CE712		Urban Transportation System
	U21EC703		IOT and its protocols
	U21EC704		Television and Video Engineering
	U21MB702		Logistics Management
	U21MB703		Management of Start Up's
	U21SH701		Display Devices
	U21SH702		Comparative Study of Literature

S. No.	Course Code	Category	Course Title
4	U21EE804	OEC 4	Smart Building Systems
	U21EE805		Industrial Automation
	U21CS806		Basics of Machine Learning
	U21IT802		Cloud computing
	U21ME806		Hybrid Vehicle Technology
	U21ME807		Power Plant Engineering
	U21CE806		Green Building Technology
	U21CE807		Environmental Impact Assessment
	U21EC805		Fundamentals of Wireless Communication
	U21EC806		Fundamental Digital Design using Verilog HDL
	U21MB802		Entrepreneurship
	U21MB803		E - Marketing
	U21SH801		Corrosion Science and Technology
	U21SH802		Introduction To Philosophical Thoughts

Course Code	**Course Title**						Core/Elective
U21CS701	**DISTRIBUTED SYSTEMS**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
OS, Java Programming	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

The objectives of this course are

1. To acquire an understanding of the issues in distributed systems.
2. To learn about Naming and synchronization with different algorithms.
3. To study architectures and working of Distributed file systems, Distributed web-based system
4. To expose the students to distributed transaction management, security issues and replication.
5. To introduce Emerging trends in distributed computing

Course Outcomes:

On Successful completion of this course, student will be able to

1. List the principles of distributed systems and describe the problems and challenges associatedwith these principles
2. To know about interposes communication and remote communication.
3. Understand Distributed Computing techniques, Synchronous and Processes.
4. Understand Distributed File Systems Apply Distributed web-based system. Understand the importance of security in distributed systems
5. Student will be able to know distributed service-oriented architecture.
6. To know about emerging trends in distributed computing.

UNIT – I

Introduction: Characteristics & Properties of Distributes Systems – Taxonomy - Types of DistributedSystems Design goals – Transparency Issues.

Architectures: Architectural Styles, System Architectures, Architectures versus Middleware, andSelf- Management in Distributed Systems.

Processes: Threads, Virtualization, Software Agents, Clients, Servers, and Code Migration. **Communication:** Inter process communication Mechanisms, Remote Procedure Call, Remote Method Invocation, Message-Oriented Communication, Stream-Oriented Communication, andMulticast Communication.

UNIT – II

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming and Attribute-BasedNaming. **Synchronization:** Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning of Nodes, and Election Algorithms.

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-CentricConsistency Models, Replica Management, and Consistency Protocols.

UNIT-III

Fault Tolerance: Introduction to Fault Tolerance, Process Resilience, Reliable Client- Server Communication, Reliable Group Communication, Distributed Commit, and Recovery.

Distributed Object-Based Systems: CORBA, DCOM, GLOBE -Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, andSecurity

UNIT-IV

Distributed File Systems: File system, DFS- definition, Characteristics, Goals, SUN NFS-NFS Architecture, NFS Implementation, Protocols, The CODA file system-Design Overview, An Example, Design Rational, Implementation, The GOOGLE file system-Definition, Architectures, GFS.

Distributed Web-Based Systems: Traditional Web-Based Systems, Web Services Fundamentals, The Apache Web Server, Web Server Clusters, Communication, HTTP Fundamentals, Simple Object Access Protocol SOAP, Web Proxy Caching, Replication for Web Hosting Systems-CDN‟S**,** Service-Oriented Architectures, REST and Web Services

UNIT -V

Distributed Coordination-Based Systems -- Architecture, Naming and Security

Emerging Trends in Distributed Systems - Emerging Trends Introduction, Grid Computing, Cloud Computing and its roots in distributed systems mechanisms and self-management of distributed systems,

Virtualization, Service Oriented Architecture, The Future of Emerging Trends.**Map-Reduce**: Example, Scaling, Programming Model, Apache Hadoop, Amazon Elastic Map Reduce, Mapreduce.net, Pig and Hive.

Suggested readings:

1. Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems*, PHI 2nd Edition, 2009.
2. Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University
3. R. Hill, L. Hirsch, P. Lake, S. Moshiri, *Guide to Cloud Computing*, Principles and Practice‖, Springer, 2013.
4. R. Buyya, J. Borberg, A. Goscinski, *Cloud Computing-Principles and Paradigms*, Wiley, 2013.
5. "Distributed Operating Systems" by P. K. Sinha, PHI

Course Code	Course Title						Core/Elective
U21CD701	**DATA HANDLING AND DATA VISUALIZATION**						
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Basics of Data Science and python Programming	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods
2. To understand various data visualization techniques
3. Supports to summarize the insurers use of predictive analytics, data science and Data Visualization
4. Approaches in the design and analysis of data visualization systems.
5. To familiarize students with the stages of the visualization pipeline, including data modeling, mapping data attributes to graphical attributes.

Course Outcomes

On completion of the course, students will be able to

1. Handle missing data in the real-world data sets try choosing appropriate methods
2. Summarize the data using basic statistics. Visualize the data using basic graphs and plots
3. Identify the outliers if any in the data set
4. Visualize the objects in different dimensions and Design and process the data for Virtualization
5. Apply the virtualization techniques for research projects

UNIT-I

Data Handling Introduction
Exploratory Data Analysis: Data Analytics lifecycle, Exploratory Data Analysis (EDA)-Definition, Motivation, Scope in data exploration, and the basic data types Data Type Portability

UNIT-II

Preprocessing-Traditional Methods and Maximum Likelihood Estimation, introduction to Missing data. Traditional methods or dealing with missing data, Maximum Likelihood Estimation-Basics Missing data handling, improving the accuracy analysis Preprocessing Bayesian Estimation Introduction to Bayesian Estimation, Multiple Imputation Phase. Analysis and Pooling Phase, Practical issues in multiple imputation, Models for Missing Notation Random Data

UNIT-III

Introduction and Data Foundation: basics relationship between visualization and other fields
The Visualization Process -Pseudo code conventions The Scatter plot. Data Foundation types of data Data Structure-within and between Records Data Preprocessing Data Sets Foundation for Visualization- Visualization stages Semiology of Graphical Symbols-The Eight Visual Variables, historical perspective- taxonomies- Experimental Semiotics based on Perception Gibson's Affordance theory- A Model of Perceptual Processing

UNIT-IV

Visualization Techniques: Spatial Data: One-dimensional data, two-dimensional data, three-dimensional data, dynamic data, combining techniques. Geospatial Data: Visualizing Spatial Data Visualization of Paint Duta -Visualization of Line Data Visualization of Area Data-Other Issues in Geospatial Data Visualization Multivariate Data: Paint Based Techniques Line Based Techniques -Region-Based Techniques - Combinations of Techniques Trees Displaying Hierarchical Structures -Graphics and Networks- Displaying Arbitrary Graphs Networks.

UNIT-V

Interaction Concepts and Techniques: Text and Document Visualization: Introduction-Levels of Text Representations. The Vector Space Model - Single Document Visualization -Document Collection Visualizations-Extended Text Visualizations Interaction Concepts: Interaction Operators -Interaction Operands and Spaces A Unified Framework-Interaction Techniques Screen Space Object-Space Data Space -Attribute Space- Data Structure Space-Visualization Structure Animating Transformations -Interaction Control

Suggested Readings:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining by Glene J Myatt

2. Matthew Ward George Grinsten and Daniel Keim, "Interactive Data Visualization

3. Foundations. Techniques, Applications, 2010
4. Colin Ware, "information Visualization Perception for Design", 2nd edition Margon Kaufmann Publishers, 2004

Course Code	**Course Title**						Core
U21CS7L1	**DISTRIBUTED SYSTEMS LAB**						**Core**
Prerequisite	Hours Per Week				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
OS ,Java Pogramming	**-**	**-**	**-**	**3**	**25**	**50**	**1.5**

Course Objectives

1. To implement client and server programs using sockets
2. To learn about working of NFS
3. Understanding Remote Communication and Inter process Communication
4. To use Map, reduce model for distributed processing
5. To develop mobile applications

Course Outcomes

After completing this course, the student will be able to

1. Write programs that communicate data between two hosts Configure NFS
2. To implement inter process communication and remote communication
3. Use distributed data processing frameworks and mobile application tool kits
4. Write program to implement date service using RPC.
5. Develop an application using three -tier architectures

List of Experiments to be performed:

1. Implementation FTP Client
2. Implementation of Name Server
3. Implementation of Chat Server
4. Understanding of working of NFS (Includes exercises on Configuration of NFS)
5. Write a program to implement hello world service using RPC or Write a program to implement date service using RPC.
6. Implement a word count application which counts the number of occurrences of each word a large collection of documents Using Map Reduce model.
7. Develop an application using 3 -tier architectures.

Suggested readings:

1. "Distributed System", Andrew S. Tanenbaum and Marten van Steen, PHI 2nd edition,2009.
2. "Distributed Computing", Sunita Mahajan and Seema Shah, Oxford University
3. "Distributed operating Systems by P.K. Sinha, PHI

Course Code	Course Title						Core/Elective
U21CD7L1	**Data Handling and Data Visualization Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basics of Data Science	-	-	-	**3**	**25**	**50**	**1.5**

Course Objectives

The course will introduce the students to

1. Understand the various types of data, apply and evaluate the principles of data visualization.
2. Acquire skills to apply visualization techniques to a problem and its associated dataset.
3. Understand the fundamental concepts of data science.
4. Understand different types of data scientists.
5. Summarize the insurers' use of predictive analytics and data science and the roles of data scientists and data science team

Course Outcomes:

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

1. . Identify the different data types, visualization types to bring out the insight.
2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on a large dataset.
3. Demonstrate the analysis of a large dataset using various visualization techniques and tools.
4. Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data.
5. Ability to create and interpret plots using R/Python.

List of Experiments:

1. Collecting and plotting data.

2. Statistical Analysis - such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance.

3. Financial analysis using Clustering, Histogram and HeatMap.

4. Time-series analysis stock market.

5. Visualization of various massive dataset Finance - Healthcare-Census-Geospatial.

6. Visualization on Streaming dataset (Stock market dataset, weather forecasting).

7. Market-Basket Data analysis-visualization.

8. Text visualization using web analytics.

Suggested reading:

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization

2. Foundations, Techniques, Applications", 2010.

3. Colin Ware, "Information Visualization Perception for Design", 2nd edition, Margon Kaufmann Publishers, 2004.

Course Code	Course Title						Core/ Elective
U21CD702	**INFORMATION STORAGE AND MANAGEMENT**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Computer Networks	3	-	-	-	40	60	3

Course Objectives

1. To understand the basic components of Storage System Environment.
2. To understand the Storage Area Network Characteristics and Components.
3. To examine emerging technologies including IP-SAN.
4. To describe the different backup and recovery topologies and their role in providingdisaster recovery and business continuity capabilities.
5. To understand the local and remote replication technologies.

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Course Outcomes

1. Design business continuity plan.
2. Select a local replication technology to provide data backup.
3. Distinguish different remote replication technologies.
4. Discuss security issues and mitigate them.
5. Select appropriate storage management software.

UNIT I STORAGE SYSTEMS

Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array.

UNIT II STORAGE NETWORKING TECHNOLOGIES

Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations.

UNIT III ADVANCED STORAGE NETWORKING AND VIRTUALIZATION

IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.

UNIT IV BUSINESS CONTINUITY

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.

UNIT V REPLICATION

Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its Technologies, Network Infrastructure.

Suggested Reading:

1. **EMC Corporation, Information Storage and Management, Wiley, India.**
2. Robert Spalding, ―Storage Networks: The Complete Reference ―, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill, Osborne, 2001.
4. Meeta Gupta, Storage Area Networks Fundamentals, Pearson Education Limited, 2002.

Course Code	Course Title						Core/ Elective
U21CD703	**CLOUD COMPUTING**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
OS,DBMS, Computer Network	3	-	-	-	40	60	3

Course Objectives

1. To understand the concept of cloud computing.
2. To understand the various issues in cloud computing.
3. To familiarize themselves with the lead players in cloud.
4. To appreciate the emergence of cloud as the next generation computing paradigm.
5. To enable students exploring some important cloud computing driven commercial systems and applications.

Course Outcomes

1. Articulate the main concepts, key technologies, strengths and limitations of cloud computing. Identify the architecture, infrastructure and delivery models of cloud computing.
2. Explain the core issues of cloud computing such as security, privacy and interoperability.
3. illustrate the use of various cloud services available online
4. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
5. Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.

UNIT-I

INTRODUCTION - Historical Development - Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics – Cloud Deployment Models: Public, Private, Community, Hybrid Clouds - Cloud Delivery Models: IaaS, PaaS, SaaS.

UNIT-II

CLOUD COMPUTING MECHANISM: Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Hypervisor, Resource Cluster, Multi Device Broker,

UNIT-III

STATE MANAGEMENT DATABASE – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System,.

UNIT-IV

SECURITY IN THE CLOUD: Basic Terms and Concepts – Threat Agents – Cloud Security Threats – Cloud Security Mechanism: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management. Data Security :Application Security –Virtual Machine Security .

UNIT-V

CASE STUDIES: Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack

Suggested Readings:

1. Thomas Erl, ZaighamMahood, Ricardo Puttini, ―Cloud Computing, Concept, Technology and Architecture‖, Prentice Hall, 2013.

2. Toby Velte, Anthony Velte, Robert C. Elsenpeter, ―Cloud Computing, A Practical Approach‖, Tata McGraw-Hill Edition, 2010.

3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.

Course Code	Course Title						Core/ Elective
U21CD704	**BUSINESS INTELLIGENCE AND ANALYTICS**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Information Technology	3	-	-	-	40	60	3

Course Objectives

1. Explain the Business Intelligence, Analytics and Decision Support system
2. List the technologies for Decision making, Automated decision systems
3. Explain sentiment analysis techniques
4. Illustrate Multi-criteria Decision making systems, predictive modeling techniques
5. Plan the implementation of a BI system

Course Outcomes

1. Understand and critically apply the concepts and methods of business analytics
2. Identify, model and solve decision problems in different settings
3. Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
4. Create viable solutions to decision making problems
5. Understand and design the technological architecture that underpins BI systems..

Unit -1:

An Overview of Business Intelligence, Analytics, and Decision Support

Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics

Unit -2:

Decision Making

Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase,Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components**.**

Unit -3:Neural Networks and Sentiment Analysis

Basic Concepts of Neural Networks, Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbor Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process,, Sentiment Analysis, Speech Analytics.

Unit -4:

Model-Based Decision Making

Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making with Pair wise Comparisons.

Unit -5:

Automated Decision Systems and Expert Systems

Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.

Suggested reading:

1. RameshSharda, DursunDelen, EfraimTurban, J.E.Aronson,Ting- PengLiang,DavidKing,"Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013
2. . Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback–12 November 2017 by Edward Mize.

Course Code	Course Title						Core/Elective
U21CD705	**SOFTWARE TESTING METHODOLOGIES**						**ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. To study fundamental concepts in software testing
2. To discuss various software testing issues and solutions in software unit test, integration and system testing.
3. To expose the advanced software testing topics, such as object-oriented software testing methods.
4. To provide knowledge of the concepts in software testing such as testing process, criteria, strategies, and methodologies.
5. To develop skills in software test automation and management using latest tools.

Course Outcomes:

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

1. List a range of different software testing techniques and strategies and be able to apply specific (automated) unit testing method to the projects.
2. Distinguish characteristics of structural testing methods
3. Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.
4. Discuss about the functional and system testing methods.
5. Demonstrate various issues for object oriented testing.

UNIT – I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: transaction flows, transaction flow testing techniques. Dataflow testing: Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing. Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT – III

Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT – IV

State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools.

SUGGESTED READING:

1. Software Testing techniques - Baris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech.

REFERENCE BOOKS:

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing Techniques – SPD(Oreille)
3. Software Testing in the Real World – Edward Kit, Pearson.
4. Effective methods of Software Testing, Perry, John Wiley.

Course Code	Course Title						Core/ Elective
U21CD706	**BASICS OF SOFT COMPUTING TECHNIQUES**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Data Mining	3	-	-	-	40	60	3

Course Objectives

Objectives of the course

1. Classify the various soft computing frame works
2. Be familiar with the design of neural networks, fuzzy logic and fuzzy systems
3. Learn mathematical background for optimized genetic programming
4. Familiar with the Artificial Intelligence, Various types of production systems, characteristics of production systems
5. To study Neural Networks, architecture, functions and various algorithms involved

Course Outcomes

Upon completion of the course, the students will be able to:

1. Learn about soft computing techniques and their applications.
2. Learn about fuzzy logic, various fuzzy systems and their functions.
3. Use fuzzy rules and reasoning to develop decision making and expert system
4. Choose and design suitable neural network for real time problems
5. Understand the genetic algorithm concepts and their applications

UNIT-I

Introduction to Soft Computing: Soft computing constituents, characteristics of neuro- computing and soft computing, difference between hard computing and soft computing, some applications of soft computing techniques, concepts of learning and adaptation.

UNIT-II

Fuzzy logic: Introduction to classical/crisp sets and fuzzy sets, classical/crisp relations and fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.
Membership functions: fuzzification, methods of membership value assignments, defuzzification, lambda cuts for fuzzy sets and fuzzy relations, defuzzification methods.

UNIT-III

Fuzzy arithmetic and fuzzy measures: Fuzzy rule base and approximate reasoning, truth values and tables in fuzzy logic, fuzzy propositions, formation of rules, decomposition and aggregation of rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making, fuzzy logic control systems, fuzzy expert systems.

UNIT-IV

Introduction Neural Network: Fundamental concept, evolution of neural networks, models of artificial neural networks, important technologies, applications, McCulloch, Pitts Neuron, linear separability, Hebb network.

Supervised learning network: Perception networks, adaptive linear neuron, multiple adaptive linear neurons, back propagation network, radial basis function network.
Unsupervised learning networks: Kohonenself-organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network.

UNIT-V
Genetic Algorithm: Difference between traditional algorithms and GA, genetic algorithm and search space, general genetic algorithm, operators, generational cycle, in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, schema theorem, classification of genetic algorithm, genetic programming, multilevel optimization.

SUGGESTED READING:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education 2004.
2. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
3. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill,1997.
4. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y.

Course Code	Course Title						Core/ Elective
U21CD707	**SEMANTIC WEB SOCIAL NETWORKS**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Computer networks, Web Technology	3	-	-	-	40	60	3

Course Objectives

Objectives of the course

1. To explain the analysis of the social Web and the design of a new class of applications that combine human intelligence with machine processing.
2. To describe how the Semantic Web provides the key in aggregating information across heterogeneous sources.
3. To understand the benefits of Semantic Web by incorporating user-generated metadata and other clues left behind by users.
4. To learn ontology engineering
5. To learn social network analysis and semantic web

Course Outcomes

Upon completion of the course, the students will be able to:

1. Understand the basics of Semantic Web and Social Networks.
2. Understand Electronic sources for network analysis and different Ontology languages.
3. Modeling and aggregating social network data.
4. Develop social-semantic applications.
5. Evaluate Web-based social network and Ontology

Unit-I

Introduction to the Semantic Web and Social Networks:

The Semantic Web-Limitations of the current Web, The semantic solution, Development of the Semantic Web, The emergence of the social web.

Social Network Analysis- What is network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis.

Unit-II

Web data, Semantics and Knowledge Representation on the Semantic Web: Electronic sources for network analysis-Electronic discussion networks, Blogs and online communities, Web-based networks. Knowledge Representation on the Semantic Web- Ontologies and their role in the Semantic Web, Ontology languages for the Semantic Web(RDF, OWL).

Unit-III

Modeling and aggregating social network data: State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data.

Unit-IV

Developing social-semantic applications:

Building Semantic Web applications with social network features, Flink: the social networks of the SemanticWeb community, open academia: distributed, semantic-based publication management

Unit-V

Evaluation of web-based social network extraction and Ontologies are us:

Differences between survey methods and electronic data extraction, Context of the empirical study, Data collection, Preparing the data, Optimizing goodness of fit, Comparison across methods and networks, Predicting the goodness of fit, Evaluation through analysis. Ontologies are us: A tripartite model of ontologies, Case studies, Evaluation.

Suggested Readings

1. Social Networks and the Semantic Web ,PeterMika,Springer, 2007.
2. SemanticWebTechnologies,TrendsandResearchinOntologyBasedSystems,J.Davies,R.Studer, P.Warren, John Wiley & Sons.
3. SemanticWebandSemanticWebServices-LiyangLuChapmanandHall/CRCPublishers, (Taylor & Francis Group)
4. InformationSharingonthesemanticWeb-HeinerStuckenschmidt;FrankVanHarmelen,Springer Publications. ProgrammingtheSemanticWeb,T.Segaran,C.Evans,J.Taylor,O"Reilly,SPD.

Course Code	Course Title						Core/Elective
U21CD708	**WEB AND SOCIAL MEDIA ANALYTICS**						**ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Web Technologies	3	-	-		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. Study several models to interpret emergent features such as the structure and evolution of the Web graph, its traffic patterns, and the spread of information
2. Apply technical and analytic skills to develop a significant group research project, with the opportunity to submit the results for publication
3. Apply multiple quantitative and qualitative methods (to analyze website traffic and social media initiatives
4. Understand sources and limitations of web-based data
5. It examines how we create social, economic and technological networks and how these networks enable and constrain our attitudes and behavior.

Course Outcomes:

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

1. Perform social network analysis to identify important social actors, subgroups (i.e., clusters), and network properties in social media sites such as Twitter, Facebook, and YouTube
2. Apply ethical principles to the use of web and social media data
3. Become familiar with core research communities, publications, and conferences focused on web and social media analytics and the research questions they are engaged in
4. Understand how web and social media analysis can be used to address original research questions in information technology and social science domains
5. Able to discuss how social networks concepts, theories, and visual-analytic methods are being used to map, measure, understand and design a wide range of phenomena

UNIT - I

An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to Manage a Vaccine Supply Chain Effectively and Safely, Changing Business Environments and Computerized Decision Support, Information Systems Support for Decision Making, The Concept of Decision Support Systems (DSS), Business Analytics Overview, Brief Introduction to Big Data Analytics.

UNIT – II

Text Analytics and Text Mining: Machine Versus Men on Jeopardy!: The Story of Watson, Text Analytics and Text Mining Concepts and Definitions, Natural Language Processing, Text Mining Applications, Text Mining Process, Text Mining Tools.

UNIT - III

Sentiment Analysis: Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Sentiment Analysis and Speech Analytics.

UNIT - IV

Web Analytics, Web Mining: Security First Insurance Deepens Connection with Policyholders, Web Mining Overview, Web Content and Web Structure Mining, Search Engines, Search Engine Optimization, Web Usage Mining (Web Analytics), Web Analytics Maturity Model and Web Analytics Tools.

UNIT - V

Social Analytics and Social Network Analysis: Social Analytics and Social Network Analysis, Social Media Definitions and Concepts, Social Media Analytics. Prescriptive Analytics - Optimization and Multi-Criteria Systems: Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking.

Suggested readings:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, Pearson Education.
2. Rajiv Sabherwal, Irma Becerra-Fernandez," Business Intelligence – Practice, Technologies and Management", John Wiley 2011.
3. Lariss T. Moss, ShakuAtre, "Business Intelligence Roadmap", Addison-Wesley It Service.
4. Yuli Vasiliev, "Oracle Business Intelligence: The Condensed Guide to Analysis and Reporting", SPD Shroff,

Course Code	Course Title						Core/ Elective
U21CD709	**SOFTWARE PROJECT MANAGEMENT**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-	-	40	60	3

Course Objectives

The course will introduce the students to

1. To understand the fundamental principles of software project management.
2. To have a good knowledge of responsibilities of project manager.
3. To be familiar with the different methods and techniques used for project
4. To be Familiar with the different activities involved in Software Project Management.
5. Explain the quality management & different types of metrics used in software development.

Course Outcomes

Upon completion of the course, the students will be able to:

1. Identify the different project contexts and suggest an appropriate management strategy.
2. Practice the role of professional ethics in successful software development.
3. Identify and describe the key phases of project management.
4. Determine an appropriate project management approach through an evaluation of the business context and scope of the project.
5. Understand the importance of risk. define the questions a decision maker needs to ask.

UNIT – 1

SOFTWARE MANAGEMENT & ECONOMICS: The Waterfall Model, Conventional Software Management Performance; Evolution of Software Economics - Software economics, Pragmatic software cost estimation, Reducing software product size, Improving software processes.

UNIT – 2

THE OLD AND THE NEW WAY OF PROJECT MANAGEMENT: Improving team effectiveness, Improving automation through software environment, Achieving required quality; Peer inspections – A pragmatic view, The principles of conventional software engineering, Principles of modern software management, Transitioning to an iterative process.

UNIT – 3

SOFTWARE MANAGEMENT PROCESS FRAMEWORK: Life cycle phases, The artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts; Model Based Software Architectures - A management perspective and A technical perspective.

UNIT – 4

PROJECT ORGANIZATION AND PLANNING: Work breakdown structures, Planning guidelines, The cost and schedule estimating process, The iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations; Process automation - Automation building blocks, The project environment.

UNIT – 5

PROJECT CONTROL AND PROCESS INSTRUMENTATION: The Seven-Core metrics, Management indicators, Quality indicators, Life-Cycle expectations, Pragmatic software metrics, Metrics automation, Modern project profiles, Next generation software economics, Modern process transitions.

Suggested Readings:

1. Walker Royce, "Software Project Management", 1st Edition, Pearson Education, 2006.

References Books:

1. Bob Hughes and Mike Cotterell, "Software Project Management", 3rd Edition, Tata McGraw Hill Edition, 2005.

2. Joel Henry, "Software Project Management", 1st Edition, Pearson Education, 2006. 3. PankajJalote, "Software Project Management in practice", 1st Edition, Pearson Education, 2005.

Course Code	Course Title						Core/ Elective
U21MA6L1	**MINI PROJECT**						
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	6	50	-	3

Course Objectives:

The objectives of this course are:

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation.
3. To expose the students to industry practices and teamwork.
4. To encourage students to work with innovative and entrepreneurial ideas.

Course Outcomes:

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

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Effectively plan a project and confidently perform all aspects of project management.
4. Develop and test the solution.
5. Demonstrate effective coding, written, presentation and oral communication skills

CASE STUDY

The students are required to carry out mini projects in any of the areas such as Data Structures, Microprocessors and Interfacing, Database Management Systems, Operating Systems, Design and Analysis of Algorithms, Software Engineering, Data Communications, Web Programming& Services, Computer Networks, Compiler Construction, and Object-Oriented System Development.

Problems Statements are suggested to be taken from Smart India Hackathon (SIH) Portal invited from the Ministries / PSUs / MNCs / NGOs to be worked out through.

The project could be classified as hardware, software, modeling, simulation etc. The project should involve one or many elements of techniques such as analysis, design, and synthesis.

The department will appoint a project coordinator who will coordinate the following:

1. Grouping of students (maximum of 3 students in a group)
2. Allotment of projects and project guides.
3. All projects allotment is to be completed by the 4th week of the semester so that the students get sufficient time for completion of the project.
4. Disseminate guidelines given by monitoring committee comprising of senior faculty members to the students and their guides.

Sessional marks are to be awarded by the monitoring committee. Common norms will be established for the final presentation and documentation of the project report by the respective departments. Students are required to submit a presentation and report on the mini project at the end of the semester.

Course Code	Course Title						Core/ Elective
U21CD801	**NATURAL LANGUAGE PROCESSING**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Python, Machine Learning	3	-	-	-	40	60	3

Course Objectives

This course will introduce students to:

1. Teach students the leading trends and systems in natural language processing.
2. Make them understand the concepts of morphology, syntax and semantics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
3. Teach them to recognize the significance of pragmatics for natural language understanding.
4. Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic and semantic processing.
5. How to evaluate the strengths and weaknesses of various NLP technologies and frameworks as they gain practical experience in the NLP toolkits available.

Course Outcomes

1. To tag a given text with basic Language features
2. To design an innovative application using NLP components
3. To implement a rule based system to tackle morphology/syntax of a language
4. To design a tag set to be used for statistical processing for real-time applications
5. To compare and contrast the use of different statistical approaches for different types of NLP applications and Perform various language phonetic analysis

UNIT I

Introduction of NLP: Origins and challenges of NLP, Language Modeling: Grammar- based LM, Statistical LM – Regular Expressions, Automata , Morphology and Finite State Transducers, Tokenization, stemming, Normalization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II

WORD LEVEL ANALYSIS: N-grams, Evaluating N-grams, Smoothing,Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Entropy, Hidden Markov and Maximum Entropy models, ; Named Entities

UNIT-III

SYNTACTIC ANALYSIS: Context free rules and trees – The noun Phrase – Co- ordination – Verb phrase – context free grammars – Parsing with context free grammars, Shallow parsing – Probabilistic CFG , Dependency Grammar , Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion- Reference Resolution- Discourse Coherence and Structure.

UNIT_IV

Speech Fundamentals: Phonetics – speech sounds and phonetic transcription – articulatory phonetics – phonological categories and pronunciation variation – acoustic phonetics and signals –phonetic resources – articulatory and gestural phonology

UNIT-V

Speech synthesis – text normalization – phonetic analysis – prosodic analysis – diphone waveform synthesis – unit selection waveform synthesis – evaluation

Suggested reading:

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, OReilly Media, 2009.

Course Code	Course Title						Core/ Elective
U21CD802	**OPTIMIZATION TECHNIQUES**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Linear Algebra, Probablity	3	-	-	-	40	60	3

Course Objectives

This course enable students to:

1. Impart knowledge on theory of optimization and conditions for optimality for unconstraint and constraint optimization problems.
2. Be familiar with the design of neural networks, fuzzy logic and fuzzy systems
3. Familiarize with the working principle of optimization algorithms used to solve linear and non-linear problems
4. Train the students to solve optimization problems using software tools
5. Learn mathematical background for optimized genetic programming

Course Outcomes

Upon completion of the course, the students will be able to:

1. Apply operations research techniques like linear programming problem in industrial optimization problems
2. Understand the theory of games for solving simple games
3. Use linear programming in the formulation of shortest route problem
4. Knowledge about network construction and to find critical path and total project duration.
5. Able to learn different tools to focus on business decisions

UNIT 1 : LINEAR PROGRAMMING Meaning and Scope of Operation Research - Formulation of a Linear Programming Problem - Solution of a Linear Programming Problem by Graphical Method. Solution of a Linear Programming Problem by Simplex method - Artificial variables techniques: Two Phase Method and Big-M method (Special Cases: Alternative Solutions, Unbounded Solutions, Non existing Feasible Solutions) – Degeneracy - Method to resolve Degeneracy - Concept of Duality - Formulation of Primal Dual Pairs - Reading of the Optimum Solution to the Dual from the Optimum Simplex Table of the Primal.

UNIT 2 : TRANSPORTATION MODELS

Transportation problem: Formulation- Transportation problem as a special case of Linear Programming Problem - Initial Basic Feasible Solution by North -West Corner Rule, Matrix Minima and Vogel's Approximation Methods - Optimal solution through MODI Tableau for Balanced and Unbalanced Transportation problem - Degeneracy in Transportation Problem.

UNIT 3 ASSIGNMENT PROBLEM

Assignment problem: Formulation- Assignment problem as a special case of Transportation Problem and Linear Programming Problem - Optimal solution using Hungarian Method for Balanced and Unbalanced Problems - Traveling Salesman problem.

UNIT 4 : MANUFACTURING

Sequencing Problem: Introduction - Optimum sequence of 'n' jobs on two machines and three machines without passing. Games Theory: Characteristics of Game Theory- Two Persons Zero Sum Game - Maximum and Minimax Criterion - Pure strategy games - Mixed strategy - Principle of dominance - Limitations of Games Theory - Solving game theory problems (Simple Problems with Analytical Formula and Graphical Methods).

UNIT 5: NETWORKING AND PROJECT PLANNING

Network Analysis: Introduction - Critical Path Method and Project Evaluation Review Technique – Rules of network construction - Time calculations in networks - probability of completing the project within given time- project crashing - optimum cost and optimum duration.

Suggested reading :

1. KantiSwarup, Gupta, P.K. and Manmohan (2014): Operations Research, 13th Edition, Sultan Chand and Sons
2. J.K.Sharma(2012) : Operations Research:Thoery and applications,5th edition, Macmillan India Ltd.

Reference books :

1. S.D.Sharma (2012) : Operations Research; Theory,Methods and applications,15th Edition , Reprint, Kedarnath
2. Taha, H. A. (2019): Operations Research: An Introduction, 8th Edition, Prentice Hall of India.
3. P. K. Gupta and D. S. Hira, Operations Research, S. Chand & co., 2015.
4. R. Ravindran, D. T. Philips and J. J. Solberg, Operations Research: Principles and Practice, 2 nd ed., John Wiley & Sons, 2007.

Course Code	Course Title						Core/ Elective
U21CD803	**INTERNET OF THINGS**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Programming in C, OS, CN, WT	3	-	-	-	40	60	3

Course Objectives

This course will introduce students to:

1. Exploration towards the integration of the physical and logical worlds
2. Exposure in understanding how IoT devices are designed & developed
3. Describe what IoT is and how it works today
4. Recognise the factors that contributed to the emergence of IoT
5. Design and program IoT devices and Use real IoT protocols for communication

Course Outcomes

After completing this course, the student will be able to:-

1. Able to understand the application areas of IOT
2. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
3. Able to understand building blocks of Internet of Things and characteristics
4. Design an IoT device to work with a Cloud Computing infrastructure.
5. Transfer IoT data to the cloud and in between cloud providers and Define the infrastructure for supporting IoT deployment

UNIT I

Introduction & Concepts: Introduction to Internet of Things (IoT), Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels

UNIT II

Architecture of IoT, Taxonomy, Sensors and Actuators, Preprocessing, Communication, Middleware, Applications of IoT

UNIT III

Introduction to ARDUINO: Getting Started with ARDUINO products, Built-In Examples

ARDUINO IoT Cloud: ARDUINO IoT Cloud Components

UNIT IV

Developing Internet of Things & Logical Design using Python: Introduction, IoT Design Methodology.

Basics of Python: Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes.

UNIT V

IoT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi,Interfaces, and Programming & IOT Devices.

Suggested Reading

1. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013.

Course Code	Course Title						Core/ Elective
U21CD804	**COGNITIVE SCIENCE AND ANALYTICS**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Data Mining	3	-	-	-	40	60	3

Course Objectives

This course will introduce students to

1. To study the basic concepts and approaches in the field of cognitive science
2. To apply the concepts of planning, reasoning and learning models in cognitive applications.
3. To analyze language and semantic models of cognitive process.
4. to understand and critically evaluate the scientific understanding of sensation and perception from an interdisciplinary perspective that includes psychology, neuroscience, computer science, and philosophy.
5. To study how mind works functions and behaves.

Course Outcomes

Upon completion of the course, the students will be able to:

1. Students will be able to understand the basic concept of cognitive science
2. Apply reasoning methodology to real world applications.
3. Students will understand and apply declarative and logic model.
4. Envisage the concept of cognitive learning.
5. Acquire knowledge in language processing and understanding

UNIT I

Introduction to Cognitive Science:

Fundamental Concepts of cognitive science – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science – Artificial Intelligence: Knowledge representation, semantic networks, frames, conceptual dependency, scripts, OntologyUnderstanding, Common Sense Reasoning.

UNIT II

Planning and Learning Methods:

Planning – Situation Logic- Learning in Cognitive Systems- Rote Learning – Learning by Examples - Incremental Concept Learning – Inductive Learning - Classification Techniques – Statistical Reasoning- Bayesian Classification- Bayesian Networks- Concept Learning- Version Spaces - Discrimination TreesArchitecture of IoT, Taxonomy, Sensors and Actuators, Preprocessing, Communication, Middleware, Applications of IoT

UNIT III

Reasoning Methods: Reasoning by analogy – Explanation based reasoning – Case based reasoning- Constraint Satisfaction- Constraint Propagation- Temporal reasoning – Temporal Constraint NetworksSpatial reasoning- Visual Spatial reasoning- Meta reasoning – Learning by correcting mistakesAI ethics

UNIT IV

Cognitive Model: Declarative/ logic-based computational cognitive modelling - connectionist models of cognition - Bayesian models of cognition - Cognitive Models of Memory and Language - Computational models of episodic andsemantic memory - modelling psycholinguistics (with emphasis on lexical semantics) - towards deep understanding - modelling the interaction of language, memory and learning.

UNIT V

Model Paradigm: Modelling Select Aspects of Cognition Classical models of rationality - symbolic reasoning and decision making under uncertainty - Formal models of inductive generalization causality - Categorization and similarity analysis.

Suggested Reading

1. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013.

Course Code	Course Title						Core/Elective
U21CD805	**SECURE SOFTWARE DESIGN & ENTERPRISE COMPUTING**						**ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	**-**		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. To fix software flaws and bugs in various software
2. To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic.
3. To equip the students with techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
4. To make students aware of various methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.
5. To develop and apply an understanding of enterprise computing systems in the safe and secure usage and storage of data.

Course Outcomes:

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

1. Differentiate between various software vulnerabilities.
2. Illustrate software process vulnerabilities for an organization.
3. Monitor resources consumption in a software.
4. Interrelate security and software development process.
5. explains how systems meet the needs of a range of enterprises

UNIT 1

Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

UNIT 2

Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

UNIT 3

Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

UNIT 4

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

UNIT 5 Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws. Case study of DNS server, DHCP configuration and SQL injection attack.

SUGGESTED READING:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

Course Code	**Course Title**						Core
U21CD8L1	**CLOUD COMPUTING LAB**						**Core**
Prerequisite	Hours Per Week				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
	-	-	-		50	50	**2**

Course Objectives

1. Understand the basic concepts of cloud computing including virtualization, scalability, and resource pooling, and how they relate to modern computing paradigms.
2. Gain a solid understanding of virtualization principles and technologies, with a focus on Virtual Box as a tool for creating and managing virtualized environments.
3. Learn the fundamentals of the C programming language, including syntax, data types, control structures, functions, and memory management.
4. Undertake a project that involves developing, testing, and deploying a C-based application within a virtualized cloud environment, demonstrating proficiency in all aspects of the development lifecycle.
5. Practice effective collaboration and documentation skills by working in teams to complete lab exercises and projects, and documenting their work for future reference.

Course Outcomes

After completing this course, the student will be able to

1. Students will learn the fundamental concepts of cloud computing, including virtualization, resource pooling, and scalability, through practical implementation using Virtual Box
2. Students will be proficient in developing C programs within a virtual environment, understanding the nuances of system-level programming and interaction with virtualized hardware resources.
3. Students will implement basic security practices within virtualized environments, including user authentication, access control, and secure communication between virtual machines.
4. Students will explore integrating C programs with cloud APIs and services, utilizing libraries and SDKs to interact with cloud platforms from within virtualized environments.
5. Students will undertake a project that involves developing, testing, and deploying a C-based application within a virtualized cloud environment, demonstrating proficiency in all aspects of the development lifecycle.

LIST OF EXPERIMENTS

1. Install Virtual box/VMware Workstation with different flavours of linux orwindows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box andexecute Simple Programs.
3. Install Google App Engine. Create *hello world* app and other simple webapplications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithmthat is not present in Cloud Sim.
6. Find a procedure to transfer the files from one virtual machine to anothervirtual machine.
7. Find a procedure to launch virtual machine using try stack (OnlineOpen stack Demo Version)

Course Code	Course Title						Core/ Elective
U21CD8P1	**MAJOR PROJECT**						
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	16	50	150	8

Course Objectives:

To prepare the students

1. To enhance practical and professional skills.
2. Enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work.
3. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry
4. . Preparing an Action Plan for conducting the investigation, including team work
5. Prepare a dissertation in the standard format.

Course Outcomes

1. Demonstrate a sound technical knowledge of their selected topic.
2. Conduct investigations by using research-based knowledge and methods to provide valid conclusions.
3. Provide solutions to societal complex problems utilizing gained engineering knowledge as an individual or by team work.
4. Create/select/use modern tools to overcome the limitation of complex engineering solutions.
5. Communicate with engineering experts and the community at large in written , oral forms And publish a paper(ugc,international conference proceedings and indexed journal)

Guidelines:

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:

Collection of project topics/descriptions from faculty members (Problems can also be invited from the industries)

➢ Grouping of students (max 3 in a group)

➢ Allotment of project guides

➢ The aim of project work is to develop solutions to realistic problems applying the knowledge and skills Obtained in different courses, new technologies and current industry practices.

This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions.

After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide. Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.

3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- ➢ Problem definition and specification
- ➢ Literature survey
- ➢ Broad knowledge of available techniques to solve a particular problem.
- ➢ Planning of the work, preparation of bar (activity)charts
- ➢ Presentation- oral and written

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-I 2. Re-Allotment of internship students to project guides.

3. Project monitoring at regular intervals All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

The first review of projects for 25 marks can be conducted after completion of five weeks.

The second review for another 25 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments.

The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: **Three periods of contact load will be assigned to each project guide**