VII Semester (Artificial Intelligence and Machine Learning)													
SL.NO	**Course and course Code**		**Course Title**	**Teaching Department**	**Teaching Hours/Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/Drawing**	**Self Study**	**Duration in hours**	**SEE Marks**	**CIE Marks**	**Total Marks**	
					L	T	P	S					
1	PEC	21AI71A	Generative AI	RD	3	0	0	0	03	50	50	100	3
2	PEC	21AI72A	Virtual Reality and Augmented Reality	RD	3	0	0	0	03	50	50	100	3
3	OEC	21AI731	Open Elective – II	RD	3	0	0	0	03	50	50	100	3
4	OEC	21AI741	Open Elective – III	RD	3	0	0	0	03	50	50	100	3
5	Project	21AIP75	Project Work	Rd	Two contact hours /week for interaction between the faculty and students.				03	50	50	100	10
6	AEC	21AI76	Ability Enhancement Course (Online 4 weeks)		-	-			03	50	50	100	2
			Total		**12**	**0**	**0**	**0**	**400**	**400**		**800**	**24**
Professional Elective Core-I					**Professional Elective Core -II**								

1. Natural Language Processing (21AI71B) 2. Multimedia & Information Retrieval (21AI71C)		1. Quantum Computing (21AI72B) 2. Image & Video Processing (21AI72C)
Open Elective-I		**Open Elective -II**
1. Big Data Analytics (21AI73OE1)		1. Cellular Technology (21AI74OE1)

	VIII Semester (Artificial Intelligence and Machine Learning)												
	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week				Examination				
Sl. NO					Lecture	Tutorial	Practical/Drawing	Self Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
1	Seminar	21AI81	Technical Seminar		One contact hour /week for interaction between the faculty and students.				03	50		50	1
2	Internship	21AI82	Research/Industry Internship		Two contact hours /week for interaction between the faculty and students.				03	50	50	100	15
	Total								**06**	**100**	**50**	**150**	**16**

Sl .No	Semester	21-22 (BATCH)
01	I	20
02	II	20
03	III	20
04	IV	20
05	V	18
06	VI	22
07	VII	24
08	VIII	16
	Total	160

Generative AI		
Course Code:	21AI71A	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.
Prerequisite: The students should have the basic knowledge of Machine learning		
Course Learning Objective • To understand the mathematical fundamentals that is prerequisites for a variety of courses like • Data mining, Network protocols, analysis of Web traffic, Computer security, Software • engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, • Machine learning. • To develop the understanding of the mathematical and logical basis to many modern techniques for technology like machine learning, programming language design, and concurrency. • To study various sampling and classification problems.		
Modules		**Teaching Hours**
Module I Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood		8 Hrs.
Module II Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over fitting model assessment.		8 Hrs.
Module III Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.		8 Hrs.
Module IV Computer science and engineering applications Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.		9 Hrs.
Module V		9 Hrs.

Recent Trands in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.	

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

1. **Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman,Pearson Education Asia.**
2. **Discrete Mathematical structures with application to Computer Science – J.P. Tremblay and R.Manohar.**
3. **Cryptography and Network Security, William Stallings.(Second Edition)Pearson Education Asia.**

Reference:

1. Introduction to languages and theory of computation – John C. Martin (MGH)
2. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole)
3. Cryptanalysis of number theoretic Cyphers, Samuel S. Wagstaff Jr.Champan& Hall/CRC Press
   2003
4. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes – Ousley, Keith
   Strassberg Tata McGraw-Hill.

Course Outcome

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

CO#	Course Outcome
CO1	To understand the basic notions of discrete and continuous probability.
CO2	To understand the methods of statistical inference, and the role that sampling distributions Play in those methods.
CO3	To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.
CO4	Apply generative models to generate new content and enhance existing data.
CO5	Utilize generative AI techniques to solve complex problems in different domains

Natural Language Processing		
Course Code:	21AI71B	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.
Prerequisite: The students should have knowledge of Neural Networks and Machine Learning		
Course Learning Objectives This course will enable students to • Define Natural Language Processing • Explain Word level and syntactic analysis • Analyze the natural language text • Understand the concepts of Text mining • Illustrate information retrieval techniques.		
Modules		**Teaching Hours**
Module I **Overview and language modeling:** Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.		8 Hrs.
Module II **Word level and syntactic analysis:** Word Level Analysis: Regular Expressions-Finite- State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar- Constituency-Parsing-Probabilistic Parsing.		8 Hrs.
Module III **Extracting Relations from Text: From Word Sequences to Dependency Paths:** Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. **Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles:** Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations. **A Case Study in Natural Language Based Web Search:** In Fact System Overview, The GlobalSecurity.org Experience.		9 Hrs.
Module IV **Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models:** Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, **Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures:** Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent		9 Hrs.

Semantic Analysis, Predictions, Results of Experiments. **Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling:** Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. **Evolving Explanatory Novel Patterns for Semantically-Based Text Mining:** Related Work, A Semantically Guided Model for Effective Text Mining.	
Module V **INFORMATION RETRIEVAL AND LEXICAL RESOURCES:** Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net- Frame Net- Stemmers-POS Tagger- Research Corpora.	8 Hrs.

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

1. Natural Language Processing and Information Retrieval Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008
2. Natural Language Processing and Text Mining Anne Kao and Stephen R. Poteet Springer-Verlag London Limited 2007

Reference:

1. Natural Language Understanding James Allen 2nd edition, Benjamin/Cummings publishing company, 1995
2. Gerald J. Kowalski and Mark.T. Maybury Information Storage and Retrieval systems Kluwer academic Publishers, 2000.

Course Outcome

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

CO#	Course Outcome
CO1	Apply the natural language text at word level
CO2	Develop syntactic structures to simple and complex applications.
CO3	Analyze the natural language text at word level and syntactic structures.
CO4	Identify the concepts of Text mining.
CO5	Apply information retrieval techniques to develop applications.

Multimedia & information Retrieval		
Subject Code:	21AI71C	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.

Prerequisite: The students should have the basic knowledge of algorithms , data structures and database

Course Learning Objectives

- Use the different information retrieval techniques in various application areas
- Apply IR principles to locate relevant information collections of data
- Analyze the performance of retrieval systems when dealing with unmanaged data sources

Modules	Teaching Hours
Module I Boolean retrieval. The term vocabulary and postings lists. Dictionaries and tolerant retrieval. Index construction. Index compression	8 Hrs.
Module II Scoring, term weighting, and the vector space model. Computing scores in a complete search system. Evaluation in information retrieval. Relevance feedback and query expansion.	8 Hrs.
Module III XML retrieval. Probabilistic information retrieval. Language models for information retrieval. Text classification. Vector space classification.	8 Hrs.
Module IV Support vector machines and machine learning on documents, Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing.	9 Hrs.
Module V Web search basics. Web crawling and indexes, Link analysis.	9 Hrs.

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

1. Introduction to Information Retrieval , Christopher D. Manning and Prabhakar Raghavan and Hinrich Schütze, Cambridge University Press, 2008.
2. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark T Maybury, Springer.

Reference:

1. Modern Information Retrieval, Ricardo Baeza-Yates, Pearson Education, 2007

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

CO#	Course Outcome
CO1	Describe models like vector-space, probabilistic and language models to identify the similarity of query and document
CO2	Implement retrieval systems for web search tasks.
CO3	Analyze ranked retrieval of a very large number of documents with hyperlinks between them.
CO4	Demonstrate genesis and diversity of information retrieval situations for text and hyper media.

VIRTUAL REALITY ANDAUGMENTED REALITY		
Course Code:	21AI72A	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.
Prerequisite: The students should have the good knowledge of C# programming, computer graphics with open GL and real time 3D concepts.		
Course Learning Objectives: To enable the students to obtain the knowledge of Virtual Augmented Reality in the following topics. • To understand opportunities and the main issues related to designing and developing VR/AR systems architectures, both in local and in distributed (even web-based) contexts. • To understand development of VR/AR applications with a multimodal perspective and approach.		
Modules		**Teaching Hours**
Module I **Introduction:** The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. **Input Devices**: (Trackers, Navigation, and Gesture Interfaces): Three dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces.		8 Hrs.
Module II **Output Devices:** Graphics displays, sound displays & haptic feedback.		9 Hrs.
Module III **Modeling:** Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management.		8 Hrs.
Module IV **Human Factors:** Methodology and terminology, user performance studies, VR health and safety issues.		8 Hrs.
Module V **Applications:** Medical applications, military applications, robotics		9 Hrs.

applications.	

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

1. Augmented Reality: A Practical Guide by Stephen Cawood and Mark Fiala**.**
2. Augmented Reality Principles and Practices by Dieter SchmalstiegandTobias Hollerer.

Reference:

1. Understanding Virtual Reality, interface, Application and Design, William R. Sherman, Alan
Craig, Elsevier (Morgan Kaufmann).
2. 3D Modeling and surfacing, Bill Fleming, Elsevier (Morgan Kauffman).
3. 3D Game Engine Design, David H.Eberly, Elsevier.
4. Virtual Reality Systems, John Vince, Pearson Education.
5. What is Virtual Reality? http://vr.isdale.com/WhatIsVR/frames/WhatIsVR4.1.html.
6. Augmented and Mixed Reality, http://www.mic.atr.co.jp/~poup/research/ar/.

Course Outcome

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

CO#	Course Outcome
CO1	Describe the components of the virtual reality system.
CO2	Describe various input and output devices used for virtual Reality.
CO3	Apply the different modeling concepts to visual virtualization.
CO4	Analyze the performance of given simple applications related to virtual reality.
CO5	Design 3D technology with virtual programming concepts in different applications.

Quantum Computing		
Subject Code:	21AI72B	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.

Prerequisite: The students should have the basic knowledge of calculus and linear algebra

Course Learning Objectives

- Learn about qubits and gating operations,
- construct quantum circuits
- learn about quantum algorithms

Modules	Teaching Hours
Module I **Introduction**: Elementary quantum mechanics:, linear algebra for quantum mechanics, Quantum states in Hilbert space,The Bloch sphere, Density operators, generalized measurements, no-cloning theorem.	8 Hrs.
Module II **Quantum correlations**: Bell inequalities and entanglement, Schmidt decomposition, superdense coding, teleportation.	8 Hrs.
Module III **Quantum cryptography**: quantum key distribution	8 Hrs.
Module IV **Quantum gates and algorithms:** Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, factoring	9 Hrs.
Module V **Programming a quantum computer**: The IBMQ, coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.	9 Hrs.

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

(1) Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007.
(2) Chris Bernhardt, Quantum Computing for Everyone, The MIT Press,Cambridge, 2020
(3)David McMahon-Quantum Computing Explained-Wiley-Interscience , IEEE Computer Society (2008)

Reference: (1) Quantum Computation and Quantum Information, M. A. Nielsen &I.Chuang, Cambridge University Press (2013).
(2) Quantum Computing, A Gentle Introduction , Eleanor G. Rieffel and Wolfgang H. Polak MIT

press (2014)

Course Outcome

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

CO#	Course Outcome
CO1	Learn about qubits and gating operations
CO2	Construct quantum circuits and learn about quantum algorithms
CO3	How to use Qiskit to construct and run quantum circuits on simulators
CO4	How to use Qiskit to construct quantum hardware using Python

Image & Video Processing

Course Code:	21AI72C	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.

Prerequisite: The students should have the knowledge of Fourier transformation and probabilistic approach.

Course Learning Objectives

To enable the students to obtain the knowledge of **Image and Video Processing** in the following topics.

- Understand of the fundamental concepts related to multidimensional video processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.
- Explore and contribute to research and further developments in the field of image and video processing

Modules	Teaching Hours
Module I **CAMERAS:** Pinhole Cameras, Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases, Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models, Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.	8 Hrs.
Module II **Linear Filters:** Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges, Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture	8 Hrs.

Module III **The Geometry of Multiple Views: Two Views, Stereopsis:** Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation?, Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,	8 Hrs.
Module IV **Segmentation by Fitting a Model**: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.	9 Hrs.
Module V **Geometric Camera Models**: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization, Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.	9 Hrs.

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks: 1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009

Reference: 1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.

Course Outcome

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

CO#	Course Outcome
CO1	Implement fundamental image processing techniques required for computer vision
CO2	Perform shape analysis
CO3	Implement boundary tracking techniques
CO4	Apply chain codes and other region descriptors & Apply Hough Transform for line, circle, and ellipse detections
CO5	Apply 3D vision techniques, Implement motion related techniques, Develop applications using computer vision techniques

Big Data Analytics		
Course Code:	21AI73OE1	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.

Prerequisite: The students should have the knowledge of DBMS.

Course Learning Objectives:

To enable the students to obtain the knowledge of Big Data Analytics in the following topics.

- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the applications using Map Reduce Concepts.
- To introduce programming tools PIG & HIVE in Hadoop echo system

Modules	Teaching Hours
Module 1 **INTRODUCTION TO BIG DATA** Types of Digital Data, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, What is Big Data?: Volume, velocity, variety, Other characteristics of Data Which are not Definitional Traits of Big Data: Why Big Data? Are we just an information consumer or do we also produce information?: Traditional business intelligence (B1) versus Big data: A typical data warehouse environment:, A typical hadoop environment:, What is new today?:, Coexistence of Big data and data warehouse, What is changing in the realms of Big data? . **Big Data Analytics** What is big data analytics? What is big data analytics Isn't? Classification Analytics, Gratest challenges that prevent business for Capitalizing on Big Data, Top challenges facing Big data, What kind of technologies are we looking toward to help meet the challenges posed by big data ?.	8 Hrs.
Module II **THE BIG DATA TECHNOLOGY LANDSCAPE** NoSQL(Not Only SQL),Where is it used?, What is it?, Types of NoSQL Databases, Why NoSQL?, Advantages of NoSQL, What We Miss With NoSQL?, Use of NoSQL in Industry,NoSQLVendors,SQL versus NoSQL,New SQL, Comparison of SQL, NoSQL, and NewSQL, **HADOOP**: Features of Hadoop, Key Advantages of Hadoop, Version of Hadoop, Overview of Hadoop Ecosysytems, Hadoop Distributions, Hadoop versus SQL, Integrated Hadoop Systems Offered by Leading Market Vendors, Cloud-Based Hadoop Solutions, **INTRODUCTION TO HADOOP** Introducing Hadoop, Data: The Treasure Trove, Why Hadoop?, Why not RDBMS?, RDBMS versus Hadoop,, Distributed Computing Challenges, Hardware Failure, How to process this Gigantic store of data?, History of Hadoop, The name "Hadoop" Hadoop Overview, key aspects of Hadoop, Hadoop Components, Hadoop Conceptual Layer,	9 Hrs.

High-level Architecture of Hadoop, use case of Hadoop, Clickstream Data, Hadoop Distributors, HDFS:Hadoop Distributed File System), HDFS Daemons, Anatomy of file read, Anatomy of file write, Replica placement strategy, working with HDFS Commands, Special features of HDFS, processing Data with hadoop, MapReduce Daemons, How does MapReduce work?, MapReduce Example, Managing Resources and applications with Hadoop YARN (Yet Another Resource Negotiator), Limitations of Hadoop 1.0 Architecture, HDFS Limitation, Hadoop 2:HDFS, Hadoop2 YARN: Taking Hadoop beyond Batch, Interacting with Hadoop Ecosystem, pig, Hive, Sqoop, Hbase.	
Module III **INTORDUCTION TO MongoDB** What is Mongo DB?, Why Mongo DB?, Using Java Script Object Notation(JSON), Creating or generation a unique key, support for dynamic queries, storing binary data, replication, sharding, updating information in-place, terms used in RDBMS and MongoDB, create database, drop database, data types in MongoDB, MongoDB Query language, insert method, save() method, Adding a new field to an existing document – update method, removing an existing field from an existing document,- remove method, finding documents based on search criteria-find method, dealing with NULL values, count, Limit, Sort, and skip, Arrays , Aggregate Function, MapReduce Function, Java Script Programming, Cursors in MongoDB, Indexes, Mongo Import, Mongo Export, Automatic Generation of unique numbers for the "- id" field. **INTRODUCTION TO CASSANDRA** Apache Cassandra, An introduction, Features of Cassandra, Peer-to-peer network, gossip and failure detection, partitioner, Replication Factor, Anti-Entropy and Read Repair, Writes in Cassandra,Hinted handoffs, tunable consistency, CQL Data types, CQLSH, Logging into cqlsh, keyspaces, CRUD(Create, Read, Update, and Delete) Operations, collections, Set collection, list collection, Map collection, More practice on Collections(SET and LIST), Using Map:Key, value pair, using a counter, time to live (TTL), Alter commands, Alter table to change the data type of a column, alter table to delete a column, drop a table, drop a database, import and export, export to CSV, Import from CSV, Import from STDIN, Export to STDOUT, Querying system Tables , Practice examples	9 Hrs.
Module IV **INTRODUCTION TO MAPREDUCE PROGRAMMING** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. **INTRODUCTION TO HIVE:** What is Hive? History of Hive and recent releases of Hive, Hive features, Hive Integration and work flow, Hive data units, Hive Architecture, Hive Data Types, Primitive Data Types, Collection Data Types, Hive File Format, Text file, Sequential File, Rcfile (Record Columnar File), Hive Query Language(HQL), DDL (Date Definition Language) Statements, DML(Data Manipulation Language) Statements, starting Hive shell, Database, Tables, Partitions, Bucketing, Views, Sub-query, Joins,	8 Hrs.

Aggregation, Group By and Having, RCfile Implementation, SerDe, User-Defined Function(UDF). **INTRODUCTION TO PIG** what is pig?, Key geatures of pig, The Anatomy of pig, pig on Hadoop, Pig philosophy, Use case for Piog:ETL Processing, Pig latin overview, pig latin statements, pig latin:keywords, pig latin: Identifiers, Pig latin: Comments, Pig Latin:Case sensitivity, Operators in pig latin, Data types in Pig, Simple data types, complex data types, Running pig, Interactive mode, batch mode, Execution modes of Pig, local Mode, mapreduce Mode, HDFS Commands,	
Module V Relational Operators in PIG FILTER, FOREACH, GROUP, DISTINCT, LIMIT, ORDER BY, JOIN, UNION, SPLIT, SAMPLE, Eval function: AVG, MAX,COUNT, Complex Data Types:TUPLE, MAP,Piggy bank, user-defined functions(UDF), Parameter Substitution, Diagnostic Operator, Word Count Example using Pig, When to use Pig?, When not to use Pig?, Pig at Yahoo, Pig versus Hive. **INTRODUCTION TO MACHINE LEARNING** Introduction to machine learning, Machine learning definition, machine learning algorithms, regression model – linear regression, clustering, collaborative filtering, Association Rule mining, Decision Tree. **CASE STUDIES PNUTS:** Yahoo!'s hosted data serving platform. Finding a Needle in a haystack: Face book's photo storage	9 Hrs.

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

1. Big data and Analytics:Seema Acharya(Infosys ltd), Subhashini hellappan(Infosys ltd)

Reference:

1. Noreen Burlingame, The little book on Big Data,New Street publisher(eBook) http://www.prlog.org/11800911-just-published-the-little-book-of-big-data-2012-edition.html
2. Norman Matloff ,The Art of R Programming: A Tour of Statistical Software Design , ISBN-13: 978-1-59327-384-2; ISBN-10: 1-59327-384-3
3. http://www.johndcook.com/R_language_for_programmers.html
4. http://bigdatauniversity.com/
5. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction

Course Outcome

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

CO#	Course Outcome
CO1	Illustrate Big-data fundamentals and challenges in big data analytics.
CO2	Demonstrate Hadoop, NOSQL frameworks to efficiently store retrieve and process Big Data.
CO3	Apply big data programming to manipulate, store, and analyze the data.

CO4	Illustrate Hive and Pig features, its architecture and data format for DDL and DML operations.
CO5	Apply statistical analysis for machine learning algorithms.

Cellular Technology		
Course Code:	21AI74OE1	Credits:3
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs.
Hours/Week:03Hrs (Theory)		Total Hours:42 Hrs.
Prerequisite:		
Course Learning Objectives • To make students familiar with fundamentals of mobile communication systems. • To identify the limitations of 2G and 2.5G wireless mobile communication and the • Design of 3G and beyond mobile communication systems.		
Modules		**Teaching Hours**
Module I **Mobile Radio Propagation -**Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms -Reflection (Ground Reflection) , Diffraction, Scattering, Practical Link Budget, **Fading and Multipath -**Broadband wireless channel, Delay Spread and Coherence Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance (fext 1-2.4) Statistical Channel Model of a Broadband Fading Channel **The Cellular Concept -**Cellular Concept , Analysis of Cellular Systems, Sectoring		8 Hrs.
Module II **GSM and TDMA Technology** **GSM System overview-** Introduction, GSM Network and System Architecture, GSM Channel Concept. **GSM System Operations-** GSM Identities, System Operations-Traffic cases, GSM Infrastructure Communications (User Interface)		8 Hrs.
Module III **CDMA Technology CDMA System Overview -** Introduction, CDMA Network and System Architecture **CDMA Basics-** CDMA Channel Concepts, CDMA System (Layer 3)operations, 3GCDMA		8 Hrs.
Module IV **LTE-4G** **Key Enablers for LTE 4G-** OFDM, SC-FDE, SC-FDMA, Channel Dependant Multiuser Resource Scheduling, Multi-Antenna Techniques,		9 Hrs.

Flat IP Architecture, LTE Network Architecture. **Multi-Carrier Modulation -** Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing and Frequency Synchronization, Peak to Average Ration, SC Frequency Domain Equalization, Computational Complexity Advantage of OFDM and SC-FDE.	
Module V **LTE - 4G OFDMA and SC-FDMA -** Multiple Access for OFDM Systems, OFDMA, SCFDMA, Multiuser Diversity and Opportunistic Scheduling, OFDMA and SC-FDMA in LTE, OFDMA system Design Considerations. **The LTE Standard-** Introduction to LTE and Hierarchical Channel Structure of LTE, Downlink OFDMA Radio Resources, Uplink SC-FDMA Radio Resources.	9 Hrs.

Question paper pattern:

1. The question paper will have TEN questions.
2. There will be TWO questions in each module, covering all the topics.
3. The student need to answer FIVE full questions, selecting ONE full question from each module.

Textbooks:

Fundamentals of LTE"Arunabha Ghosh, Jan Zhang, JeffereyAndrews, Riaz Mohammed, Pearson education (Formerly Prentice Hall, Communications Engg and Emerging Technologies), ISBN-13: 978-0-13- 703311-9.

2 "Introduction to Wireless Telecommunications Systems andNetworks", Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN -13: 978-81-315-0559-5.

Reference:

1. "Wireless Communications: Principles and Practice" Theodore Rappaport,2• Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.

2. LTE for UMTS Evolution to LTE-Advanced' Harri Holma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003. 2

Course Outcome

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

CO#	Course Outcome
CO1	Understand the Communication theory both Physical and networking associated with GSM, CDMA& LTE 4G systems.
CO2	Explain concepts of propagation mechanisms like Reflection, Dif fraction, Scattering in wireless channels.
CO3	Develop a scheme for idle mode, call set up, call progress handling and call tear down in a GSM cellular network.
CO4	Develop a scheme for idle mode, call set up, call progress handling and call tear down in a CDMA cellular network.

CO5	Understand the Basic operations of Air interface in a LTE 4G system.

PROJECT WORK		
Course Code	**21AIP75**	Credits:10
CIE:50	SEE:50	SEE: 03hours
Prerequisite: The students should have Thorough knowledge of Software Engineering and Mastering any one programming language.		
Course Objectives: • To understand the current requirement of the Industries. • To understand the different software development and testing methodologies. • To understand and apply architectural model, data flow and control flow diagrams. • To acquire good documentation, demonstration skills and impact of application on society		
Project Phase – I Comprises of:		Teaching Hours

1. Literature Survey 2. Requirement Analysis - S/w Requirements - H/w Requirements 3. Design Module presentation 4. Application 5. System Requirement Specification document SRS document contains synopsis, problem formulation and requirement analysis based on above factors. Document should be submitted by the end of VII Sem. Project Phase-I would be evaluated for 2 credits by means of presentation.	

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Demonstrate the skills of performing surveys on current industrial requirements.
	CO2	Analyze the requirements and apply appropriate software development methodology.
	CO3	Implement and Validate the architectural model, data flow and control flow structures.
	CO4	Demonstrate the documentation and presentation skills
	CO5	Implement the Societal and Ethical systems.

VIII - SEMESTER

TECHNICAL SEMINAR		
Course Code	21AIS81	Credits:01
CIE:50	SEE:---	Total hours: 14 hrs
Prerequisite: The Students should have the knowledge of current technologies, Creativity and programming skills.		

Course Objectives:

- To understand the current trends in the industries
- To apply the documentation techniques.
- To exhibit the presentation skills and interactive skills.
- To apply the analysis skills.

Modules	Teaching Hours
SEMINAR COMPRISES OF: • Technical survey–identifying the recent development in the modern technology. • Technical requirement–identifying the current industrial skills. • Co-related technologies–identifying the co-related technologies. • Report generation–preparing the IEEE standard documents of the same. • Seminar document contains Abstract, introduction, problem formulation, design and application based on the above factors. Document should be submitted in the mid of semester. • Seminar will be evaluated for 1 credit by means of presentation.	**14 Hours**

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	To demonstrate the different surveys to understand the current industrial requirements.
	CO2	To analyze different technical requirements and demonstrate interactive skills.
	CO3	To demonstrate the presentation skills.
	CO4	To demonstrate the analytical skills.
	CO5	To examine the intensity of the interactive sessions.

INTERNSHIP		
Course Code	**21AII82**	Credits:15
CIE:50	SEE.50	SEE: 03hours

Research Internship /Industry Internship of sufficient duration encourages students early on in their career. Its main goal is to give an opportunity to improve their analytical and technical skills in an international environment. Internship can be in an industry or at an appropriate work place. Research internships and industrial internships have different purposes and come with their set of benefits. A prior experience in any field is always preferred over a fresh start. Therefore, one of them can be selected depending on the interest the students have. Internships pose unexpected challenges and make students to think appropriately, tackle difficulties with ease and act in a scholarly way to get past the hurdles and practical constraints. An internship is always beneficial however good or bad it is. Internships not only enhance one's learning but also identifies him/her as someone who has thecommitment to approaching a project and completing it with or without the guidance. The internship learning is an impetus to professional development. While research internship is a step stone to higher studies, an industry internship is a pathway for a placement. Those who are self-motivated and interested in search of new things that are original and unique can choose a research internship. Those who are interested in the real industry- experience and aspire to get a job soon after graduation can choose an industry internship.