B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION - 2021

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABI

(SEM V & VI)

VISION:

To make the Department of Computer Science and Engineering the unique of its kind in the field of Research and Development activities in this part of world.

MISSION:

To impart highly innovative and technical knowledge to the urban and unreachable rural student folks in Computer Science and Engineering through "Total Quality Education".

PROGRAM EDUCATIONAL OBJECTIVES:

PEO 1: Apply the basic engineering skills and domain knowledge for developing effective computing solutions to address various social issues.

PEO 2: Able to have successful career in technical / managerial roles in multi-disciplinary environment.

PEO 3: To confront the evolving technical challenges and problems in the areas of computing.

PROGRAM OUTCOMES:

After going through the four years of study, the Artificial Intelligence and Data Science will have the ability to

	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1: Professional Skills: To apply learned skills to build optimized solutions pertaining to Data Processing, Artificial Intelligence and Machine Learning.

PSO 2: Problem - Solving Skills: To analyze data using domain knowledge to get insights and develop appropriate solutions.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION 2021

III YEAR CURRICULUM & SYLLABI

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AI2301	Big Data Tools and Techniques#	PC	4	2	0	2	3
2	AI2302	Computer Networks and Security#	PC	4	2	0	2	3
3	AI2303	Fundamentals of Deep Learning	PC	3	3	0	0	3
4	CS2301	Internet Programming	PC	3	3	0	0	3
5		Professional Elective I	PE	-	-	-	-	3
6		Professional Elective II	PE	-	-	-	-	3
PRACTICALS								
7	AI2304	Deep Learning Laboratory	PC	4	0	0	4	2
8	CS2307	Internet Programming Laboratory	PC	4	0	0	4	2
9	EM2301	Internship**	EM	0	0	0	0	1
10	EM2202	Interpersonal skills – Listening and Speaking	EM	2	0	0	2	1
			TOTAL	-	-	-	-	**24**

Theory cum Laboratory Course
Credits earned by the students through Internship will be given in the final consolidated mark statement.

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AI2351	Fundamentals of Natural Language Processing	PC	3	3	0	0	3
2		Professional Elective III	PE	-	-	-	-	3
3		Professional Elective IV	PE	-	-	-	-	3
4		Professional Elective V	PE	-	-	-	-	3
5		Professional Elective VI	PE	-	-	-	-	3
6		Open Elective – I*	OE	3	3	0	0	3
PRACTICALS								
7	AI2352	Mini project	EM	3	0	0	3	1
8	AI2353	Natural Language Processing Laboratory	PC	4	0	0	4	2
9	EM2351	Professional Communication	EM	2	0	0	2	1
			TOTAL	**-**	**-**	**-**	**-**	**22**

* Open Elective shall be chosen from the list of open electives offered by other Programmes

VERTICALS – Semester V and VI

Verticals / Courses	Cognitive Analytics	Software Application Development	Data Center Technologies
1	Image Analytics and Computer Vision#	Agile Project Development with Scrum	DevOps for Cloud#
2	Business Intelligence	Software Testing and Quality Assurance	Digital Marketing Essentials
3	Human Computer Interaction	Rest Framework for Business Applications#	Virtualization and Cloud Computing#
4	Application of Robotics	Full Stack Development#	Mobile Adhoc Networks
5	Social Network Analytics	Application Development using Flutter#	Multicore Architecture
6	Information Retrieval Techniques	UI UX Design#	Distributed Systems
7	Robotic Process Automation	C # and .Net Fundamentals#	Blockchain Technologies#

 # Theory cum Laboratory Course

COGNITIVE ANALYTICS

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	VCS313	Image Analytics and Computer Vision #	PE	4	2	0	2	3
2	VAI311	Business Intelligence	PE	3	3	0	0	3
3	VAI312	Human Computer Interaction	PE	3	3	0	0	3
4	VAI313	Application of Robotics	PE	3	3	0	0	3
5	VAI314	Social Network Analytics	PE	3	3	0	0	3
6	VCS316	Information Retrieval Techniques	PE	3	3	0	0	3
7	VCS311	Robotic Process Automation	PE	3	3	0	0	3

 # Theory cum Laboratory Course

SOFTWARE APPLICATION DEVELOPMENT

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	VCS321	Agile Project Development with Scrum	PE	3	3	0	0	3
2	VCS322	Software Testing and Quality Assurance	PE	3	3	0	0	3
3	VCS323	Rest Framework for Business Applications#	PE	4	2	0	2	3
4	VCS324	Full Stack Development#	PE	4	2	0	2	3
5	VCS325	Application Development using Flutter#	PE	4	2	0	2	3
6	VCS326	UI UX Design#	PE	4	2	0	2	3
7	VCS327	C# and .NET Fundamentals#	PE	4	2	0	2	3

 # Theory cum Laboratory Course

DATA CENTER TECHNOLOGIES

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	VCS333	DevOps for Cloud #	PE	4	2	0	2	3
2	VCS347	Digital Marketing Essentials	PE	3	3	0	0	3
3	VCS335	Virtualization and Cloud Computing #	PE	4	2	0	2	3
4	VAI331	Mobile Adhoc Networks	PE	3	3	0	0	3
5	VCS336	Multicore Architecture	PE	3	3	0	0	3
6	VCS337	Distributed Systems	PE	3	3	0	0	3
7	VCS334	Blockchain Technologies#	PE	4	2	0	2	3

Theory cum Laboratory Course

MINOR DEGREE – COLLEGE LEVEL – FINTECH AND BLOCKCHAIN

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MFB001	Fundamentals of Blockchain	OE	3	3	0	0	3
2	MFB002	Engineering Economics and Financial Management	OE	3	3	0	0	3
3	MFB003	Banking, Financial Services and Insurance	OE	3	3	0	0	3
4	MFB004	Fundamentals of Fintech	OE	3	3	0	0	3
5	MFB005	Digital Marketing	OE	3	3	0	0	3
6	MFB006	Logistics and Supply Chain Management	OE	3	3	0	0	3

Course Code	Course Name	L	T	P	C
AI2301	**BIG DATA TOOLS AND TECHNIQUES**	2	0	2	3

Category: Professional Core Course (Theory cum Lab)

a. Preamble

The course enables the students to understand Big Data processing used in different business intelligence applications and provide an in-depth coverage of Map Reduce analytics using Hadoop Eco system tools. The students will gain programming knowledge in Pig, Hive, Hbase to handle the Big Data applications and they will get exposure in blooming Big Data technologies.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of Big Data tools and techniques	K2
CO2	Apply MapReduce algorithms in Hadoop framework	K3
CO3	Construct NoSQL data models for the appropriate databases	K3
CO4	Develop scripts using Pig Latin	K3
CO5	Build HiveQL queries for data analytics	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build the file management tasks in Hadoop	K3
CO2	Solve problems using MapReduce	K3
CO3	Construct NoSQL data models for the appropriate databases	K3
CO4	Develop scripts using Pig Latin	K3
CO5	Develop DDL and DML commands using HiveQL	K3

c. Course Syllabus   **Total : 60 Periods**

INTRODUCTION TO BIG DATA   **6**

Introduction - Types of Digital Data - Characteristics of BigData - 3Vs of Big Data - Evolution of Big Data - Architecture of Big Data systems - Advantages of Big Data - Challenges with Big Data - Big Data Use Cases -Analytics – Descriptive Analytics – Diagnostic Analytics – Predictive Analytics – Prescriptive Analytics

DATA ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK   **6**

Introduction to Hadoop - RDBMS versus Hadoop - Hadoop Overview - HDFS (Hadoop Distributed File System) - Processing Data with Hadoop - Introduction to MapReduce - Features of MapReduce - Algorithms Using MapReduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation - Extensions to MapReduce.

NOSQL DATA MANAGEMENT FOR BIG DATA   **6**

NoSQL Databases - CAP Theorem - BASE Concept –- NoSQL data Models - Increasing Flexibility for Data Manipulation-Key Value Stores - Document Stores - Tabular Stores - Object Data Stores - Graph Databases - Hive – Sharding - Hbase

DATA ANALYTICS USING PIG   **6**

Introduction - Installation and Execution - Pig Data Model - Pig Latin - Input, Output- Relational Operators - User Defined Functions - Join Implementations - Integrating Pig with Legacy Code and Map Reduce - Developing and Testing Pig Latin Scripts

DATA ANALYTICS USING HIVE   **6**

Introduction - Data Types and File Formats - Databases in Hive – HiveQL - Data Definition - Data Manipulation - Queries - Views - Indexes - Schema Design

LIST OF LABORATORY EXPERIMENTS   **30**

1. (i) Installation of Hadoop in two operating modes:

   - Pseudo distributed

   - Fully distributed

   (ii) Monitoring Hadoop setup using web based tools

2. (i) Implementation of file management tasks in Hadoop

   (ii) Benchmark and stress test on Apache Hadoop cluster

3. Implementation of Word Count Map Reduce program

   (i) Finding the number of occurrence of each word appearing in the input file(s)

   (ii) Perform a MapReduce Job for word search count (look for specific keywords in a file).

4. Implementation of stop word elimination problem using MapReduce

5. Implementation of HBase queries in NOSQL

6. Installation of Pig on Hadoop

7. Development of Pig Latin scripts to sort, group, join, project and filter data

8. Installation of Hive

9. DDL and DML commands using HiveQL

10. Mini Project

d. Activities

Students shall be exposed to programming knowledge in Hadoop, MapReduce, Pig, Hive to handle the Big Data applications.

e. Learning Resources

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, *Data Science and Big data Analytics*, EMC, 2013.

2. Seema Acharya and Subhasini Chellappan, *Big Data and Analytics*, Wiley Publication, 2015.

3. Raj Kamal and Preeti Saxena, *Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning*, McGraw Hill, 2018.

4. Tom White, *Hadoop: The Definitive Guide*, 3rd Edition, O'reily Media, 2015.

5. EMC Education Services, *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data,* 2015.

Reference Books

1. Mark Van Rijmenam, *Think Bigger: Developing a Successful Big Data Strategy for Your Business*, 1st Edition, Amazon, 2014.

2. Hurwitz JS, Nugent A, Halper F and Kaufman M, *Big data for dummies*, John Wiley & Sons, 2013.

3. Bill Franks, *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics,* John Wiley & sons, 2012.

4. Jure Leskovec, Anand Rajaraman and Jeffrey Ullman, *Mining of Massive Datasets,* Cambridge University Press, 2020.

5. Alan Gates and Daniel Dai, *Pig: Data flow Scripting with Hadoop*, O'Reilly Media, 2016.

6. Jason Rutherglen, Dean Wampler and Edward Capriolo, *Programming Hive*, 1st Edition, O'Reilly Media, 2012.

7. Dayong Du, *Apache Hive Essentials*, Packet Publishing, 2015.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 6 GB RAM)	30
2.	Java	30
3.	Hadoop	30
4.	Big data tools - Pig Latin, Hive, HBase	30

Course Code	Course Name	L	T	P	C
AI2302	**COMPUTER NETWORKS AND SECURITY**	**2**	**0**	**2**	**3**

Category: Professional Core Course (Theory cum Lab)

a. Preamble

This course enables the students to gain the knowledge of layered approaches in OSI model, protocols of Network layer and Transport layer. The students get familiarize with the functions of Application layer protocols and the fundamentals of Network Security. This course empowers the students to acquire the knowledge on various Cryptographic Algorithms.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the basic networking concepts highlighting the layered approaches in OSI and TCP/IP models	K2
CO2	Apply an appropriate addressing scheme and routing protocol for communication in a network	K3
CO3	Identify the functionalities of various application layer protocols and their real time usage	K3
CO4	Organize the fundamental of network security	K3
CO5	Utilize the knowledge on various cryptographic algorithms	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concepts of TCP/UDP Socket Programming	K3
CO2	Organize the functions and performance of various network protocols	K3
CO3	Identify appropriate simulation tools (NS) for visualizing the behaviour of working model network.	K3
CO4	Choose appropriate classical symmetric cryptosystem to provide data security.	K3
CO5	Make use of modern symmetric and asymmetric cryptosystem to enhance data security.	K3

c. Course Syllabus   **Total : 60 Periods**

PHYSICAL & DATA LINK LAYER   **6**

ISO/OSI architecture – Types of Networks (LAN, WAN, VPN, VLAN) – Network Components (NIC, Bridges, Switches, Routers, Hubs, Gateways) Introduction – Data-Link Layer Protocols – HDLC – Media Access Control – Wired LANs: Ethernet – Wireless   LANs – IEEE 802.11.

NETWORK LAYER & TRANSPORT LAYER   **6**

IP V4/6 addressing, Circuit & Packet switching, Transport Layer Services: Flow Control – TCP - UDP, Congestion control.

APPLICATION LAYER   **6**

Hyper Text Transfer Protocol (HTTP) - Domain Name System (DNS) - File Transfer Protocol (FTP) - TELetypeNETwork (TELNET).

SECURITY FUNDAMENTALS   **6**

Introduction to Computer Security - Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).

CRYPTOGRAPHIC ALGORITHMS   **6**

Block Ciphers – DES – Public Key Cryptography: RSA – SHA - Physical & Data Link   Layer – Networks Layer – IPsec - Application Layer- Firewall.

LIST OF LABORATORY EXPERIMENTS   **30**

1.   Develop an application using TCP sockets like: echo client and echo server
2.   Simulation of DNS using UDP sockets
3.   Develop the code to simulate ARP /RARP protocols.
4.   Implementation of Caesar Cipher and Shift Cipher
5.   Implementation of Row - Columnar Transformation
6.   Apply DES algorithm for practical applications
7.   Implement RSA Algorithm
8.   Implement the Diffie-Hellman Key Exchange algorithm
9.   Calculate the message digest of a text using the SHA algorithm.
10.   Mini project

d. Activities

Students shall be exposed to the core concepts of Networking and Security using case study.

e. Learning Resources

Text Books

1. Behrouz A Forouzan, *Data Communications and Networking*, 5th Edition, Tata Mc Graw Hill, 2013.

2. Behrouz A Ferouzan, *Cryptography & Network Security*, 1st Edition, Tata Mc Graw Hill, 2007.

Reference Books

1. Larry L Peterson and Bruce S Davie, *Computer Networks: A Systems Approach*, 5th Edition, Morgan Kaufmann Publishers Inc, 2012.

2. William Stallings, *Data and Computer Communications*, 10th Edition, Pearson Education, 2013.

3. Bruce Schneier and Neils Ferguson, *Practical Cryptography*, 1st Edition, Wiley Dreamtech India Pvt. Ltd, 2003.

4. Charles Pfleeger, *Security in Computing*, 4th Edition, Prentice Hall of India, 2006.

5. William Stallings, *Cryptography and Network Security*, 6th Edition, Pearson Education, 2013.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: i. C / C++ / Java / Python or equivalent compiler ii. Network simulator NS2	30

Course Code	Course Name	L	T	P	C
AI2303	**FUNDAMENTALS OF DEEP LEARNING**	**3**	**0**	**0**	**3**

Category: Professional Core Course

a. Preamble

This course enables the students to understand the concepts of neural networks. This course aims to provide students with knowledge in deep learning with Convolutional Neural Network. This course enables the students to familiarize with various deep learning models.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts and techniques of deep learning, including neural networks with activation functions	K2
CO2	Illustrate the optimization algorithms used to train Recurrent Neural Network (RNN) models such as Long Short Term Memory (LSTM) and Gated Recurrent Units (GRUs)	K2
CO3	Apply Convolutional Neural Network (CNN) models, like LeNet, for image classification tasks	K3
CO4	Construct modern Convolutional Neural Network (CNN) architectures for various computer vision tasks, such as object detection and voice recognition	K3
CO5	Develop and train deep Reinforcement Learning (RL) and generative models on various data sources and tasks.	K3

c. Course Syllabus   **Total : 45 Periods**

DEEP LEARNING FUNDAMENTALS   **9**

Artificial Intelligence, Machine Learning and Deep Learning - Need for Deep Learning - Fundamentals of Neural Networks - Model of Artificial Neuron - Neural Network Architectures - Data Representations for Neural Networks - Activation functions - Linear Neural Networks: Regression and Classification - Perceptron - Deep learning applications.

RECURRENT NEURAL NETWORKS   **9**

Feed forward network - Back propagation process - Stochastic and Gradient Descent - Regularization network - kohenen Self Organizing Map (kSOM) - Recurrent Neural Networks Architecture - Long Short Term Memory (LSTM) - Gated Recurrent Units (GRU) - Deep

Recurrent Neural Network - Bidirectional Recurrent Neural Network - Optimization Algorithms - Applications of RNN.

CONVOLUTIONAL NEURAL NETWORKS   9

CNN Architecture - Layers in CNN architecture - Convolutions - Padding - ReLU function - Pooling - min, max, average pooling - Striding - Padding - Rollout - Softmax functions - Multiple Input and Multiple Output Channels - Convolutional Neural Networks (LeNet).

MODERN CONVOLUTIONAL NEURAL NETWORKS   9

Deep Convolutional Neural Networks - Networks using Blocks - Network in Network - Multi Branch Networks - Batch Normalization - Residual Networks - Densely Connected Networks - Applications of CNN - Case Study: Voice Recognition using CNN - Music Recommended Systems using CNN.

DEEP LEARNING TECHNIQUES AND MODELS   9

Deep Belief Networks - Deep Boltzmann Machine - Deep Associative Memory networks - Generative deep learning - Variational auto encoders - Reinforcement Learning - Generative Adversarial Networks - Natural Language Processing applications.

d. Activities

Students shall be exposed to the Deep Learning concepts using case study.

e. Learning Resources

Text Book

1. Zhang, A, Lipton, Z C, Li M and Smola, A J, *Dive into deep learning*, arXiv preprint arXiv:2106.11342, 2021.

Reference Books

1. Francois Chollet, *Deep Learning with Python*, Manning Publication, New York, 2018.

2. Lovelyn Rose S, Ashok Kumar L and Karthika Renuka D, *Deep Learning using Python*, Wiley India Pvt. Ltd., New Delhi, 2019.

3. Thomas Farth, *Deep Learning: A Comprehensive Guide for Beginners*, Atlantic Publishers, 2019.

Course Code	Course Name	L	T	P	C
CS2301	**INTERNET PROGRAMMING**	**3**	**0**	**0**	**3**

Category: Professional Core Course

a. Preamble

This course enables the students to understand the basic concepts of web development. The students get familiarized with the markup and coding involved in web development. This course focuses on different web programming languages, webservers and clients.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build responsive web pages using HTML, CSS	K3
CO2	Develop dynamic and interactive web pages by embedding JavaScript in HTML	K3
CO3	Construct server side web applications using JSP, Java servlets	K3
CO4	Apply PHP and DB concepts to develop interoperable web Applications	K3
CO5	Construct web applications using lightweight data-interchange format	K3

c. Course Syllabus **Total : 45 Periods**

WEB ESSENTIALS **9**

Internet - Internet Protocol Address - Domain Names - World Wide Web - Web Browsers - Web Servers-HTTP Message Structure – HTML5 – Tables – Lists – Images - HTML5 control, Semantic, Media controls – HTML APIs – HTML graphics elements - CSS3 – Inline, embedded and external style sheets – Rule cascading- Backgrounds – Border Images – Colors.

CLIENT SIDE SCRIPTING **9**

Client side scripting basics - An introduction to JavaScript–JavaScript DOM Model - Date and Objects - Built-in objects - Regular Expressions - Validation, built-in objects- Exception Handling, Event Handling - DHTML with JavaScript – JavaScript frameworks.

SERVER SIDE SCRIPTING **9**

Servlets: Java Servlet Architecture - Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies - Database Connectivity: JDBC perspectives, JDBC

program -JSP: Understanding Java Server Pages - Creating HTML forms by embedding JSP code – JSP Standard Tag Library (JSTL).

PHP **9**

An introduction to PHP- Variables - Program control –Arrays - Built-in functions – Graphics – Form Validation- Regular Expressions - File handling – Cookies - Connecting to Database – Database operations - Email basics.

XML AND JSON **9**

Basics of XML - Document Type Definition- XML Schema - XML Parsers and Validation- JSON introduction - Syntax - Function – Files - AJAX: Ajax Client Server Architecture –XML response – JSON response – text file response - Retrieve Database Information.

d. Activities

Students shall be exposed to the web development concepts using simple applications.

e. Learning Resources

Text Book

1. Deitel, Deitel and Nieto, *Internet and World Wide Web - How to Program*, 5th Edition, Prentice Hall, 2012.

Reference Books

1. Chris Bates, *Web Programming – Building Intranet Applications*, 3rd Edition, Wiley Publications, 2009.

2. Jeffrey C and Jackson, *Web Technologies A Computer Science Perspective*, Pearson Education, 2011.

3. Uttam K Roy, *Web Technologies*, Oxford University Press, 2011.

Course Code	Course Name	L	T	P	C
AI2304	**DEEP LEARNING LABORATORY**	0	0	4	2

Category: Professional Core Course

a. Preamble

This course enables the students to build various neural networks. The students get familiarized with Recurrent Neural Network. This course enables the students to perform multimedia analytics using CNN. This course focuses on solving real-world applications using deep learning techniques.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Construct a feed forward neural networks and understand the role of activation functions	K3
CO2	Develop and train Recurrent Neural Networks (RNNs) for Natural Language Processing (NLP) tasks with optimization algorithms	K3
CO3	Construct deep learning models to various real-world applications, including image recognition and speech recognition	K3
CO4	Identify transfer learning techniques to adapt pre-trained Convolutional Neural Network (CNN) models like VGG for new tasks	K3
CO5	Apply deep reinforcement learning and generative models together to build complex systems that can learn and generate behaviors	K3

c. Course Syllabus   **Total : 60 Periods**

Implement the following using Python and Tensor Flow

1. Construct a simple neural network for the following problem statement:

	INPUTS			OUTPUTS
A	0	0	1	0
B	1	1	1	1
C	1	0	1	1
D	0	1	1	0

New Situation	1	0	0	?

2. Apply the Perceptron training algorithm for AND or OR gates.

3. Construct and train a feed forward neural network using Back propagation algorithm to wheat seeds dataset for a classification problem.

4. Create a robust and accurate Self Organizing Map (SOM) model that can be used for clustering similar instances in the given Iris dataset.

5. Develop and train Long Short Term Memory (LSTM) models for sequence prediction problems and evaluate the performance of the network.

6. Build and train a model to predict the category of an animal using Convolutional Neural Network(CNN).

7. Construct a Convolutional Neural Network (CNN) model for an audio analysis problem. Train a CNN to classify the audio files into appropriate categories based on their features.

8. Build a model that is able to classify videos into their respective categories using Action Recognition Data Set. The model extracts relevant features from videos and tunes the hyper parameters to ensure optimal performance of the network.

9. Construct Visual Geometry Group (VGG) model for a binary classification task.

10. Develop and train a Variational Auto Encoder (VAE) on the MNIST dataset to generate new images of handwritten digits.

11. Build a Generative Adversarial Network (GAN) model to create new images that look like real images but with variations in style, design and to capture the different styles in the original dataset and generate new images with similar styles.

12. Mini Project

d. **Learning Resources**

Reference Book

1. Zhang, A, Lipton, Z C, Li M and Smola, A J, *Dive into deep learning*, arXiv preprint arXiv:2106.11342, 2021.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Python packages - Numpy, Pandas, Matplotlib, Sklearn, Scipy, Keras, Tensor Flow, Pytorch and Pyspark	30

Course Code	Course Name	L	T	P	C
CS2307	INTERNET PROGRAMMING LABORATORY	0	0	4	2

Category: Professional Core Course

a. Preamble

The course has been designed to impart practical knowledge on Web application development to understand the need of different web programming languages to meet out user requirements. This course enables the students to develop web application for business, industries and educational institutions.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build dynamic web pages using HTML5, CSS3, JavaScript and its related frameworks	K3
CO2	Develop three-tier web applications using server-side scripting languages	K3
CO3	Construct simple web applications using PHP and Data base	K3
CO4	Develop interoperable web applications using XML and its related technologies	K3
CO5	Build web application for solving real world applications	K3

c. Course Syllabus   **Total : 60 Periods**

1. Develop a website using HTML5 tables, lists, control elements, media elements, graphics elements, Geo location, drag and drop effects, image maps.

2. Develop web pages with the following.

    a) Use different CSS selectors

    b) External style sheets.

    c) Embedded style sheets.

    d) Inline style sheets.

3. Construct and Validate the Registration, user login, user profile and payment by credit card forms using JavaScript.

4. Develop programs in Java using Servlets:

a) To invoke servlets from HTML forms

b) To track sessions using hidden form fields, URL rewriting techniques

c) To track sessions for counting the number of visitors who visited the web page

5. Develop a three-tier web application using servlets. (Assume that related information is available in a database which has been stored in a database server)

a) Online examination System.

b) Library management System.

c) Ticket reservation system, etc.

6. Develop a simple dynamic web application along with database connectivity using JSP and cookies.

7. Construct a PHP application for the following:

a) Validate the HTML forms using regular expressions

b) Send an email

c) Store form data into database

8. Construct an PHP application for reading data from XML and processing

9. Develop a web application for online shop using lightweight data-interchange format.

d. **Learning Resources**

Reference Book

1. Deitel, Deitel and Nieto, *Internet and World Wide Web - How to Program*, 5th Edition, Prentice Hall, 2018.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software Tools: NetBeans IDE, XAMPP	30

Course Code	Course Name	L	T	P	C
EM2301	INTERNSHIP	0	0	0	1

Category: Employability Enhancement Course

a. Preamble

To enable the students to

- Get connected with industry/ laboratory/research institute.
- Get practical knowledge on production process in the industry and develop skills to solve industry related problems.
- Develop skills to carry out research in the research institutes/laboratories.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Validate system-level processes, techniques, manufacturing and production processes in the industry/research facilities of the laboratory/research institute.	K5
CO2	Analyse the solutions of industry/research problems.	K4
CO3	Document system specifications, design methodologies, process parameters, testing parameters and results.	K2
CO4	Comprehend the process followed in the industry/research institute in the form of presentation.	K2
CO5	Demonstrate the technical knowledge observed in the industry/research institute with the courses studied.	K2

c. Course Instruction

The students individually undergo training in reputed industry/ research institutes / laboratories for the specified duration. After completion of the training, a detailed report should be submitted within ten days from the commencement of next semester. The evaluation will be done as per the Regulations. Credits shall be awarded to the students who satisfy the clauses for industrial training/ internship of the Regulation concerned.

Course Code	Course Name	L	T	P	C
EM2202	INTERPERSONAL SKILLS – LISTENING AND SPEAKING	0	0	2	1

Category: Employability and Enhancement course

a. Preamble

This course equips students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills. It provides guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities. Also, it enables the students to improve general and academic listening skills and to make effective presentations.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop their communicative competence in English with specific reference to listening	K3
CO2	Prepare conversation with reasonable accuracy	K2
CO3	Apply lexical Chunking for accuracy in speaking	K3
CO4	Demonstrate their ability to communicate effectively in GDs	K2
CO5	Explain directions and instructions in academic and business contexts	K2

c. Course Syllabus

Total: 30 Periods

LISTENING AS A KEY SKILL   **6**

 Listening as a key skill- its importance- speaking – give personal information – ask for personal information – express ability – enquire about ability – ask for clarification - Improving pronunciation– pronunciation basics — stressing syllables and speaking clearly – intonation patterns – conversation starters: small talk.

LISTEN TO A PROCESS INFORMATION   **6**

Introduction to Visualization – Top Data Visualization Tools – Reasons to make a switch to Tableau – Positioning of Tableau - File types in Tableau – Tableau environment - Connection to various data Sources – Custom SQL.

LEXICAL CHUNKING 6

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk – greet – respond to greetings – describe health and symptoms – invite and offer – accept – decline – take leave – listen for and follow the gist- listen for detail.

GROUP DISCUSSION 6

Being an active listener: giving verbal and non-verbal feedback – participating in a group discussion – summarizing academic readings and lectures conversational speech listening to and participating in conversations – persuade- negotiate disagreement in group work.

GROUP & PAIR PRESENTATIONS 6

Formal and informal talk – listen to follow and respond to explanations, directions and instructions in academic and business contexts – strategies for presentations and interactive communication – group/pair presentations.

d. Activities

Students shall be taken to the English language lab for enhancing their listening and speaking skills.

e. Learning Resources

Text Books

1. Brooks, Margret, *Skills for Success. Listening and Speaking. Level 4,* Oxford University Press, Oxford, 2011.

2. Richards C, Jack and David Bholke, *Speak Now Level 3,* Oxford University Press, Oxford, 2010.

Reference Books

1. Bhatnagar, Nitin and Mamta Bhatnagar, *Communicative English for Engineers and Professionals,* Pearson, New Delhi, 2010.

2. Hughes, Glyn and Josephine Moate, *Practical English Classroom,* Oxford University Press, Oxford, 2014.

3. Vargo, Mari, 2013, *Speak Now Level 4*, Oxford University Press, Oxford.

4. Richards, C, Jack, *Person to Person (Starter)*, Oxford University Press, Oxford, 2006.

Web resources

- https://www.cambridge.org/elt/blog/wp-content/uploads/2019/10/Learning-Language-in-Chunks.pdf
- https://english.eagetutor.com/english/628-how-to-greet-your-boss-people-in-office.html
- https://www.groupdiscussionideas.com/group-discussion-topics-with-answers/
- https://www.bbc.co.uk/worldservice/learningenglish/business/talkingbusiness/unit3presentations/1opening.shtml

Course Code	Course Name	L	T	P	C
AI2351	**FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING**	**3**	**0**	**0**	**3**

Category: Professional Core Course

a. Preamble

This course enables the students to explore word level analysis. The students get familiarized with the use of Context Free Grammar (CFG) in NLP and the role of semantics and pragmatics. This course also focuses on discourse analysis.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of Natural Language Processing	K2
CO2	Illustrate the algorithms used in word level analysis	K2
CO3	Demonstrate the use of CFG in syntactic analysis	K2
CO4	Outline the need for semantics and pragmatics	K2
CO5	Interpret the context of the discourse using coherence and various resources	K2

c. Course Syllabus   **Total: 45 Periods**

INTRODUCTION   **9**

Origins and challenges of NLP – Processing Indian Languages – NLP applications - Language Modeling: Grammar-based LM, Statistical LM - Regular Expression basics – Corpora - Preprocessing - Text tokenization – Stemming – Lemmatization – Removing stop-words - Minimum Edit Distance - Sign language basics

WORD LEVEL ANALYSIS   **9**

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes - Part-of-Speech Tagging - Named Entities and Named Entity Tagging - HMM Part-of-Speech Tagging - Evaluation of Named Entity Recognition

SYNTACTIC ANALYSIS   **9**

Context-Free Grammars, Treebanks, Grammar Equivalence and Normal Form – Ambiguity - CKY parsing – Span-Based Neural Constituency Parsing - Evaluating Parsers - Dependency

Relations - Transition-Based Dependency Parsing - Graph-Based Dependency Parsing – Evaluation

SEMANTICS AND PRAGMATICS 9

Word Senses - Relations between Senses – WordNet - Word Sense Disambiguation (WSD) – WSD algorithms and Tasks - Thesauruses to Improve Embedding's - Word Sense Induction - Semantic Roles - The Proposition Bank – FrameNet - Semantic Role Labeling - Selectional Restrictions

DISCOURSE ANALYSIS AND RESOURCES 9

Coherence Relations - Discourse Structure Parsing - Centering and Entity-Based Coherence - Representation learning models for local coherence - Global Coherence - Resources: Porter Stemmer – Lemmatizer - Penn Treebank - Brill's Tagger – WordNet – PropBank –   FrameNet - Brown Corpus - British National Corpus (BNC).

d. Activities

Students shall be exposed to the core concepts of Natural Language Processing using case study.

e. Learning Resources

Text Book
1. Daniel Jurafsky and James H Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*, 3rd Edition, Pearson Publication, 2023.

Reference Books

1. Tanveer Siddiqui and Tiwary U S, *Natural Language Processing and Information Retrieval*, Oxford University Press Reprint, 2023.

2. Richard M Reese, *Natural Language Processing with Java*, O'Reilly Media, 2015.

3. Nitin Indurkhya and Fred J Damerau, *Handbook of Natural Language Processing*, 2nd Edition, Chapman and Hall/CRC Press, 2010.

4. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, 1st Edition, O_Reilly Media, 2009.

5. Breck Baldwin, *Language Processing with Java and LingPipe Cookbook*, Atlantic Publisher, 2015.

Course Code	Course Name	L	T	P	C
AI2352	**MINI PROJECT**	**0**	**0**	**3**	**1**

Category: Employability Enhancement Course

a. Preamble

This course develops the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. It is used to train the students in preparing project reports and to face reviews and viva voce examination

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify challenging engineering problems/Societal needs to propose project-based solutions	K3
CO2	Build critical-thinking and analytical decision-making capabilities to find solution by formulating proper methodology	K3
CO3	Analyze various algorithmic strategies using technological tools to provide software solutions	K4
CO4	Develop solutions to identified problems	K3
CO5	Build an independent project, resulting in at least a publication in reputed journals or conference proceedings	K3

Total : 45 Periods

The students will be working in single or group of 3 to 4 on a scientific problem approved by the Head of the Department under the guidance of the faculty member and prepare a comprehensive report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on project evaluation process as recommended in the respective regulation

The student can also be permitted to work on the project in Industry/Research organization with the due permission from Head of the Department. The Engineer/Scientist from Industry/ Research Organization can jointly act as supervisor in addition to the Project Supervisor. The student should undergo project evaluation process as recommended in the respective regulations.

Course Code	Course Name	L	T	P	C
AI2353	**NATURAL LANGUAGE PROCESSING LABORATORY**	**0**	**0**	**4**	**2**

Category: Professional Core Course

a. Preamble

The primary aim of the course is to introduce students with essentials of natural language processing. The essentials cover linguistic aspects and core algorithms for solving basic tasks. This course enables the students to explore word level analysis. The students get familiarized with the role of syntax, semantics and pragmatics. This course also focuses on applying NLP techniques for some real-world applications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Experiment with the techniques for text-based preprocessing	K3
CO2	Construct sparse N-gram table for a given sentence	K3
CO3	Model POS tagging and chunking for a given sentence	K3
CO4	Apply word similarity and word disambiguation methods	K3
CO5	Build real-world applications such as machine translation, document classification and chatbot design	K3

c. Course Syllabus   **Total : 60 Periods**

1. Create Regular expressions for detecting word patterns and tokenizing text
2. Getting started with Python and NLTK - Preprocessing – stop word removal and Stemming
3. Implement N-gram tagging
4. Implement N-gram smoothing
5. Implementation of part-of- speech tagging
6. Implementation of chunking
7. Implementation of word similarity
8. Implementation of Lesk Algorithm for word disambiguation

9. Mini project – Machine Translation, Documents Classification, Chatbot design with a simple dialog system

d. Learning Resources

Reference Book

1. Daniel Jurafsky and James H Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*, 3rd Edition, Pearson Publication, 2023.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Python with NLTK package	30

Course Code	Course Name	L	T	P	C
EM2351	PROFESSIONAL COMMUNICATION	0	0	2	1

Category: Employability Enhancement Course

a. Preamble

The aim of the course is to enhance the Employability and Career Skills of students. It also orients the students towards grooming as a professional. This course focuses on students to make them employable graduates, develop their confidence and help them to attend interviews successfully.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply hard and soft skills to enhance their employability	K3
CO2	Utilize adequate presentation skills to present a PPT	K3
CO3	Demonstrate the proper usage of grammar in GD	K3
CO4	Make use of the acquired skills while attending interviews	K3
CO5	Develop adequate Soft Skills required for the workplace	K3

c. Course Syllabus

Total : 30 Periods

SOFT SKILLS 6

Introduction to Soft Skills – Hard skills & soft skills – employability and career Skills- Grooming as a professional with values - Time Management - General awareness of Current Affairs.

EFFECTIVE PRESENTATIONS 6

Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice – presenting the visuals effectively – 5 minute presentations.

GROUP DISCUSSION 6

Introduction to Group Discussion - Participating in group discussions – understanding group dynamics – brainstorming the topic - questioning and clarifying – GD strategies - activities to improve GD skills.

INTERVIEW ETIQUETTE 6

Interview etiquette – dress code – body language – attending job interviews – telephone/skype interview - one to one interview &panel interview – FAQs related to job interviews.

CAREER PLAN 6

Recognizing differences between groups and teams - managing time - managing stress - networking professionally - respecting social protocols - understanding career management - developing a long-term career plan-making career changes.

d. Activities

Students shall be trained in Individual Presentation, Group Discussion and Mock Interview.

e. Learning Resources

Reference Books

1. Butterfield and Jeff, *Soft Skills for Everyone*, Cengage Learning: New Delhi, 2015.

2. Suresh Kumar E, *Communication for Professional Success,* Orient Blackswan: Hyderabad, 2015.

3. *Interact English Lab Manual for Undergraduate Students*, Orient BlackSwan: Hyderabad, 2016.

4. Raman, Meenakshi and Sangeeta Sharma, *Professional Communication*, Oxford University Press: Oxford, 2014.

5. Hariharan S, *Soft Skills*, MJP Publishers: Chennai, 2010.

Course Code	Course Name	L	T	P	C
VCS313	**IMAGE ANALYTICS AND COMPUTER VISION**	2	0	2	3

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to learn image processing techniques for computer vision. This course enriches the students in image processing concepts like histograms, geometric transformations, edge detection, features and recognition techniques. This course focuses on real time problems like video tracking and image panoramas.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain fundamental image processing techniques required for computer vision	K2
CO2	Explain histogram and thresholding techniques	K2
CO3	Apply edge detection and geometric transformations on images	K3
CO4	Apply feature extraction techniques on images	K3
CO5	Develop image panorama and video tracking	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Experiment with fundamental image processing techniques	K3
CO2	Apply image enhancement using histograms and image smoothing, sharpening techniques on images	K3
CO3	Apply geometric transformations, morphological operations on images	K3
CO4	Make use of edge detection and feature extraction techniques	K3
CO5	Develop applications using moving object detection, image panorama and classification concepts	K3

c. Course Syllabus   **Total : 60 Periods**

BASIC OPERATIONS ON IMAGESUSING OPENCV   6

History of OpenCV - Displaying Images from Disk in a Window - The cv::Mat Structure - Converting Between Colorspaces - Circle and Line Detection - Image Inpainting - GUI TrackBars and Callback Functions – ROI.

HISTOGRAM AND THRESHOLDING   6

Noise – Smoothing - 1D and 3D histograms - Histogram/Image Equalisation - Histogram Comparison - Thresholding - Threshold Detection Methods - Variations on Thresholding - Mathematical Morphology-Connectivity.

GEOMETRIC TRANSFORMATIONS AND EDGES   6

Problem Specification and Algorithm -Affine Transformations - Perspective Transformations- Specification of More Complex Transformations– Interpolation - Edge Detection - Hough Transform.

FEATURES AND RECOGNITION   6

Moravec Corner Detection - Harris Corner Detection - FAST Corner Detection - SIFT - Template Matching - Chamfer Matching - Statistical Pattern Recognition - Cascade of Haar Classifiers – YOLO Algorithm - Performance.

VIDEO AND PANORAMAS   6

Moving Object Detection – Tracking - Video Datasets and Formats - Metrics for Assessing Video Tracking Performance - Image panorama.

LIST OF LABORATORY EXPERIMENTS   30

Implement the following using OpenCV

1. Your client has provided you with a 24-bit color image that needs to be converted to an 8-bit image,4-bit image and 1-bit image but they have requested that the image's overall color balance and contrast remain unchanged.

2. You are working with a team to develop a photo editing application and one of the features you need to implement is the ability to convert between color-spaces on the fly.

3. You have a digital camera that captures images in the RAW format, which has a higher dynamic range than most display devices can show. Implement histogram equalization, stretching to improve the contrast of these images and histogram

mapping to adjust the exposure and dynamic range of these images so that they can be displayed on a standard monitor.

4. Your client has provided you with a set of images that have been captured using a low-quality camera. They want you to smoothing out the rough edges and also sharpen the edges.

5. Your lab has been tasked with creating a program that can scale, rotate, translate and shear an image. The program needs to be able to handle images of different sizes and aspect ratios.

6. You have a binary image that contains small gaps, specks and noise in the foreground. Implement dilation and closing on the image to fill in these gaps to create a continuous foreground, erosion to remove specks and opening to remove noise.

7. Given an image of a handwritten letter, implement edge detection to highlight the edges of the letter.

8. You have a dataset of images of different animal faces. Implement feature extraction to identify the unique features of each animal's face.

9. You have a video stream from a surveillance camera overlooking a parking lot. Implement moving object detection to identify cars entering and exiting the parking lot.

10. You have a series of images taken from a drone flying over a city. Use image panorama to stitch these images together to create a high-resolution map of the city.

11. You are working on a project to develop an image classification system that can identify different types of animals in images. The dataset contains images of various animals, including dogs, cats, and birds. Your task is to annotate each image with the corresponding animal label.

d. Activities

Students shall be exposed to image processing concepts and to solve simple problems using OpenCV.

e. Learning Resources

Text Books

1. Kenneth Dawson-Howe, *A Practical Introduction to Computer Vision with OpenCV*, Wiley, 2014.

2. Samarth Brahmbhatt, *Practical OpenCV*, Apress, 2013.

Reference Books

1. Adrian Kaehler and Gary Bradski, *Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library,* 1st Edition, O'Reilly Media, 2017.

2. Prateek Joshi, David MillánEscrivá and Vinicius Godoy, *OpenCV by Example*, Packt Publishing, 2016.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: OpenCV	30

Course Code	Course Name	L	T	P	C
VAI311	**BUSINESS INTELLIGENCE**	3	0	0	3

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the modeling process behind business analytics. The students get knowledge on business intelligence concepts, techniques and models. This Course focus on impart knowledge about different data analysis tools and techniques.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Infer the fundamental concepts of Business Intelligence	K2
CO2	Explain the techniques and reporting methods of predictive analytics	K2
CO3	Illustrate the methods used for speech and text analysis	K2
CO4	Summarize the concepts of web mining and its analytics	K2
CO5	Explain the concept of Business analytics	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION TO BUSINESS INTELLIGENCE   **9**

Introduction to Business Intelligence - Designing Business Intelligence Application - Data Warehousing - Architectures - Data Warehouse Development Approaches - Data Warehouse Data Warehouse Administration, Security Issues, and Future Trends - Business Reporting and Visual Analytics.

PREDICTIVE ANALYTICS   **9**

Data Mining Concepts - Data Mining Versus Statistics Data Mining Process - Methods - Data Mining and Privacy Issues - Regression - Classification - Association Rules - Clustering - Techniques for Predictive Modeling - ANN – SVM.

TEXT ANALYTICS, TEXT MINING, AND SENTIMENT ANALYSIS 9

Natural Language Processing - Text Mining Process - tools - Sentiment Analysis - Overview, Process, Applications - Speech Analytics - Rule based, Multi, Layer, Hybrid Sentimental analysis - Machine Learning in Sentimental analysis.

WEB ANALYTICS AND WEB MINING 9

Web Mining Overview - Web Content and Web Structure Mining - Search Engines - Search Engine Optimization - Web Analytics Technologies, metrics - Web Analytics Maturity Model and Web Analytics Tools - Decision Support Systems Modeling - Problem Solving Search Methods.

KNOWLEDGE MANAGEMENT AND BIG DATA ANALYTICS 9

Knowledge Management - Concepts, Definitions, Approaches, tools and techniques - Fundamentals of Big Data Analytics - Technologies - Data Scientist - Big Data and Data Warehousing - Automated Decision Systems and Expert Systems - Business Analytics: Emerging Trends and Future Impacts.

d. Activities

Students shall be exposed to the concepts of Business Intelligence using Case Studies and Real-World Examples.

e. Learning Resources

Text Book

1. Efraim Turban, Ramesh Sharda and Dursun Delen, *Business Intelligence and Analytics*, 10th Edition, Pearson, 2015.

Reference Books

1. Christian Albright, S and Wayne L Winston, *Business Analytics: Data Analysis and Decision Making*, 6th Edition, Cengage India, 2017.

2. Dinabandhu Bag, *Business Analytics*, 1st Edition, Routledge, 2016.

3. Rick Sherman, *Business Intelligence Guidebook: From Data Integration to Analytics*, 1st Edition, Morgan Kaufmann, 2014.

Course Code	Course Name	L	T	P	C
VAI312	**HUMAN COMPUTER INTERACTION**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the foundations of Human Computer Interaction. The students get familiarized with the design technologies for individuals and persons with disabilities. This course focuses on various mobile HCI and user interface.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain fundamental design and evaluation methodologies of HCI	K2
CO2	Demonstrate an understanding of guidelines, principles, and software process influencing HCI	K2
CO3	Identify user models, social organizational issues and stake holder requirements of HCI	K2
CO4	Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites	K2
CO5	Develop meaningful user interface	K3

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION   **9**

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - Case Studies.

DESIGN AND SOFTWARE PROCESS   **9**

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

MODELS AND THEORIES   9

HCI Models: Cognitive models - Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

MOBILE HCI   9

Mobile Ecosystem: Platforms, Application frameworks - Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools - Case Studies.

WEB INTERFACE DESIGN   9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies.

d. Activities

Students shall be exposed to the core concepts of HCI using case study.

e. Learning Resources

Text Books

1. Alan Dix, Janet Finlay, Gregory Abowd and Russell Beale, *Human Computer Interaction*, 3rd Edition, Pearson Education, 2004.

2. Brian Fling, *Mobile Design and Development*, 1st Edition, O'Reilly Media Inc, 2009.

3. Bill Scott and Theresa Neil, *Designing Web Interfaces*, 1st Edition, O'Reilly, 2009.

Reference Books

1. Shneiderman, *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, Pearson Education, 2014.

2. Rogers and Sharp, *Interaction Design: Beyond Human Computer Interaction*, Wiley Edition, 2013.

Course Code	Course Name	L	T	P	C
VAI313	**APPLICATION OF ROBOTICS**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the various parts of robots and fields of robotics. The course includes various kinematics and inverse kinematics of robots. This course discusses the localization, planning and navigation. The course will provide basic humanoid robots and control strategies of robots for some specific applications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the basic concepts of service robot	K2
CO2	Summarize the localization and map representation of the robot	K2
CO3	Demonstrate the planning strategies of a robot	K2
CO4	Outline the various applications in field robots	K2
CO5	Summarize the use of humanoid Robots in real world applications	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION   **9**

History of service robotics – Present status and future trends – Need for service robots – applications - examples and Specifications of service and field Robots. Non- conventional Industrial robots.

LOCALIZATION   **9**

Introduction-Challenges of Localization - Map Representation - Probabilistic Map based Localization - Monte Carlo Localization - Globally Unique Localization - Positioning Beacon Systems - Route based localization.

PLANNING AND NAVIGATION   **9**

Introduction-Path planning overview - Road map path planning -Cell decomposition path planning - Potential field path planning - Obstacle avoidance - Case studies: tiered robot architectures.

FIELD ROBOT APPLICATIONS   9

Ariel robots -Collision avoidance - Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

HUMANOIDS APPLICATIONS   9

Wheeled and legged - Legged locomotion and balance - Arm movement - Gaze and auditory orientation control - Facial expression - Hands and manipulation - Sound and speech generation - Motion Capture Learning from demonstration - Human activity recognition using vision, touch, sound, Vision, Tactile Sensing - Models of emotion and motivation- Performance – Interaction - Safety and robustness – Applications - Case studies.

d. **Activities**

Students shall be exposed to working of robots and to solve the various applications robots using case study.

e. **Learning Resources**

 Text Books

1. Mittal, R K and Nagrath, I J, *Robotics and Control*, 22nd Reprint, Tata McGraw Hill, New Delhi, 2019.

2. John J Craig, *Introduction to Robotics Mechanics and Control*, 3rd Edition, Pearson Education, 2009.

 Reference Books

1. Ashitava Ghoshal, *Robotics - Fundamental Concepts and Analysis*, Oxford University Press, Sixth impression, 2010.

2. Klafter, R D, Chimielewski, T A and Negin, M, *Robotic Engineering–An Integrated Approach*, Prentice Hall of India, New Delhi, 1994.

3. Ghosh, B K, *Control in Robotics and Automation: Sensor Based Integration*, Allied Publishers, Chennai, 1998.

4. Groover, M P, Weiss, M, Nageland, R N and Odrej, N G, *Industrial Robotics*, McGraw Hill, 1996.

Course Code	Course Name	L	T	P	C
VAI314	**SOCIAL NETWORK ANALYTICS**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the concept of semantic web and related applications. The students get familiarized with the human behavior in social web and related communities. This course focuses on visualization of social networks.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the role of semantic web and its applications	K2
CO2	Illustrate the role of ontology in semantic web applications	K2
CO3	Demonstrate the knowledge on various techniques for mining communities in various social networks.	K2
CO4	Apply the techniques for predicting human behavior in social networks.	K3
CO5	Identify the knowledge about various applications of social networks	K3

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION   **9**

Introduction to Semantic Web-Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Applications of Social Network Analysis.

MODELLING AND KNOWLEDGE REPRESENTATION   **9**

Ontology and their role in the Semantic Web- Ontology-based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework - Web Ontology Language - Modeling and aggregating social network data- Ontological representation of social individuals and relationships.

EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS   **9**

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities.

PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES   **9**

Understanding and predicting human behavior for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust network analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS   **9**

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

d. Activities

Students shall be exposed to the core concepts of Social Network Analysis using case study.

e. Learning Resources

   Text Books

   1. Peter Mika, *Social Networks and the Semantic Web*, 1st Edition, Springer, 2007.

   2. BorkoFurht, *Handbook of Social Network Technologies and Applications*, 1st Edition, Springer, 2010.

   Reference Books

   1. Guandong Xu,Yanchun Zhang and Lin Li, *Web Mining and Social Networking – Techniques and applications*, 1st Edition, Springer, 2011.

   2. Dion Goh and Schubert Foo, *Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively*, IGI Global Snippet, 2008.

   3. Max Chevalier, Christine Julien and Chantal Soule-Dupuy, *Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling*, IGI Global Snippet, 2009.

   4. John G Breslin, Alexander Passant and Stefan Decker, *The Social Semantic Web*, Springer, 2009.

Course Code	Course Name	L	T	P	C
VCS316	**INFORMATION RETRIEVAL TECHNIQUES**	3	0	0	3

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the basic concepts about information retrieval, machine learning techniques, text classification, clustering and web retrieval. The students get familiarized with web crawler, scheduling algorithms and evaluation process. This course focuses on various retrieval algorithms and recommender systems and their techniques useful for a real time user.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the architectural design and basic concepts of Information Retrieval	K2
CO2	Identify the suitable search engine model to retrieve documents	K3
CO3	Apply machine learning techniques to text classification and clustering which is used for efficient information retrieval	K3
CO4	Outline several search engine architecture operations, crawling, and indexing principles for web search	K2
CO5	Demonstrate characteristics and potentials of different prediction techniques in recommender systems	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION   **9**

Information Retrieval – Early Developments – The IR Problem – The User's Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes – The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today–Visualization in Search Interfaces.

MODELING AND RETRIEVAL EVALUATION   **9**

Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model –

Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback

TEXT CLASSIFICATION AND CLUSTERING   9

A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes.

WEB RETRIEVAL AND WEB CRAWLING   9

The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations - Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

RECOMMENDER SYSTEM   9

Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighborhood models.

d. Activities

Students shall be exposed to the core concepts of information retrieval and its associated algorithms using case study.

e. Learning Resources

Text Books

1. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, *Modern Information Retrieval: The Concepts and Technology behind Search*, 2nd Edition, ACM Press Books, 2011.

2. Iresh A Dhotre, *Information Retrieval Techniques*, Technical Publications, 2020.

3. Ricci, F, Rokach, L, Shapira B and Kantor, *Recommender Systems Handbook*, 1st Edition, 2011.

Reference Books

1. Manning, C, Raghavan, P and Schütze, H, *Introduction to Information Retrieval*, Cambridge University Press, 2008.

2. Stefan Buettcher, Charles, L A, Clarke and Gordon V. Cormack, *Information Retrieval: Implementing and Evaluating Search Engines*, The MIT Press, 2010.

Course Code	Course Name	L	T	P	C
VCS311	**ROBOTIC PROCESS AUTOMATION**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the Robotic Process Automation (RPA) and the ability to differentiate it from other types of automation and outline the benefits of RPA with the various platforms supported for automation. The students will be able to understand to store and manipulate data in a more persistent way using such files as CSV and Excel. They experiment with workflow in a manner to get the optimized output from a Bot.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Describe the fundamental concepts of RPA	K2
CO2	Illustrate the work flow sequence and control flow of UiPath	K2
CO3	Interpret the data manipulation in UiPath	K2
CO4	Demonstrate event handling and exception strategies	K2
CO5	Develop simple bot applications	K3

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION TO ROBOTIC PROCESS AUTOMATION   **9**

Introduction - RPA vs Automation –Scope and techniques of automation – Purpose of RPA – Benefits of RPA – Components of RPA – RPA platforms- About UiPath – The future of automation.

UiPATH SEQUENCE AND CONTROL FLOW   **9**

UiPath Stack-Learning UiPath Studio-Task recorder-Sequencing the work flow- Activities-Control Flow-Various types of loops and decision making-Example.

DATA MANIPULATION   **9**

Variables and scope – Collections - Arguments purpose and use – Data table usage with examples - Clipboard Management - File operation with step by step example – CSV/Excel to data table and vice versa.

TAKING CONTROL OF THE CONTROLS 9

Finding and attaching windows – Finding the control – Techniques for waiting for a control – Act on control – Mouse and Keyboard activities – Working with UiExplorer – handling events – Revisit recorder – Screen Scraping – Usage of OCR – Types of OCR available – How to use OCR – Avoiding typical failure points.

HANDLING USER EVENTS AND ASSISTANT BOTS 9

Assistant bots – Monitoring system event triggers – Launching an assistant bot on a keyboard event – Deploying and Maintaining the Bot – Publishing using public utility – Overview of Orchestration Server – Using Orchestration Server to control bots - Using Orchestration Server to deploy bots – License management – Publishing and managing updates.

d. Activities

Students shall be exposed to the core concepts of Robotics Process Automation using case study.

e. Learning Resources

Text Books

1. Tom Taulli, *The Robotic Process Automation Handbook: A Guide to Implementing RPA System*, Apress, 2020.

2. Alok Mani Tripathi, *Learning Robotic Process Automation*, Packt Publishing, 2018.

Reference Books

1. Nandan Mullakara and Arun Kumar Asokan, *Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere*, Packt Publishing Ltd, 2020.

2. Frank Casale, Rebecca Dilla, Heidi Jaynes and Lauren Livingston, *Introduction to Robotic Process Automation: a Primer*, 1st Edition, Institute of Robotic Process Automation, 2015.

3. Lim Mei Ying, *Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes*, 1st Edition, Packet Publishing, 2018.

4. Srikanth Merianda, *Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation*", 1st Edition, Consulting Opportunity Holdings LLC, 2018.

Course Code	Course Name	L	T	P	C
VCS321	**AGILE PROJECT DEVELOPMENT WITH SCRUM**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the concepts of agile methodology. This course enriches the skills of the students to iterative software development processes.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of agile software development methodology	K2
CO2	Demonstrate iterative software development processes using SCRUM	K2
CO3	Explain the processes and tools designed to address actual business needs	K2
CO4	Illustrate the techniques and tools for Requirements Engineering in Agile Practices	K2
CO5	Illustrate the advantages of Devops practices	K2

c. Course Syllabus   **Total : 45 Periods**

AGILE METHODOLOGY   **9**

Theories for Agile Management – Agile Software Development – Traditional Model vs Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agility in Design - Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

AGILE PROCESSES   **9**

Lean Production – SCRUM, Crystal, Feature Driven Development- Adaptive Software Development – Introducing GitLab - GitLab Flow - Merge Requests - Continuous Integration and Continuous Deployment - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

AGILITY AND KNOWLEDGE MANAGEMENT **9**

Agile Information Systems – Agile Decision Making – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

AGILITY AND REQUIREMENTS ENGINEERING **9**

Overview of RE Using Agile – Requirements Elicitation – Agile Requirements Abstraction Model – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

DEVOPS **9**

Devops: Motivation - Cloud as a platform – Operations - Deployment Pipeline - Overall Architecture - Building and Testing – Deployment - Case study: Migrating to Micro services - Version control systems: Git and Github.

d. Activities

Students shall be exposed to develop iterative software development process for real world application.

e. Learning Resources

Text Books

1. Puntambekar, A A, *Agile Project Development with Scrum*, 1st Edition, Technical Publications, 2019.

2. Evertse and Joost, *Mastering GitLab 12*, Packt Publishing, 2019.

3. Len Bass, Ingo Weber and Liming Zhu, *DevOps: A Software Architect's Perspective*, Pearson Education, 2016.

Reference Books

1. David J Anderson and Eli Schragenheim, *Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results*, Prentice Hall, 2003.

2. Craig Larman, *Agile and Iterative Development: A Managers Guide*, Addison-Wesley, 2004.

3 Kevin C Desouza, *Agile Information Systems: Conceptualization, Construction, and Management*, Butterworth Heinemann, 2006.

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Course Code	Course Name	L	T	P	C
VCS322	**SOFTWARE TESTING AND QUALITY ASSURANCE**	3	0	0	3

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the basic concepts about software testing processes. The students get familiarized with the test management and test automation techniques. This course focuses on various testing concepts and testing strategies.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the concepts of software testing and defect classes	K2
CO2	Outline the approaches of test case design suitable for testing the software	K2
CO3	Demonstrate the levels of testing for testing the Object Oriented system	K2
CO4	Illustrate test management strategies and organization structure of test team	K2
CO5	Apply selenium tool to test the Software	K3

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION 9

Testing as an Engineering Activity - Testing as a Process - Testing maturity model - Software Testing Principles-The Tester's Role in a Software Development Organization - Origins of Defects - Cost of Defects – Developer & Tester Support for Developing a Defect Repository.

TEST CASE DESIGN 9

Test case Design Strategies - Using Black Box Approach to Test Case Design - Boundary Value Analysis - Equivalence class Partitioning - State Based Testing, Cause-effect graphing - Using White - Box Approach to Test design - Test Adequacy Criteria - Coverage and Control Flow Graphs - Covering Code Logic - Code Complexity Testing.

LEVELS OF TESTING 9

The Need for Levels of Testing - Unit Test Planning - Designing the Unit Tests - Integration Tests - Designing Integration Tests - Integration Test Planning - System Testing - Acceptance Testing - Performance Testing - Regression Testing - Compatibility Testing, Testing the Documentation - Website Testing.

TEST MANAGEMENT 9

People and Organizational Issues in Testing - Organization Structures for testing teams - Testing Services - Test Management - Test Process - Reporting Test Results - Building a Testing Group - Structure of Testing Group - Google Extension - The technical training program.

SELENIUM 9

Introduction – Selenium IDE, RC - Selenium WebDriver -Selenium Components - Selenium IDE – TestNG- Maven - UI elements Locators – Xpath - CssSelector - TestNG Annotations and Data Providers – Jenkins – Modular Framework – Paramitarization- Hybrid Framework.

d. Activities

Students shall be exposed to the concepts of software testing using case study.

e. Learning Resources

Text Books

1. Paul C Jorgensen, *Software Testing: A Craftsman's Approach*, 5th Edition, Auerbach Publications, 2022.
2. Yogesh Singh, *Software Testing*, Cambridge University Press, 2012.

Reference Books

1. Glenford J Myers, Corey Sandler and Tom Badgett, *The Art of Software Testing*, 3rd Edition, John Wiley & Sons, Inc, 2012.
2. Satya Avasarala, *Selenium WebDriver Practical Guide*, Packt Publishing, 2014.

Course Code	Course Name	L	T	P	C
VCS323	**REST FRAMEWORK FOR BUSINESS APPLICATIONS**	**2**	**0**	**2**	**3**

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to develop web based applications using DJANGO framework. This course enriches the web development skills of the students to fulfill the end user's requirement.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the concept of views and templates	K2
CO2	Develop web applications using models and databases	K3
CO3	Build web applications using Forms and Query processing	K3
CO4	Apply User Authentication concepts in web applications	K3
CO5	Explain various State Management techniques in Django	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop simple Django application using HTML	K3
CO2	Build simple Django application using models	K3
CO3	Develop Django application using forms	K3
CO4	Build Django application for secured data access	K3
CO5	Construct a Django customized website for a specific customer	K2

c. Course Syllabus   **Total : 60 Periods**

INTRODUCTION TO DJANGO   **6**

Installing DJANGO - setting up environment - DJANGO Architecture - Basics DJANGO CLI - Starting a Project and Application - Views - Http Responses - URLs – Templates – Introduction to Flask.

MODELS 6

Setting Up a Database - Django Models - Querying with models - Working with templates - Django Administration Site.

FORMS 6

Working with Forms - Custom Validation Rules - Working with Filters - Query Fetching - JSON - Working with JSON - Generic Views – Mail.

AUTHENTICATION 6

Users and Authentication - Enabling Authentication Support - Logging in and out - Managing Users, Permissions and Groups - Using Authentication Data in Templates.

STATE MANAGEMENT 6

Cookies - Getting and Setting Cookies - Django's Session Framework - Using Sessions in Views - Using Sessions Outside of Views - Other Session Settings – Caching – Types of caching.

LIST OF LABORATORY EXPERIMENTS 30

1. Build a Personal Portfolio Webpage
2. Develop a home page for a general store to display their aim, features, products and contact information
3. Develop a user authentication page for library application
4. Develop a Feedback form for a technical event conducted in an engineering college with validation
5. Develop a Dynamic web site for a college to represent departments features and activities
6. Implement a user registration form and store the data in DB
7. Develop an enquiry form and send the responses through mail
8. Write a Django application to restrict the page access to certain users

d. Activities

Students shall be exposed to DJANGO framework concepts and to develop simple web applications to demonstrate the different concepts

e. Learning Resources

Text Books

1. Nigel George, *Build a Website With Django 3: A complete introduction to Django*, GNW Independent Publishing, 2019.
2. Adrian Holovaty and Jacob K Moss, *The Definitive Guide to Django: Web Development Done Right*, 2nd Edition, Apress, 2009.

Reference Books

1. Antonio Mele, *Django 3 By Example: Build powerful and reliable Python web applications from scratch,* 3rd Edition, Packt Publication, 2020.

2. William S Vincent, *Django for Beginners*, Lean Publishing, 2020.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Visual Studio Code, Python, SQLite	30

Course Code	Course Name	L	T	P	C
VCS324	**FULL STACK DEVELOPMENT**	**2**	**0**	**2**	**3**

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to develop both front-end and back-end of a web application. This course enriches the logical skills of the students on the latest web technologies, tools and libraries.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Illustrate responsive web pages using Bootstrap and jQuery	K2
CO2	Explain an Angular.JS for web application development	K2
CO3	Demonstrate the simple web applications using node	K2
CO4	Infer web applications using express and node	K2
CO5	Outline the concepts of MongoDB with CURD operations	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build responsive web design using Bootstrap and jQuery	K3
CO2	Develop simple web applications using Angular framework	K3
CO3	Build web applications using Node.js Framework	K3
CO4	Construct web applications using Express.js Framework	K3
CO5	Develop web applications using MongoDB	K3

c. Course Syllabus **Total : 60 Periods**

INTRODUCTION TO FULLSTACK DEVELOPMENT **6**

Overview of Full Stack development – MEAN stack framework - Introduction to Bootstrap– Layouts – Components – Forms – Introduction to JQuery.

ANGULAR FRAMEWORK **6**

Introduction to Angular - Binding and Expression – Directives – Controllers – Filters – Modules – Services – Scopes – Tables & forms – Angular DOM – Routing.

NODE.JS FRAMEWORK 6

Introduction to Node.js – Node.js Architecture – NPM (Node Packaging Manager) -Installing NPM module - Creating and locating modules - Creating a simple HTTP server.

EXPRESS.JS FRAMEWORK 6

Overview of Express.js framework – Simple Express application – Routing – MVC in Express – Middleware – Templates – Error handling – API and Socket call.

MONGODB 6

Overview of NoSQL– Introduction to MongoDB - Basic CRUD Operations – Indexing – Aggregation -Data Modeling concepts - Connecting MongoDB using Mongoose.

LIST OF LABORATORY EXPERIMENTS 30

1. Develop a single page Company web site using Bootstrap
2. Develop Quiz web application using jQuery
3. Develop To-Do-List application using AngularJS
4. Develop a BMI application using Node.JS framework
5. Build Employee Survey application to demonstrate GET/POST Request method in Express JS
6. Build Student Management application to perform CRUD operations using Express.JS and MongoDB

d. Activities

Students shall be exposed to Frond-end Technologies and Back-end Technologies concepts to solve real-time problems.

e. Learning Resources

Text Books

1. Vasan Subramanian, *Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node*, Apress Publisher, 2019.
2. Brad Dayley and Brendan Dayley, *Node.js, MongoDB and Angular Web Development*, 2nd Edition, Pearson Education, 2018.

Reference Books

1. Cay S Chris Northwood, *The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*, Apress Publisher, 2018.
2. Adam Bretz and Colin J Ihrig, *Full Stack JavaScript Development With MEAN*, Sitepoint Publisher, 2016.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Visual Studio Code, Node.js, MongoDB, Angular.js	30

Course Code	Course Name	L	T	P	C
VCS325	**APPLICATION DEVELOPMENT USING FLUTTER**	**2**	**0**	**2**	**3**

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to develop a mobile application for real world challenges. This course gives a hands-on experience on cross platform framework Flutter.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the features and installation process of Flutter	K2
CO2	Explain the basics of Dart and the common widgets	K2
CO3	Develop simple Flutter application using Layouts	K3
CO4	Build Animation on Flutter	K3
CO5	Construct database application using Firebase	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop simple Flutter application using widgets	K3
CO2	Build simple Flutter application using Intents and Layouts	K3
CO3	Develop Flutter application using Custom widgets	K3
CO4	Build Flutter application for text to speech conversion	K3
CO5	Construct database application using Firebase	K3

c. Course Syllabus **Total : 60 Periods**

INTRODUCTION TO FLUTTER **6**

Introduction - Advantages of Flutter- Disadvantages of Flutter - Flutter Installation- Creating Hello World App - Architecture of Flutter Applications.

WIDGETS 6

Dart Basics –Widgets – Widget Tree - Common Widgets - Widget Build Visualization.

LAYOUTS 6

Layout – Weather Section Layout -Tags Layout – Footer Images Layout – Final Layout.

ANIMATION 6

Animated Container - App's Navigation – Scrolling Lists and Effects – List View – Grid View, Making the UI responsive for web, Android and iOS.

DATABASE CONNECTIVITY USING FIREBASE 6

JSON Format - Building the Journal App - Firebase and Firestore Backend - Cloud Fire store - Firestore client App.

LIST OF LABORATORY EXPERIMENTS 30

1. Develop a mobile application for implementing a counter using floating action button
2. Develop a mobile application for library management using widgets
3. Develop a mobile application for implementing login credentials with appropriate Toast messages
4. Develop a mobile application using alert box
5. Develop a mobile application for implementing Banking transactions using intents and layouts
6. Develop a mobile application using Custom widgets in Flutter: App Bar, Drawer, Bottom Navigation Bar
7. Develop a mobile application for text to speech conversion
8. Develop a mobile application using Flutter Firebase

d. Activities

Students shall be exposed to Dart programming concepts and to design applications for solving simple problems using Flutter.

e. Learning Resources

Text Book

1. Macro L Napoli, *Beginning Flutter- A Hands on Guide to App Development*, John Wiley & Sons, Inc, 2020.

Reference Book

1. Rap Payne, *Beginning App Development with Flutter: Create Cross-Platform Mobile Apps (English Edition),* 1st Edition, Apress, 2019.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 8 GB RAM)	30
2.	Printer	1
3.	Software: Android Studio	30

Course Code	Course Name	L	T	P	C
VCS326	UI UX DESIGN	2	0	2	3

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to understand the theories, principles and practice of user interface design and user experience design. This course helps the students to present the information effectively to the potential users. This course enriches the logical skills of the students to design the user interface for real time applications.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the basic user interface and user experience design concepts	K2
CO2	Illustrate user experience design process and its methodology	K2
CO3	Develop user interface design for real time applications	K3
CO4	Build simple application design using design tools	K3
CO5	Explain reusable user interface design using design pattern	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop Artboards for real time applications	K3
CO2	Experiment with user experience design process	K3
CO3	Construct graphics for user interface design	K3
CO4	Apply tools and designs for user interface and experience	K3
CO5	Build Responsive user interface design for real time applications	K3

c. Course Syllabus   **Total: 60 Periods**

INTRODUCTION   **6**

Introduction to User Interface (UI) and User Experience (UX) – Evolution of Design – Need of Good design – UX design to UI design – Principles of UI and UX Design – Core Stages of Design Thinking – Characteristics of graphical and web user interfaces.

USER EXPERIENCE DESIGN PROCESS   **6**

UX Design Process and its Methodology – Requirement Gathering– User Research – Analysis – Design phase – Usability Testing – Information architecture – Sitemaps.

DESIGNING USER INTERFACES   **6**

Designing for People – Spacing and Grid – Responsive Grids and Breakpoints – Typography– Color Schemes – Visual Assets – Plugins and Icons – Accessibility – Getting Input from Users – Forms and Controls.

WIREFRAMING AND PROTOTYPING   **6**

Tools used for UI and UX Design – Wireframing – Principles of wireframing – Build Prototypes – Create interaction – Share Prototypes – Comment on Prototype – Incorporate feedback – Export designs.

DESIGN EXPLORATION   **6**

Design Patterns – Analyzing Design Patterns – Mobile Design – Visual Style – Design Fidelity – Micro Interactions – Components – Cards – Layout and composition – Using Templates.

LIST OF LABORATORY EXPERIMENTS   **30**

1. Construct and manage Artboards for an e-commerce application
2. Identify the users for an agriculture information system by conducting end-to-end user research methods
3. Develop an interface for responsive home page of hotel management system using Icons, Primary and Secondary Buttons
4. Develop an interface using Plugins, color and accessibility for an integrated transport system in a metro city
5. Implementation of wireframing, prototyping, sharing and exporting the project for the online food ordering application
6. Develop a responsive layout using templates for a societal application

d. Activities

Students shall be exposed to UI and UX Design concepts and to make simple design using User Interface Design tools.

e. Learning Resources

Text Books

1. Jenifer Tidwell, Charles Brewer and Aynne Valencia, *Designing Interfaces,* 3rd Edition, O'Reilly Media, 2020.

2. Joel Marsh, *UX for Beginners*, O'Reilly, 2022.

Reference Books

1. David Platt, *The Joy of UX: User Experience and Interactive Design for Developers*, Addison-Wesley Professional, 2016.

2. Elisa Paduraru, *Fundamentals of Creating a Great UI/UX,* Creative Tim, 2022.

3. Peter Morville and Louis Rosenfeld, *Information Architecture for the World Wide Web,* 3rd Edition, O'Reilly Media, 2015.

4. Garrett J J, *The elements of user experience: user-centered design for the Web*, Berkeley: New Riders, 2011.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500GB, 8 GB RAM)	30
2.	Printer	1
3.	Software: Figma	30

Course Code	Course Name	L	T	P	C
VCS327	**C# AND .NET FUNDAMENTALS**	**2**	**0**	**2**	**3**

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to learn object oriented and advanced features of C# programming for solving simple problems. This course also focuses on developing simple database application and web application using ASP.NET.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the .NET architecture and C# language fundamental constructs	K2
CO2	Develop simple applications in C# using object oriented programming concepts.	K3
CO3	Illustrate the use of delegates, exception handling and multithreading in C#	K2
CO4	Explain the basic features of ASP.NET and its controls	K2
CO5	Build database driven ASP.NET applications and web services	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build a simple C# application using jagged array	K3
CO2	Develop simple C# programs using different types of function parameters	K3
CO3	Build object oriented programs using C# class and constructors	K3
CO4	Develop simple applications in C# using exception handling and delegate concepts	K3
CO5	Construct three tier applications using ASP.NET	K3

c. Course Syllabus   **Total : 60 Periods**

INTRODUCTION TO .NET AND C# FUNDAMENTALS   **6**

Introduction to .NET Architecture - CLS, CTS, BCL, Overview of C# - Data types, Literals and Variables, Boxing and Un Boxing - Operators - Control statements - Parameter passing mechanisms - Arrays, Strings.

OBJECT ORIENTED CONCEPTS IN C# 6

Classes and Objects, Inheritance: Virtual methods and Overriding - Abstract Class, Sealed Class - Interfaces - Generic classes and methods – Collection.

ADVANCED FEATURES OF C# 6

Exception handling - Delegates and Events - lambda expressions, Multithreading - Properties–Reflection.

WEB APPLICATIONS 6

Introduction to ASP.NET - ASP.NET web application - Web forms - Code behind model - Autopostback - Validating controls - Master and Content pages.

ASP.NET AND DATABASE CONNECTIVITY 6

Data provider classes - Connection - Command - Data Reader - Data Adapter - Data Controls-Grid View - FormView – DetailsView - Concept of state - Web services.

LIST OF LABORATORY EXPERIMENTS 30

1) Implement a C# program to find the sum of each row of a jagged array

2) a) Develop a C# program to swap two numbers using ref parameter

   b) Develop a C# program to find the area of triangle using in and out parameters

3) a) Create a C# class named Circle constructed by a data member "radius" and two methods which will compute the area and the perimeter of a circle

   b) Define a STUDENT class with roll number, name and marks in 3 tests of subjects. Use appropriate functions to find the average of two best marks for a student and print the roll number, name and average marks of a student. First, initialize the data members using constructors

4) Create a class *Time* to display a time value with the data members of *hours, minutes* and *seconds*. Include the member functions to get and display the time separated by: (HH:MM:SS). Assume the time is represented in 12 hours. If the input value exceeds the hour, minute and second then your function should report the exception as invalid hour/minute/second. Write a C# program to model the above relationships

5) Write a program to create a delegate called TrafficDel and a class called TrafficSignal with the following delegate methods

   Public static void Yellow()

   {

   Console.WriteLine("Yellow Light Signal To Get Ready");

```
}
Public static void Green()
{
Console.WriteLine("Green Light Signal To Go");
}
Public static void Red()
{
Console.WriteLine("Red Light Signal To Stop");
}
```

Also include a method IdentifySignal() to initialize an array of delegate with the above methods and a method show() to invoke members of the above array

6) The department table consists of two fields (DeptID, DeptName). Write an ASP.NET web application to insert, update, delete and display the records in the department table

d. Activities

Students shall be practiced to solve the simple real time use case and to debug the C# code effectively.

e. Learning Resources

Text Books

1. Herbert Schildt, *C# 4.0: The Complete Reference*, Reprint, McGraw Hill Education, Indian Edition, 2017.

2. Andrew Troelsen and Philip Japikse, *ProC# 10 with .NET: Foundational Principles and Practices in Programming*, 11th Edition, Apress, 2022.

Reference Books

1. Mark Michaelis and Eric Lippert, *Essential C# 6.0*, Pearson, 2015.

2. John Sharp, *Microsoft Visual C# 2013 Step by Step Developer*, Pearson Education, 2013.

3. Thamarai Selvi, S and Murugesan, R, *A textbook on C#*, Pearson, 2012.

4. Joseph Albahari and Ben Albahari, *C# 4.0 in a Nutshell: The Definitive Reference*, O'Reilly, 2010.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Microsoft Visual Studio, SQL Server or equivalent	30

Course Code	Course Name	L	T	P	C
VCS333	DEVOPS FOR CLOUD	2	0	2	3

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to understand the importance of DevOps and its tools. This course enriches the students to be aware of different Version control tools. This course enables the students to get familiarized with DevOps environment.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the importance of DevOps tools used in cloud	K2
CO2	Demonstrate the concepts of Jenkins to Build, Deploy and Test Software Applications	K2
CO3	Explain about the different Container strategies in Docker	K2
CO4	Explain about the Kubernetes concepts	K2
CO5	Summarize the importance of Ansible tools	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify the basic concepts of Jenkins	K3
CO2	Apply the performance using different version control tools	K3
CO3	Build applications using Docker	K3
CO4	Construct micro services in Kubernetes	K3
CO5	Experiment the installation of Ansible	K3

c. Course Syllabus **Total:60 periods**

DEVOPS IN CLOUD **6**

Essentials of Cloud Computing – Cloud and Virtualization Architecture – Cloud Deployment Architecture – Need of DevOps on Cloud – Introduction to AWS – DevOps Principles – DevOps Delivery Pipeline – Market Trends – Technical Challenges – Tools used in DevOps.

JENKINS AND GIT INTEGRATION 6

Version Control – Essentials of GIT – How to setup GIT – GIT Workflows – Jenkins Architecture – Essentials of Continuous Integration – Jenkins Tool Management – User management in Jenkins – Notification Settings in Jenkins – Terraform Architecture – Terraform CLI.

DOCKER DEPLOYMENT 6

Introduction to Docker – Docker Tools – Docker Swarm – Docker Networking –Working with Container – Docker deployment and orchestration.

KUBERNETES CONTAINER ORCHESTRATION 6

Introduction to Kubernetes – Kubernetes Cluster Architecture –Understanding Labels, Selectors, Jobs, and Schedulers.

ANSIBLE AUTOMATION PLATFORM 6

Introduction– Ansible Modules – How to use Adhoc Commands – Introduction to YAML Script Playbook.

LIST OF LABORATORY EXPERIMENTS 30

1. Deployment of Web applications using Jenkins
2. Performance of Version Control on websites using different Version control tools like GIT
3. Installation and Configuration Docker for creating Containers of different Operating System Images
4. Build, deploy and manage web or Java application on Docker.
5. Deployment of micro services in Kubernetes.
6. Installation and configuration of Software Configuration Management and provisioning using Ansible.

d. Activities

Students shall be exposed to DevOps tools like Jenkins, Kubernetes and Ansible for deploying in web applications.

e. Learning Resources

Text Books

1. Karl Matthias and Sean P Kane, *Docker: Up and Running*, 2nd Edition, O'Reilly Publication, 2018.
2. Len Bass, Ingo Weber and Liming Zhu, *DevOps, A Software Architects Perspective*,1st Edition, Addison Wesley–Pearson Publication, 2015.
3. John Ferguson Smart, *Jenkins The Definitive Guide*, O'Reilly Publication, 2011.

Reference Books

1. Sanjeev Sharma and Bernie Coyne, *DevOps for Dummies*, 2nd Edition, Wiley Publication, 2015.

2. Httermann and Michael, *DevOps for Developers*, Apress Publication, 2012.

3. JoakimVerona, *Practical DevOps*, 2nd Edition, Pack publication, 2018.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Java (JDK), NetBeans IDE or equivalent	30

Course Code	Course Name	L	T	P	C
VCS347	**DIGITAL MARKETING ESSENTIALS**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the importance of competitive strategies for the digital marketing. This course creates awareness on the concepts of digital marketing and its impact on modern business.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain about comprehensive marketing plan by integrating digital marketing tactics.	K2
CO2	Demonstrate proficiency in using a variety of search engine optimization (SEO) tools.	K2
CO3	Utilize the knowledge of keyword research, ad creation, and bidding strategies for effective ad campaigns.	K3
CO4	Apply the knowledge of social media marketing and web analytics tools.	K3
CO5	Develop strategies for integrating email and affiliate marketing program to maximizing its impact on business.	K3

c. Course Syllabus   **Total : 45 Periods**

DIGITAL MARKETING   **9**

Introduction to Digital Marketing – History and evolution of digital marketing – Difference between traditional marketing and digital marketing – Types of digital marketing   approaches - Importance of Digital Marketing - Strategy Building Process – The 4p's of Marketing (Product, Price, Place and Promotion) - Different platforms for digital advertising.

SEARCH ENGINE OPTIMIZATION   **9**

Inheritance Search Engine Optimization (SEO): Definition, working, techniques – ON Page SEO: Web Site Domain, Relevant Filenames, Design & Layout - Optimized Keywords, Metatags, Anchor, Title – OFF Page SEO: Content Writing, Verifying Web Site, Link Building – Mobile SEO Techniques - SEO Tools and Techniques.

GOOGLE ADWORDS AND PAY PER CLICK 9

Google Adwords – Expensive Keyword – Google Adwords Bidding Process, Bidding Methods – Conversion Optimizer and its working – Adwords Campaign – Determination of Quality score and rank in Google Ads, Advertising on Google Adwords - Pay Per Click(PPC): Introduction, PPC - Terminology – Creating a Keyword List - Setting Location & Language – PPC - Landing Pages and its types – Measuring Results.

SOCIAL MEDIA MARKETING AND WEB ANALYTICS 9

Social Media Marketing (SMM): Facebook Marketing, Twitter Marketing, Linkedin Marketing - Google plus Marketing, Pinterest Marketing - Video Marketing - Social Bookmaking - Introduction Web Analytics and its importance - Web Analytics Process–Google Analytics – Web Analytics – Optimization – Web Analytics Tools (Crazy Egg) - Key Metrics.

EMAIL MARKETING AND AFFILIATE MARKETING 9

Email Marketing Overview, Mailing List, Organizing the Mailing List – HTML & CSS Emails, Email Invitation, Email Content – Landing Pages, Spam Compliance – Email Automation and Metrics, Email Marketing Tips - Affiliate Marketing – History - Action and Reward – Tracking - Promote Merchants - Affiliate Networks, Case Study.

d. Activities

Students shall be exposed to Google Tag Manager and to create the Business Website.

e. Learning Resources

Text Books

1. Rob Stokes, *eMarketing: The Essential Guide to Digital Marketing*, 6th Edition, Quirk Education, 2018.

2. Damian Ryan and Calvin Jones, *Understanding DIGITAL Marketing: Marketing strategies for engaging the digital generation*, 3rd Edition, Kogan Page, 2016.

Reference Books

1. Brian Clifton, *Advanced Web metrics with Google Analytics*, 3rd Edition, Wiley Publication, 2012.

2. Chuck Hemann and Ken Burbary, *Digital Marketing Analytics*, 2nd Edition, Que Publication, 2018.

3. Jeffery Mark, *Data-Driven Marketing: The 15 Metrics Everyone in Marketing Should Know,* 1st Edition, Wiley Publication, 2010.

Course Code	Course Name	L	T	P	C
VCS335	**VIRTUALIZATION AND CLOUD COMPUTING**	**2**	**0**	**2**	**3**

Category: Professional Elective Course (Theory cum Lab)

a. Preamble

This course enables the students to understand the importance of the cloud concepts. This course enriches the knowledge on the various securities in cloud computing. This course focuses on the emergence of cloud as the next generation computing paradigm.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the basic concepts of cloud computing and its principles	K2
CO2	Apply virtualization techniques for efficient resource utilization	K3
CO3	Summarize various models, services and resource management in cloud computing	K2
CO4	Apply cloud services in different programming models and software environment	K3
CO5	Interpret security and resource allocation issues in cloud computing	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Experiment with various virtualization tools such as Virtual Box, VMware workstation.	K3
CO2	Develop web applications in a PaaS environment.	K3
CO3	Model a cloud environment to implement new schedulers.	K3
CO4	Show the Installation and use a generic cloud environment that can be used as a private cloud.	K3
CO5	Apply large data sets in a parallel environment.	K3

c. Course Syllabus   **Total : 60 Periods**

INTRODUCTION, PRINCIPLES AND ARCHITECTURE   **6**

Cloud Computing: Reference model – Characteristics and challenges – Historical development building cloud computing environment – Technologies for distributed computing – Cloud Computing Architecture: NIST Cloud Computing Reference Architecture – Types of Clouds – Cloud Service Providers.

VIRTUALIZATION TECHNOLOGIES   **6**

Characteristics of virtualized environments – Taxonomy of virtualization techniques –Execution virtualization – Hypervisors Hardware virtualization techniques – Operating system Level virtualization – Application Level virtualization – Virtualization and cloud computing – Pros and cons of virtualization.

CLOUD INFRASTRUCTURE AND RESOURCE MANAGEMENT   **6**

Cloud Computing and Services Model – Public, Private and Hybrid Clouds – Cloud Eco System IaaS – PaaS – SaaS – Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Cloud Costing - Design Challenges – Inter Cloud Resource Management.

CLOUD PROGRAMMING ENVIRONMENT   **6**

Cloud capabilities and platform features – Hadoop – HDFS – MapReduce – Mapping Applications – Cloud Platforms – Cloud Service Providers - Amazon Web Service – Microsoft Azure - Google App Engine - Open Stack.

CLOUD SECURITY   **6**

Cloud Computing Risk Issues – Cloud Computing Security Challenges – Cloud Computing Security Architecture – Trusted cloud Computing – Identity Access Management and Control.

LIST OF LABORATORY EXPERIMENTS   **30**

1. Configure a VM instance in your local machine and in cloud - Allocate CPU, memory and storage space as per a specified requirement and Install Guest OS image in that instance.

2. Configure a Nested Virtual Machine (VM under another VM) in cloud and local machine. Install OS images and work with OS commands.

3. Find a procedure to transfer the files from one virtual machine to another virtual machine.

4. Deploying a Sample Python Application on Google Cloud Platform App Engine

5. Demonstrate cloud application using Windows Azure.

6. Implementation of Amazon cloud services - EC2, S3

7. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim

8. Install the Hadoop framework and create an application using Map Reduce Programming Model

9. Creating and Executing Your First Container Using Docker.

d. Activities

Students shall be exposed to cloud computing and to implement the cloud concepts.

e. Learning Resources

Text Books

1. Rittinghouse, John W and James F Ransome, *Cloud Computing: Implementation, Management and Security*, CRC Press, 2017.

2. Kai Hwang, Geoffery C Fox and Jack J Dongarra, *Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet*, 1st Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.

Reference Books

1. Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi S, *Mastering Cloud Computing*, Tata Mcgraw Hill, 2013.

2. Toby Velte, Anthony Velte and Robert Elsenpeter, *Cloud Computing – A Practical Approach*, Tata Mcgraw Hill, 2009.

3. George Reese, *Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)*, O'Reilly, 2009.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 8 GB RAM)	30
2.	Printer	1
3.	Software: Oracle Virtual Box, Ubuntu Guest OS, GAE, Docker, Cloud Sim, Java NetBeans, Hadoop, Openstack	30

Course Code	Course Name	L	T	P	C
VAI331	MOBILE ADHOC NETWORKS	3	0	0	3

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the fundamental and advanced concepts of Mobile Adhoc Networks. This course enriches the knowledge about protocols in the different layer of network architecture. This course describes about the issues and challenges in achieving QoS and the solutions in providing QoS.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of Mobile Adhoc Networks	K2
CO2	Illustrate the classification of MAC Layer Protocols and IEEE standards	K2
CO3	Compare the Table-Driven and On-Demand Routing Protocols	K2
CO4	Identify the security issues and challenges in Transport Layer Protocols	K3
CO5	Apply the solutions for solving the issues and challenges in achieving QoS	K3

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION TO MOBILE ADHOC NETWORKS   **9**

Fundamentals – The electromagnetic spectrum – Characteristics of Wireless Channel – Modulation techniques – Multiple access techniques – Voice coding – Error control – IEEE 802 networking standard – IEEE 802.11 standard.

MAC PROTOCOLS   **9**

Design issues – Goals – Classification – Contention based protocols – Reservation – Scheduling algorithms – Protocols using directional antennas – IEEE standards – 802.11a – 802.11b – 802.11g – 802.15 – HIPERLAN.

ROUTING PROTOCOLS 9

Design issues – Classification – Table – Driven routing – On Demand routing – Hybrid routing – Routing protocols with efficient flooding mechanisms – Hierarchical routing – Power – Aware routing – Multicast routing – Classification – Tree based routing – Mesh based routing.

TRANSPORT LAYER AND SECURITY PROTOCOLS 9

Issues – Design Goals – Classification – TCP over Adhoc network – Security – Issues and challenges – Network security attacks – Key management – Secure routing protocols.

QUALITY OF SERVICE 9

Issues and Challenges – Classification of QoS Solutions – MAC Layer Solutions – Cluster – IEEE 802.11e – 3DBASE – Network Layer Solutions – QoS Frameworks.

d. Activities

Students shall be exposed to the core concepts of Mobile Adhoc Networks using simulation tools.

e. Learning Resources

Text Book

1. Siva Ram Murthy C and Manoj, B S, *Ad hoc Wireless Networks Architecture and Protocols*, 2nd Edition, Pearson Education Asia, 2007.

Reference Books

1. Sarkar, *Ad Hoc Mobile Wireless Networks Principles Protocols and Applications*, Taylor & Francis, 2020.

2. Stefano Basagni and Marco Conti Silvia, *Mobile Ad Hoc Networking: The Cutting Edge Directions,* Wiley India, 2015.

3. Toh, C K, *Adhoc Mobile Wireless Networks*, Pearson Education, 2015.

Course Code	Course Name	L	T	P	C
VCS336	**MULTICORE ARCHITECTURE**	**3**	**0**	**0**	**3**

Category: Professional Elective Course

a. Preamble

This course enables the students to understand the importance of multi–core architectures. This course cultivates the practice of writing efficient parallel programs which are executed by multi–core processors.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of multi–core processors	K2
CO2	Explain the issues in programming parallel processors	K2
CO3	Build parallelized programs using MPI	K3
CO4	Develop parallelized programs using OpenMP	K3
CO5	Compare programming for serial processors and parallel processors	K2

c. Course Syllabus   **Total : 45 Periods**

MULTI–CORE PROCESSORS   **9**

Single core to multi–core architectures – SIMD and MIMD systems – Cache coherence – Symmetric and Distributed Shared Memory Architectures – Caveats – Shared memory – Distributed Memory – Programming hybrid systems – Performance Issues – Speedup and efficiency – Amdahl's law – Parallel program design.

PARALLEL PROGRAM CHALLENGES   **9**

Defining performance – How structure impacts performance – The role of the compiler – Synchronization and data sharing – Data races – Deadlocks and Livelocks – Communication between threads and processes.

DISTRIBUTED MEMORY PROGRAMMING WITH MPI   **9**

Introduction – The Trapezoidal Rule in MPI – Collective communication – MPI derived data types – Performance evaluation – Parallel sorting algorithm.

SHARED MEMORY PROGRAMMING WITH OpenMP   **9**

Introduction – Compiling and running OpenMP programs – The Trapezoidal Rule – Scope of variables – The Reduction Clause – The parallel for Directive – Handling Loops.

PARALLEL PROGRAM DEVELOPMENT   **9**

Case studies – Two n–Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

d. Activities

Students shall be exposed to the parallelization of C programs using OpenMP and MPI.

e. Learning Resources

Text Books

1. Peter S Pacheco, *An Introduction to Parallel Programming*, Morgan–Kauffman/Elsevier, 2011.

2. Darryl Gove, *Multicore Application Programming for Windows, Linux, and Oracle Solaris*, Pearson Education, 2011.

Reference Books

1. Michael J Quinn, *Parallel programming in C with MPI and OpenMP*, Tata McGraw Hill, 2003.

2. Victor Alessandrini and Ken Burbary, *Shared Memory Application Programming: Concepts and Strategies in Multicore Application Programming*, 1st Edition, Morgan Kaufmann, 2015.

3. Yan Solihin, *Fundamentals of Parallel Multicore Architecture,* CRC Press, 2015.

Course Code	Course Name	L	T	P	C
VCS337	DISTRIBUTED SYSTEMS	3	0	0	3

Category: Professional Elective Course

a. Preamble

The course enables the students to understand the fundamental principles and models underlying all aspects of distributed computing. The course addresses the principles underlying the theory, algorithms, systems aspects and practical systems-like problems of distributed computing.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the foundations and issues of distributed systems	K2
CO2	Outline the various synchronization issues and global state for distributed systems	K2
CO3	Explain the mutual exclusion and deadlock detection algorithms in distributed systems	K2
CO4	Summarize the agreement protocols and fault tolerance mechanisms in distributed systems	K2
CO5	Illustrate the features of content delivery networks	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION   **9**

Introduction – Message – Passing systems versus shared memory systems – Primitives for distributed communication – Synchronous versus asynchronous executions – Design issues and challenges. A model of distributed computations – Global state – Cuts – Past and future cones of an event – Models of process communications. Logical Time: A framework for a system of logical clocks – Scalar time – Vector time – Physical clock synchronization: NTP.

MESSAGE ORDERING AND SNAPSHOTS   **9**

Message ordering and group communication: Message ordering paradigms – Asynchronous execution with synchronous communication – Synchronous program order on an asynchronous system – Group communication – Causal order (CO) – Total order. Global state and snapshot recording algorithms: Introduction – System model and definitions –Snapshot algorithms for FIFO channels.

DISTRIBUTED MUTEX AND LOCKS 9

Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart Agrawala algorithm – Maekawa's algorithm – Suzuki Kasami's broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp's classification – Algorithms for the single resource model, the AND model and the OR model.

RECOVERY AND CONSENSUS 9

Check pointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint based recovery – Log–based rollback recovery – Coordinated check pointing algorithm – Algorithm for asynchronous check pointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure – Free system – Agreement in synchronous systems with failures.

CONTENT DELIVERY NETWORKS AND P2P 9

Content Delivery Networks – Identifying the content – Key Delivery Methods : Peer-to-peer systems - Introduction – Data indexing and overlays – Chord –Content addressable networks – Initialization –Routing – Maintenance – Optimization – Tapestry – Delivery Performance and Quality.

d. Activities

Students shall be exposed to the fundamental principles and practical systems–like problems of distributed computing

e. Learning Resources

  Text Books

  1. Ajay D Kshemkalyani and Mukesh Singhal, *Distributed computing: principles, algorithms, and systems*, Cambridge University Press, 2011.

  2. George Coulouris, Jean Dollimore and Tim Kindberg, *Distributed Systems Concepts and Design*, 5th Edition, Pearson Education, 2012.

  Reference Books

  1. Pradeep K Sinha, *Distributed Operating Systems: Concepts and Design*, Prentice Hall of India, 2000.

  2. Tanenbaum, A S, and Van Steen, M, *Distributed Systems: Principles and Paradigms* Pearson Education, 2007.

  3. Liu, M L, *Distributed Computing, Principles and Application*, Pearson Education, 2004.

Course Code	Course Name	L	T	P	C
VCS334	**BLOCKCHAIN TECHNOLOGIES**	**2**	**0**	**2**	**3**

Category: Professional Core Course (Theory cum Lab)

a. Preamble

This course helps the students to understand the Blockchain structure and the consensus mechanisms. This course enriches the students to develop a smart contract using solidity programming. This course enables the students to develop a Ethereum DApp to deploy a smart contract for real time application.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Interpret the Components, types and Application of Blockchain Technology	K2
CO2	Explain the algorithms that supports Distributed Consensus	K2
CO3	Construct a Ethereum network using Ethereum Virtual Machine	K3
CO4	Apply solidity programming for deploying a smart contract for a real-time application.	K3
CO5	Build a Ethereum DApp for a real time application using blockchain	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build a Merkle Tree in blockchain	K2
CO2	Construct a block in Blockchain	K2
CO3	Develop a smart contract for interacting with the transactions using Remix IDE.	K3
CO4	Construct a blockchain and to implement transactions.	K3
CO5	Model a Private Network using Ethereum Virtual Machine to perform mining.	K3

c. Course Syllabus **Total: 60 Periods**

INTRODUCTION TO BLOCKCHAIN 6

Introduction – Components of Blockchain - Blockchain Architecture –-Structure of Blockchain – Types of Blockchain - Tiers of Blockchain technology – Cryptocurrencies - Cryptographic primitives – Hash functions – Applications of Blockchain.

CONSENSUS MECHANISMS AND SMART CONTRACTS 6

Introduction - Distributed Consensus - Paxos – RAFT Consensus – Byzantine Fault Tolerant (BFT) System – Pease BFT algorithm – Practical Byzantine Fault Tolerance (PBFT) System. – Smart contracts – Need of Smart Contract in real world applications.

ETHEREUM SMART CONTRACT 6

Ethereum overview – Ethereum network – Components of Ethereum – The Ethereum Virtual Machine (EVM) – Smart Contracts – Mining on the private network – using MetaMask and Remix IDE to deploy smart contract.

SOLIDITY PROGRAMMING 6

The solidity Compiler – Tools and Libraries – Smart Contract development and Deployment – Layout of Solidity source code – solidity language – variables – Datatypes – Control Structures – Events- Inheritance- Libraries – Functions - Error handling.

BUILDING ETHEREUM DAPP 6

DApp – Metamask - Setting up a Private Ethereum Network - Install go-etherum – Creategeth Data directory – Create a geth account – create genesis.json configuration File – Runthe first Node of the Private Network – Run the second node of the Network – CreatingSmart Contract – Deploying the Smart Contract – Client Application.

LIST OF LABORATORY EXPERIMENTS 30

1. Creation of Merkle Tree for data verification and synchronization in blockchain
2. Creation of a block in blockchain
3. Deposit some Ether in your MetaMask accounts
4. Create several accounts using MetaMask and make some transactions between these accounts
5. Develop a Smart Contract using Solidity programming and interacting with the smart contract using Remix IDE
6. Creating and adding transactions to a blockchain using Ethereum
7. Interacting with the blockchain using Geth console
8. Mining on a private network to view transactions and blocks using Ganache

d. Activities

Students shall be exposed to the developing real-time applications using blockchain technology.

e. Learning Resources

Text Books

1. Imran Bashir, *Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols,smart contracts, DApps, Cryptocurrencies, Ethereum, and more*, 3rd Edition, Packt Publishing, 2020.

2. Ritesh Modi, *Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain,* Packt Publishing, 2018.

Reference Books

1. Kevin Solorio, Randall Kanna, David H. Hoover, *Hands-On Smart Contract Development with Solidity and Ethereum*, 1st Edition, O'Reilly Media, 2019.

2. Andreas Antonopoulos, Gavin Wood, *Mastering Ethereum*, 1st Edition, O'Reilly Media, 2018.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Python, Remix IDE, MetaMask, Geth, Ganache, Ethereum Virtual Machine, solc compiler	30

Course Code	Course Name	L	T	P	C
MFB001	**FUNDAMENTALS OF BLOCKCHAIN**	**3**	**0**	**0**	**3**

Category: Open Elective (Minor Degree)

a. Preamble

This course helps the students to understand the needs of cryptographic algorithms in Blockchain Technologies. This course describes the operational and functional aspects of trading and mining in Blockchain. This course enriches the knowledge about the Bitcoin Consensus and various algorithms that supports Distributed Consensus. This course enables the students to realize the usage of Hyper ledger fabric and Ethereum in various fields.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Interpret the needs of cryptographic algorithms in Blockchain Technologies	K2
CO2	Explain the algorithms that supports Distributed Consensus	K2
CO3	Outline the usage of Hyper ledger fabric and Ethereum in real world applications	K2
CO4	Identify the defense mechanisms to secure the Blockchain network from attacks	K3
CO5	Apply Blockchain in finding the solution to the real-world problems	K3

c. Course Syllabus   **Total:45 Periods**

INTRODUCTION TO BLOCKCHAIN   **9**

History of Blockchain - Blockchain Architecture - Generic elements of Blockchain - Features of Blockchain - Types of Blockchain - Consensus Mechanisms - Cryptographic Primitives- Cryptographic Constructs in Blockchain Technology - Cryptocurrency.

CONSENSUS MECHANISMS   **9**

Consensus Mechanisms - Attacks - Mining Difficulty - Mining Pool - Permissioned Model - Permissionless Model - Distributed Consensus - Paxos - RAFT Consensus - Byzantine Fault Tolerant (BFT) System - Pease BFT algorithm - Practical Byzantine Fault Tolerance (PBFT) System

ETHEREUM AND HYPERLEDGER FABRIC 9

Ethereum network - Components of Ethereum ecosystem - EVM - Blocks - Wallet and Client software - Nodes and Miners- Hyper Ledger Fabric - Introduction, Architecture, Introduction, chain code - Mining - Transaction fee - Mist Browser - Ether - Gas - Solidity - Smart Contracts - Issues in Cryptocurrency.

BLOCKCHAIN SECURITY 9

Attacks on Blockchain - Sybil attacks - Denial-of-Service attacks - 51% attacks - Eclipse/Routing attacks - Considerations for Secure Blockchain Design - Pseudo-anonymity versus Anonymity - Zcasand zk-SNARKs for anonymity preservation - Ring Signatures - Stealth Addresses.

BLOCKCHAIN APPLICATIONS 9

DApps - DAO Blockchain Applications - Blockchain in Real Time - Internet of Things - Health Care - Government - Border Control - Finance - Supply Chain - Logistics - Asset Management.

d. Activities

Students shall be exposed to the core concepts of Blockchain Technology using case study.

e. Learning Resources

Text Books

1. Imran Bashir, *Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained*, 2nd Edition, Packet Publishing, 2018.

2. Narayanan, A, Bonneau, J, Felten, E, Miller, A and Goldfeder, S, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton University Press, 2016.

Reference Books

1. Andreas Antonopoulos and Satoshi Nakamoto, *Mastering Bitcoin*, O'Reilly Publishing, 2014.

2. Roger Wattenhofer, *The Science of the Blockchain*, Create Space Independent Publishing Platform, 2016.

3. Alex Leverington, *Ethereum Programming*, Packet Publishing Limited, 2017.

Course Code	Course Name	L	T	P	C
MFB002	**ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT**	**3**	**0**	**0**	**3**

Category: Open Elective (Minor Degree)

a. Preamble

This course enables the students to acquire knowledge of economics to facilitate the process of economic decision making. This course equips students with the skills required to analyze and evaluate engineering projects' financial feasibility, assess risk, and optimize financial and economic outcomes.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of Economics	K2
CO2	Outline the market structures and integration concepts	K2
CO3	Illustrate the measures of national income, the functions of banks and concepts of globalization	K2
CO4	Summarize the concepts of financial management	K2
CO5	Demonstrate accounting systems and analyze financial statements using ratio analysis	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUTION TO ECONOMICS   **9**

Introduction to Economics - Flow in an economy, Law of supply and demand, Concept of Engineering Economics - Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break - Even analysis.

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES   **9**

Firm - Industry - Market - Market structure - Diversification - Vertical integration - Merger - Horizontal integration.

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT   **9**

National income concepts - GNP - NNP - Methods of measuring national income - Inflation - Deflation - Kinds of money - Value of money - Functions of bank - Types of bank - Economic liberalization - Privatization - Globalization.

CONCEPTS OF FINANCIAL MANAGEMENT   **9**

Financial management - Scope - Objectives - Time value of money - Methods of appraising project profitability - Sources of finance - Working capital and management of working capital.

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS   **9**

Accounting system - Systems of book-keeping - Journal - Ledger - Trail balance - Balance sheet - Financial statements - Ratio analysis - Types of ratios - Significance - Limitations.

d. Activities

Students shall be exposed to the basics of engineering economics, cost analysis and financial management to take economically sound decisions in engineering projects.

e. Learning Resources

Text Books

1. Prasana Chandra, *Financial Management: Theory and Practice*, 11th Edition, McGraw Hill Education, 2022.

2. Besley, S and Eugene F Brigham, *Essentials of Managerial Finance*, 14th Edition, South-Western College Publisher, 2007.

Reference Books

1. Robert Hanrahan, J and James C Van Horne, *Fundamentals of Financial Management*, 13th Edition, Pearson, 2008.

2. Pandey, I M, *Financial Management*, 12th Edition, Pearson, 2021.

3. Panneer Selvam, R, *Engineering Economics*, 2nd Edition, Prentice Hall India Learning Private Limited, 2013.

Course Code	Course Name	L	T	P	C
MFB003	**BANKING, FINANCIAL SERVICES AND INSURANCE**	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course aims to enhance the ability of students to explicate the operations and latest technology of Banking system in India. This course seeks to develop knowledge on insurance mechanism of various policies.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the structure, functions & operations of financial and banking system in India	K2
CO2	Discuss NPA management functions and norms	K2
CO3	Illustrate the latest technologies used in banks Payment and Settlement system	K2
CO4	Summarize the financial services in India	K2
CO5	Demonstrate the general insurance business and its forms	K2

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO INDIAN BANKING SYSTEM **9**

Overview of Banking system - Structure - Functions - Banking system in India - Key Regulations in Indian Banking sector - RBI - Relationship between Banker and Customer - Retail & Wholesale Banking - Types of Accounts - Opening and operation of Accounts.

MANAGING BANK FUNDS/ PRODUCTS **9**

Liquid Assets - Investment in securities - Advances - Loans - Negotiable Instruments - Cheques, Bills of Exchange & Promissory Notes - Designing deposit schemes - Asset and Liability Management - NPA's - Current issues on NPA's - M&A's of banks into securities market.

DEVELOPMENT IN BANKING TECHNOLOGY **9**

Payment system in India - Paper based - E payment - Electronic banking - Plastic money - Forecasting of cash demand at ATM's - National Gateways - RTGS - International gateways -

SWIFT - The Information Technology Act, 2000 in India - RBI's Financial Sector Technology vision document - Security threats in E-banking & RBI's Initiative.

FINANCIAL SERVICES 9

Introduction - Need for Financial Services - Financial Services Market in India - NBFC - Leasing and Hire Purchase - Mutual funds - Venture Capital Financing - Bill discounting - Factoring - Merchant Banking.

GENERAL INSURANCE 9

Insurance - Concept - History of Insurance industry in India. Insurance Act, 1938 - IRDA - Regulations - Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy - revival - Settlement of claim.

d. Activities

Understanding Taxes and Paycheck:

Students analyze statements about taxes to better understand how taxes affect people's paychecks.

e. Learning Resources

Text Books

1. Padmalatha Suresh and Justin Paul, *Management of Banking and Financial Services*, Pearson, 2017.

2. Peter S Rose and Sylvia, C and Hudgins, *Bank Management and Financial Service,* Tata McGraw Hill, 2017.

Reference Books

1. Gupta, *Insurance and Risk Management*, 2nd Edition, Himalaya Publishing House 2017.

2. Bharati and Pathak, V, *Indian Financial System*, 5th Edition, Pearson Education, 2014.

3. Neelam, Gulati, C, *Principles of Insurance Management*, Excel Books, 2012.

4. Vijaragavan Iyengar, G, *Introduction to Banking*, Excel Books, 2008.

5. Saunders Anthony and Marcia Millon Cornett, *An Introduction to the Risk Management Approach*, 3rd Edition, Tata Mc-Graw Hill Education, 2007.

6. Ganguly and Anand, *Insurance Management*, New Age International Pvt. Ltd, 2007.

Course Code	Course Name	L	T	P	C
MFB004	**FUNDAMENTALS OF FINTECH**	3	0	0	3

Category: Open Elective (Minor Degree)

a. **Preamble**

This course enables the students with exposure to new Fintech services within a critical context and framework analyzing traditional money, banking and financial markets combined with interdisciplinary content from Computer Science and Entrepreneurship.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the importance and evolution of Fintech	K2
CO2	Illustrate the technologies used in Payment Industry	K2
CO3	Infer the knowledge of Fintech in insurance industry	K2
CO4	Outline the Fintech developments around the world	K2
CO5	Summarize the concepts of startup finance and Fintech future	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUTION TO FINTECH   **9**

Fintech - Definition - Architecture - Goals - Role of Fintech in economic development, opportunities and challenges in Fintech - Evolution of Fintech in different sectors of the industry - Infrastructure - Banking Industry - Startups and Emerging Markets - Recent developments in Fintech, future prospects and potential issues with Fintech.

PAYMENT INDUSTRY   **9**

Fintech in Payment Industry - Multichannel digital wallets - Applications supporting wallets - Onboarding and KYC application - Fintech in Lending Industry - Formal lending - Informal lending - P2P lending - POS lending - Online lending - Payday lending - Microfinance - Crowdfunding.

INSURANCE INDUSTRY   **9**

Fintech in Wealth Management Industry - Financial Advice - Automated investing - Socially responsible investing - Fractional Investing - Social Investing - Fintech in Insurance Industry - P2P insurance - On-Demand Insurance - On-Demand Consultation - Customer engagement

through Quote to sell - Policy servicing - Claims Management - Investment linked health insurance.

FINTECH AROUND THE GLOBE   9

Fintech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East - Regulatory and Policy Assessment for Growth of Fintech - Fintech as disruptors - Financial institutions collaborating with Fintech companies - The new financial world.

FUTURE OF FINTECH   9

Emerging technologies and financial services - Future of financial services - Banking on innovation through data - The Fintech Supermarket - Banks partnering with Fintech start-ups - The rise of Banktech - Fintech and Retail Banking - Ethics in Fintech.

d. Activities

Students shall be exposed to provide background and framework for understanding current and future new products and services in fixed income, equities and foreign exchange markets.

e. Learning Resources

Text Book

1. Parag Y Arjunwadkar, *FinTech: The Technology Driving Disruption in the financial service industry*, CRC Press, 2018.

Reference Books

1. Sanjay Phadke, *Fintech Future: The Digital DNA of Finance Paperback*, Sage Publications, 2020.

2. Arner, D, Barbers, J and Buckley, R, *The evolution of FinTech: a new post crisis paradigm*, University of New South Wales Research Series, 2015.

3. Susanne Chishti and Janos Barberis, *The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries*, Wiley publications, 2016.

4. Pranay Gupta and Mandy Tham, T, *Fintech: The New DNA of Financial Services Paperback*, 2008.

Course Code	Course Name	L	T	P	C
MFB005	**DIGITAL MARKETING**	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course enables the students to understand the importance of competitive strategies for the digital marketing. This course creates awareness on the concepts of digital marketing and its impact on modern business.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the fundamental concepts of Digital Marketing	K2
CO2	Illustrate Search Engine Optimization tools and techniques	K2
CO3	Demonstrate Google AdWords and Pay Per Click	K2
CO4	Experiment Social Media Marketing and Web Analytics tools	K3
CO5	Summarize Email Marketing and Affiliate Marketing	K2

c. Course Syllabus   **Total : 45 Periods**

DIGITAL MARKETING   **9**

Introduction to Digital Marketing - Difference between traditional marketing and digital marketing - Types of digital marketing approaches - Importance of Digital Marketing - The 4p's of Marketing (Product, Price, Place and Promotion) - Different platforms for digital advertising.

SEARCH ENGINE OPTIMIZATION   **9**

Inheritance Search Engine Optimization (SEO): Definition, working, techniques - ON Page SEO: Web Site Domain, Design& Layout - OFF Page SEO: Content Writing, Verifying Web Site, SEO Tools and Techniques.

GOOGLE ADWORDS AND PAY PER CLICK   **9**

Google Adwords - Google Adwords Bidding Process, Bidding Methods - Conversion Optimizer and its working - Determination of Quality score and rank in Google Ads, Advertising on Google Adwords - Pay Per Click (PPC): Introduction, PPC - Terminology - Setting Location & Language - PPC - Measuring Results.

SOCIAL MEDIA MARKETING AND WEB ANALYTICS 9

Social Media Marketing (SMM): Facebook Marketing, Twitter Marketing, Linkedin Marketing, Google plus Marketing - Introduction Web Analytics, Web Analytics Process - Google Analytics - Web Analytics Tools (Crazy Egg).

EMAIL MARKETING AND AFFILIATE MARKETING 9

Email Marketing Overview, Mailing List - HTML & CSS Emails, Email Invitation - Landing Pages, Spam Compliance - Email Automation and Metrics - Affiliate Marketing - Tracking - Promote Merchants - Affiliate Networks.

d. Activities

Students shall be exposed to Google Tag Manager and to create the Business Website.

e. Learning Resources

Text Books

1. Rob Stokes, *eMarketing: The Essential Guide to Digital Marketing*, 5th Edition, Quirk Education, 2014.

2. Damian Ryan and Calvin Jones, *Understanding DIGITAL Marketing: Marketing strategies for engaging the digital generation*, 3rd Edition, Kogan Page, 2014.

Reference Books

1. Brian Clifton, *Advanced Web metrics with Google Analytics*, 2nd Edition, Wiley Publication, 2008.

2. Chuck Hemann and Ken Burbary, *Digital Marketing Analytics*, 2nd Edition, Que Publication, 2018.

3. Jeffery Mark, *Data-Driven Marketing: The 15 Metrics Everyone in Marketing Should Know,* 1st Edition, Wiley Publication, 2010.

Course Code	Course Name	L	T	P	C
MFB006	**LOGISTICS AND SUPPLY CHAIN MANAGEMENT**	**3**	**0**	**0**	**3**

Category: Open Elective (Minor Degree)

a. Preamble

This course enables the students to understand the importance and dynamics of a firm's physical distribution functions and management of its supply chain. This course enables the students to understand the strategic role of logistics management.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain about the value propositions, work and arrangements of Supply Chain Management	K2
CO2	Illustrate the functionality of transportation	K2
CO3	Infer the role of logistic and supply chain management in Global Economics	K2
CO4	Interpret the International Insurance Policies in Cargo Movements	K2
CO5	Explain about the pipeline transport of goods in International market segments	K2

c. Course Syllabus   **Total : 45 Periods**

INTRODUCTION   **9**

Business logistics and supply chain - Importance, objectives and drivers - Strategy - Planning, selecting proper channel, performance measurement – Outsourcing - Make vs Buy approach - Sourcing strategy.

MANAGING FLOWS   **9**

Planning Networks - Decision making under risk - Decision trees - Decision making under uncertainty - Distribution Network Design - Role - Factors Influencing Options, Value Addition - Supply Chain Network optimization models - Logistics information system - Role of IT - Framework for IT adoption.

INVENTORY AND WAREHOUSING   9

Inventory - Objectives, bullwhip effect, control - Probabilistic inventory models - Risk pooling - Vendor managed inventory - Multi-echelon inventory - Warehousing Functions - Types - Site Selection - Decision Model - Layout Design - Costing - Virtual Warehouse.

TRANSPORTATION AND PACKAGING   9

Transportation - Drivers - Modes - Measures - Strategies for Transportation, 3PL and 4PL, Vehicle Routing and Scheduling - Packaging - Design considerations, Material and Cost - Packaging as Unitisation - Consumer and Industrial Packaging.

ORGANISATION AND CONTROL   9

Organisation Structure - Need and development - Organizational - Choices, Orientation and positioning – Inter functional and inter organisational management - Alliances and partnerships - Control - Process framework, system details, information, measurement and interpretation.

d. Activities

Students shall be exposed to various functionality involved in logistics and supply chain management.

e. Learning Resources

Text Books

1. Sunil Chopra, Peter Meindl, *Supply Chain Management*, 7th Edition, Pearson Education, India, 2019.

2. Martin Christopher, *Logistics and Supply Chain Management*, 5th Edition, FT Publication, 2016.

Reference Books

1. Burt, Dobbler and Starling, *World Class Supply Management*, 7th Edition, McGraw Hill, 2017.

2. Hill Bowersox, Closs and Cooper, *Supply Chain Logistics Management*, 5th Edition, McGraw Hill, 2020.