Course Code	**Course Title**						Core/Elective
U23CM702	**DEEP LEARNING**						**Core**
Prerequisite	Contact Hours Per Week				**CIE**	**SEE**	**Credits**
Machine Learning	**L**	**T**	**D**	**P**			
	3	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

This course will enable students to

1. Understand the concept of neural networks, convolutional neural networks, and recurrent neural networks.
2. Implement deep learning algorithms, and learn how to train deep networks.
3. Gain in-depth knowledge of Tensor Flow along with its functions, operations, and the execution pipeline.
4. Understanding the major Architectures of Neural Networks and getting into the Convolutional neural Networks.
5. Understand the applications of implementing deep learning such as image processing, natural language processing

Course Outcomes:

On completion of this course, the students are able to

1. Understand the fundamentals of deep learning.
2. Demonstrate various deep learning algorithms and design neural network.
3. Train and implement a neural network.
4. Implement convolutional neural networks for checking the accuracy.
5. Apply neural networks in various fields.

UNIT - I

Introduction:

What is deep learning? Artificial intelligence, Machine learning, and Deep learning - Artificial intelligence - Machine learning – Learning representations from data - The "deep" in deep learning -Understanding how deep learning works, in three figures - What deep learning has achieved so far- The promise of AI.

UNIT - II

Neural Network: Getting started with neural networks - Anatomy of a neural network - Layers: the building blocks of deep learning Models: networks of layers - Loss functions and optimizers: keys to configuring the learning process The Neural Network-Building Intelligent Machines, The Limits of Traditional Computer Programs, The Mechanics of Machine Learning, The Neuron, Expressing Linear Perceptrons as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh.

UNIT- III

Training Feed-Forward Neural Networks - The Fast-Food Problem - Gradient Descent - The Delta Rule and Learning Rates - Gradient Descent with Sigmoidal Neurons – The Back propagation Algorithm - Stochastic and Minibatch Gradient Descent - Test Sets, Validation Sets, and Overfitting - Preventing Overfitting in Deep Neural Networks

UNIT -IV

Introduction to Major Architectures of Deep Networks–Unsupervised Pretrained Networks (UPNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Recursive Neural Networks

UNIT -V

Convolutional Neural Networks -Neurons in Human Vision - The Shortcomings of Feature Selection - Vanilla Deep Neural Networks Don't Scale - Filters and Feature

Maps – Full Description of the Convolutional Layer - Max Pooling - Full Architectural Description of Convolution Networks - Closing the Loop on MNIST with Convolutional Networks - Accelerating Training with Batch Normalization.

Suggested Readings:

1. Fundamentals of Deep Learning : Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma and Nicholas Locascio, First Edition - O'Reilly , 2017
2. Deep Learning with Python ,Francois Chollet, Second Edition, Manning Publications,2017.
3. Deep Learning: A Practitioner's Approach , Josh Patterson and Adam Gibson, First Edition - O'Reilly , 2017.

Course Code	**Course Title**						Core/Elective
U23IT701	**BIG DATA ANALYTICS**						**CORE**
Prerequisite	**Contact Hours Per Week**				**CIE**	**SEE**	**Credits**
DBMS	**L**	**T**	**D**	**P**			
	3	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

Develop ability to

1. Understand big data for business intelligence.
2. Identify name nodes and dta nodes of HDFS and can work with the file systems.
3. Work and Defend big data using NOSQL.
4. Discuss the process of data analytics using Hadoop and related tools.
5. Work with the Pig, Hive and HiveQL.

Course Outcomes

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

1. Demonstrate big data and use cases from selected business domains.
2. Implement the knowledge of NoSQL big data management with Install, configure, and run Hadoop and HDFS.
3. Apply the concept of Sharding and Map Reduce with the procedural approach
4. Analyse map-reduce analytics using Hadoop.
5. Apply big data and echo system techniques for real world

UNIT – I

Understanding Big Data: Characteristics of Data, Introduction to Big Data and its importance, Challenges posed by Big Data, Big data analytics and its classification.

Big Data Applications: big data and healthcare, big data in banking, advertising and big data, big data technologies.

UNIT – II

Hadoop Distributed File System: Hadoop Ecosystem, Hadoop Architecture, HDFS Concepts, Blocks, Namenodes and Datanodes, Hadoop FileSystems, The Java Interface, Reading Data from a Hadoop URL, Writing Data, Querying the FileSystem, Deleting Data, Anatomy of File Read and Write.

UNIT- III

NOSQL Data Management: Introduction to NOSQL, aggregate data models, aggregates key value and document data models, relationships, graph databases, schema less databases, Sharding, map reduce, partitioning and combining, composing map-reduce calculations.

UNIT – IV

Map Reduce and Yarn: Hadoop Map Reduce paradigm, Map and Reduce tasks, Job and Task trackers, Mapper, Reducer, Map Reduce workflows, classic Map-reduce, YARN – failures in classic Map-reduce and YARN – job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats.

UNIT - V

Pig: Installing and Running Pig, an Example, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators.

Hive: The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User- Defined Functions, writing a User Defined Functions.

Suggested Readings:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilly, 2012, ISBN -13: 978-1449311520, ISBN-10:1449311520
2. Pramod Sadalage, Martin Fowler, "NoSQL Distilled - A brief guide to the emerging world of polyglot", Addison Wesley 2013.
3. VigneshPrajapati, Big data analytics with R and Hadoop, 2013, ISBN -13:978- 1782163282.

Course Code	Course Title						Core/Elective
U23CM7L1	DEEP LEARNING LAB						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
ML	L	T	D	P			
	-	-	-	3	25	50	1.5

Course Objectives

Develop ability to

1. Understand the concepts of Artificial Neural Networks and Deep Learning concepts.
2. Implement ANN and DL algorithms with Tensorflow and Keras.
3. Gain knowledge on Sequence learning with RNN.
4. Gain knowledge on Image processing and analysis with CNN
5. Get information on advanced concepts of computer vision.

Course Outcomes

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

1. Develop ANN without using Machine Learning/Deep learning library
2. Understand the Training ANN model with back propagation
3. Develop model for sequence learning using RNN
4. Develop image classification model using ANN and CNN.
5. Generate a new image with auto-encoder and GAN.

List of Programs:

1. Create Tensors and perform basic operations with tensors
2. Create Tensors and apply split & merge operations and statistics operations.
3. Design single unit perceptron for classification of iris dataset without using predefined models
4. Design, train and test the MLP for tabular data and verify various activation functions and optimizers tensor flow.
5. Design and implement to classify 32x32 images using MLP using tensorflow/keras and check the accuracy.
6. Design and implement a simple RNN model with tensorflow / keras and check accuracy.
7. Design and implement LSTM model with tensorflow / keras and check accuracy.
8. Design and implement GRU model with tensorflow / keras and check accuracy.
9. Design and implement a CNN model to classify multi category JPG images with tensorflow / keras and checkaccuracy. Predict labels for new images.
10. Design and implement a CNN model to classify multi category tiff images with tensorflow / keras and check the accuracy. Check whether your model is overfit / underfit / perfect fit and apply the techniques to avoid overfit and underfit like regulizers, dropouts etc.
11. Implement a CNN architectures (LeNet, Alexnet, VGG, etc) model to classify multi category Satellite images with tensorflow / keras and check the accuracy. Check whether your model is overfit / underfit / perfect fit and apply the techniques to avoid overfit and underfit.
12. Implement an Auto encoder to de-noise image.
13. Implement a GAN application to convert images

Suggested Readings:

1. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.H., and Van Loan, C.F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw Hill Education, 2004.

Course Code	Course Title						Core/Elective
U23IT7L2	BIG DATA ANALYTICS LAB						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
DBMS	L	T	D	P			
	-	-	-	3	25	50	1.5

Course Objectives

Develop ability to

1. Understand how to setup a Hadoop Cluster
2. Work with mappings and to develop programs using MapReduce Techniques
3. Learn file handling in HDFS
4. Work with the NOSQL and can differentiate between SQL and NOSQL
5. Implement Pig, PigLatin and HiveQL to process big data.

Course Outcomes

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

1. Understand and work with the Hadoop working environment
2. Work with big data applications in multi node clusters
3. Write scripts using Pig to solve real world problems
4. Write queries using Hive to analyse the datasets
5. Apply big data and echo system techniques for real world

List of Experiments

1. Understanding and using basic HDFS commands.
2. Word count application using Mapper Reducer on single node cluster.
3. Working with files in Hadoop file system: Reading, Writing and Copying.
4. Develop a MapReduce program to implement Matrix Multiplication.
5. Develop a MapReduce program to find the maximum temperature in each year.
6. Implement a MapReduce program to find the grades of students.
7. Detect Suspicious Login Patterns using Pig Latin.
8. Develop Pig Latin Scripts to sort, group, join, project and filter the data.
9. Use and implement hive to analyze user usage of system data.
10. Implement User Defined functions for Data cleaning and Format transformation in Hive

Suggested Readings:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, April 2015.
2. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.

Course Code	Course Title						Core/Elective
U23CR7P1	PROJECT PHASE-I						PROJ
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mini Project, Programming Langauges	-	-	-	4	50	-	2

Course Objectives:

Develop ability to:

1. Enhance practical and professional skills
2. Familiarize tools and techniques of systematic literature survey and documentation
3. Expose the students to industry practices and team work.
4. Encourage students to work with innovative and entrepreneurial ideas
5. Obtain knowledge of societal and environmental related areas.

Course Outcomes:

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

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Analyse various modules pertaining to the sub routines of the projects.
4. Effectively plan a project and confidently perform all aspects of project management.
5. Demonstrate effective written and oral communication skills.

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester. The department will appoint a project coordinator who will coordinate the following:

1. Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
2. Grouping of students (max 3 in a group)
3. Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent

on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide. Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

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

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

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

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

Course Code	Course Title						Core/Elective
U23CR701	NATURAL LANGUAGE PROCESSING						Professional Elective-II
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
DBMS	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Understand the leading trends and systems in natural language processing.
2. Understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
3. Identify the significance of pragmatics for natural language understanding.
4. Understand the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing

Course Outcomes

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

1. Interpret linguistic phenomena and an ability to model them with formal grammars.
2. Apply and analyze proper experimental methodology for training and evaluating empirical NLP systems.
3. Interpret the morphemes, syntax and semantics of a language.
4. Apply probabilistic approaches, construct statistical models over strings and trees and estimate parameters using supervised and unsupervised training methods.
5. Design, implement and apply NLP Algorithms.

Unit- I Introduction: What is Natural Language Processing? NLP tasks in syntax, semantics and pragmatics, Applications such as information extraction, question answering and machine translation. The problem of ambiguity. The role of Machine Learning. Brief history of the field.

Unit -II N-gram Language Models: The role of language models, Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Parts of Speech Tagging and Sequence Labelling: Lexical Syntax, Hidden Markov Models, Maximum Entropy models and Conditional Random Fields.

Unit -III Syntactic Parsing:Grammar Formalisms and tree banks, Efficient parsing for Context Free Grammars(CFGs), Statistical Parsing and probabilistic CFGs(PCFGs) and Lexicalized PCFGs.

Unit –IV Semantic Analysis: Lexical Semantics and word sense disambiguation, Compositional semantics, Semantic Role Labelling and Sematic Parsing.

Unit- V Information Extraction(IE) and Machine Translation(MT): Named Entity recognition and relation extraction, IE using sequence labelling, Basic issues in Machine Translation. Statistical translation, word alignment, phrase based translation, and synchronous grammars. Dialogues: Turns and utterances Natural Language Generation: Introduction to language generation, architecture, discourse planning, grounding, dialogue acts and structures.

Suggested Readings:

1. Speech and Language Processing- An introduction to Language Processing, Computational Linguistics, and Speech Recognition, D.Jurafsky, J. H. Martin, Pearson Education.
2. Foundation of Statistical Naturl Language Processing, Manning and Schutze.
3. Natural Language Understanding, Allen, James Benjamin/Cummings, 2ed.
4. Natural Language Processing – A Pananian Perspective, Bharathi, A., Vineet Chaitanya and Rajiv
5. Sangal, Prentice H11 India, Eastern Economy Edition.

Course Code	Course Title						Core/Elective
U23IT702	DESIGN PATTERNS						Professional Elective-II
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
SE	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Understand the concept of Design patterns and its importance .
2. Understand the behavioral knowledge of the problem and solutions.
3. Relate the Creational, Structural , behavioral Design patterns.
4. Apply the suitable design patterns to refine the basic design for given context.

Course Outcomes

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

1. Identify the appropriate design patterns to solve object oriented design problems.
2. Develop design solutions using creational patterns.
3. Apply structural patterns to solve design problems.
4. Construct design solutions by using behavioral patterns.

UNIT 1 Introduction: What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT 2 A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation.

UNIT 3 Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton.

UNIT 4 Structural Patterns: Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.

UNIT 5 Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, Strategy, Template Method, Visitor. Conclusion: What to Expect from Design Patterns, The Pattern Community

Text Books

1. Design Patterns By Erich Gamma, Pearson Education
2. Design Patterns Explained By Alan Shalloway,Pearson Education..
3. Meta Patterns designed by Wolf gang , Pearson.

References

1. Head First Design Patterns By Eric Freeman-Oreilly-spd
2. JAVA Enterprise Design Patterns Vol-III By Mark Grand ,Wiley DreamTech.
3. Pattern‟s in JAVA Vol-I By Mark Grand ,Wiley DreamTech.
4. Pattern‟s in JAVA Vol-II By Mark Grand ,Wiley DreamTech

Course Code	Course Title						Core/Elective
U23CR703	DATA WAREHOUSING						Professional Elective-II
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
DBMS	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Understand data warehouse concepts and architecture.
2. Differentiate ETL, OLTP, and OLAP systems.
3. Design data warehouse models and schemas.
4. Analyze metadata, data marts, and partitioning strategies.
5. Understand warehouse system and process management.

Course Outcomes

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

1. Explain data warehouse architecture, components, and modern warehouse concepts.
2. Compare ETL and ELT processes and evaluate OLAP operations and types for analytical processing.
3. Design dimensional models using star, snowflake, and fact constellation schemas.
4. Analyze metadata, data marts, and partitioning strategies for performance optimization.
5. Apply system and process management techniques for efficient data warehouse implementation and maintenance.

UNIT I: INTRODUCTION TO DATA WAREHOUSE :Data Warehousing

Data warehouse Introduction – Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture – Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake – Modern Data Warehouse

UNIT II: ETL AND OLAP TECHNOLOGY

What is ETL – ETL Vs ELT – Types of Data warehouses – Data warehouse Design and Modeling – Delivery Process – Online Analytical Processing (OLAP) – Characteristics of OLAP – Online Transaction Processing (OLTP) Vs OLAP – OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

UNIT III: META DATA, DATA MART AND PARTITION STRATEGY Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management – Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting– Horizontal Partition

UNIT IV DIMENSIONAL MODELING AND SCHEMA

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition – Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools

UNIT V : SYSTEM & PROCESS MANAGERS

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager – System Event Manager – System Database Manager – System Backup Recovery Manager – Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing

Suggested Readings:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013
3. Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
4. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006

Course Code	Course Title						Core/Elective
U23CR704	WIRELESS SENSOR NETWORKS						Professional Elective-II
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
CN	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. To understand the characteristics, basic concepts in Wireless sensor networks
2. To understand the architecture framework and goals of WSN
3. To understand the Medium Access control and its protocols
4. To understand the routing metrics and network layer protocols
5. To understand the QoS based routing protocols **Course Outcomes**

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

1. Understand the challenges, design goals and architecture of Wireless sensor networks
2. Understand the channel encoding and modulation mechanism.
3. Understand the contention free and contention based MAC protocols.
4. Understand the routing metrics and protocols of Network layer
5. Understand the QoS based routing protocols

UNIT - I: Introduction: Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture.

UNIT - II: Basic Architectural Frame-work:-Physical Layer, Basic Components, Source Encoding, Channel Encoding, Modulation. Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT - III: Medium Access Control: : Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC B-Tech CSE(Emerging Technologies)-IoT WSN Page 2 Protocols, Contention-Based MAC Protocols, and Hybrid MAC Protocols. Location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

UNIT - IV: Network Layer: Routing Metrics, Flooding and Gossiping, DataCentric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing.

UNIT - V: QoS-Based Routing Protocols:Node and Network Management: Power Management, Local Power Management aspects, Dynamic Power Management, Conceptual Architecture

TEXTBOOKS:

1. WaltenegusDargie, Christian Poellabauer, ―Fundamentals of Wireless Sensor Networks: Theory and Practice‖, Wiley 2010
2. Mohammad S. Obaidat, Sudip Misra, ―Principles of Wireless Sensor Networks‖, Cambridge, 2014
3. LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
4. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers

Suggested Readings:

1. Ian F. Akyildiz, Mehmet Can Vuran , ―Wireless Sensor Networks‖, Wiley 2010
2. C S Raghavendra, K M Sivalingam, TaiebZnati, ―Wireless Sensor Networks‖, Springer, 2010
3. C. Sivarmmurthy& B.S. Manoj, ―Adhoc Wireless Networks‖, PHI-2004
4. FEI HU., XIAOJUN CAO, ―Wireless Sensor Networks‖, CRC Press, 2013
5. Feng ZHAO, Leonidas GUIBAS, ― Wireless Sensor Networks‖, ELSEVIER , 2004 B-Tech

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6. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning

7. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , ArshdeepBahga 8. Designing the Internet of Things , Adrian McEwen (Author), HakimCassimally

Course Code	Course Title						Core/Elective
U23CR705	COMPUTER VISION						Professional Elective-III
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Python, ML	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. To introduce the fundamentals of image formation
2. To provide understanding of segmentation and Augmentation techniques in Computer Vision
3. To Identify and interpret appropriate sources of information relating to computer vision.
4. To analyse, evaluate and examine existing practical computer vision
5. To Design and develop practical and innovative image processing and computer vision applications.

Course Outcomes

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

1. Understand the fundamental concepts in computer vision.
2. Apply segmentation and augmentation techniques and descriptors.
3. Identify and interpret appropriate sources of information relating to computer vision.
4. Analyse, evaluate and examine existing practical computer vision
5. Design and develop practical and innovative image processing and computer vision applications

UNIT – I Introduction to Computer Vision and Basic Concepts of Image Formation: Introduction and Goals of Computer Vision and Image Processing, Image Formation Concepts, Fundamental Concepts of Image Formation: Radiometry, Geometric Transformations, Geometric Camera Models.

UNIT – II Fundamental Concepts of Image Formation: Camera Calibration, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projections. Image Processing Concepts: Image Transforms, Image Transforms, Image Enhancement, Image Filtering, Color Image Processing, Image Segmentation.

UNIT - III Image Descriptors and Features: Texture Descriptors, Colour Features, Edges/Boundaries, Object Boundary and Shape Representations, Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency.

UNIT - IV Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.

UNIT – V Applications of Computer Vision: Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, Autoencoders, Gesture Recognition, Motion Estimation and Object Tracking, Programming Assignments.

Suggested Reading:

1. Manas kamal Bhuyan, “computer vision and image processing fundamentals and applications”, Taylor and Francis,2020
2. David A. Forsyth,“ COMPUTER VISION A MODERN APPROACH.”, Pearson 2012
3. Richard szeliski, “computer vision algorithms and Applications”, second Edition, springer 2022
4. E.R.Devis, “Computer and Machine Vision: Theory, Algorithms, Practicalities, Fourth edition, Appress, 2012

Course Code	Course Title						Core/Elective
U23CR706	AGILE METHODOLOGIES						Professional Elective-III
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
SE	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. understand agile software development process models and plan driven process models.
2. To understand software project characteristics that would be suitable for an agile process.
3. To impart and Identify software project characteristics that would not be suitable for an agile process.
4. To implement a small scale software project using the Scrum process methodology to introduce characteristics of an agile development process.

Course Outcomes

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

1. Define the common characteristics of an agile development process.
2. List and contrast state of the practice agile methodologies.
3. Contrast agile software development process models and plan driven process models.
4. Identify software project characteristics that would be suitable for an agile process.
5. Identify software project characteristics that would not be suitable for an agile process.

UNIT 1: Introduction to Agile Methodologies

History of Agile Methodologies, Agile and Lean Software Development: Basics and Fundamentals, Extreme Programming, Scrum, Agile and Scrum Principles Agile Manifesto, Twelve Practices of XP

Unit 2: Agile Estimation & Planning

Agile Estimation concepts – Story points and estimation techniques – Planning Poker – Velocity and its importance – Release planning and iteration (Sprint) planning – Agile Requirements Engineering – User Stories (format, examples) – Acceptance criteria – Backlog management (Product backlog, Sprint backlog) – Prioritization techniques – Agile Architecture basics – Emergent design – Refactoring concepts.

UNIT 3: Tracking Agile Projects and Lean Development

Agile project tracking – Burn-down charts and burn-up charts – Velocity tracking – Daily Scrum meetings – Sprint review and Sprint retrospective – Lean Software Development principles – Eliminating waste – Continuous improvement – Agile Risk Management – Risk identification, assessment, and mitigation – Handling changing requirements in Agile.

UNIT 4: Agile Project Tools and Continuous Integration

Agile project management tools – Task boards (Scrum board, Kanban board) – Issue tracking tools – Version control basics – Continuous Integration (CI) concepts – Build and integration process – Frequent code integration – Automated builds – Introduction to Continuous Delivery (basic idea) – Importance of collaboration tools in Agile.

UNIT 5: Agile Testing and Scaling Agile

Agile testing principles – Testing in Scrum lifecycle – Test-driven development (TDD) basics – Unit testing and integration testing – Continuous testing – Regression testing – Defect tracking – Scaling Agile for large projects – Scrum of Scrums – Distributed Agile teams – Challenges in large-scale Agile adoption.

Suggested Readings:

1. Agile Development with Scrum, Ken Schwaber & Mike Beedle, Prentice Hall, 2001
2. Integrating Agile Development in the Real World, Peter Schuh, Charles River Media, 2005
3. Agile Software Development – The Cooperative Game (2nd Edition), Alistair Cockburn, 2007
4. Succeeding With Agile, Software Development Using Scrum, Mike Cohn, Addison Agile Methodologies 2024-2025 Wesley, 2010 SDLC 3.0 Beyond a Tacit Understanding of Agile, Mark Kennaley, Fourth Medium Press, 2010

Course Code	Course Title						Core/Elective
U23CR707	STATISTICAL LEARNING						Professional Elective-III
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
ML, M-III	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. To introduce fundamental concepts of probability and random variables relevant to statistical learning.
2. To provide basic understanding of concentration inequalities and their role in analyzing data variability.
3. To explain the principles of statistical learning including ERM, bias–variance tradeoff, and generalization.
4. To introduce learning theory concepts such as PAC learning and VC dimension at a conceptual level.
5. To familiarize students with kernel methods, dimensionality reduction, and real-world applications of statistical learning.

Course Outcomes

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

1. Explain probability concepts, random variables, and basic inequalities used in statistical learning.
2. Interpret the concept of concentration of measure and its role in bounding learning errors.
3. Apply fundamental statistical learning principles such as ERM and bias–variance tradeoff.
4. Analyze learning models using concepts of PAC learning, VC dimension, and model complexity.
5. Apply kernel methods and dimensionality reduction techniques to real-world problems.

UNIT – I: Basics of Probability and Random Variables

Probability concepts – Random variables (discrete & continuous) – PMF, PDF, CDF – Expectation and variance – Common distributions (Gaussian, Bernoulli) – Introduction to sequences of random variables – Basic inequalities: Markov and Chebyshev.

UNIT – II: Introduction to Concentration of Measure

Idea of concentration of measure – Intuition in high dimensions – Chernoff bound (basic idea) – Hoeffding inequality (concept) – Applications in bounding errors – Simple examples using Bernoulli and Gaussian variables.

UNIT – III: Foundations of Statistical Learning

Learning framework – Supervised learning basics – Empirical Risk Minimization (ERM) – Overfitting and underfitting – Bias–variance tradeoff – Introduction to generalization.

UNIT – IV: Learning Theory Concepts

Basic idea of PAC learning (intuitive) – VC dimension (concept only, no proofs) – Model complexity and generalization – Trade-off between accuracy and complexity – Practical implications.

UNIT – V: Kernel Methods and Applications

Linear classification – Support Vector Machines (basic idea) – Kernel trick (intuitive) – PCA for dimensionality reduction – Applications of statistical learning in real-world problems.

Suggested Reading:

1. An Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 2nd Edition.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 2nd Edition.
3. Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
4. Mathematics for Machine Learning, Cambridge University Press, 2020.
5. Pattern Recognition and Machine Learning, Springer, 2006.
6. Practical Statistics for Data Scientists, O'Reilly, 2nd Edition.

Course Code	Course Title						Core/Elective
U23CR708	NETWORK PROTOCOLS						Professional Elective-III
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
CN	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Understand fundamentals of data communication, protocols, and network models.
2. Analyze multiplexing techniques and ATM architecture.
3. Understand data transmission methods and error control mechanisms.
4. Examine internetworking concepts, IP addressing, and routing protocols.
5. Understand application layer protocols and network services.**Course Outcomes**

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

1. Explain data communication concepts, protocols, and ISO/OSI model.
2. Analyze multiplexing techniques and ATM communication.
3. Evaluate data transmission methods and network types.
4. Analyze IP addressing, routing, and firewall mechanisms.
5. Apply knowledge of application layer protocols for network communication.

UNIT - I Data Communication networks & Open System Standards: Data Communication Networks, Protocols & Standards, Open Systems, ISO Reference Model, Switching & Switching Elements

UNIT - II Multiplexing: FDM, STDM; i.e Synchronous & Statistical Time Division Multiplexing. ATM Protocol Architecture, ATM Logical Connection, ATM Cells, Transmission of ATM Cells, ATM Service categories, ATM adaptation Layer.

UNIT - III Data Transmission: Data Transmission basics, Asynchronous Transmission, Synchronous Transmission, Error Detection & Control, Data Link Control Protocols. Local Area Networks & Wide Area Networks: Wired LANs, Wireless LANs & Protocols, Performance, High Speed LANs: FDDI, Fast Ethernet, Packet Switched & Circuit Switched Networks, X.25 Networks, ISDN.

UNIT - IV Internetworking and Firewalls: Introduction, Subnet & Subnet Architecture, Internetworking Architectures & Issues, Internet Protocol Standards, IPv4, IPng, ICMPv4, ICMPv6, Routing Protocols, Firewalls Basics.

UNIT - V Application Layer Protocols: Basics, Commands: TCP, UDP, FTP, TFTP, TELNET, Ping, Trace route, SMTP, POP3, SNMP, Time Protocol, NNTP.

Suggested Reading:

1. Data Communications & Networking, Forouzan, Tata McGraw 2nd Edition 2006. 2. Data Communications, Computer & Computer Networks & Open Systems, Fred Halsall, Pearson Education 2006 edition.
2. Stallings William, Data and Computer Communication, Pearson.

Course Code	Course Title						Core/Elective
U23CR801	EDGE COMPUTING						Professional Elective-IV
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Computer Networks	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Introduce fundamental concepts and architectures of Edge Computing.
2. Analyze IoT architectures and their integration with Edge Computing using real-world scenarios.
3. Develop practical knowledge of Raspberry Pi hardware, configuration, and interfacing.
4. Implement edge-to-cloud communication using MQTT and related protocols.
5. Explore industrial and commercial applications of Edge Computing systems.

Course Outcomes

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

1. Explain Edge Computing concepts, architectures, and differentiate Edge and Fog computing models.
2. Apply IoT architectures and analyze real-world Edge-enabled IoT systems.
3. Configure and interface Raspberry Pi with sensors and peripherals for edge applications.
4. Implement and analyze MQTT-based communication for edge-to-cloud integration.
5. Design Edge Computing solutions for industrial and commercial IoT use cases.

UNIT- I: IoT AND EDGE COMPUTING DEFINITION AND USE CASES

Introduction to Edge Computing Scenario's and Use cases- Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge *vs* Fog Computing, Communication Models-Edge, Fog and M2M

UNIT- II: IoT ARCHITECTURE AND CORE IoT MODULES

A Connected ecosystem, IoT versus machine-to-machine versus, SCADA, The value of Network and Metcalfe's and Beckstroms's laws, IoT and Edge Architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study-Telemedicine palliative care, Requirements, Implementation, Use case retrospective.

UNIT- III: RASBERRYPi

RasberryPi: Introduction to RasberryPi, About RasberryPi Board, Hardware Layout and Pin outs, Operating systems on RasberryPi, Configuring RasberryPi, Programming RasberryPi, Connecting RasberryPi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera.

UNIT- IV: INTERFACING RASBERRYPi & MQTT

Implementation of Microcomputer RasberryPi and device Interfacing, Edge to Cloud Protocols- MQTT Protocols, MQTT publish-subscribe, MQTT Architecture, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.

UNIT- V: EDGE COMPUTING WITH RASBERRYPi

Edge Computing with RasberryPi, Industrial and Commercial IoT and Edge, Edge Computing and solutions.

Suggested Readings:

1. IoT Edge Computing for Architects –Second Edition, by Perry Lea, Publisher: Packet Publishing, 2020.
2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc.

Course Code	Course Title						Core/Elective
U23CR802	SCALABLE ARCHITECTURES						Professional Elective-IV
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Computer Networks	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Learn the fundamentals of Scalable Architecture.
2. Understand the various Overview of Hadoop and Current Big Data Systems
3. Understand the Anatomy of Fast Data Applications
4. Understand the Compute Engines-.
5. Understand the Deployment environments for Fast Data Applications

Course Outcomes

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

1. Learn the fundamentals of Scalable Architecture.
2. Understand the various Overview of Hadoop and Current Big Data Systems
3. Implement the Anatomy of Fast Data Applications
4. Analyze the Compute Engines.
5. Understand the Deployment environments for Fast Data Applications

UNIT – I Introduction to scalable applications, challenges with running applications using Machine Learning with scaling, Algorithms for Large scale Learning.

UNIT – II Overview of Hadoop and Current Big Data Systems. How Programming for Data Flow Differs, Basic Spark, Working with Vectors and Matrices in Spark, Brief tour of Spark ML, Beyond parallelization, Practical Big Data.

UNIT- III Anatomy of Fast Data Applications, SMACK Stack - Functional Decomposition, Message BackboneUnderstanding messaging requirements, Data ingestion, Fast data& low latency, Message Delivery Semantics, Distributing Messages.

UNIT – IV Compute Engines- Micro Batch Processing, One-at-a time Processing, Choice of processing engine, Storage as the Fast Data Borders, The message backbone as Transition Point.

UNIT - V Sharing Stateful Streaming State, Data Driven Micro-services, State and Micro-services. Deployment environments for Fast Data Applications, Application containerization, resoufce scheduling, Apache Mesos, Kubernetes, Cloud Deployments.

Suggested Readings:

1. Jan Kunigk, Ial Buss, Paul Wilkinson & Lars George," Architecting Modem Data Platforms", O"reilly, 20 I 9.
2. Gerard Maas, Stavros Kontopoulos, Sean Glover, "Designing Fast Data Application Architectures", O'Reilly Media, Inc., June 2018.
3. Bill Chambers, Matei Zaharia "Spark- The definitive Guide", O'Reilly Media, Inc., June 2019.

Course Code	Course Title						Core/Elective
U23CR803	DATA VISUALIZATION						Professional Elective-IV
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Python	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. To learn different statistical methods for Data visualization.
2. To learn basics of R and Python.
3. To learn usage of Watson studio.
4. To learn about packages Numpy, pandas and matplotlib.
5. To learn functionalities and usages of Seaborn.

Course Outcomes

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

1. Apply statistical methods for Data visualization.
2. Gain knowledge on R and Python
3. Understand usage of various packages in R and Python.
4. Demonstrate knowledge of Watson studio.
5. Apply data visualization tools on various data sets.

DATA VISUALIZATION

UNIT I Introduction to Statistics: Introduction to Statistics, Difference between inferential statistics and descriptive statistics, Inferential Statistics- Drawing Inferences from Data, Random Variables, Normal Probability Distribution, Sampling, Sample Statistics and Sampling Distributions. R overview and Installation- Overview and About R, R and R Studio Installation, Descriptive Data analysis using R, Description of basic functions used to describe data in R.

UNIT II Data manipulation with R: Data manipulation packages, Data visualization with R. Data visualization in Watson Studio: Adding data to data refinery, Visualization of Data on Watson Studio

UNIT III Python: Introduction to Python, How to Install, Introduction to Jupyter Notebook, Python scripting basics, Numpy and Pandas.

UNIT IV Data Visualization Tools in Python- Introduction to Matplotlib, Basic plots using matplotlib, Specialized Visualization Tools using Matplotlib, Advanced Visualization Tools using Matplotlib Waffle Charts, Word Clouds.

UNIT V Introduction to Seaborn: Seaborn functionalities and usage, Spatial Visualizations and Analysis in Python with Folium, Case Study.

Suggested Reading:

1. Core Python Programming - Second Edition, R. Nageswara Rao, Dream tech Press.
2. R Graphics Essentials for Great Data Visualization by Alboukadel Kassambara.

Course Code	Course Title						Core/Elective
U23CR804	CRYPTOGRAPHY AND NETWORK SECURITY						Professional Elective-IV
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
CN	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Discuss fundamentals of IoT and its applications and requisite infrastructure
2. Describe Internet principles and communication technologies relevant to IoT
3. Discuss hardware and software aspects of designing an IoT system
4. Describe concepts of cloud computing and Data Analytics
5. Discuss business models and manufacturing strategies of IoT products

Course Outcomes

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

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT
3.Design simple IoT systems with requisite hardware and C programming software
4.Understand the relevance of cloud computing and data analytics to IoT
5.Comprehend the business model of IoT from developing a prototype to launching a product

UNIT – I Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT – II Symmetric key Ciphers:Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange.

UNIT – III Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service.

UNIT – IV Transport-level Security:Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

UNIT – V E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations.

Suggested reading:

1. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition
2. Cryptography and Network Security: AtulKahate, Mc Graw Hill, 3rd Edition

Course Code	Course Title						Core/Elective
U23CR805	GENERATIVE AI						Professional Elective-V
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Machine Learning	3	-	-	-	40	60	3

Course Objectives:
Develop ability to
1. Learn the fundamental concepts of Generative AI.
2. Acquire the knowledge of encoders, decoders and autoregressive models.
3. Acquire the knowledge of various generative models for image generation, style transfer and text generation.
4. Learn to apply transforms, prompt engineering and APIs for real world problems.
5. Learn to implement develop application using chat GPTs and open API.

Course Outcomes
At the end of the course, student would be able to
1. Understand the fundamental concepts and significance of Generative AI and the unique challenges associated with generative models.
2. Learn the structure, function, and applications of autoencoders and autoregressive models in machine learning.
3. Understand the principles, architecture, and applications of Generative Adversarial Networks for image generation and style transfer.
4. Grasp the architecture and functionality of transformers, and apply prompt engineering techniques using Hugging Face pretrained transformers and APIs.
5. Explore the advancements, capabilities, and practical applications of GPT models, including developing a GPT-3 powered question-answering application.

UNIT-I
Introduction: An Introduction to Generative AI, Applications of AI, The rules of Probability, Why use generative models, Unique challenges of generative models.

UNIT-II
Auto Encoders and Autoregressive Models: Auto encoders, Regularized autoencoders, Stochastic Encoders and Decoders, Autoregressive Models, Fully Visible Sigmoid Belief Network (FVSBN), Neural Autoregressive Density Estimation (NADE), Masked Autoencoder for Distribution Estimation (MADE)

UNIT-III
Generative Adversarial Network: Generative Adversarial Networks, Vanilla GAN, Progressive GAN, Style transfer and Image transformation, Image Generation with GANs, Style Transfer with GANs

UNIT-IV
Transformers and Prompt Engineering: Transformers, Large Language Models, MLM/NSP, Generative Pretrained Transformers (GPT), Task-Specific GPT Fine Tuning, Prompt Engineering, Hugging Face pretrained Transformers, Hugging Face APIs

UNIT-V
Chat GPTs and OpenAI GPT 3, 3.5, 4, OpenAI APIs, working with the OpenAI Playground, Application and Use Cases: Content Filtering, Generating and Transforming Text, Classifying and Categorizing Text, building a GPT-3 Powered Question Answering App

Suggested Readings:
1. Steve Tingiris, Exploring GPT-3, Packt Publishing Ltd. UK, 2021
2. Joseph Babcock, Raghav Bali, Generative AI with Python and TensorFlow 2, Packt Publishing Ltd. UK, 2021

Course Code	Course Title						Core/Elective
U23CR806	SOFTWARE PROJECT MANAGEMENT						Professional Elective-V
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Understand the Software Project Planning and Evaluation techniques.
2. Plan and manage projects at each stage of the software development life cycle (SDLC).
3. Learn about the activity planning and risk management principles
4. Manage software projects and control the software deliverables.
5. Learn the management of activities of various phases involved in also learn how to allocate the right job to right people.

Course Outcomes

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

1. Gain extensive knowledge about the basic project management concepts framework and the process models.
2. Demonstrate and apply the Project Management principles while developing software.
3 Apply software project metrics to estimate the software Efforts, Duration, Cost, and Staff Size, using various estimation techniques.
4.Identify, Analyze, categorize, Estimate and Manage the risks involved in various project activities
5.Learn and practice the staff selection process and the issues related to people management

UNIT – I
Project Evaluation And Project Planning: Importance of Software Project Management Activities Methodologies – Categorization of Software Projects, Setting objectives, Management Principles, Management Control – Project portfolio Management – Cost-benefit evaluation technology, Risk evaluation, Strategic program Management – Stepwise Project Planning

UNIT – II Project Life Cycle And Effort Estimation: Software Process and Process Models, Choice of Process models, mental delivery, Rapid Application Development, Agile methods, Extreme Programming, SCRUM, Managing interactive processes, Basics of Software estimation, Effort and Cost estimation techniques, COSMIC Full function points - COCOMO II, Parametric Productivity Model, Staffing Pattern.

UNIT- III Activity Planning And Risk Management: Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Network Planning models, Forwardass & Backward Pass techniques, Critical path (CRM) method, Risk identification, Assessment, Monitoring, PERT technique, Monte Carlo simulation, Resource Allocation, Creation of critical patterns, Cost schedules.

UNIT – IV Project Management And Control : Framework for Management and control, Collection of data Project termination,Visualizing progress,Cost monitoring, Earned Value Analysis, Project tracking, Change controlSoftware Configuration Management, Managing contracts- Contract Management.

UNIT - V Staffing In Software Projects: Managing people, Organizational behavior, Best methods of staff selection, Motivation, The Oldham-Hackman job characteristic model, Ethical and Programmed

concerns, Working in teams, Decision making, Team structures, Virtual teams, Communications genre, Communication plans

Suggested Readings: 1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012. 2. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication,2011.

Course Code	Course Title						Core/Elective
U23CR807	DEVOPS						Professional Elective-V
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
CC,SE	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Understand DevOps principles, Agile models, and continuous delivery practices.
2. Analyze DevOps lifecycle and its impact on software architecture.
3. Explore source code management and version control systems.
4. Understand build automation and continuous integration tools.
5. Explore testing, deployment, and automation tools in DevOps.

Course Outcomes

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

1. Explain DevOps concepts, Agile practices, and delivery pipelines.
2. Analyze DevOps lifecycle and architectural considerations like microservices.
3. Apply version control systems and collaborative development practices.
4. Implement build automation and continuous integration using tools like Jenkins.
5. Apply testing and deployment tools for automated software delivery.

UNIT - I Introduction: Introduction, Agile development model, DevOps, and ITIL. DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

UNIT - II Software development models and DevOps: DevOps Lifecycle for Business Agility, DevOps, and Continuous Testing. DevOps influence on Architecture: Introducing software architecture, The monolithic scenario, Architecture rules of thumb, The separation of concerns, Handling database migrations, Microservices, and the data tier, DevOps, architecture, and resilience.

UNIT - III Introduction to project management: The need for source code control, The history of source code management, Roles and code, source code management system and migrations, Shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, GitLab.

UNIT - IV Integrating the system: Build systems, Jenkins build server, Managing build dependencies, Jenkins plugins, and file system layout, The host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.

UNIT - V Testing Tools and automation: Various types of testing, Automation of testing Pros and cons, Selenium - Introduction, Selenium features, JavaScript testing, Testing backend integration points, Test-driven development, REPL-driven development Deployment of the system: Deployment systems, Virtualization stacks, code execution at the client, Puppet master and agents, Ansible, Deployment tools: Chef, Salt Stack and Docker

Suggested Reading:

1. Joakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN10: 1788392574 2. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952

Course Code	Course Title						Core/Elective
U23CR808	SOFTWARE DEFINED NETWORKS						Professional Elective-V
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
CN	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives

Develop ability to

1. Learn the fundamentals of software defined networks.
2. Gain the separation of the data plane and the control plane.
3. Aware of data centers in software defined networks
4. Learn about the SDN Programming.
5. Observe the various applications of SDN
1.

Course Outcomes

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

1. Analyze the evolution of software defined networks.
2. Express the various components of SDN and their uses.
3. Explain the use of SDN in the current networking scenario.
4. Develop the SDN programming using current language and tools
5. Design and develop various applications of SDN

UNIT-I

INTRODUCTION: History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes

UNIT-II

OPEN FLOW & SDN CONTROLLERS: Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor- Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts.

UNIT-III

DATA CENTERS: Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

UNIT-IV

SDN PROGRAMMING: Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications

UNIT-V

SDN Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

Suggested reading:

1 Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks”, O'Reilly Media, August 2013.
2 Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, First Edition, Morgan Kaufmann, June 2014.

REFERENCES:

1 Siamak Azodolmolky, “Software Defined Networking with Open Flow”, Packet Publishing, 2013.
2 Vivek Tiwari, “SDN and Open Flow for Beginners”, Amazon Digital Services, Inc., 2013.
3 Fei Hu, Editor, “Network Innovation through Open Flow and SDN: Principles and Design”, CRC Press, 201