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(Under Maharashtra Act No. XXIX of 2014)
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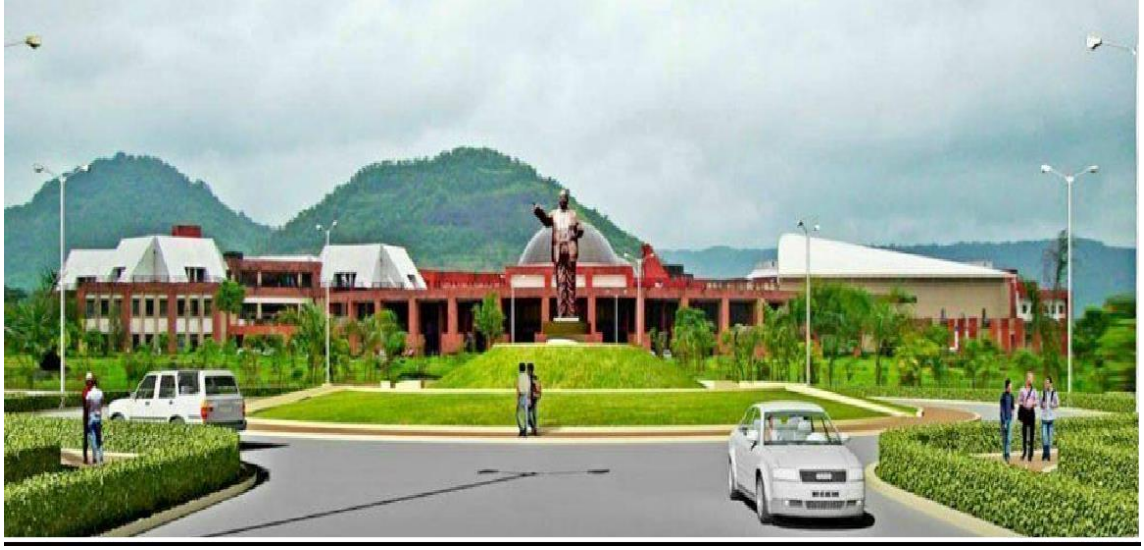
# CURRICULUM UNDER GRADUATE PROGRAMME FOR B. TECH

## COMPUTER SCIENCE AND DESIGN

**WITH EFFECT FROM THE ACADEMIC YEAR**
**B.Tech: 2024-2025**



# Course Structure for Final Year
# B. Tech in Computer Science and Design

| Semester VII ( Term 7) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| | | Natural Language Processing | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| | | Advanced Computer Vision | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| | | Data Science Optimization Techniques | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| | | **Elective -VI** | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| | | 1. Real Time Systems | | | | | | | | |
| | | 2. Cryptography and Network Security | | | | | | | | |
| | | 3. Virtual Reality | | | | | | | | |
| | | 4. Full Stack Development | | | | | | | | |
| | | **Elective- VII** | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| | | 1. Design Thinking | | | | | | | | |
| | | 2. Block chain Technology | | | | | | | | |
| | | 3. Bioinformatics | | | | | | | | |
| | | 4. Mobile Application Development | | | | | | | | |
| | | Foreign Language Studies* | - | - | 4 | - | - | - | - | Audit |
| | | Natural Language Processing & Data Engineering Lab | - | - | 4 | 60 | - | 40 | 100 | 2 |
| | | Project Phase – I | - | - | | 60 | - | 40 | 100 | 2 |
| | | Field Training / Internship / Industrial Training – III (Evaluation) | - | - | - | - | - | - | - | Audit |
| | | | **15** | **-** | **8** | **220** | **100** | **380** | **700** | **19** |

*Any Foreign language can be opted by the students as per their need /demand conducted in online or offline mode by the institute.

| Semester VIII ( Term 8) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| | | Project Phase – II (In-house) / Internship and Project in Industry | - | - | 24 | 60 | - | 40 | 100 | 12 |
| | | | **-** | **-** | **24** | **60** | **-** | **40** | **100** | **12** |

## Semester –VII

# Natural Language Processing

| | | | | |
|---|---|---|---|---|
| | **Natural Language Processing** | | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:**

**Course Objectives:**
To explore Natural Language Processing (NLP) methods and applications, gaining insights into language understanding, sentiment analysis, and text generation for innovative advancements.

**Course Outcomes:**
On completion of the course, students will be able to:

| | |
|---|---|
| CO1 | Understand the basics of Natural language processing. |
| CO2 | Analyze the different language models and vector semantics. |
| CO3 | Understand the sequence labelling for text analysis. |
| CO4 | Implement text classification and sentiment analysis systems. |
| CO5 | Implement recurrent network for language models and illustrate the NLP applications. |

**Course Contents:**

**Unit No 1: Introduction to NLP [7 Hours]**
Definition and scope of NLP, Applications and real-world examples of NLP, Linguistic Fundamentals, Regular Expressions, Words, Corpora, Text Normalization: Tokenization and segmentation, Stop word removal, Stemming and lemmatization, Handling capitalization and punctuation, Minimum Edit distance.

**Unit No 2: Language Models and Vector Semantics [7 Hours]**
N-gram models, Language model evaluation, Smoothing techniques, Information Retrieval, Vector space models, Term frequency-inverse document frequency (TF-IDF), Pointwise Mutual Information, Applications of the TF-IDF or PPMI vector models, Word2vec, Relevance ranking algorithms.

**Unit No 3: Sequence Labeling [7 Hours]**
Text Preprocessing, Context-Free Grammars, Part-of-speech tagging, HMM Tagging, CRF, Named entity recognition, Evaluation of Named Entity Recognition. Syntax and Parsing,

Parsing techniques: dependency parsing, constituency parsing, Maximum Entropy Markov Models.

**Unit No 4: Text Classification and Sentiment Analysis [7 Hours]**

Classifiers for text classification and sentiment analysis, Optimizing Sentiment Analyzer, Other text classification tasks and the Language Model, Text Classification with Logistic Regression Model, Multinomial logistic regression, Cross-entropy loss function, Gradient Descent, Regularization, Interpreting model.

**Unit No 5: Deep Learning for NLP Applications [7 Hours]**

Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, The Encoder-Decoder Model with RNNs, Words, Characters and Byte-Pairs, Transformers and Pretrained Language Models, Fine-Tuning and Masked Language Models

CASE STUDY: ChatGPT, GPT, AI Powered Tools, Sentiment Classification, Dialog Systems, Chatbots, Movie review system, Text Summarization, Language Translation, Question Answering and Information Retrieval, Automatic Speech Recognition, Text-to-Speech Conversion, Speech to Text Conversion.

**Text Books**


1. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin.
2. "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and Hinrich Schutze.


**Reference Books**


1. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper.
2. "Natural Language Processing: Python and NLTK" by Jacob Perkins.
3. “Sentiment Analysis and Opinion Mining” by Bing Liu.

## Semester –VII

# Advanced Computer Vision

| | | | | |
|---|---|---|---|---|
| | **Advanced Computer Vision** | | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Basic knowledge of linear algebra and calculus, Image processing fundamentals, Programming skills in Python.

**Course Objectives:**

To acquire a comprehensive understanding of Computer Vision principles and techniques, enabling the development of advanced image processing, recognition systems, and visual perception applications

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Demonstrate a solid understanding of fundamental computer vision & image processing concepts. |
| CO2 | Apply various computer vision algorithms and techniques in image processing. |
| CO3 | Apply various computer vision algorithms and techniques to solve real-world engineering problems, such as object recognition, motion analysis, and texture. |
| CO4 | Analyze and interpret results obtained from computer vision algorithms, and critically evaluate their performance and limitations |
| CO5 | Implement and evaluate computer vision algorithms using programming languages and libraries commonly used in the field, such as Python and OpenCV |

**Course Contents:**

**Unit No 1: Introduction to Computer Vision & Image Processing [7 Hours]**

Introduction to computer vision and its applications, Image representation, image processing operations, Image filtering & convolution.

Image enhancement: Contrast stretching, Histogram specification, Adaptive Histogram Equalization (AHE), Wavelet-based enhancement.

Image Filtering: Smoothing: Linear Filter (Box filter, Gaussian Filter) & Non-linear Filter: Median, Mini. & Max.), Sharpening: Laplacian Filter.

**Unit No 2: Image Transformation & Restoration: [7 Hours]**

**Image Transformation**: Definition & its properties (scaling, rotation), DFT, DCT, DST, Walsh-Hadamard Transform, Slant Transform, Haar Transform.

**Image Restoration:** Noise model, Types of Noise: Gaussian, Rayleigh, Erlang, Exponential, Uniform, salt & Pepper noise. Restoration Filtering: Mean Filter (Arithmetic, Geometric, Hormonic, Contrahamonic), Median Filter, Midpoint Filter.

**Unit No 3: Segmentation, Texture & Motion Analysis [7 Hours]**

**Segmentation:** Edge Detection (Prewitt, Sobel, Canny), Optimum Edge Detection, Thresholding techniques, Region-based segmentation.

**Texture Analysis:** Introduction to texture in images, Statistical texture analysis methods: Gray Level Co-occurrence Matrix (GLCM), Local Binary Patterns (LBP); Filter-based texture analysis methods: Gabor filters, Laws' texture energy measures; Texture-based segmentation. **Motion Analysis:** Optical flow estimation, Lucas-Kanade method, Horn-Schunck method, Background subtraction, Dense optical flow using Deep Learning (FlowNet), Motion-based segmentation.

**Unit No 4: Feature Matching Algorithms [7 Hours]**

**Feature Extraction**: SIFT (Scale-Invariant Feature Transform), SURF (Speeded-Up Robust Features), BRISK (Binary Robust Invariant Scalable Keypoints).

**Feature Representation:** Building a dataset with extracted features, feature vector representation by Bag-of-words, vector quantization.

**Feature Classification:** SVM, KNN, Random forest.

**Unit No 5: Computer Vision with Deep Learning [7 Hours]**

Image classification: CNN, Attention models, Vision transformation.

Generative Models: GAN.

Object detection: Regions with CNN, Fast R-CNN, Faster R-CNN & Mask R-CNN, SSD,YOLO. Semantic Segmentation using U-Net, Centroid based object tracking

**Text Books / Reference Books**


1. Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Cambridge University Press.
2. Computer Vision: Algorithms & Applications, R. Szeleski, Springer. Computer vision: A modern approach: Forsyth and Ponce, Pearson.
3. Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
4. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
5. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
6. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
7. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
8. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
9. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
10. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004.

## Semester –VII

# Data Science Optimization Techniques

| | | | | |
|---|---|---|---|---|
| | **Data Science Optimization Techniques** | | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Concept of Data Analysis.

**Course Objectives:**

1. To familiarize the students with some basic concepts of optimization techniques and approaches.
2. To formulate a real-world problem as a mathematical programming model.
3. To develop the model formulation and applications are used in solving decision problems.
4. To solve specialized linear programming problems like the transportation and assignment Problems.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Apply operations research techniques like linear programming problem in industrial optimization problems. |
| CO2 | Solve allocation problems using various OR methods. |
| CO3 | Understand the characteristics of different types of decision making environment and the appropriate decision making approaches and tools to be used in each type. |
| CO4 | To solve specialized linear programming problems like the transportation and assignment Problems. |
| CO5 | Recognize competitive forces in the marketplace and develop appropriate reactions based on existing constraints and resources. |

**Course Contents:**

**Unit No 1: Mathematical Functions [7 Hours]**

Functions and Continuity, Review of Calculus, Vectors, Matrix Algebra, Eigenvalues and Eigenvectors, Optimization and Optimality, General Formulation of Optimization Problems Algorithms, Complexity, and Convexity: What Is an Algorithm?, Order Notations, Convergence Rate, Computational Complexity, Convexity, Stochastic Nature in Algorithms.

**Unit No 2: Optimization Algorithms [7 Hours]** .

Unconstrained Optimization, Gradient-Based Methods, Gradient-Free Nelder–Mead Method Constrained Optimization: Mathematical Formulation, Lagrange Multipliers, Slack Variables, Generalized Reduced Gradient Method, KKT Conditions, Penalty Method Optimization Techniques: Approximation Methods: BFGS Method, Trust-Region Method, Sequential Quadratic Programming, Convex Optimization, Equality Constrained Optimization, Barrier Functions, Interior-Point Methods, Stochastic and Robust Optimization.

**Unit No 3: Linear Programming [7 Hours]**

Introduction, Simplex Method, Worked Example by 12 Simplex Method, Interior-Point Method for LP Integer Programming: Integer Linear Programming, LP Relaxation, Branch and Bound, Mixed Integer Programming, Applications of LP, IP, and MIP Regression and Regularization: Sample Mean and Variance, Regression Analysis, Nonlinear Least Squares, Over-fitting and Information Criteria, Regularization and Lasso Method, Logistic Regression, Principal Component Analysis.

**Unit No 4: Machine Learning Algorithms [7 Hours]**

Data Mining, Data Mining for Big Data, Artificial Neural Networks, Support Vector Machines, Deep Learning Queueing Theory and Simulation: Introduction, Arrival Model, Service Model, Basic Queueing Model, Little's Law, Queue Management and Optimization Multiobjective Optimization: Introduction, Pareto Front and Pareto Optimality, Choice and Challenges, Transformation to Single Objective Optimization, The Constraint Method, Evolutionary Approaches.

**Unit No 5:** Constraint-Handling Techniques **[8 Hours]**

Introduction and Overview, Method of Lagrange Multipliers, Barrier Function Method, Penalty Method, Equality Constraints via Tolerance, Feasibility Criteria, Stochastic Ranking, Multi-objective Constraint-Handling and Ranking Evolutionary Algorithms: Evolutionary Computation, Evolutionary Strategy, Genetic Algorithms, Simulated Annealing, Differential Evolution Nature-Inspired Algorithms: Introduction to SI, Ant and Bee Algorithms, Particle Swarm Optimization, Firefly Algorithm, Cuckoo Search, Bat Algorithm, Flower Pollination Algorithm, Other Algorithms.

**Text Books / Reference Books**


1. Optimization Techniques and Applications with Examples Xin-She Yang Wiley 3 rd 2018
2. Optimization Techniques A.K. Malik, S.K. Yadav, S.R. Yadav I.K. International Publishing House 1 st 2012
3. Optimization methods: from theory to design Marco Cavazzuti Springer 1st 2012
4. Optimization Techniques Chander Mohan, Kusum Deep New Age International 1st 2009

## Semester –VII

# Real Time Systems

| | Real Time Systems | | 3L- 0T - 0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** .

**Course Objectives:**

1. To introduce students to the fundamental problems, concepts and approaches in the design and analysis of realtime systems.
2. To study issues related to the design and analysis of systems with real-time constraints.
3. To learn real-time scheduling and schedulability analysis.
4. To understand formal specification and verification of timing constraints and properties.
5. To design methods for real-time systems.
6. To learn new techniques of state-of-the-art real-time systems research.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | To characterize real-time systems and describe their functions. |
| CO2 | To analyze, design and implement a real-time system |
| CO3 | To apply formal methods to the analysis and design of real-time systems |
| CO4 | To apply formal methods for scheduling real-time systems. |
| CO5 | To characterize and debug a real-time system. |

Course Content:

**Unit No 1: Introduction** **[7 Hours]**

Introduction: Hard vs. Soft real time systems, A reference model of real time system. Real-time scheduling: Clock driven approach, Weighted Round-robin approach, Priority driven approach, Dynamic vs. static system, Effective Release Times and Deadlines, EDF and LST algorithm, Optimality and Non-Optimality of the EDF and LST algorithms, Offline vs. online Scheduling

**Unit No 2:** **[7 Hours]**

**Clock-Driven Scheduling:** Static, Time-Driven Scheduler, General structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of a-periodic Jobs, Scheduling Sporadic Jobs. Priority **Driven Scheduling of Periodic Tasks:** Fixed priority vs. Dynamic priority algorithms, Maximum

Schedulable Utilization, Optimality of the RM and DM algorithms, A Schedulability test for fixed-priority tasks with short response times, Sufficient Schedulability conditions for the RM and DM algorithms.

**Unit No 3:** Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems **[7 Hours]**

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and Approaches, Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and Weighted Fair-Queuing Servers.

**Unit No 4:** Resources and Resource Access control **[7 Hours]**

Resources and Resource Access control: Resource contention, Resource access control, Non Preemptive critical section, Basic Priority-Inheritance protocol, Basic Priority Ceiling Protocol, Stack based, Priority-ceiling protocol, preemption ceiling protocol.

**Unit No 5:** Multiprocessor scheduling, Resource Access Control, and Synchronization **[7 Hours]**

Multiprocessor scheduling, Resource Access Control, and Synchronization: Model of multiprocessor & distributed systems, task assignment, multiprocessor Priority-ceiling protocol, Elements of Scheduling Algorithms for End-to-End Periodic Tasks- IPS protocols, PM protocols, MPM protocol.

**Text Books:**

1. Jane W. S. Liu, “Real-Time System”, Pearson Education.

2. C. M. Krishna and K. G. Shin, “Real-Time Systems”, McGraw Hill.

**Reference Books:**

1. Laplante, “Real Time System Design and Analysis: An Engineer Handbook”, PHI.
2. Dr. K. V. K. Prasad, “Embedded Real Time System Concept Design and Programming”, Wiley India.

**Semester –VII**

# Cryptography & Network Security

| | | | | |
|---|---|---|---|---|
| | **Cryptography & Network Security** | | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Concept of Security.

**Course Objectives:**

1. The objectives of information security
2. Explain the importance and application of each of confidentiality, integrity, authentication and availability
3. Understand various cryptographic algorithms.
4. Describe public-key cryptosystem.
5. Discuss the fundamental ideas of public-key cryptography.

Course Outcomes:

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

| | |
|---|---|
| CO1 | Understand basic cryptographic algorithms, message and web authentication and security issues. |
| CO2 | Ability to identify information system requirements for both of them such as client and server. |
| CO3 | Ability to understand the current legal issues towards information security. |
| CO4 | Develop transport level security. |
| CO5 | Apply knowledge for develop model. |

**Unit No 1: Security Concepts:** **[7 Hours]**

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 No 2: Symmetric key Ciphers:** **[7 Hours]**

Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

**Unit No 3: Cryptographic Hash Functions, key management and distribution:** **[7 Hours]**

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

**Unit No 4: Transport-level Security:** **[7 Hours]**

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 No 5: Case Study:** **[7 Hours]**

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange
Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability

**Text Book:**


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


***Reference Books:***


1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

## Semester –VII

# Virtual Reality

| | Virtual Reality | | 3L- 0T - 0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Concept of Data Analysis.

**Course Objectives:**

This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

**Course Outcomes:**
On completion of the course, students will be able to:

| | |
|---|---|
| CO1 | Describe how VR systems work and list the applications of VR. |
| CO2 | Understand the design and implementation of the hardware that enables VR systems tobe built. |
| CO3 | Understand the system of human vision and its implication on perception and rendering. |
| CO4 | Explain the concepts of motion and tracking in VR systems. |
| CO5 | Describe the importance of interaction and audio in VR systems. |

**Unit No 1: Introduction to Virtual Reality: [7 Hours]**

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

**Unit No 2: Representing the Virtual World: [7 Hours]**
Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

**Unit No 3: The Geometry of Virtual Worlds & The Physiology of Human Vision: [7 Hours]**

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

**Unit No 4: Visual Perception & Rendering: [7 Hours]**
Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates.

***Unit No 5: Motion & Tracking:*** ***[7 Hours]***

Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies.

***Text Books***


1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016 2.
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.


***Reference Books***


1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
5. http://lavalle.pl/vr/book.html

## Semester –VII

# Full Stack Development

| | | | | |
|---|---|---|---|---|
| | **Full Stack Development** | | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Basic Knowledge of HTML and CSS

**Course Objectives:**

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Fundamentals of web essentials and markup languages
2. Use of the Client-side technologies in web development
3. Use of the Server-side technologies in web development
4. Understand the web services and frameworks

**Course Outcomes:**
On completion of the course, students will be able to:

| | |
|---|---|
| CO1 | Implement and analyze behavior of web pages using HTML and CSS |
| CO2 | Apply the client-side technologies for web development |
| CO3 | Analyze the concepts of Servlet and JSP |
| CO4 | Analyze the Web services and frameworks |
| CO5 | Apply the server side technologies for web development |

**Course Contents:**

**Unit No 1: Full Stack Fundamentals** **[7 Hours]**
HTML, Basic, HTML5 Doctype, Some New HTML5 Elements, HTML5 advance feature Canvas Elements, Geolocation API, Responsive Images, Audio and Video Support, Header And Footer, Allow spell check and editable areas, Adding audio, Drag & drop.
CSS Advanced: Advanced Colors: Alpha transparency, At-Rules: Importing style sheets, styles for different media types, specifying the character set of a stylesheet and embedded fonts, CSS3: also known as Cascading Style Sheets Level 3.

**Unit No 2: jQuery** **[7 Hours]**
jQuery Introduction, - Overview, Syntax, Selectors, Events, Attributes, jQuery DOM manipulation: - Add Elements, Remove Elements, Replace Elements. jQuery CSS manipulations: CSS Classes, Dimensions, CSS Properties.
Jquery Traversing, Traversing Ancestors, Traversing Descenants.

**Unit No 3: Angular JS** **[7 Hours]**
Overview, Environment Setup, AngularJS – MVC Architecture, directives, Expressions, controllers, Angular Lifecycle, HTML DOM, Angular Modules, Angular Components, Angular Data Binding, Angular services, Dependency Injection.

**Unit No 4: Javascripts Advanced** **[7 Hours]**

Arrow Functions, Template Strings, Rest Operator, Spread Operator, Object Literals, Destructuring objects in javascript, inheritance, Getting parts of a value: split & substr, Programming fundamentals: Try...Catch And Throw, Getting the users date and time, Some more complex math, Regular Expressions, Get the users browser (navigator), Add timing: setInterval & setTimeout, Javascript Classes, Async in JavaScript, Error Handling in JavaScript.

**Unit No 5: Node JS** **[7 Hours]**

Introduction to Node JS, What is Node JS, Node.js Process Model, Node JS Modules: Functions, Buffer, Module, Core Modules, Local Modules, Built-in Modules.

File System, Fs.readFile, Writing a File, Opening a file, deleting a file, Other IO Operations

Database operations: Database Connectivity, Connecting String, Configuring, Working with Select Command, Updating Records, Deleting Records, MERN: Overview of MERN, Introduction of MERN.

**Text Books / Reference Books**


1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035
2. Robert W Sebesta, “Programming the World Wide Web , 4th Edition, Pearson education, 2008 3. Marty Hall, Larry, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
4. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
5. Chris Bates, “Web Programming Building Internet Applications , 3rd Edition, Wiley India, 2006.
6. Xue Bai et al, “The web Warrior Guide to Web Programming , Thomson, 2003

## Semester –VII

# Design Thinking

| | | | | |
|---|---|---|---|---|
| | Design Thinking | OEC-3 | 3L- 0T - 0P | 3 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Basic Algorithm concepts

**Course Objectives:**

1. To recognize the latest and future issues and challenges in design thinking
2. To expose the student with state-of-the-art perspectives, ideas, concepts, and solutions related to the design and execution of innovation driven projects using design thinking principles.
3. To develop an advance innovation and growth mindset form of problem identification and reframing, foresight, and insight generation

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Understand the concepts of design thinking approaches |
| CO2 | Illustrate and use phases of design thinking |
| CO3 | To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions. |
| CO4 | Understand prototyping and validation for design thinking |
| CO5 | To propose a concrete, feasible, viable and relevant innovation project/challenge |

**Course Contents:**

**Unit No 1: Overview of Design Thinking Process [7 Hours]**

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Cantered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyse, Solve and Test.

**Unit No 2: Empathize [7 Hours]**

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user persons, customer journey mapping, How might we questions.

**Unit No 3: Analyse or Define [7 Hours]**

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

**Unit No 4: Prototyping and Validation [7 Hours]**

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

**Unit No 5: Design Innovation** **[7 Hours]**

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

**Text Books / Reference Books**


1. Bala Ramadurai, "Karmic Design Thinking", First Edition, 2020
2. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization by Vijay Kuma.
3. Human-Centered Design Toolkit: An Open-Source Toolkit To Inspire New Solutions in the Developing World by IDEO.
4. Human-Centered Design Toolkit: An Open-Source Toolkit To Inspire New Solutions in the Developing World by IDEO.
5. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

# Semester –VII
# Blockchain Technology

| | | | | |
|---|---|---|---|---|
| | Blockchain Technology | | 3L- 0T - 0P | 3 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Digital Communication**.**

**Course Objectives:**

1. To understand the cryptographic techniques used in blockchain systems and to introduce the fundamental concepts and principles of blockchain technology.
2. Understand the fundamentals of Ethereum and DApps and implementation Smart contract.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Explain the fundamental characteristics of blockchain using bitcoin. |
| CO2 | Demonstrate the application of hashing and public key cryptography in protecting the blockchain. |
| CO3 | Explain the elements of trust in a Blockchain: validation, verification, and consensus. |
| CO4 | Develop smart contracts in Ethereum framework. |
| CO5 | Blockchain Usecases |

**Course Contents:**

**Unit No 1: Introduction to blockchain [7 Hours]**

History of blockchain, peer to peer (P2P) network, public ledger, double spend problem, features of blockchain, types of blockchain: public, private and consortium based blockchain and applications of blockchain.

**Unit No 2: Cryptographic primitives [7 Hours]**

Public key cryptography, hash functions, message digest, secure hash algorithms (SHAS256), digital signature, elliptic curve digital signature algorithms (ECDSA), merkle tree.

**Unit No 3: Bitcoin definition, transactions [8 Hours]**

The transaction life cycle, the structure of a block, genesis block, wallet, bitcoin mining, forking: hard and soft fork. Consensus algorithms: proof of work, proof of stake, practical byzantine fault tolerance, proof of burn and prof of elapsed time.

**Unit No 4: Smart contracts, Ethereum basics [7 Hours]**

Introduction to Ethereum & Ether, Gas, the world state, transactions, Ethereum virtual machine (EVM), types of accounts, block structure, ether, DApps. Ethereum vs bitcoin.

**Unit No 5: Blockchain Use Cases [7 Hours]**

Land Registry Records, Cross-border payments over blockchain, Project Ubin, Food Security, Supply chain financing, Voting system and Identity on Blockchain, Supply chain management, Healthcare and electronic medical records, Blockchain and Metaverse.

**Text Books / Reference Books**


1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, A Beginner's Guide to Building Blockchain Solutions, Apress, 2018.
2. Ritesh Modi, Solidity Programming Essentials-A Beginner's Guide to Build Smart Contractsfor Ethereum and Blockchain, 2018, Packt Publishing Ltd.
3. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly, 2015
4. William Stallings, Cryptography and Network Security, eighth edition, Pearson, 2020.
5. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O Dowd, Venkatraman Ramakrishna, Hands-On Block Chain with Hyperledger: Building Decentralized Applicationswith Hyperledger Fabric and Composer , Import, 2018.
6. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing,2020, ISBN:9781839213199, book website:https://www.packtpub.com/product/mastering-blockchain- thirdedition/9781839213199

## Semester –VII
# Bioinformatics

| | | | | |
|---|---|---|---|---|
| | Bioinformatics | | 3L- 0T - 0P | 4 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Some familiarity with molecular biology along with probability and statistics

**Course Objectives:**

1. To introduce students to the rapidly evolving field of bioinformatics
2. To cover the most fundamental topics, such as sequence alignment and pattern finding
3. To gain an understanding of the computational challenges (and their solutions) in the analysis of large biological data sets

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Illustrate the basic concepts of bioinformatics, biological databases and their growth |
| CO2 | Understand genomics and proteomics |
| CO3 | Identifying interactions and applications of microarrays |
| CO4 | Understand the use of bioinformatics in drug discovery |
| CO5 | Pattern finding in protein and DNA sequencing |

**Course Contents:**

**Unit No 1: Introduction to Bioinformatics [7 Hours]**

The Brain of Biotechnology Evolutionary Biology Origin & History of Bioinformatics Origin of Bioinformatics/Biological Databases Importance of Bioinformatics Use of Bioinformatics Basics of Molecular Biology Definitions of Fields Related to Bioinformatics Applications. Biological Databases: Introduction Categories of Biological Databases The Database Industry Classification of Biological Databases The Creation of Sequence Databases Bioinformatics Programs and Tools Bioinformatics Tools Application of Programmes in Bioinformatics.

**Unit No 2: Genomics & Proteomics [7 Hours]**

DNA, Genes and Genomes DNA Sequencing Genome Mapping Implications of Genomics for Medical Science Proteomic Application of Proteomics to Medicine Difference between Proteomics and Genomics Protein Modeling. Sequence Alignment: Introduction Pairwise Sequence Alignment Sequence Alignment (MSA) Substitution Matrices Two Sample Applications.

**Unit No 3: Phylogenetic Analysis [7 Hours]**

Introduction Fundamental Elements of Phylogenetic Models Tree Interpretation Importance of Identifying Paralogs and Orthologs Phylogenetic Data Analysis Alignment Building the Data Model Determining the Substitution Model Tree-Building Methods Tree Evaluation. Microarray Technology: A Boon to Biological Sciences Introduction to Microarray Microarray Technique Potential of Microarray Analysis Microarray Products Microarray Identifying Interactions Applications of Microarrays.

**Unit No 4: Bioinformatics in Drug Discovery [7 Hours]**

A Brief Overview Introduction Drug Discovery Informatics and Medical Sciences Bioinformatics and Medical Sciences Bioinformatics in Computer-Aided Drug Design Bioinformatics Tools.

**Unit No 5: Human Genome Project [7 Hours]**

Human Genome Project: Introduction Human Genome Project Genome Sequenced in the Public (HGP) and Private Project Funding for Human Genome Sequencing DNA Sequencing Bioinformatics Analysis: Finding Functions Insights Learned from the Human DNA Sequence Future Challenges.

**Text Books / Reference Books**


1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.
2. "Introduction to Bioinformatics Algorithms" by Neil Jones and Pavel Pevzner. DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE
3. "Bioinformatics" by David Mount (2nd edition).


**NPTEL Course:**

1. Prof. M. Michael Gromiha, BioInformatics: Algorithms and Applications, https://nptel.ac.in/courses/102/106/102106065/

## Semester –VII
## Mobile Application Development

| | | | | |
|---|---|---|---|---|
| | Blockchain Technology | | 3L- 0T - 0P | 4 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Data Structures, Object Oriented, Java Programming**.**

**Course Objectives:**

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Overall life cycle of Android programming
2. Essential Components of an Android Application

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Understand Android architecture, activities and their life cycle |
| CO2 | Apply the knowledge to design user interface using Android UI and Component |
| CO3 | Describe Memory and File operations in Android |
| CO4 | Manage system database, remote database operations using web services and Firebase |
| CO5 | Apply knowledge of map, location services, Graphics, android system and background services |

**Course Contents:**

**Unit No 1: Introduction to Anriod [7 Hours]**

Background about mobile technologies, Android – An Open Platform for Mobile development, Native Android Application, Android SDK Features, Android Architecture, Application Frameworks, Android Libraries, Android Runtime, Dalvik Virtual Machine. Creating First Android Application. Creating Configurations. Android Project Structure. Testing the application (AVD, Active device), Android Manifest file. Running and Debugging.

**Unit No 2: User Interface, Activities [7 Hours]**

Introduction, Android Application Life Cycle, Activity, Layouts, Application Priority and process states, Fundamental Android UI Design, Study of different layouts, Introducing Views, Creating new Views, Draw able Resources. Designing fragments: Fragments lifecycle, Fragment management and integration. Advanced UI: Adapters, Complex UI components, Menus and Dialogs, Tabbed Activities, Navigation Drawer, Animations, Create activity layouts programmatically. Android Material Design: introduction, properties, Material Styling / Animations, Material Patterns.

**Unit No 3: Intents, Broadcast Receivers and Files [7 Hours]**

Introducing Intents, Intents and Intent filters, What are Pending Intents, Adapters, Internet Resources, Notifications, Introducing Dialogs, Saving Application Data in external and internal memory, Creating and saving preferences, Retrieving shared preferences, Creating a standard preference activity, Saving Activity State, Saving and Loading Files, Including static files as Resources, File management tools.

**Unit No 4: Database and Content Providers [7 Hours]**

Introducing Android Databases, Introducing SQLite, Cursors and content values, working with SQLite Database, Creating new content Provider. SQLite Open Helper and creating a database. Opening and closing a database, working with cursors, Inserts, updates, and deletes. Native Content Providers: Content provider types, searching for content, Adding, changing, and removing content, Native Android Content Providers, Accessing Contact Book, Calendar. Custom Content Providers: Custom Content Provider classes, Publishing content providers. Introduction to Firebase, Real time/Cloud, Authentication in firebase. Connecting to MySQL using JSON (Web services).

**Unit No 5: Telephony, Hardware and Network Services [7 Hours]**

Telephony, Reading Phone device details, Reading Sims Details, Incoming and outgoing call monitoring, Tracking Service Change, Introducing SMS and MMS, Sending SMS and MMS, Sending SMS messages manually, Use of Bluetooth, Managing Network Connectivity, ManagingWi-Fi. Google Map - Layout file, Google Map – Android Manifest file, Customizing Google Map, Adding Marker, Changing Map Type

**Text Books / Reference Books**


1. John Horton, “Android Programming for Beginners”, 2nd Edition Packt Publishing
2. Pradeep Kothari “Android Application Development Black Book” , DreamTech
3. Dawn Griffiths, “Headfirst Android Development”, 1st Edition, O′Reilly
4. Lauren Darcey, “Android Wireless Application Development”, Shane Conder, Pearson
5. Wei Meng Lee “Beginning Android 4 Application Development”, Wrox

## Semester –VII

# Natural language Processing Lab and Data Engineering Lab

| | | | | |
|---|---|---|---|---|
| | Natural language Processing Lab and Data Engineering Lab | | 0L-0T-4P | 2 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Practical: 04 hrs./week | Continuous Assessment 1: 30 Marks<br>Continuous Assessment 2: 30 Marks<br>End Semester Examination: 40 Marks |

## Natural language Processing Lab

**List of Practical/Tutorial**

| Experiment No. | Title of Experiment |
|---|---|
| 01 | Convert the text into tokens. Find the word frequency. |
| 02 | Find the synonym /antonym of a word using WordNet. |
| 03 | Demonstrate a bigram / trigram language model. Generate regular expression for a given text |
| 04 | Perform Lemmatization and Stemming. Identify parts-of Speech using Penn Treebank tag set. |
| 05 | Implement HMM for POS tagging. Build a Chunker |
| 06 | Implement Named Entity Recognizer. |
| 07 | Implement semantic role labelling to identify named entities. |
| 08 | Implement text classifier using logistic regression model. |
| 09 | Implement a movie reviews sentiment classifier |
| 10 | Implement RNN for sequence labelling. |
| 11 | Implement POS tagging using LSTM |
| 12 | Word sense disambiguation by LSTM/GRU. |

**Note:**

1. Open-Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents.
4. Conduct any 10 practical.

# Data Engineering Lab

**List of Practical/Tutorial**

| Experiment No. | Experiment Based On | Title of Experiment |
|---|---|---|
| 01 | **Excel** | To study and demonstrate fundamentals in Microsoft excel. |
| 02 | | To study and demonstrate Entering and editing text and formulas. |
| 03 | **Advanced Excel** | To study and demonstrate working with basic excel functions, modifying an excel worksheet. |
| 04 | | To study and demonstrate data formatting in an excel worksheet. |
| 05 | **Power BI** | To study and demonstrate introduction to Power BI, basic charts in Power BI, working with maps, Tables and Matrix in Power BI |
| 06 | | To study and demonstrate other charts in Power BI, cards and filters, slicers in Power BI, Advanced charts in Power BI. |
| 07 | | To study and demonstrate objects in Power BI, Power BI service introduction, power query [text, Date functions]. |
| 08 | | To study and demonstrate Number functions, append files, merge files, conditional columns, power query [imp topics, M language introduction]. |
| 09 | **Tableau** | To study and demonstrate Introduction to Tableau, Data in Tableau, Sets, sorting and filtering in Tableau, parameters. |
| 10 | | To study and demonstrate Groups, folders and hierarchies, marks card, views and highlighting, formatting in Tableau. |
| 11 | | To study and demonstrate Lines and bands, Tableau worksheets, charts in Tableau part -1, calculated fields. |
| 12 | | To study and demonstrate charts in Tableau part -2, aggregation and granularity, database functions, box and whisker plot, time series and forecasting. |

Note:

1. Open-Source tools and technology use for programs (Advanced Excel, Power BI & Tableau).
2. Lab should be in the scope of hands of experience and practice related programs.
3. Add case study and Live project experience if any related content.
4. Conduct any 10 practical.

## Semester –VII
# Project Phase – I

| | | | | |
|---|---|---|---|---|
| | **Project Phase-I** | | 0L-0T-4P | 2 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Practical: 024hrs./week | Continuous Assessment : 60 Marks<br>End Semester Examination: 40 Marks |

## Guidelines for Project

The students shall study in group of max. three members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Cyber security, Computer Vision, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions
4. Implement solution using latest technology
5. Write 35-40 pages report and submit with hard binding (use of latex is more suitable).
6. Present / demonstrate the solution in front of faculty member
   The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

**Continues Assessment:**

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

## Semester –VIII
# Project Phase – II

| | | | | |
|---|---|---|---|---|
| | Project Phase – II (In-house) / Internship and Project in Industry | | 0L-0T-24P | 12 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Practical: 24 hrs./week | Continuous Assessment : 60 Marks<br>End Semester Exam: 40 Marks<br>Total : 100 Marks |

## Guidelines for Project

It is recommended to complete industry or industry sponsored project. The students shall study in group of max. three members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Machine learning or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

**In this subject head, it is expected that the student should complete the following tasks.**

1. Identify problem statement / idea which is solving one problem preferablylocal problem may being their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions,
4. Implement solution using latest technology,
5. Write 60-70 pages report and submit with hard binding (use of latex is more suitable),
6. Present / demonstrate the solution in front of faculty member.
   The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

**Continues Assessment:**

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution