



**CHAITANYA BHARATHI  
INSTITUTE OF TECHNOLOGY (A)**  
Kokapet (Village), Gandipet, Hyderabad, Telangana-500075. www.cbit.ac.in



COMMITTED TO  
RESEARCH,  
INNOVATION AND  
EDUCATION

**43**  
years

**SCHEME OF INSTRUCTION AND SYLLABI**  
**of**  
**BE VII to VIII SEMESTERS**  
**of**  
**FOUR YEAR DEGREE COURSE**  
**in**  
**B.E. – INFORMATION TECHNOLOGY**  
(AICTE Model Curriculum with effect from AY 2020-21)

**R-20 Regulation**



**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**

(Autonomous Institution under UGC), Affiliated to Osmania University,  
Accredited by NBA and NAAC-UGC,

Kokapet Village, Gandipet Mandal, Hyderabad –500075. Telangana

E-Mail:principal@cbit.ac.in;Website:www.cbit.ac.in;PhoneNos.:040-24193276/277/279

Mail:principal@cbit.ac.in;Website:www.cbit.ac.in;PhoneNos.:040-24193276/277/279



# CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

Scheme of Instruction of VII Semester of B.E. – Information Technology  
as per AICTE Model Curriculum, w.e.f: 2023-24

## DEPARTMENT OF INFORMATION TECHNOLOGY

### SEMESTER-VII

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1		Professional Elective - 4	3	-	3	40	60	3
2		Professional Elective - 5	3	-	3	40	60	3
3		Professional Elective - 6	3	-	3	40	60	3
4		Open Elective – 1	3	-	3	40	60	3
5	20EGMO4	Gender Sensitization	2	-	2	-	50	NC
<b>PRACTICALS</b>								
6		Professional Elective-4 Lab	-	2	3	50	50	1
7	20ITC28	Project Part-1	-	4	-	50	-	2
8	20ITI03	Internship-III	135 Hours		-	-	-	3
<b>TOTAL</b>			<b>14</b>	<b>6</b>		<b>260</b>	<b>340</b>	<b>18</b>

**L: Lecture**

**T: Tutorial**

**P: Practical**

**CIE - Continuous Internal Evaluation**

**SEE - Semester End Examination**

<b>Professional Elective-4</b>					
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>
1.	20ITE13	Computer Vision	6.	20ITE18	Computer Vision Lab
2.	20ITE14	Applied Predictive Analytics	7.	20ITE19	Applied Predictive Analytics Lab
3.	20ITE15	Unmanned Aerial Vehicles	8.	20ITE20	Unmanned Aerial Vehicles Lab
4.	20ITE16	Fundamentals of Block Chain Technology	9.	20ITE21	Fundamentals of Block Chain Technology Lab
5.	20ITE17	Software Architecture and Design Patterns	10.	20ITE22	Software Architecture and Design Patterns Lab

<b>Professional Elective-5</b>			<b>Professional Elective-6</b>		
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>
1.	20ITE23	Social Media Analytics	1.	20ADE13	Reinforcement Learning
2.	20ADE10	Robotic Process Automation	2.	20ITE25	Software Defined Networks
3.	20ADE11	Business Intelligence	3.	20ADE12	Serverless Computing
4.	20ITE24	Mobile Computing	4.	20ITE26	Digital Forensics
5.	20ADE07	Explainable Artificial Intelligence	5.	20ITE27	Real Time Operating System

<b>Open Elective - 1</b>		
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>
1.	20MEO03	Research Methodologies
2.	20MEO12	3D Printing
3.	20ECO14	Neural Networks and Fuzzy Logic
4.	20EGO01	Technical Writing Skills
5.	20BTO04	Bio-Informatics

20ITE13

**COMPUTER VISION**  
(Professional Elective – 4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To understand the Fundamental Concepts related to Computer Vision and Image formation.
2. To understand Feature Extraction algorithms.
3. To define the structure of an image based on motion.
4. To provide knowledge about object recognition and scene recognition algorithms.
5. To impart the knowledge about 3D Reconstruction techniques.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Summarize the fundamentals of Image formation and describe the Geometric primitives and Transformations.
2. Describe different approaches to recognition of objects.
3. Inspect algorithms for feature detection and feature alignment.
4. Analyze images and videos for problems such as tracking and structure from motion.
5. Design recovered 3D structure for ill-posed scenes.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	1	2	2	-	-	-	-	-	-	2	2	3	3
<b>CO2</b>	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
<b>CO3</b>	3	3	2	2	2	-	-	-	-	-	-	2	3	3	3
<b>CO4</b>	3	3	2	3	2	-	-	-	-	-	-	2	3	3	2
<b>CO5</b>	3	3	2	3	2	-	-	-	-	-	-	2	3	3	3

**UNIT-I**

**Introduction to Computer Vision and Image Formation:** Introduction, Photometric image formation, Digital Camera image formation.

**Image Processing:** Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.

**UNIT-II**

**Feature detection and matching:** Points and patches, Edges, Lines. Segmentation: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts. **Feature-based alignment:** 2D and 3D feature-based alignment, Pose estimation.

**UNIT-III**

**Structure from motion:** Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion. **Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion.

**UNIT-IV**

**Recognition:** Object detection-Face detection, Pedestrian detection, Face recognition : Eigenfaces, Active appearance and 3D shape models, Application: Personal photo collections, Instance recognition : Geometric alignment, Large databases, Application: Location recognition, Category recognition : Bag of words, Part-

based models, Recognition with segmentation, Application: Intelligent photo editing, Context and scene understanding : Learning and large image collections, Application: Image search.

#### **UNIT-V**

**3D Reconstruction:** Shape from X: Shape from shading and photometric stereo, Shape from texture, Shape from focus, Active range finding: Range data merging, Application: Digital heritage, Surface representations: Surface interpolation, Surface simplification, Geometry images, Point-based representations, volumetric representations: Implicit surfaces and level sets, Model-based reconstruction: Architecture, Heads and faces, Application: Facial animation, Recovering texture maps: Estimating BRDFs, Application: 3D photography

#### **Text Book:**

1. Richard Szeliski “Computer Vision: Algorithms and Applications”, Springer-Verlag London Limited, 2011.

#### **Suggested Reading:**

1. Robert J. Schallkoff, “Pattern Recognition: Statistical. Structural and Neural Approaches”, John Wiley and Sons; 1992.
2. D. A. Forsyth and J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
3. R. Hartley and A. Zisserman, “Multiple View geometry”, Cambridge university Press, 2002.
4. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Second Edition, Cambridge University Press, March 2004.
5. K. Fukunaga; “Introduction to Statistical Pattern Recognition”, Second Edition, Academic Press, Morgan Kaufmann, 1990.

#### **Web Resources:**

1. CV online: <http://homepages.inf.ed.ac.uk/rbf/CVonline>
2. Computer Vision Homepage: <http://www2.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html>

20ITE14

**APPLIED PREDICTIVE ANALYTICS**

(Professional Elective – 4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To introduce Predictive Modeling.
2. To familiarize Regression and Classification Techniques.
3. To impart knowledge on the concepts of Support vector machines and Neural Networks.
4. To explore tree-based classifiers and ensemble methods.
5. To introduce Topic modeling.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Comprehend predictive modeling and assess the performance.
2. Apply regression techniques and analyse the performance.
3. Demonstrate Support Vector Machines and build an efficient networking model.
4. Analyze ensemble methods by choosing Tree based classifiers.
5. Select appropriate probabilistic Graphic models and identify topics through topic modeling.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	-	-	-	-	-	-	-	-	1	3	3	2
CO2	2	3	1	3	2	-	-	-	-	1	-	1	3	3	2
CO3	2	3	1	3	2	-	-	-	-	2	-	1	3	3	3
CO4	2	3	2	3	1	-	-	-	-	2	-	1	3	3	2
CO5	2	3	2	3	2	-	-	-	-	1	-	1	3	3	2

**UNIT-I**

**Gearing Up for Predictive Modeling:** Models, **Types of models** : Supervised, unsupervised, semi-supervised, and reinforcement learning models, Parametric and nonparametric models, Regression and classification models, Real-time and batch machine learning models, **The process of Predictive Modeling:** Defining the model's objective, Collecting the data, Picking a model, Preprocessing the data, Exploratory data analysis, Feature transformations, Encoding categorical features, Missing data, Outliers, Removing problematic features, Feature engineering and dimensionality reduction, Training and assessing the model, Repeating with different models and final model selection, Deploying the model, **Performance metrics:** Assessing regression models, Assessing classification models, Assessing binary classification models.

**UNIT-II**

**Linear Regression:** Introduction to linear regression, Simple linear regression, Multiple linear regression, Assessing linear regression models, Problems with linear regression, Feature selection, Regularization, Ridge regression.

**Logistic Regression:** Classifying with linear regression, Assessing logistic regression models, Regularization with the lasso, Classification metrics, Extensions of the binary and Multinomial logistic classifier

**UNIT-III**

**Support Vector Machines:** Maximal margin classification, Support vector classification, Inner products, Kernels and support vector machines, Cross-validation.

**Neural Networks:** Stochastic gradient descent: Gradient descent and local minima, The perceptron algorithm, Linear separation, The logistic neuron, **Multilayer perceptron networks:** Training multilayer perceptron networks.

#### UNIT-IV

**Tree-based Methods:** The intuition for tree models, Algorithms for training decision trees- Classification and regression trees, CART regression trees, Tree pruning, Missing data, Regression model trees CART classification trees, C5.0, Predicting complex skill learning, Variable importance in tree models, **Ensemble Methods: Bagging** - Margins and out-of-bag observations, Predicting heart disease with bagging, Limitations of bagging, **Boosting** – AdaBoost, Limitations of boosting, **Random forests-** The importance of variables in random forests

#### UNIT-V

**Probabilistic Graphical Models:** A little graph theory, Bayes' Theorem, Conditional independence, Bayesian networks, The Naïve Bayes classifier. Hidden Markov models- Predicting letter patterns in English words.

**Topic Modeling:** An overview of topic modeling, Latent Dirichlet Allocation, The Dirichlet distribution, The generative process, Fitting an LDA model, Modeling the topics of online news stories, Model stability, Finding the number of topics, Topic distributions, Word distributions, LDA extensions.

#### Text Books:

1. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publishing Ltd, 2015.
2. Roger D. Peng, “R Programming for Data Science”, Lean Publishing, 2015.

#### Suggested Reading:

1. Dean Abbott, “Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst”, Wiley, 2014,
2. Tom Fawcett, “Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking”, O’Reilly, 1<sup>st</sup> edition, 2013.

#### Web Resources:

1. <https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/>
2. <https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1>
3. <http://uc-r.github.io/mars>
4. <https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products>
5. <https://www.coursera.org/learn/meaningful-predictive-modeling>

20ITE15

**UNMANNED AERIAL VEHICLES**

(Professional Elective – 4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Understand the basics of Unmanned Aerial Vehicles (Drones) and its various applications.
2. Learn working principle of the drone and explains the components that are used to built the drone devices.
3. Provide hands on experience on design, fabrication and flying of UAV category aircraft.
4. Explain the rules and regulations to the specific country to fly drone.
5. Introduce safety measures to be taken during flight.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Identify the parts and functions of UAV and drones
2. Demonstrate the concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts
3. Determine the payload and its corresponding propeller's RPM to successfully fly the drone
4. Design a drone with automatic recovery mechanism.
5. Understand Navigation of UAV.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	3	1	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-	-	2	-
CO4	-	-	-	-	-	-	-	-	-	-	-	2	-	3	-
CO5	3	3	3	3	1	3	-	-	-	-	-	-	-	1	-

**UNIT-I**

**Introduction to Flight and UAVs** - Basics of Flights - Different types of flight vehicles - Components and functions of an airplane - Forces acting on Airplane - Physical properties and structure of the atmosphere; **UAV (Unmanned Aerial Vehicle)** – Definition – History – Characteristics of UAV - Applications of UAV (Defence, Civil, Environmental monitoring) – Difference between Aircraft and UAV.

**UNIT-II**

**Fundamental Components of a Drone** – Types of Drones – Components of a Drone – Frames: Lightweight and sold material – Working principles of Electromagnetic Motors – Types of Motors (Brushed DC motor, Brushless DC motor, Induction Motor) – Microcontroller/microprocessor (Arducopter Flight Controller) – Working principles of Electromagnetic radiations – Radio Transmitter and Receiver – Li-ion Battery – Electric Speed Controller – Global Positioning System – Camera.

**UNIT-III**

**Payload for UAV:** Payloads – Classification of Payloads – camera – sensors – radars – various measuring devices – classification of payload based on applications – Hyper spectral sensors – laser detection and range – synthetic aperture radar – thermal cameras – ultra sonic detectors - case study on payloads.



#### **UNIT-IV**

**Launch and Recovery:** Launching systems - UAV Launch Methods for Fixed-Wing Vehicles - Vertical Take-off and Landing UAV Launch – Automatic Recovery systems. Regulatory and regulations: Civil Aviation Requirements, DGCA RPAS Guidance Manual, UAS Rules 2021.

#### **UNIT-V**

**UAV Navigation and Guidance System:** Navigation - Dead Reckoning – Inertial – Radio Navigation – Satellite – Way point Navigation. Dijkstra’s Algorithm – A- star Algorithm - –UAV Guidance – Types of guidance - UAV communication systems - Ground control station – Telemetry - UAS future.

#### **Text Books:**

1. Andey Lennon “Basics of R/C model Aircraft design” Model airplane news publication, 1996
2. A.R.Jha , “Theory, Design, and Applications of Unmanned Aerial Vehicles”, CRC, Press, 2020

#### **Suggested Reading:**

1. Kenneth Munson , Jane's Unmanned Aerial Vehicles and Targets , Jane's Information Group , 2010
2. Rafael Yanushevsky , Guidance of Unmanned Aerial Vehicles- CRC Press, 2017.

#### **Web Resources:**

1. <https://www.mdpi.com/2504-446X/4/3>
2. <https://www.youtube.com/watch?v=ixYnzcZZu9g>

20ITE16

**FUNDAMENTALS OF BLOCKCHAIN TECHNOLOGY**

(Professional Elective – 4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To Familiarize the basic concepts of blockchain.
2. To provide the significance of the bitcoin ecosystem.
3. To explore the consensus mechanisms and technologies that support ethereum.
4. To introduce Hyperledger Fabric and its architecture.
5. To familiarize BlockChain use cases in various domains.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Describe the concepts of distributed systems and blockchain properties.
2. Discuss the concepts of bitcoin and consensus mechanisms in bitcoin mining.
3. Explore the consensus mechanisms and technologies that support Ethereum.
4. Outline the Hyperledger Fabric architecture and Hyperledger Projects.
5. Analyse blockchain use cases in various domains.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	2	3	-	1	-	-	1	-	1	3	3	3
<b>CO2</b>	3	3	2	1	3	-	2	-	-	2	-	1	3	3	2
<b>CO3</b>	3	3	2	1	3	-	2	-	-	1	-	2	3	3	3
<b>CO4</b>	3	3	2	2	2	-	1	-	-	2	-	2	3	3	2
<b>CO5</b>	3	3	2	2	3	-	2	-	-	2	-	1	3	3	3

**UNIT-I**

**Introduction:** Overview of distributed systems, Introduction to Blockchain, Generic elements of a blockchain, Features of Blockchain, Applications of Blockchain.

**Cryptocurrency And Blockchain :** Hash Functions and Merkle Trees, Components of Blockchain Ecosystem, Cryptography and Consensus Algorithms; Types of Blockchain, Blockchain Platforms.

**UNIT-II**

**Bitcoin Platform:** Bitcoin definition, Keys and addresses , Public keys and Private keys in bitcoin, The transaction life cycle, The transaction structure, Bitcoin payments, Bitcoin investment and buying and selling bitcoins. Consensus mechanism in bitcoin

**Wallets:** Wallet types, Non-deterministic wallets, Deterministic wallets, Alternative Coins- Namecoin, Litecoin, Zcash

**UNIT-III**

**Smart contracts and Ethereum:** Introducing Smart Contracts, Ethereum blockchain , The Ethereum stack, Ethereum virtual machine (EVM), Consensus mechanism in Ethereum, The Ethereum network, Ethereum

Development, Setting up a development environment, Development tools and clients, Applications developed on Ethereum

#### **UNIT-IV**

**Hyperledger Fabric:** Introduction to Hyperledger Fabric, Hyperledger Fabric architecture, Membership services Blockchain services, Hyperledger Projects- Fabric, Sawtooth lake, Iroha , Components of the Fabric, Peers or nodes, Applications on Blockchain, Alternate Blockchains- Ripple, Corda

#### **UNIT-V**

**Applications of Blockchain:** Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade — Trade Finance Network, Supply Chain Financing, Identity on Blockchain

#### **Text Books:**

1. Imran Bashir, “Mastering Blockchain”, 2<sup>nd</sup> Edition, Packt Publishers, 2018.
2. Melanie Swan, "BlockChain: Blueprint for a New Economy", 1<sup>st</sup> Edition, O'Reilly, 2018.

#### **Suggested Reading:**

1. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 1<sup>st</sup> Edition, Apress, 2017.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to BuildSmart Contracts for Ethereum and BlockChain”, Packt Publishing, 2019.

#### **Web Resources:**

1. <https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html>
2. <https://www.hyperledger.org/projects/fabric>
3. <https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger>
4. <https://www.amazon.com/Hands-Blockchain-Hyperledger-decentralized-applications/dp/1788994523>
5. <https://github.com/HyperledgerHandsOn/trade-finance-logistics>

20ITE17

**SOFTWARE ARCHITECTURE AND DESIGN PATTERNS**

(Professional Elective-4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Acquire the skills how to add functionality to designs while minimizing complexity.
2. To identify code qualities are required to maintain to keep code flexible
3. To understand the common design patterns.
4. To explore the appropriate patterns for design problems.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Realize the basic concepts to identify state & behaviour of real world objects.
2. Apply Object Oriented Analysis and Design concepts to solve complex problems.
3. Construct various UML models using the appropriate notation for specific problem context.
4. Design models to Show the importance of systems analysis and design in solving complex problems using case studies.
5. Study of Pattern Oriented approach for real world problems.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	-	-	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2

**UNIT-I**

**Introduction:** Introduction of Software Architecture, what is a design pattern? Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. What is object-oriented development? key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm.

**UNIT-II**

**Analysis a System:** overview of the analysis phase, stage 1: gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain. Design and Implementation, discussions and further reading.

**UNIT-III**

**Design Pattern Catalog:** Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, and prox.

**UNIT-IV**

**Interactive systems and the MVC architecture:** Introduction, The MVC architectural pattern, analyzing a simple drawing program, designing the system, designing of the subsystems, getting into implementation, implementing undo operation, drawing incomplete items, adding a new feature , pattern based solutions.

## **UNIT-V**

**Designing with Distributed Objects:** Client server system, java remote method invocation, implementing an object oriented system on the web (discussions and further reading) a note on input and output, selection statements, loops arrays.

### **Text Books:**

1. Brahma dathan, Sarnath rammath, “Object-oriented analysis, design and implementation”, universities press, 2013
2. Erich gamma, Richard helan, Ralph johman, john vlissides, “Design patterns”, Pearson Publication, 2013.

### **Suggested Book:**

1. Frank Bachmann, RegineMeunier, Hans Rohnert, “Pattern Oriented Software Architecture” –Volume 1, 1996.
2. William J Brown et al., "Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998.

### **Web Resources:**

1. <http://nptel.ac.in/courses>

20ITE18

**COMPUTER VISION LAB**

(Professional Elective – 4)

Instruction	2 Periods per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. To make students acquainted with practical aspects of computing with images.
2. To Improve quality of image by applying enhancement techniques.
3. To know the process of Histogram.
4. To understand Feature Extraction algorithms.
5. To develop computer vision applications for real world problems.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Demonstrate the fundamental image processing operations.
2. Relate computer vision system for real world problems.
3. Implement image enhancement techniques.
4. Make use of kernels and transformations to detect edges in an image.
5. Apply histogram processing and conversion between various colour spaces.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	2	2	3	-	-	-	-	-	-	-	-	3	3	2
CO3	3	2	2	3	-	-	-	-	-	-	-	-	3	3	3
CO4	3	2	2	3	-	-	-	-	-	-	-	-	3	3	2
CO5	3	2	2	3	-	-	-	-	-	-	-	-	3	3	3

**LIST OF PROGRAMS**

1. Implement basic image operations
  - a. Loading and displaying an image.
  - b. Color formats.
  - c. Image enhancement.
2. Implement smoothing on images using below filters
  - a. Gaussian Filter
  - b. Median Filter
  - c. Mean Filter.
3. Implement histogram calculation and equalization for the given image.
4. Implement morphological operations like dilation, erosion, opening and closing on the given image.
5. Implement edge detection on images using Prewitt Operator and Sobel Operator.
6. Implement Dense Image-based Motion Estimation Algorithms..
7. Case Study: Object detection like recognizing pedestrians.

8. Case Study: Face recognition of an image using K-Means clustering.
9. Case Study: Dimensionality reduction using PCA for the given images.
10. Case Study: Demonstrate model based reconstruction using tensor flow.

**Text Books:**

1. Gary Bradski and Adrian Kaehler, "Learning OpenCV", O'Reilly Media, Inc., 1<sup>st</sup> Edition, 2008.
2. Joe Minichino, Joseph Howse "Learning OpenCV 3 Computer Vision with python" Second Edition Packt publication.2015
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer-Verlag London Limited 2011.

**Suggested Reading:**

1. R C Gonzalez and R E woods, "Digital Image Processing", Addison Pearson, 3rd Edition, 2013.
2. David A. Forsyth and Jean Ponce, "Computer Vision-A Modern Approach", PHI, 1<sup>st</sup> Edition, 2003.

**Web Resources:**

1. [https://atoms.scilab.org/categories/image\\_processing](https://atoms.scilab.org/categories/image_processing)
2. <https://docs.opencv.org/2.4/doc/tutorials/tutorials.html>

20ITE19

**APPLIED PREDICTIVE ANALYTICS LAB**  
(Professional Elective – 4)

Instruction	2 Periods per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. To introduce R libraries for managing and interrogating raw and derived, observed, experimental datasets.
2. To build programs using Predictive Modeling.
3. To familiarize Regression and Classification Techniques with case studies.
4. To impart knowledge on the concepts of Neural Networks and various model Evaluation Techniques.
5. To explore time series models, Topic Modeling and Recommender Systems.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Demonstrate the basic functions and implement R packages and commands
2. Apply regression analysis methods and infer the problems
3. Develop applications of neural networks and evaluate the techniques
4. Evaluation of ensemble methods
5. Build a system to perform topic modeling on real time datasets

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	-	-	-	-	-	-	-	-	1	3	3	2
CO2	2	2	1	3	2	-	-	-	-	1	-	1	3	3	2
CO3	2	2	1	3	2	-	-	-	-	2	-	1	3	3	3
CO4	2	3	2	3	1	-	-	-	-	2	-	1	3	3	2
CO5	2	3	2	3	2	-	-	-	-	1	-	1	3	3	2

**LIST OF PROGRAMS**

1. Implementation of basic statistical functions of R programming
2. Demonstrate the file operations read and write, importing and exporting datasets
3. Demonstrate the regularization with the lasso in R
4. Implement the pocket perceptron algorithm for classification with neural networks
5. Solve a real-world regression problem by evaluating a neural network model to predict the energy efficiency of the buildings
6. Build a neural network model that predicts a numerical digit (0-9) from *MNIST* database of handwritten digits
7. Explore the field of Banking and Finance and build a classification model which predicts credit scores
8. Design and evaluate a decision tree classifier which predicts whether a particular banknote is genuine or whether it has been forged
9. Build a model to predict heart disease based on their profile and a series of medical tests with bagging
10. Implement Topic Modeling on online news stories



**Text Books:**

1. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publishing Ltd, 2015.
2. Roger D. Peng, “R Programming for Data Science”, Lean Publishing, 2015.

**Suggested Reading:**

1. Lantz Brett, “Machine Learning with R”, 2<sup>nd</sup> Edition, Packt Publishing Limited.
2. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Dean Abbott, 2014, Wiley.
3. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Tom Fawcett, O’Reilly, 1<sup>st</sup> edition, 2013.

**Web Resources:**

1. <https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/>
2. <https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1>
3. <http://uc-r.github.io/mars>
4. <https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products>
5. <https://www.coursera.org/learn/meaningful-predictive-modeling>

20ITE20

**UNMANNED AERIAL VEHICLES LAB**  
(Professional Elective – 4)

Instruction	2 Periods per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. Understand the basic components of Unmanned Aerial Vehicles (Drones) and its various applications.
2. Provide hands-on experience on design, fabrication and flying of UAV category aircraft.
3. Integration of drones with other hardware and software applications.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Identify the parts and functions of UAV and drones
2. Demonstrate the concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts
3. Determine the payload and its corresponding propeller's RPM to successfully fly the drone
4. Design a drone with an automatic recovery mechanism.
5. Design a mission-controlled surveillance drone.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	3	3	-	-	-	3	-	-	3	-	-	-	-	3	3
<b>CO3</b>	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
<b>CO4</b>	3	3	3	3	3	-	-	-	-	-	-	3	-	3	3
<b>CO5</b>	3	3	3	3	3	3	-	-	-	-	-	-	-	2	2

**LIST OF PROGRAMS**

1. Connect a single BLDC drone motor with LIPO battery using Electric Speed Controller (EDC) and XT60 connector.
2. Measure the speed of the BLDC drone motor using a laser tachometer
3. Write a Raspberry Pi program to control the BLDC motor connected to the microprocessor.
4. Connect four BLDC drone motors with one LIPO battery using four different Electric Speed Controllers (EDC).
5. Write a program to control all the 4 BLDC motors connected to the microprocessor.
6. Write a Raspberry Pi program to measure the battery level (remaining battery level) of the Li-ion battery connected to the BDLC motors and alert the user if the battery is less than 30%.
7. Using 433Mhz Tx and Rx, design a BLDC motors based Remote Control car using Raspberry Pi Module.
8. Measure the temperature of the drone using DHT11 sensor in Raspberry Pi microcontroller
9. Design and assemble a radio transmitter and receiver module using Raspberry Pi.
10. Connect the camera module with the microprocessor and perform face detection.
11. Assemble an Arducopter flight controller with GPS Module.

**Laboratory Equipment/Software/Tools Required:**

1. Drone Frames (4-Axis Quadcopter with integrated PCB wires), BDLC Motors, Li-ion Battery, Battery Chargers, Propellers, Electric Speed Controller (EDC), EDC XT-60 Connectors (EDC M2F, EDC F2F, EDC F2F), Li-ion Battery Connectors, Arducopter Flight Controller, 2.4Ghz Transmitter and Receiver module, 433 MHz RF Transmitter Receiver wireless modules, GPS system, Sim800A Model, RC car frame, BDC motors, RC car tires, 9A Battery, Battery connectors.
2. Raspberry Pi 4+ 8GB Ram, Arduino Mega, Breadboard, connecting wires, Resistors, capacitors, Sensors (Ultrasonic Sensor, Inertia measurement unit, Inertial sensor, Proximity sensor, Gas Sensor, DHT11 Temperature sensor, Heat Sensor, IR sensor), PCB Boards, Soldering kit.

**Text Books:**

1. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publishing Ltd, 2015.
2. Roger D. Peng, "R Programming for Data Science", Lean Publishing, 2015.

**Suggested Reading:**

1. Lantz Brett, "Machine Learning with R", 2<sup>nd</sup> Edition, Packt Publishing Limited.
2. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Dean Abbott, 2014, Wiley.
3. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Tom Fawcett, O'Reilly, 1<sup>st</sup> edition, 2013.

**Web Resources:**

1. <https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/>
2. <https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1>
3. <http://uc-r.github.io/mars>
4. <https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products>
5. <https://www.coursera.org/learn/meaningful-predictive-modeling>

**20ITE21 FUNDAMENTALS OF BLOCKCHAIN TECHNOLOGY LAB**

(Professional Elective-4)

Instruction	2 Periods per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. To familiarize the basic concepts of blockchain.
2. To provide the significance of the Ethereum blockchain.
3. To introduce solidity programming for developing blockchain applications
4. To explore Remix Tool for developing smart contracts.
5. To explore the features of Hyper ledger Fabric .

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Explore the working of blockchain fundamentals such as cryptography and distributed computing.
2. Implement smart contract on the Ethereum blockchain.
3. Build smart contracts using Solidity programming language
4. Write smart contracts using the Remix tool.
5. Acquire thorough knowledge of Hyperledger fabric.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	2	2	-	-	-	-	-	-	1	3	3	3
<b>CO2</b>	3	3	2	2	3	-	-	-	-	-	1	1	3	3	2
<b>CO3</b>	3	2	2	3	2	2	1	-	-	-	-	-	3	3	3
<b>CO4</b>	2	2	2	3	2	1	1	-	-	-	1	-	3	3	2
<b>CO5</b>	3	2	2	3	3	3	1	-	-	-	-	-	3	3	3

**LIST OF PROGRAMS**

1. Understanding Blockchain Foundations: Elements of Distributed Computing, Elements of Cryptography, Digital Signature.
2. Getting familiar with the Ethereum platform and Ethereum virtual machine.
3. Introduction to solidity program structure, compilation and deployment environment.
4. Creating and deploying the simple smart contract to store and get “Hello World”, on the Blockchain network.
5. Develop a smart contract to create a function setter and getter to set and get a value.
6. Develop Solidity contracts to illustrate inheritance and polymorphism.
7. Familiarize with the working of Remix Ethereum tool.
8. Design a smart contract on Remix Ethereum to print the array of integers and its length.
9. Setup a Simple Ethereum wallet and use it to send and receive Ethers.
10. Hyperledger Fabric Demo.

**Text Books:**

1. Imran Bashir “Mastering Blockchain” 2<sup>nd</sup> Edition Packt Publishers, 2018.
2. Melanie Swan, "BlockChain: Blueprint for a New Economy", 1<sup>st</sup> Edition O'Reilly, 2018.

**Suggested Reading:**

1. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 1<sup>st</sup> Edition, Apress, 2017.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to BuildSmart Contracts for Ethereum and BlockChain”, Packt Publishing, 2019.

**Web Resources:**

1. <https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html>
2. <https://www.hyperledger.org/projects/fabric>
3. <https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger>
4. <https://www.amazon.com/Hands-Blockchain-Hyperledger-decentralized-applications/dp/1788994523>
5. <https://github.com/HyperledgerHandsOn/trade-finance-logistics>

20ITE22

**SOFTWARE ARCHITECTURE AND DESIGN PATTERNS LAB**

(Professional Elective-4)

Instruction	2 Periods per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. Software Architecture & Design Patterns are taught as reusable components of the design.
2. Construct software architecture and OO design models (artifacts) for given complex problem in team.
3. Several architectural styles, middleware architectures are briefly studied with systems examples to help students understand the concept and offer quick practice
4. Translate the architectural views into an implementable architectural model using CASE tools.
5. Investigate existing solutions i.e. architectural styles and software design patterns of a particular complex software system design problem for evaluation.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Describe all important concepts of Software Architecture and design
2. Construct software architecture and OO design models (artifacts) for given complex problem in a team.
3. Investigate existing solutions i.e. architectural styles and software design patterns of a particular complex software system design problem for evaluation.
4. Translate the architectural views into an implementable architectural model using CASE tools.
5. Apply the various technologies for design pattern

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2	2	-	-	-	-	3	2	3	-	2	-	3
<b>CO2</b>	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3
<b>CO3</b>	3	2	2	2	-	-	-	-	2	2	-	-	3	-	3
<b>CO4</b>	3	-	-	-	-	-	-	-	2	2	-	-	3	-	3
<b>CO5</b>	-	2	-	2	2	-	-	-	-	-	2	2	2	-	3

**LIST OF PROGRAMS**

1. User gives a print command from a word document. Design to represent this chain of responsibility design pattern.
2. Use case Diagram for Librarian Scenario.
3. Design Adapter-class using UML.
4. Using UML design pattern for Abstract factory
5. Design Iterator Pattern Using UML
6. Using UML design Bridge design pattern.
7. Using UML design Decorator Design pattern.
8. Using UML Design a Flyweight Design pattern.
9. Using UML design Facade Design pattern.
10. Using UML design Visitor Design pattern.

**Text Book:**

1. F. Buschmann, R. Meunier, H. Rohnert, P. Sommerlad, M. Stal, "Pattern-Oriented Software Architecture (Part I)", A System of Patterns, Wiley, 1996, ISBN: 0 471 95869 7

**Web Resource:**

1. Software Architecture (uvic.ca)

20ITE23

**SOCIAL MEDIA ANALYTICS**  
(Professional Elective – 5)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To introduce the essentials of social media analytics.
2. To impart the computations to detect the communities.
3. To introduce the data mining techniques to process the network.
4. To introduce the concept of Influence and Homophily
5. To familiarize the various applications of social media analytics.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Demonstrate the basics on social media analytics and its significance
2. Find the communities based on computations.
- 3 Apply the different data mining techniques to get the task relevant information.
4. Demonstrate the skill in developing various applications to influence social media resource.
5. Discuss about the various application based on the analytics.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	2	2	3	1	1	-	-	-	-	1	1	1	3	3	3
<b>CO2</b>	2	2	2	1	2	-	-	-	-	-	1	1	2	2	3
<b>CO3</b>	2	2	2	2	1	-	-	-	-	-	-	1	3	3	3
<b>CO4</b>	2	2	1	1	1	-	-	-	-	-	-	1	1	3	3
<b>CO5</b>	2	2	1	1	1	-	-	-	-	-	-	1	1	2	3

**UNIT-I:**

**Introduction:** Social Media Mining, New Challenges for Mining **Graph Essentials:** Graph Basics, Graph Representation, Types of Graphs, Connectivity in Graphs, Special Graphs, Graph Algorithms.

**UNIT-II**

Introduction to various Network measures and models, **Community Analysis:** Community Detection, Community Evolution, Community Evaluation, Information.

**UNIT-III**

**Data Mining Essentials:** Data, Data Preprocessing, Data Mining Algorithms, Supervised Learning, Unsupervised Learning., **Information Diffusion in Social Media:** Herd Behaviour, Information Cascades, Diffusion of Innovations, Epidemics.

**UNIT-IV**

**Influence and Homophily:** Measuring Assortativity, Influence, Homophily, Distinguishing Influence and Homophily,

## UNIT-V

**Recommendation in Social Media:** Challenges, Classical Recommendation Algorithms, Recommendation Using Social Context, Evaluating Recommendations. **Behavior Analytics:** Individual Behavior, Collective Behavior.

### Text Book:

1. Zafarani R., Abbasi M.A., Liu H, "Social Media Mining: An Introduction", Cambridge University Press, 2014.

### Suggested Reading:

1. Jennifer Golbeck, "Analyzing the social web", Waltham, MA: Morgan Kaufmann (Elsevier), First Edition, 2013.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, First Edition, 2010.
3. Peter Mika, "Social Networks and the Semantic Web", Springer, First Edition, 2007
4. Stanley Wasserman and Katherine Faust, "Social network analysis: methods and applications", Cambridge University Press, First Edition, 1999.
5. Charu Aggarwal, "Social Network Data Analytics," Springer, First Edition, 2014.
6. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, Github and more", O'REILLY, Third Edition, 2018.

### Web Resources:

1. <https://www.ibm.com/topics/social-media-analytics>
2. <http://charuaggarwal.net/socialtoc.pdf>
3. <https://nptel.ac.in/courses/106106146>
4. [https://onlinecourses.nptel.ac.in/noc21\\_cs74/preview](https://onlinecourses.nptel.ac.in/noc21_cs74/preview)
5. <https://www.coursera.org/learn/social-media-data-analytics#syllabus>



20ADE10

**ROBOTIC PROCESS AUTOMATION**

(Professional Elective – 5)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To understand basic concepts of RPA
2. To Describe IIPA, where it can be applied and how it implemented
3. To Describe the different types of variables, Control Flow and data manipulation techniques
4. To Understand Image, Text and data Tables Automation
5. To Describe various types of Exceptions and strategies to handle

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. To Understand the basic concepts of RPA
2. To Describe various components and platforms of RPA
3. To Describe the different types of variables, control flow and data manipulation techniques
4. To Understand various control techniques and OCR in RPA
5. To Describe various types and strategies to handle exception

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	1	2	2	2	-	-	-	-	-	-	-	1	-	-	-
<b>CO2</b>	2	2	1	1	1	-	-	-	-	-	-	1	2	-	-
<b>CO3</b>	2	3	1	2	1	-	-	-	-	1	-	1	3	-	2
<b>CO4</b>	1	2	1	1	-	-	1	-	-	1	1	-	2	-	-
<b>CO5</b>	2	2	1	2	1	-	1	-	-	-	1	-	-	-	2

**UNIT-I**

RPA Foundations- What is RPA - flavors of RPA- history of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall Devops- Flowcharts.

**UNIT-II**

RPA Platforms- Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by step examples using the recorder.

**UNIT-III**

Sequence, Flowchart, and Control Flow-sequencing the workflow- Activities-Control flow, various types of loops, and decision making-Step-by step example using Sequence and Flowchart-Step-by-step example using Sequence and Control Flow-Data Manipulation-Variables and Scope Collections-Arguments - Purpose and use-Data table usage with examples Clipboard Management-File operation with step-by-step example-CSV/Excel to data table and vice versa [with a step-by-step example).

#### **UNIT-IV**

Taking Control of the Controls- Finding and attaching windows- Finding the 08 control- Techniques for waiting for a control- Act on controls - mouse and keyboard activities- Working with Ui Explorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

#### **UNIT-V**

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA.

#### **Text Books:**

1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 2020, ISBN-13 (electronic):978-7-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, "Learning Robotic Process Automation", Publisher: Packt Publishing Release Date: March 2018 ISBN: 9787788470940

#### **Suggested Reading:**

1. Frank Casale, Rebecca Dilla, Iieidi Jaynes,Lauren Livingston,"Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant"
3. Srikanth Merianda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation"

#### **Web Resources:**

1. Learning Robotic Process Automation, <https://www.packtpub.com/in/business/learning-robotic-process-automation>
2. Automation Anywhere University, <https://university.automationanywhere.com/>
3. <https://www.urbanpro.com/ghaziabad/rpa-robotics-process-automation-automation-anywhere/11461411>

20ADE11

**BUSINESS INTELLIGENCE**  
(Professional Elective – 5)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

- 1 Exposed with the basic rudiments of business intelligence system.
- 2 Understand the architectural aspects behind Business Intelligence
- 3 Understand data science, data visualization dashboard design, performance dashboard and future of BI.
- 4 Implement the business intelligence life cycle and the techniques used in it.
- 5 Exposed with different visualization, data analysis tools and techniques

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the concepts and components of Business Intelligence (BI) and Decision support systems.
2. Analyze how BI will help an organization and whether it will help yours.
3. Identify the technological architecture that makes up BI systems
4. Use the tools that make up BI (data science).
5. Plan the implementation of a BI system

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-

**UNIT-I**

Introduction to Business Intelligence BI concept, BI architecture, BI in today's perspective, BI Process, Applications of BI like Financial analysis, statistical analysis, sales analysis, CRM, result pattern and ranking analysis, Balanced Scorecard, BI in Decision Modelling: Optimization, Decision making under uncertainty. Ethics and business intelligence.

**UNIT-II**

Data Science The concept, process and typical tools in data science. Example of different algorithms i.e segmentation, classification, validation, regressions, recommendations. Exercises using Excel and R to work on histograms, regression, clustering and text analysis. Co-relation between Algorithm and Code in data science.

**UNIT-III**

Decision support systems: Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system  
Mathematical models for decision making: Structure of mathematical model, Development of a model, Classes of models

#### **UNIT-IV**

Data Visualization and Dashboard Design Responsibilities of BI analysts by focusing on creating data visualizations and dashboards. Importance of data visualization, types of basic and composite charts. Performance Dashboard Measuring, Monitoring and management of Business, KPIs and dashboard, the types of dashboards, the common characteristics of Enterprise dashboard, design of enterprise dashboards, and the common pitfalls of dashboard design.

#### **UNIT-V**

Business Intelligence Applications:

Marketing models: Relational marketing, Salesforce management, Business case studies.

Logistic and production models: Supply chain optimization, Optimization models for logistics planning, Revenue management systems, Business case studies.

Data envelopment analysis: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices.

#### **Text Books:**

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9<sup>th</sup> Edition, Pearson 2013 (1,4 units)
2. Carlo Vercellis, Business Intelligence: Data Mining and Optimization for Decision Making by, wiley publishers.2009 (2,3,5 Units)

#### **Suggested Reading:**

1. "Business Intelligence – Grundlagen und praktische Anwendungen: Eine Einführung in die IT" by Hans-Georg Kemper and Henning Baars
2. David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager's Guide", Second Edition, 2012.
3. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003
4. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009

20ITE24

**MOBILE COMPUTING**  
(Professional Elective – 5)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To introduce GSM communication system
2. To familiarize students with MAC protocols in mobile networks
3. To impart knowledge about the functionality of mobile IP
4. To provide insights on mobile TCP protocols
5. To enable students to gain knowledge on Data hoarding techniques and QoS issues.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Describe GSM architecture, services and protocols
2. Examine challenges in medium access control in wireless and mobile context and associated protocols
3. Analyze the need for mobile IP and its associated functionalities in mobile environments.
4. Evaluate the mobile TCP protocols in terms of their functionality, advantages and limitations
5. Identify and solve database issues using hoarding techniques

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	2	1	1	-	-	-	-	-	-	-	-	1	3	3	3
<b>CO2</b>	2	1	1	-	-	-	-	-	-	-	-	1	3	3	3
<b>CO3</b>	2	1	1	-	-	-	-	-	-	-	-	1	3	3	2
<b>CO4</b>	2	1	1	-	-	-	-	-	-	-	-	1	3	3	2
<b>CO5</b>	2	1	1	-	-	-	-	-	-	-	-	1	3	3	2

**UNIT-I**

**Introduction:** Introduction to Mobile Computing - Architecture of Mobile Computing - Novel Applications – Limitations. GSM - GSM System Architecture - Radio Interface – Protocols - Localization and Calling - Handover - Security - New Data Services.

**UNIT-II**

**Data Link Layer :** Medium Access Control Protocol, Wireless MAC Issues - Hidden and exposed terminals, near and far terminals, SDMA, FDMA, TDMA, CDMA ,Tunnelling, Cellular Mobility, IPv6

**UNIT-III**

**Mobile Network Layer:** Mobile IP, Goals, Assumption, Entities and Terminology, IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunnelling and Encapsulation, Optimizations, Dynamic Host Configuration Protocol

**UNIT-IV**

**Mobile Transport Layer:** Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmit and Fast Recovery, Transmission /Time-Out Freezing, Selective Retransmission, Transaction Oriented TCP.

## **UNIT-V**

**Data Hoarding Techniques:** Caching Invalidation Mechanisms, Client Server Computing with Adaptation-Power Aware and Context Aware Computing, Transactional Models, Query Processing, Recovery and Quality of Service Issues.

### **Text Book:**

1. Jochen Schiller, "Mobile Communications", Second edition Addison-Wesley, 2008

### **Suggested Reading:**

1. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden, Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", McGraw-Hill Professional, 2005.
2. Hansmann, Merk, Nickolas, Stober, "Principles of Mobile Computing", second edition, Springer, 2003. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley DreamTech, 2003.
3. Ivan Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002.

20ADE07

**EXPLAINABLE ARTIFICIAL INTELLIGENCE**

(Professional Elective – 5)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Understand the concepts within Explainable AI and interpretable machine learning
2. Demonstrate comprehension of current techniques for generating explanations from black-box machine learning methods
3. Demonstrate the ability to select and assess Explainable AI methods
4. Demonstrate comprehension of current ethical, social and legal challenges related to Explainable AI

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Describe the context of the machine learning application and why explainability would help, but also scrutinise which kind of explainability technique is necessary.
2. Understand the concepts that are important in model validation, evaluation, and performance visualization for both supervised and unsupervised learning.
3. Install and set up one or more post hoc explain ability techniques through a self-chosen set of programming platforms.
4. Critically reflect on the results from Explainable deep learning techniques and suggest how it helps the problem context.
5. Demonstrate comprehension of challenges and future related to Explainable AI

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
<b>CO2</b>	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
<b>CO3</b>	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
<b>CO4</b>	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
<b>CO5</b>	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2

**UNIT-I**

**Introduction:** Black-Box problem, Goals, Brief History, Purpose, Societal Impact, Types of Explanations, Trade-offs, Taxonomy, Flowchart for Interpretable and Explainable Techniques.

**Pre-model Interpretability and Explainability:** Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering.

**UNIT-II Model Visualization Techniques and Traditional Interpretable Algorithms:** Model Validation, Evaluation, and Hyperparameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms.

### **UNIT-III**

**Model Interpretability:** Advances in Interpretable Machine Learning: Interpretable vs. Explainable Algorithms, Tools and Libraries, Ensemble-Based, Decision Tree-Based, Rule-Based Techniques, Scoring System.

**Post-Hoc Interpretability and Explanations:** Tools and Libraries, Visual Explanation, Feature Importance, Example-Based.

### **UNIT-IV**

**Explainable Deep Learning:** Applications, Tools and Libraries, Intrinsic, Perturbation, Gradient / Backpropagation.

### **UNIT-V**

**Explainability:** Time Series Forecasting, Natural Language Processing, and Computer Vision.

**XAI: Challenges:** Properties of Explanation, Categories of Explanation, Taxonomy of Explanation Evaluation

**XAI: Future:** Formalization of Explanation Techniques and Evaluations, Adoption of Interpretable Techniques, Human-Machine Collaboration, Collective Intelligence from Multiple Disciplines, Responsible AI (RAI), XAI and Security, Causality and XAI.

#### **Text Book:**

1. Uday Kamath and John Liu “Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning”, Springer Cham, First Edition, 2021.

#### **Suggested Reading:**

1. Leonida Gianfagna and Antonio Di Cecco, “Explainable AI with Python”, Springer International Publishing, First Edition, 2021.
2. Denis Rothman, “Hands-On Explainable AI (XAI) with Python”, Packt Publishing, First Edition, 2020

#### **Web Resources:**

1. <https://www.ibm.com/in-en/watson/explainable-ai>
2. <https://sites.google.com/view/explainable-ai-tutorial>
3. <https://cloud.google.com/explainable-ai>



20ADE13

**REINFORCEMENT LEARNING**

(Professional Elective – 6)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To present an overview of reinforcement learning concepts, Multi Armed bandits problem, Finite MDP.
2. To introduce Dynamic programming, Monte Carlo methods and Temporal-Difference Learning.
3. To familiarize Planning and Learning with Tabular Methods, Prediction with Approximation.
4. To provide information about Reinforcement learning mechanisms.
5. To facilitate remarkable point of contact between reinforcement learning and neuroscience.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Explain the fundamental concepts of reinforcement learning and finite markov decision process.
2. Design a Reinforcement Learning system that knows how to make automated decisions
3. Illustrate the integration of model-based and model-free methods.
4. Analyse how a learning algorithm can be implemented in a different ways to obtain computational advantages.
5. Discuss parallels between reinforcement learning and neuroscience

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	2	2	3	2	1	-	-	-	1	1	1	1	3	2	3
<b>CO2</b>	2	2	3	2	1	-	-	-	-	-	1	-	2	2	2
<b>CO3</b>	2	1	2	2	2	-	-	-	-	-	-	-	3	2	3
<b>CO4</b>	2	2	3	1	2	-	-	-	-	-	-	1	1	2	2
<b>CO5</b>	2	2	3	2	1	-	-	-	-	-	-	1	1	2	3

**UNIT-I**

**Introduction:** Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, Examples. **Multi Armed Bandits:** A K-armed Bandit Problem, Action-Value Methods, Incremental implementation, tracking a Non-stationary problem, Optimistic initial values, UCB, GBA, Associative search. **Finite Markov Decision Process:** The Agent-Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions, Optimal Policies and optimal Value Functions, Optimality and Approximation.

**UNIT-II**

**Dynamic Programming:** Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous dynamic programming, Generalized Policy Iteration, Efficiency of dynamic programming. **Monte Carlo Methods:** Monte Carlo Prediction, Monte Carlo Estimation of Action values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy prediction via Importance Sampling, Incremental implementation. **Temporal-Difference Learning:** TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-policy TD control, Q-learning Off-policy TD control.

### UNIT-III

**Planning and Learning with Tabular Methods:** Models and Planning, Dyna: Integrated Planning, acting and learning, Prioritized Sweeping, Expected vs Sample updates, Trajectory sampling, Real-time dynamic programming, Planning at decision time, Heuristic search, Rollout algorithms, Monte carlo tree search. **Approximate Solution Methods: On-policy Prediction with Approximation:** Value-function approximation, stochastic-gradient and semi-gradient methods, linear methods, Feature construction for linear methods, selecting step-size parameters manually, Nonlinear function approximation: ANN, Least-squares TD, Memory based function approximation, and Kernel-based function approximation.

### UNIT-IV

**Eligibility Traces:** The  $\lambda$ -return, TD ( $\lambda$ ), n-step truncated  $\lambda$ -return methods, Online  $\lambda$ -return algorithm, True online TD ( $\lambda$ ), Stable off-policy methods with traces, Implementation issues. **Policy Gradient Methods:** Policy Approximation and its advantages, The Policy Gradient theorem, REINFORCE: Monte Carlo Policy Gradient, REINFORCE with Baseline, Actor-Critic methods, Policy gradient for continuing problems, Policy parameterization for continuous actions.

### UNIT- V

**Neuroscience:** Neuroscience basics, The reward prediction error hypothesis, Dopamine, Neural Actor-Critic, Actor and critic learning rules, Hedonistic Neurons, Collective reinforcement learning.

#### Applications and Case studies

#### Text Book:

1. Sutton & Barto, "Reinforcement Learning: An Introduction", MIT Press 2018, 2<sup>nd</sup> Edition. .

#### Suggested Reading:

1. Vincent François-Lavel, Peter Henderson, Riashat Islam, Marc G. Bellemare, Joelle Pineau, "An Introduction to Deep Reinforcement Learning", Now Publishers, 2018
2. Csaba Szepesvari, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 2010
3. Maxim Lapan "Deep Reinforcement Learning Hands-On" Packt publisher, 2<sup>nd</sup> edition, 2020

#### Web Resources:

1. Nptel Course: Reinforcement Learning: <https://nptel.ac.in/courses/106/106/106106143/>
2. Swayam Course: Reinforcement Learning: [https://swayam.gov.in/nd1\\_noc19\\_cs55/previe](https://swayam.gov.in/nd1_noc19_cs55/previe)

**20ITE25**

**SOFTWARE DEFINED NETWORKS**

(Professional Elective - 6)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To understand the concepts of software defined networks
2. To understand the separation of the data plane and the control plane.
3. To learn the interface between networking devices and the software controlling them
4. To know about SDN in data centers
5. To explore modern approaches like openflow, openstack

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Differentiate between traditional networks and software defined networks.
2. Understand advanced and emerging networking technologies.
3. Learn how to use SDN controllers to perform complex networking tasks.
4. Demonstrate the skills to do advanced networking research and programming.
5. Apply the knowledge on SDN and security measures to solve real world problems

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	-	-	1	-	-	-	-	-	-	-	2	3	3	1
<b>CO2</b>	3	2	2	-	-	-	1	-	-	-	1	3	3	3	2
<b>CO3</b>	3	3	3	1	3	-	-	-	1	1	2	2	3	3	1
<b>CO4</b>	3	3	3	2	3	2	2	-	-	1	1	2	3	3	2
<b>CO5</b>	3	3	3	3	3	2	2	1	2	2	3	3	3	3	2

**UNIT-I**

**Introduction:** Basic packet-Switching terminology - Historical background - The modern Data Center - Traditional switch architecture - Autonomous and dynamic forwarding Tables- Open source and technological shifts.- Evolution of switches and Control plane – Cost- SDN Implications for research and innovation- Data Center Innovation- Data Center needs -The evolution of networking technology - Forerunners of SDN- Sustaining SDN interoperability - Open Source contributions- Legacy mechanisms evolve towards SDN- Network virtualization.

**UNIT-II**

**SDN and Open Flow Specification:** Fundamental characteristics of SDN - SDN operation - SDN Devices- SDN Controller - SDN applications- Alternate SDN methods - OpenFlow Overview - OpenFlow 1.0 and OpenFlow basics- OpenFlow 1.1 additions - OpenFlow 1.2 additions - OpenFlow 1.3 additions - OpenFlow limitations.

### **UNIT-III**

**SDN in Data Centers and Other Environment:** Data Center definition - Data Center demands- Tunneling technologies for the Data Center- Path technologies in the Data Center - Ethernet fabrics in the Data Center- SDN Use Cases in the Data Center- Open SDN vs Overlays in the Data Center- Real World Data Center implementations- SDN in other environments - Wide Area Networks - Service provider and carrier networks - Campus networks- Hospitality networks- Mobile network - In-Line network functions- Optical Networks - SDN vs P2P/Overlay Networks.

### **UNIT-IV**

**SDN Applications and Open-Source Perspectives:** Reactive versus proactive applications - Analyzing simple SDN Applications- A simple reactive Java application - Background on controllers - Using the Floodlight controller - Using the Open Daylight controller - Using the Cisco XNC Controller - Switch considerations- Creating network virtualization tunnels - Offloading flows in the Data Center- Access control for the campus- Traffic engineering for service providers - Open source licensing issues - Profiles of SDN Open Source users- OpenFlow source code- Switch implementations - Controller implementations - SDN applications - Orchestration and network virtualization - Simulation and testing - Tools- OpenStack.

### **UNIT-V**

**SDN Security Challenges:** Characteristics of SDN - Security analysis and potential attacks in SDN - Solutions to the security issues in SDN - Network security enhancement using the SDN Framework - Issues and Challenges.

#### **Text Books:**

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publications, First Edition, 2014.
2. S. Scott-Hayward, S. Natarajan and S. Sezer, "A Survey of Security in Software Defined Networks," in IEEE Communications Surveys & Tutorials, vol. 18, no. 1, pp. 623-654, First quarter 2016.

#### **Suggested Reading:**

1. Thomas D. Nadeau and Ken Gray, "SDN - Software Defined Networks" O'Reilly Media, 2013.
2. Siamak Azodolmolky, "Software Defined Networking with OpenFlow", Packt Publishing, 2013
3. Feamster, Nick, Jennifer Rexford, and Ellen Zegura, "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review, Volume 44, Number 2, 2014, Pages 87-98.
4. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.
5. Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.

20ADE12

**SERVERLESS COMPUTING**  
(Professional Elective – 6)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Fundamentals of Serverless computing..
2. Concepts of event driven applications.
3. Difference between containerization and serverless computing.
4. Understanding the concepts of FaaS, and Comparison with PaaS.
5. How to use AWS lamda to build serverless applications
6. Automation with Serverless.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the evolution of computing and architectures.
2. Summarize the requirements of serverless computing.
3. Develop event driven applications.
4. Use AWS Lambda for serverless applications.
5. Develop Functions for serverless applications in AWS Lambda

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	3	3	3	-	-	-	-	-	3	-	-	2	-
CO4	-	-	-	-	3	-	-	-	-	-	3	3	-	2	-
CO5	-	-	3	3	1	-	-	-	-	-	3	3	-	2	-

**UNIT-I**

The Evolution of Compute, Understanding enterprise data centers, Exploring the units of compute, Understanding software architectures, Predicting what comes next.

**UNIT-II**

**Introduction:** Serverless computing, Serverless and event-driven collision, Introduction to FaaS, FaaS states, benefits, Comparison with PaaS, Comparison with containers, #NoOps, Limitations of serverless computing.

**UNIT-III**

Event-Driven Applications, Understanding modern applications, Evolution of integration patterns, Automation with serverless.

**UNIT-IV**

**AWS Lambda:** Getting Started with AWS Lambda, What is AWS Lambda?, How does AWS Lambda work, Use cases, Execution environment, AWS Lambda Function–Hello World, Configuring options for AWS Lambda, Securing AWS Lambda using IAM.

**UNIT-V**

The Foundations of a Function in AWS, Technical requirements, Learning about AWS Lambda, Fundamentals of a function, Use cases, Setting up security, Invoking Lambda functions, Anatomy of a Lambda function, The programming model, Writing your first Lambda function, Adding Amazon API Gateway, Introducing Amazon

API Gateway, Serverless APIs, Securing an API, Building, deploying, and managing APIs, Building a Lambda-backed API.

**Text Books:**

1. Learn AWS Serverless Computing By Scott Patterson · 2019, Packt Publishers.
2. Hands-On Serverless Computing b Kuldeep Chowhan, 2018 Packt Publishing

**Suggested Reading:**

1. Maddie Stigler, Beginning Serverless Computing, Apress, 2018
2. Kuldeep Chowhan , Hands-On Serverless Computing: Build, run and orchestrate serverless applications using AWS Lambda, Microsoft Azure Functions, and Google Cloud Functions, Packt Publishers, 2018

**Web Resources:**

1. <https://journalofcloudcomputing.springeropen.com/articles/10.1186/s13677-021-00253-7>
2. <https://cacm.acm.org/magazines/2019/12/241054-the-rise-of-serverless-computing/fulltext>

20ITE26

**DIGITAL FORENSICS**  
(Professional Elective – 6)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To study digital forensic concepts and the investigative process
2. To learn about the legal issues of digital forensic analysis and the role of investigator.
3. To study the data acquisition, identification and storage of digital Evidence.
4. To Learn the usage of digital forensics tools.
5. To learn E-mail investigation and Mobile device forensics.

**Course Outcomes:**

Upon successful completion of the course, students will able to

1. Describe digital forensics and relate it to an investigative process.
2. Explain the legal issues of preparing for and performing digital forensic analysis based on the investigator's position and duty.
3. Interpret the cyber pieces of evidence, Digital forensic process model and their legal perspective.
4. Demonstrate various forensic tools to investigate the cybercrime and to identify the digital pieces of evidence.
5. Analyse the digital evidence used to commit cyber offenses

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	3	-
CO3	-	-	-	1	-	2	-	2	-	-	-	-	-	3	-
CO4	-	-	-	2	3	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-

**UNIT-I**

**Computer Forensics Fundamentals:** What is Computer Forensics? Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists.

**Types of Computer Forensics Technology:** Types of Military Computer Forensic Technology, Types of Law Enforcement Computer Forensic Technology, Types of Business Computer Forensic Technology.

**UNIT- II**

**Understanding Digital Forensics and Investigations:** Procedure for Private Sector High-Tech investigations, Understanding Data Recovery Workstations and Software, Conducting an investigation.

**Data Acquisition:** Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Using Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Remote Network Acquisition Tools, Other Forensics Acquisition Tools.

**UNIT-III**

**Processing Crime and Incident Scenes:** Identifying Digital Evidence, Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes, Preparing for a Search, Securing a Digital Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence, Obtaining a Digital Hash, Reviewing a Case.

#### **UNIT-IV**

**Current Digital Forensics Tools:** Evaluating Computer Forensic Tool Needs, Digital Forensics Software Tools, Digital Forensics Hardware Tools, Validating and Testing Forensics Software.

**Digital Forensics Analysis and Validation:** Determining What Data to Collect and Analyse, Validating Forensic Data, Addressing Data-Hiding Techniques.

#### **UNIT-V**

**E-Mail and Social Media Investigations:** Exploring the Role of E-Mail in Investigation, Exploring the Roles of the Client and Server in E-Mail, Investigating E-Mail Crimes and Violations, Understanding E-Mail Servers, Using Specialized E-Mail Forensic Tools, Applying Digital Forensics Methods to Social Media Communications.

**Mobile Device Forensics and Internet of Anything:** Understanding Mobile Device Forensics, Understanding Acquisition Procedures for Mobile Devices.

#### **Text Books:**

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, Charles River Media, 2015.
2. Nelson, B, Phillips, A, Stuart, C., "Guide to Computer Forensics and Investigations", 5<sup>th</sup> edition., Cengage Learning, 2016.

#### **Suggested Reading:**

1. John Sammons," The basics of digital Forensics – The primer for getting started in digital forensics", Elsevier Syngress Imprint, 2012.
2. Richard Boddington," Practical Digital Forensics" [PACKT] Publication, Open-source community, 2016



20ITE27

**REAL TIME OPERATING SYSTEMS**  
(Professional Elective – 6)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To study issues related to the design and analysis of systems with real-time constraints.
2. To learn the features of Real time OS.
3. To study the various Uniprocessor and Multiprocessor scheduling mechanisms.
4. To learn about various real time communication protocols.
5. To study the difference between traditional and real time databases

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Gain knowledge about Stimulability analysis.
2. Ability to learn Real-time programming environments.
3. Develop efficient algorithms for real-time task scheduling in uniprocessor and multi-processor environments.
4. Knowledge about real time communication protocols.
5. Able to use real-time databases.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	1	1	1	-	-	-	-	-	-	-	-	-	2	-	2
<b>CO2</b>	1	1	-	-	-	-	-	-	-	-	-	-	2	-	-
<b>CO3</b>	2	2	-	1	-	-	-	-	-	-	-	-	3	-	-
<b>CO4</b>	2	2	1	-	-	-	-	-	-	-	-	-	3	-	-
<b>CO5</b>	1	1	1	-	-	-	-	-	-	-	-	-	2	-	-

**UNIT-I**

Introduction to real time computing - Concepts; Example of real-time applications – Structure of a real time system – Characterization of real time systems and tasks - Hard and Soft timing constraints - Design Challenges - Performance metrics - Prediction of Execution Time : Source code analysis, Micro-architecture level analysis, Cache and pipeline issues- Programming Languages for Real-Time Systems

**UNIT-II**

Real time OS – Threads and Tasks – Structure of Microkernel – Time services – Scheduling Mechanisms Communication and Synchronization – Event Notification and Software interrupt

**UNIT-III**

Task assignment and Scheduling - Task allocation algorithms - Single-processor and Multiprocessor task scheduling - Clock-driven and priority-based scheduling algorithms- Fault tolerant scheduling.

**UNIT-IV**

Real Time Communication -Network topologies and architecture issues – protocols – contention based, token based, polled bus, deadline-based protocol, Fault tolerant routing. RTP and RTCP.

**UNIT-V**

Real time Databases – Transaction priorities – Concurrency control issues – Disk scheduling algorithms – Two phase approach to improve predictability.

**Text Book:**

1. C.M. Krishna, Kang G. Shin – “ Real Time Systems”, International Edition, McGraw Hill Companies, Inc., New York, 1997

**Suggested Reading:**

1. Jane W.S. Liu, Real-Time Systems, Pearson Education India, 2000.
2. Philip A. Laplante and Seppo J. Ovaska, “Real-Time Systems Design and Analysis: Tools for the Practitioner” IV Edition IEEE Press, Wiley, 2011.

**Web Resources:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cs16/preview](https://onlinecourses.nptel.ac.in/noc20_cs16/preview)
2. [http://web.iyte.edu.tr/~tolgaayav/courses/ceng314/uC\\_RTOS.pdf](http://web.iyte.edu.tr/~tolgaayav/courses/ceng314/uC_RTOS.pdf)
3. <https://user.it.uu.se/~yi/courses/rts/dvp-rts-08/notes/RTOS.pdf>

<b>Open Elective- 1</b>		
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>
1.	20MEO03	Research Methodologies
2.	20MEO12	3D Printing
3.	20ECO14	Neural Networks and Fuzzy Logic
4.	20EGO01	Technical Writing Skills
5.	20BTO04	Bioinformatics

20MEO03

**RESEARCH METHODOLOGIES  
(Open Elective-1)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To make the students to formulate the research problem.
2. To identify various sources for literature review and data collection.
3. To prepare the research design.
4. To equip the students with good methods to analyze the collected data.
5. To explain how to interpret the results and report writing.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Define research problem.
2. Review and assess the quality of literature from various sources.
3. Understand and develop various search designs.
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square.
5. Improve the style and format of writing a report for technical paper/Journal report.

**UNIT – I**

**Research methodology:** Objectives and motivation of research, types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical, research approaches, significance of research, research methods vs. methodology, research process, criteria of good research, problems encountered by researchers in India, technique involved in defining a problem.

**UNIT-II**

**Literature survey:** Importance of literature survey, sources of information-primary, secondary, tertiary, assessment of quality of journals and articles, information through internet.

**UNIT – III**

**Research design:** Meaning of research design, need of research design, feature of a good design important concepts related to research design, different research designs, basic principles of experimental design, steps in sample design.

**UNIT – IV**

**Data collection:** Collection of primary data, Secondary data, measures of central tendency-mean, mode, median, measures of dispersion- range, mean deviation, standard deviation, measures of asymmetry (skewness), important parametric tests -z, t, F, Chi-Square, ANOVA significance.

**UNIT – V**

**Research report formulation and presentation:** Synopsis, dissertation, technical paper and journal paper, writing research grant proposal, making presentation with the use of visual aids, writing a proposal for research grant.

**Text Books:**

1. C.R Kothari, Research Methodology Methods & Technique, New Age International Publishers, 2004.
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011.
3. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009.

**Suggested Reading:**

1. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
2. Naval Bajjai, Business Research Methods, Pearson Education,2011.

**20MEO12**

**3D PRINTING  
(Open Elective-1)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To make students understand the basic concept of digital manufacturing.
2. To teach different processes involved in digital fabrication of products.
3. To demonstrate the STL file generation and manipulations.
4. To demonstrate various post processing techniques.
5. To demonstrate the applications of RP in different fields of engineering.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the concept of 3D printing processes, advantages and limitations.
2. Evaluate real-life scenarios and recommend the appropriate 3D printing technology.
3. Analyze various pre-processing and post processing techniques.
4. Explain current and emerging 3D printing technologies in diversified applications.
5. Identify components required in construction of 3D printer.

**UNIT-I**

**Introduction to 3D Printing:** Introduction to 3D printing, evolution, distinction between 3D printing & CNC machining.

**Design considerations:** Materials, size, resolution, mass customization, additive vs. subtractive manufacturing, its advantages and limitations

**UNIT-II**

**Photo polymerization processes:** Photo polymerization, Stereolithography Apparatus (SLA), Applications, advantages and disadvantages.

**Powder bed fusion processes:** Introduction, Selective laser Sintering (SLS), Materials, Applications, advantage and disadvantages.

**Extrusion-based systems:** Fused deposition modeling (FDM), laminated object manufacturing (LOM), Principles, Materials, Process Benefits and Drawbacks.

**Material Jetting AM Processes:** Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes.

**UNIT-III**

**Preprocessing in AM:** Modeling and viewing - 3D scanning; Model preparation – STL conversion, STL error diagnostics, STL file Repairs, generic solution, slicing, newly proposed file formats.

**Post processing in AM:** Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

**UNIT-IV**

**Construction of basic 3D printer:** Construction of 3D printing machine – axes, linear motion guide ways, ball screws, motors, bearings, encoders, process chamber, safety interlocks, sensors.

**UNIT-V**

**Applications of AM:** Application in aerospace industry, automotive industry, jewelry industry, coin industry. medical and bioengineering applications: planning and simulation of complex surgery, forensic science.

**Text Books:**

1. Gibson, DW. Rosen and B.Stucker; Additive manufacturing methodologies: Rapid prototyping to direct digital manufacturing, Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, 3D printing and additive manufacturing: principles and application, 4<sup>th</sup> edition of rapid proto typing, World scientific publishing company, 2014.
3. P.K. Venuvinod, Rapid prototyping – Laser based and other technologies, Kluwer, 2004.

**Suggested Reading:**

1. Jacob, Paul, Rapid tooling: Technologies and industrial applications, Taylor & Francis Group, 2000.
2. Alain Bernard, Georges Taillandier, Additive Manufacturing, Wiley, 2014.

20ECO14

**NEURAL NETWORKS AND FUZZY LOGIC  
(Open Elective-1)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Probability knowledge is required

**Course Objectives:**

1. Learn various types of neural networks
2. Learn the concepts of Fuzzy systems
3. Study the applications of neural networks and Fuzzy controllers.

**Course Outcomes:**

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

1. Understand the principles of Neural Networks and Fuzzy Logic fundamentals.
2. Apply the basic concepts to model the Neural Networks and Fuzzy Logic systems.
3. Compare the Neural Network based systems and Fuzzy Logic based systems.
4. Analyze Fuzzy Logic controllers and its applications.
5. Explain the concepts of Fuzzy target tracing control systems.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
CO2	3	3	2	2	1	-	-	-	-	-	-	2	3	1	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	2	1	1
CO4	2	2	3	2	1	-	-	-	-	-	-	2	3	1	1
CO5	1	1	2	1	2	-	-	-	-	-	-	1	2	1	1

**UNIT-I**

**Introduction:** Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline.

**UNIT-II**

**Probabilistic Models,** Fuzzy ARTMAP and Recurrent Networks: Probabilistic Neural Networks, General Regression Neural Networks, Fuzzy ARTMAP, Recurrent Back propagation Neural Networks.

**UNIT-III**

**Application of Neural Networks:** - Design and optimization of Systems: Non-Linear optimization, Inverse design problems, Pattern Recognition Applications: Control Chart pattern Recognition, Recognition of Machine-Cells in a group technology layout. Complex pattern Recognition tasks: Pattern mapping, pattern variability.

**UNIT-IV**

**Introduction to Fuzzy systems,** Fuzzy sets and operations on Fuzzy sets, Basics of Fuzzy relations, Fuzzy measures, Fuzzy integrals, Transform Image coding with Adaptive Fuzzy systems.

**UNIT-V**

**Fuzzy Target Tracking control systems,** Fuzzy and Math Model Controllers, Real Time Target Tracking, Fuzzy Controller, Fuzzified CMAC and RBF – Network based self-learning Controllers.



**Text Books:**

1. James A. Freeman and David M. Skapura, "Neural Networks: Algorithms Applications and Programing Techniques", Pearson Education, India, 2008.
2. James A. Anderson, "An introduction to Neural Networks", PHI, 2003.

**Suggested Reading:**

1. B. Yegnanarayana, "Artificial Neural Networks", PHI Publications, India, 2006.
2. M.AnandaRao and J.Srinivas, "Neural Networks:Algorithms and Applications", Narosa Publications, 2009

20EGO01

**TECHNICAL WRITING SKILLS  
(Open Elective-1)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 marks
CIE	40 marks
Credits	3

**Course Objectives:**

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	2	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	2	-	-	2	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-

**UNIT-I**

**Communication** – Nature and process.

**Channels of Communication** – Downward, upward and horizontal communication. Barriers to communication.

**Technical Communication** – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication.

Technical communication Skills – Listening, Speaking, Reading & Writing.

**UNIT-II**

**Technical Writing** – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

**UNIT-III**

**Business correspondence** – Sales letters, letters of Quotation, Claim and Adjustment letters.

**Technical Articles:** Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

#### **UNIT-IV**

**Technical Reports:** Types, significance, structure, style and writing of reports. Routine reports, Project reports.

**Technical Proposals:** Definition, types, characteristics, structure and significance.

#### **UNIT-V**

**Mechanics of Meetings:** Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

**Technical Presentations:** Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

#### **Text Books :**

1. Meenakshi Raman & Sangeeta Sharma, “**Technical Communications-Principles and Practice**”, Oxford University Press, Second Edition, 2012.
2. M Ashraf Rizvi, “**Effective Technical Communication**”, Tata McGraw Hill Education Pvt Ltd, 2012.

#### **Suggested Reading :**

1. Kavita Tyagi & Padma Misra, “**Basic Technical Communication**”, PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, “**Business Correspondence and Report Writing**”, Tata McGraw Hill, 2003

#### **Web Resources:**

1. [https://onlinecourses.nptel.ac.in/noc18\\_mg13/preview](https://onlinecourses.nptel.ac.in/noc18_mg13/preview)
2. <https://www.technical-writing-training-and-certification.com/>
3. <https://academy.whatfix.com/technical-writing-skills>

20BTO04

**BIO-INFORMATICS  
(Open Elective-1)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisites:** The school level basic knowledge in Fundamental science is required.

**Course Objectives:**

1. To provide elementary knowledge in biology and bioinformatics and biological information available to a biologist on the web and learn how to use these resources on their own.
2. To learn the fundamentals of biological databases, Sequence analysis, data mining, sequence alignment and phylogenetic
3. To learn methods for determining the pre dictinggene and protein

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Explain the basic concepts of biology and bioinformatics
2. Identify various types of biological databases used for the retrieval and analysis of the information
3. Explain the sequence analysis and data mining
4. Discuss the methods used for sequence alignment and construction of the phylogenetic tree
5. Describe the methods used for gene and protein structure prediction

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	0	0	0	0	0	0	1	0	1
CO2	1	1	0	1	1	0	0	0	0	1	0	1
CO3	2	0	0	1	1	0	0	0	0	1	0	1
CO4	2	0	0	1	1	0	0	0	0	1	0	1
CO5	2	1	0	1	1	0	0	0	0	1	0	1

**\*The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

**UNIT-I**

**Introduction And Basic Biology:** Bioinformatics- Introduction, Scope and Applications of Bioinformatics; Basics of DNA, RNA, Gene and its structure, Protein and metabolic pathway; Central dogma of molecular biology; Genome sequencing, Human Genome Project.

**UNIT-II**

**Biological Databases:** Introduction to Genomic Data and Data Organization, types of databases, biological databases and their classification, Biological Databases - NCBI, SWISS PROT/Uniprot, Protein Data Bank, Sequence formats; Information retrieval from biological databases; Data mining of biological databases

**UNIT-III**

**Sequence Analysis and Data Mining:** Scoring matrices, Amino acid substitution matrices- PAM and BLOSUM; Gap, Gap penalty; Database similarity searching - BLAST, FASTA algorithms to analyze sequence data, FASTA and BLAST algorithms comparison; Data Mining- Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation, Visualization, Designing new queries, Pattern Recognition and Discovery, Text Mining Tools

#### **UNIT-IV**

**Sequence Alignment And Phylogenetics:** Sequence Alignment – Local and Global alignment; Pairwise sequence alignment – Dynamic Programming method for sequence alignment - Needleman and Wunsch algorithm and Smith Waterman algorithm. Multiple sequence alignment - Methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment. Concept of tree, terminology, Methods of phylogenetic analysis, tree evaluation – bootstrapping, jackknifing

#### **UNIT-V**

##### **Macromolecular Structure Prediction:**

Gene prediction, - neural networks method, pattern discrimination methods, conserved domain analysis; Protein structure basics, protein structure visualization, Secondary Structure predictions; prediction algorithms; Chou-Fasman and GOR method, Neural Network models, nearest neighbor methods, Hidden-Markov model, Tertiary Structure predictions; prediction algorithms; homology modeling, threading and fold recognition, ab initio prediction.

##### **Text Books:**

1. David Mount, “Bioinformatics Sequence and Genome Analysis”, 2<sup>nd</sup> edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, “Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery”, 3<sup>rd</sup> edition, PHI Learning Private Limited, New Delhi, 2010

##### **Suggested Reading:**

1. Baxebanis AD and Francis Ouellette BF, “Bioinformatics a practical guide the analysis of genes and proteins”, 2<sup>nd</sup> edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, “Bioinformatics: A modern approach. PHI Learning Private Limited”, New Delhi, 2009
3. JiXiong, “Essential Bioinformatics”, Cambridge University Press, 2006

**20EGMO4**

**GENDER SENSITIZATION**

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

**Course Objectives:**

1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

**Course Outcomes:**

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

1. Understand the difference between “Sex” and “Gender” and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of “Man” and “Women” in relation to evolving notions of “Masculinity” and “Femininity”.
3. Appreciate women’s contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	2	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	2	-	2	-	-

**UNIT – I**

**Understanding Gender:**

**Gender:** Why Should We Study It? (*Towards a World of Equals*: Unit -1)

**Socialization:** Making Women, Making Men (*Towards a World of Equals*: Unit -2)

Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

**UNIT – II**

**Gender and Biology:**

**Missing Women:** Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4)

Declining Sex Ratio. Demographic Consequences.

**Gender Spectrum:** Beyond the Binary (*Towards a World of Equals*: Unit -10)

Two or Many? Struggles with Discrimination.

**UNIT – III**

**Gender and Labour:**

**Housework:** the Invisible Labour (*Towards a World of Equals*: Unit -3)

“My Mother doesn’t Work.” “Share the Load.”

**Women’s Work:** Its Politics and Economics (*Towards a World of Equals*: Unit -7)

Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

#### UNIT-IV

##### Issues of Violence:

**Sexual Harassment:** Say No! (*Towards a World of Equals*: Unit -6)

Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: “*Chupulu*”.

**Domestic Violence:** Speaking Out (*Towards a World of Equals*: Unit -8)

Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice.

Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)

Blaming the Victim-“I Fought for my Life....” - Additional Reading: The Caste Face of Violence.

#### UNIT – V

##### Gender: Co – Existence:

**Just Relationships:** Being Together as Equals (*Towards a World of Equals*: Unit -12)

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.

Additional Reading: Rosa Parks-The Brave Heart.

##### Text book:

1. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu “Towards a World of Equals: A Bilingual Textbook on Gender” published by Telugu Akademi, Hyderabad, Telangana State, 2015.

##### Suggested Reading:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. “I Fought For My Life...and Won.”, Available online at:  
<http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdul/>

##### Web Resources:

1. <https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction>
2. <https://theconversation.com/achieving-gender-equality-in-india>

**Note:** Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

**20ITC28**

**PROJECT PART-1**

Instruction	4 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

**Prerequisite:** Knowledge of core engineering courses, Capable of searching for suitable literature, Problem Identification and Solving.

**Course Objectives:**

1. The student takes up investigative study in the broad field of Engineering / Technology, involving both theoretical and practical knowledge.
2. Motivate student(s) towards Research & Development with creative problem solving.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Identify problem from literature survey in his/her area of interest
2. Formulate possible solutions for the selected problem and compare with existing ones
3. Prepare synopsis of the selected problem
4. Gather the required information to set up the environment for the implementation of preliminary experimentation
5. Communicate the work effectively in both oral and written forms

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	1	-	-	1	-	3	1	1	3	3	3	2
<b>CO2</b>	3	3	2	1	1	-	1	-	3	2	1	3	3	3	2
<b>CO3</b>	3	3	3	3	3	-	1	-	3	3	2	3	3	3	3
<b>CO4</b>	3	3	2	3	3	-	1	-	3	3	2	3	3	3	3
<b>CO5</b>	3	2	2	2	1	-	1	2	3	3	2	3	3	3	3

**The work shall include:**

1. Survey and study of published literature on the assigned topic
2. Preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a Departmental Research Committee.



### Guidelines for the award of 50 Marks

<b>Evaluation by</b>	<b>Max. Marks</b>	<b>Evaluation Criteria / Parameter</b>
Supervisor	5	Regularity and Punctuality
	5	Work Progress
	5	Quality of the work
	5	Report on Project Part-1
Project Coordinator	5	Technical Content
	5	Presentation
	5	Partial Implementation
Department Review Committee	10	Project Review
	5	Conference/Journal Publication

**Note:**

**Students are instructed to**

1. Prepare an Action Plan with project work timelines.
2. Submit weekly project status reports duly signed by the supervisor.
3. Prepare a report in the specified format.
4. Present project seminars as per schedules
5. Write a Survey paper for Conference presentation/ Publication in Journals.



# CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

Scheme of Instruction of VIII Semester of B.E. – Information Technology  
as per AICTE Model Curriculum, w.e.f: 2023-24

## DEPARTMENT OF INFORMATION TECHNOLOGY

### SEMESTER –VIII

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1		Open Elective – 2	3	-	3	40	60	3
2		Open Elective – 3	3	-	3	40	60	3
<b>THEORY</b>								
3	20ITC29	Technical Seminar	-	2	-	50	-	1
4	20ITC30	Project Part-2	08 Hours per week /180 Hours Industry		-	100	100	4
<b>TOTAL</b>			<b>6</b>	<b>2</b>	<b>6</b>	<b>230</b>	<b>220</b>	<b>11</b>

**L: Lecture**

**T: Tutorial**

**P: Practical**

**CIE - Continuous Internal Evaluation**

**SEE - Semester End Examination**

**Open Electives offered by other Departments**

<b>Open Elective- 2</b>			<b>Open Elective- 3</b>		
<b>S.No.</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>S.No.</b>	<b>Subject Code</b>	<b>Subject Name</b>
1	20MEO04	Principles of Entrepreneurship	1	20MEO07	Intellectual Property Rights
2	20MEO10	Introduction to Operations Research	2	20MEO15	Principles of Industry 4.0
3	20EEO04	Energy Conservation	3	20ECO01	Remote Sensing and GIS
4	20BTO05	Cognitive Neuro Science	4	20CEO02	Disaster Risk Reduction and Management
5	20ECO06	Principle of VLSI	5	20MTO03	Quantum Computing

20MEO04

**PRINCIPLES OF ENTREPRENEURSHIP  
(Open Elective-2)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and its procedure.
4. Project management and its techniques.
5. Behavioral issues and Time management.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey

**UNIT-I**

**Entrepreneurship:** Definition, functions of entrepreneurship, qualities of entrepreneurs, identification and characteristics of entrepreneurs, entrepreneur vs. intrapreneur, first generation entrepreneurs, women entrepreneurs, conception and evaluation of ideas and their sources.

**UNIT-II**

**Indian industrial environment:** Competence, opportunities and challenges, entrepreneurship and economic growth, small scale industry in India, objectives, linkage among small, medium and heavy industries, types of enterprises, corporate social responsibility.

**UNIT-III**

**Business plan:** Introduction, elements of business plan and its salient features, business model canvas, technical analysis, profitability and financial analysis, marketing analysis, feasibility studies, executive summary, selection of technology and collaborative interactions.

**UNIT-IV**

**Project management:** During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management, assessment of tax burden.

**UNIT-V**

**Behavioral aspects of entrepreneurs:** Personality, determinants, attributes and models, leadership concepts and models, values and attitudes, motivation aspects, time management: approaches of time management, their strengths and weaknesses. time management matrix and the urgency addiction.

**Text Books:**

1. Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, 1997.
2. Prasanna Chandra, “Project-Planning, Analysis, Selection, Implementation and Review”, Tata Mcgraw-Hill Publishing Company Ltd, 1995.
3. S.S. Khanka, Entrepreneurial Development, S. Chand & Co. Pvt. Ltd., New Delhi, 2015.

**Suggested Reading:**

1. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, 5<sup>th</sup> edition, Tata Mc Graw Hill Publishing Company Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication, 1994.

20MEO10

**INTRODUCTION TO OPERATIONS RESEARCH  
(Open Elective-2)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To know the formulation of LPP models.
2. To Algorithms of Graphical and Simplex Methods,
3. To understand the Transportation and Assignment techniques.
4. To come to know the procedure of Project Management along with CPM and PERT techniques.
5. To understand the concepts of sequencing.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the concepts of linear programming problem.
2. Solve the given transportation problem.
3. Develop optimum pair of operations and resources by using assignment technique.
4. Analyze project management techniques like CPM and PERT to plan and execute projects successfully.
5. Apply sequencing concepts for industry applications.

**UNIT-I**

**Introduction:** Definition and scope of operations research.

**Linear programming:** Introduction, formulation of linear programming problems, graphical method of solving LP problem, simplex method, degeneracy in simplex method.

**UNIT-II**

**Transportation models:** Finding an initial feasible solution - north west corner method, least cost method, vogel's approximation method, finding the optimal solution, special cases in transportation problems - unbalanced transportation problem, degeneracy in transportation.

**UNIT-III**

**Assignment techniques:** Introduction, Hungarian technique of assignment techniques, unbalanced problems, problems with restrictions, maximization in assignment problems, travelling salesman problems.

**UNIT-IV**

**Project management:** Definition, procedure and objectives of project management, differences between CPM and PERT, rules for drawing network diagram, scheduling the activities, Fulkerson's rule, earliest and latest times, determination of ES and EF times in forward path, LS & LF times in backward path, determination of critical path, duration of the project.

**UNIT-V**

**Sequencing models:** Introduction, general assumptions in sequencing, sequencing rules processing  $n$  jobs through two machines, processing  $n$  jobs through three machines.

**Text Books:**

1. Hamdy A. Taha, "Operations Research-An Introduction", 10<sup>th</sup> edition, Pearson education edition, 2017.
2. S.D. Sharma, Kedarnath, Ramnath & Co, "Operations Research", Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

**Suggested Reading:**

1. R. Panerselvam, "Operations Research", 2<sup>nd</sup> edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
2. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013.

20EEE004

**ENERGY CONSERVATION  
(Open Elective-2)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisites:**

Students should have prior knowledge on Fundamentals of power systems, electrical machines, and power electronics.

**Course Objectives:**

1. To know the concept of Energy conservation.
2. To understand the formulation of efficiency for various engineering systems.
3. To explore the different ways to design various technologies for efficient engineering systems.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Know the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy conservation.
3. Evaluate the performance of existing engineering systems
4. Explore the methods of improving energy efficiency in different engineering systems.
5. Understand different energy efficient devices.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	3	-	1	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	2	2	-	-	-	-	-	-	2	1	-
CO4	3	2	2	2	2	1	-	-	-	-	-	-	2	1	-
CO5	2	2	1	2	2	1	-	-	-	-	-	-	-	-	-

**UNIT-I**

**Basics of Energy and its various forms:** Overview of engineering elements, Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bioenergy, biomass energy conservation, sources of chemical energy, fuel cells, Energy Scenario in India.

**UNIT-II**

**Energy conservation-1: Domestic Sector:** Energy conservation needs and objectives, energy conservation strategies in domestic sector, energy conservation tips in the kitchen, other energy saving tips in the domestic house, energy conservation measures in office, energy conservation processes/activities for a building.

HVAC (heating, ventilation, air conditioning), components of HVAC, energy conservation opportunities in HVAC systems.

**UNIT-III**

**Energy conservation-2: Industrial Sector:** Energy conservation in Indian industrial sector, energy saving potential in industry: boiler, furnaces, air compressors, refrigeration systems, heat exchanger, heat pump, turbines, electric drives, pumps, cooling towers, fans and blowers.

Energy conservation in agriculture sector: Energy conservation opportunities in pumps used in agriculture sector, summary.



#### **UNIT-IV**

**Energy Efficient Technologies-I:** Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure; Energy efficient technology in agriculture: IoT and Drone Technology.

#### **UNIT-V**

**Energy Efficient Technologies-II:** Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper, Green buildings concept.

#### **Text Books:**

1. Umesh Rathore, "Energy management", Kataria publications, 2<sup>nd</sup> edition, 2014.
2. Guide books for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects
3. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) "An Overview of Energy Efficiency", opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.

20BTO05

**COGNITIVE NEURO SCIENCE  
(Open Elective-2)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisites:**

The school level basic knowledge in Fundamental science is required.

**Course Objectives:**

1. Understanding the brain effects that give rise to our abilities to perceive, act and think.
2. Gain skills on the way that cognition is associated with neural activity.
3. Compare and contrast the organization and function of numerous systems within the brain.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Gain familiarity and basic knowledge about brain systems and functions.
2. Understand brain's neuro-transmitter system.
3. Understanding the brain's methods gives rise to behaviour whether we engage in any activity (e.g., walking, talking, etc.).
4. Identify the patterns of varied activities in neurons that correspond to a person's attempts to move in particular ways.
5. Understand the feedback system and brain disorders.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	1	1	1	1	-	2	-	-	-	2	-	3
<b>CO2</b>	1	1	1	1	-	2	-	-	-	2	-	3
<b>CO3</b>	1	1	1	1	-	2	-	-	-	2	-	3
<b>CO4</b>	1	2	2	3	3	3	-	3	1	3	-	3
<b>CO5</b>	1	1	2	3	3	3	-	3	1	3	-	3

**\*The above table is applicable for biotechnology department. Respective departments opting for this subject may prepare similar table**

**UNIT-I**

**Introduction to neuroscience:** Outline of neuroanatomical, Neurogenesis, migration Axon path-finding, cell death, Role of neural activity in development, Membranes and membrane potentials.

**UNIT-II**

**Action potential:** Conductance mechanisms; Chemical and electrical transmission, Postsynaptic potentials; neural integration, Energy consumption in the brain, Attention, Methods jigsaw, Executive Control, Evolution/development, Sheep's brain dissection.

**UNIT-III**

**Neurotransmitter systems:** Visual information processing, Visual cortex, Visual plasticity, critical periods, Somatosensory system, Pain, Chemoreception, Auditory system, Spinal mechanisms, Brain mechanisms.

#### **UNIT-IV**

**Human and Animal Memory:** Pattern completion and separation, LTP and synapses; Spatial cognition, Social cognition, Cellular mechanisms of neural plasticity.

#### **UNIT-V**

**Feedback System and Brain Disorders:** Endocrine systems; feeding behaviour, Stress, Addiction, Depression, Schizophrenia, Alzheimer's, Huntington's disease, Parkinson's disease.

#### **Text books:**

1. Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell, "Principles of Neural Science", 6<sup>th</sup> Edition, 2021, McGraw Hill.
2. Dale Purves, Roberto Cabeza, Scott A. Huettel, Kevin S. LaBar, Michael L. Platt, and Marty G. Woldorff. Sinauer Associates Inc., "Principles of Cognitive Neuroscience", 2<sup>nd</sup> Edition, 2013.
3. Mark Bear, Brian Connors, and Michael Paradiso, "Neuroscience: Exploring the Brain", 3<sup>rd</sup> ed. Baltimore: Lippincott, Williams & Wilkins, 2007.

20ECO06

**PRINCIPLES OF VLSI  
(Open Elective-2)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Basic Electronics and Digital Logic Fundamentals are required

**Course Objectives:**

1. To study various characteristics of MOS transistor.
2. To learn various concepts required to obtain the digital logic layout diagrams.
3. To learn various memory design concepts.
4. To study various VLSI Fabrication process steps.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand characteristic behavior of MOSFET.
2. Describe various MOS layers and layout design rules.
3. Implement various CMOS logic circuits.
4. Design various MOS memories.
5. Understand the concepts of VLSI technology.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	2	1	1	1	-	-	-	-	-	-	-	2	1	1	1
<b>CO2</b>	1	1	2	1	-	-	1	1	-	-	-	2	2	2	2
<b>CO3</b>	1	2	1	1	1	-	1	1	-	-	-	2	2	2	2
<b>CO4</b>	1	2	1	-	1	-	1	1	-	-	-	2	2	2	1
<b>CO5</b>	-	1	-	1	-	-	-	1	-	-	-	2	1	1	1

**UNIT – I**

**Introduction to MOS Technology:** Basic MOS Transistor action. Enhancement and Depletion Modes. Basic electrical properties of MOS. Threshold voltage and Body Effect.

**UNIT-II**

**MOS and CMOS circuit Design Process:** N-Well, P-Well and Twin-Tub process. MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

**UNIT- III**

**CMOS Design:** Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter, D flip flop using Transmission gates.

**UNIT- IV**

**Memories:** Design of Dynamic Register Element, 3T, 1T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design.

**UNIT-V**

**Introduction to VLSI Technology and Fabrication Process:** Various layers of IC, Wafer preparation and crystal growth, Oxidation, CVD, Lithography, Etching, Ion implantation, Diffusion techniques.

**Text Books:**

1. Kamran Eshraghian, Douglas A. Pucknell, SholehEshraghian, “Essentials of VLSI circuits and systems”, PHI, 2011.
2. Neil H E Weste, David Harris, Ayan Banerjee “CMOC VLSI Design –A circuit and System Perspective”, 3/e, Pearson Education, 2006.
3. J.D.Plummer, M.D.Deal and P.B.Griffin, “The Silicon VLSI Technology Fundamentals”, Practice and modeling, Pearson Education 2009.

**Suggested Reading:**

1. John P. Uyemura, “Introduction to VLSI Circuits and systems”, John Wiley & Sons, 2011.
2. Simon Sze” VLSI Technology, 2/E”, McGraw-Hill Education (India) Pvt Limited-2003

<b>Open Elective- 3</b>		
<b>S.No.</b>	<b>Subject Code</b>	<b>Subject Name</b>
1.	20MEO07	Intellectual Property Rights
2.	20MEO15	Principles of Industry 4.0
3.	20ECO01	Remote Sensing and GIS
4.	20CEO02	Disaster Risk Reduction and Management
5.	20MTO03	Quantum Computing

20MEO07

**INTELLECTUAL PROPERTY RIGHTS**  
**(Open Elective-3)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Fundamental aspects of IP.
2. Salient features of IPR acts.
3. The methods of registrations of Intellectual property.
4. Awareness for innovation and its importance of protection.
5. The changes in IPR culture and techno-business aspects of IPR.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the evolution of IP, working of organization's at global level to protect and promote IP.
2. Familiarize with the patent filing process at national and international level.
3. Draw the logical conclusion of research, innovation and patent filing.
4. Compare different kinds of IP and their patenting system.
5. Understand the techno-legal-business angle of IP, infringement and enforcement mechanisms for protection.

**UNIT-I**

**Introduction:** Definition of intellectual property, the need for intellectual property rights (IPR), kinds of intellectual property rights, IPR in India – genesis and development, IPR abroad, importance of WTO, TRIPS agreement, patent cooperation treaty, Berne and universal copyright conventions.

**UNIT-II**

**Patents:** Definition of patent, commercial significance, term of patent, patentable subject-matter, rights and obligations of patentee, searching of existing patents, drafting of patent, specification of patent, filing of a patent, the different layers of the patent system (national, regional and international options), compulsory licensing and licenses of rights, revocation of patents, differences between utility model and patent.

**UNIT-III**

**Industrial Designs:** Definition of designs, registration of design, rights and duties of proprietor of design, piracy of registered design.

**Trademarks:** Meaning of trademarks, purpose of protecting trademarks, registration of trademarks, passing off, assignment and licensing of trademarks, infringement of trademarks.

**Geographical indications:** Definition, differences between GI and trademarks.

**UNIT-IV**

**Copyright:** Nature and scope of copy right, term of copyright, subject matter of copyright, rights conferred by copyright, publication, broad casting, telecasting, computer program, database protection, assignment and transmission of copyright, infringement of copy right trade secrets and know-how agreement.

**UNIT-V**

**Enforcement of Intellectual Property Rights:** Infringement of intellectual property rights, enforcement measures, emerging issues in intellectual property protection, case studies of patents and IP Protection.

**Unfair Competition:** What is unfair competition, relationship between unfair competition and intellectual property laws.

**Text Books:**

1. Ajit Parulekar and SaritaD'Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India Ltd., 2006.
2. B.L.Wadehra, "Law relating to Patents, Trade Marks", Copyright, Designs & Geographical Indications, Universal law Publishing Pvt Ltd., India, 2000.
3. P.Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, New Delhi, 2010.

**Suggested Reading:**

1. CronishW.R, "Intellectual Property Patents, Copyright, Trade Marks and Allied rights", Sweet & Maxwell,1993.
2. P.Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.



20MEO15

**PRINCIPLES OF INDUSTRY 4.0**  
**(Open Elective-3)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Understand the concept and applications of Digital Manufacturing and Industry 4.0.
2. Relate different Additive manufacturing processes as a part of Digital Manufacturing.
3. Understand the concept of Virtual prototyping, digital design and Importance of reverse engineering in Digital Manufacturing.
4. To understand the concept of Industry 4.0 and allied technologies.
5. To Provide an understanding on the challenges faced and relevant industrial applications of Industry 4.0.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the Basics and applications of Digital Manufacturing and Industry 4.0.
2. Understand the role of Additive Manufacturing, Virtual prototyping and Reverse Engineering processes and their adaptability to Digital Manufacturing.
3. Understand the concepts of digital manufacturing based product life cycle and its management.
4. Understand the concept of Industry 4.0 and allied technologies.
5. Understand the basics of Internet of things and cloud computing pertaining the fourth industrial revolution.

**UNIT-I**

**Introduction to Digital Manufacturing:** Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System, Impact on manufacturing careers, Advantages of digital manufacturing and design, Information sharing in the digital thread, Digital twins and Files format (STL, AMF, 3MF), Multiple organizations in the manufacturing process. Introduction of Industry 4.0, case study on car manufacturing by Bosch.

**UNIT-II**

**Additive Manufacturing Processes:** Additive Manufacturing processes – Engineering polymers, metals and ceramics. Stereolithography, Selective Laser Sintering, Fused Deposition Modeling, Layered object manufacturing. Electronic Materials, Bio-printing, Food Printing. Preprocessing and Post processing in AM

**Virtual Prototyping & Reverse Engineering:** Virtual Prototyping, Applications, Virtual Prototyping and Virtual Manufacturing. Reverse Engineering, Application of Reverse Engineering in Digital Manufacturing. Self-Learning of Manufacturing System and Intelligent Manufacturing System.

**UNIT-III**

**Key Technology of Digital Manufacturing:** Various Digital Technologies in Product Lifecycle, Digital Equipment and Digital Processing Technology, Technology of Digital Maintenance and Diagnosis.

**Product Life Cycle Management:** Introduction, Types of Product Data, Product life cycle management (PLM) systems. Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

**UNIT-IV**

**Industry 4.0:** Various Industrial Revolutions, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, automation, data exchanges, cloud, cyber-physical systems, mobile

robots, Big Data, deep machine learning, Production Systems, IoT, Challenges of implementing Industry 4.0, Impact of implementing Industry 4.0 in various sectors, Applications domains and the way forward.

#### **UNIT–V**

**Internet of Things (IoT)** - IoT design methods, physical devices and enabling technologies, Industrial Internet of Things (IIoT), Smart Manufacturing.

**Cloud Computing and Manufacturing**- Cloud models, cloud manufacturing examples, cloud based manufacturing, Cloud service and platforms for manufacturing.

Augmented Reality and Virtual Reality in Manufacturing.

#### **Text Books:**

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, “Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
2. Brent Stucker, David Rosen, and Ian Gibson, Additive Manufacturing Technologies, ISBN 978-1-4419-1120-9, Springer, 2010.
3. Chee Kai Chua, Kah Fai Leong, 3D printing and additive manufacturing: principles and Application, 4<sup>th</sup> edition of rapid prototyping.
4. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things.

#### **Suggested reading:**

1. Lihui Wang and Andrew Yeh Ching Nee, “Collaborative Design and Planning for Digital Manufacturing”, Springer-Verlag London Limited, 2009.
2. Venu Vinod, PK; Ma, W, “Rapid prototyping – Laser based and other technologies”, Kluwer,2004.

20ECO01

**REMOTE SENSING and GIS  
(Open Elective-3)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Basic knowledge of Geography

**Course Objectives:**

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

**Course Outcomes:**

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

1. Demonstrate the understanding of basic concepts of remote sensing and interpret energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply Microwave remote sensing techniques
5. Explain the procedure for encoding data and geospatial data analysis.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
<b>CO1</b>	3	1	1	1	-	1	1	1	-	1	-	2	1	-	-
<b>CO2</b>	3	1	1	1	-	1	1	1	-	1	-	2	1	-	-
<b>CO3</b>	3	1	1	1	-	1	1	1	-	1	-	2	1	-	-
<b>CO4</b>	2	1	1	1	-	1	1	1	-	1	-	2	1	-	-
<b>CO5</b>	3	1	1	1	-	1	1	1	-	1	-	2	1	-	-

**UNIT-I**

**Concept of Remote Sensing:** Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages and limitations of Remote sensing, Orbits of Remote sensing satellites, Indian remote sensing satellites.

**UNIT-II**

**Digital Imaging:** Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

**UNIT-III**

**Microwave Remote Sensing:** Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

**UNIT-IV**

**Concept of Geographic Information Systems:** Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

## **UNIT-V**

**Process of GIS and Geospatial analysis:** Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

### **Text Books:**

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley & Sons, 2000.

### **Suggested Reading:**

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

20CE002

**DISASTER RISK REDUCTION AND MANAGEMENT  
(Open Elective-3)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Outcomes:**

Upon completion of this course, the student will be able to,

1. Identify and understand the concepts of hazards, causes and impacts of disasters.
2. Develop a critical capacity to evaluate the principles and practices of disaster risk reduction and management.
3. Develop a deep awareness of disaster resilience, risk mitigation, and recovery policies as they arise from natural hazards around the globe.
4. Apply knowledge about existing global frameworks and existing agreements and role of community in successful Disaster Risk Reduction.
5. Evaluate DM study including data search, analysis and presentation as a case study.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	2	1	1	2	2	2	2	1	2	2	2	1	1	1	1
<b>CO2</b>	1	1	2	2	2	3	3	1	2	1	1	1	1	1	-
<b>CO3</b>	2	2	2	2	2	2	3	2	1	1	2	1	1	-	-
<b>CO4</b>	2	2	2	2	3	2	1	1	1	1	1	1	-	-	-
<b>CO5</b>	2	1	2	1	2	3	1	2	2	2	2	1	1	1	1

**UNIT-I**

- Hazard and disaster-concepts, vulnerability and risk
- Hazard and disaster type – Natural, Water- related, Pandemic and Human induced hazards disasters
- Causes and Impacts of disasters – Impacts on natural eco systems: physical, psychological and social impact
- Disaster and financial resilience
- GIS and remote sensing
- Disaster vulnerability profile of India –Specific to geographical regions and states (as per regional significance)

**UNIT-II**

- Disaster Management Cycle –Rescue, Relief, Rehabilitation, Prevention, Mitigation and Preparedness
- Disaster risk reduction {DRR) –Community based DRR, institutions concerned with safety, disaster mitigation and construction techniques as per Indian standards
- Early warning systems

**UNIT-III**

- Trauma and stress management
- First aid and emergency procedures
- Awareness generation strategies for the community on safe practises in disaster (as per regional significance)

**UNIT-IV**

- Components of disaster management –preparedness of rescue and relief, mitigation, rehabilitation &reconstruction

- Institutional frame work of disaster management in India (NDMA-SDMA, NDRF, Civic volunteers, NIDM)
- Phases of disaster/risk management and post-disaster responses
- Compensation and insurance
- Applications of remote sensing &GIS in disaster management

#### **UNIT-V**

- Capacity building for disaster/damage mitigation (structural and non structural measures).
- Disaster risk reduction strategies and national disaster management guidelines
- Disaster management Act -2005
- Regional issues as per regional requirement/university can take minimum two topics as per high powered committee

#### **Text Books:**

1. Singh, R., "Disaster management Guidelines for Earth quakes, Landslides, Avalanches and Tsunami". Horizon Press publications, 2017.
2. Taimpo, "Disaster management and preparedness". CRC Press Publications, 2016.
3. Nidhi, G.D., "Disaster management preparedness". CBS Publications Pvt. Ltd., 2014.
4. Gupta, A.K., Nair, S.S., Shiraz, A. and Dey, S., "Flood Disaster Risk Management-CBS Publications Pvt Ltd., 2013.
5. Singh, R., "Disaster management Guidelines for Natural Disasters" Oxford University Press Pvt. Ltd., 2016

20MT003

**QUANTUM COMPUTING  
(Open Elective-3)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To learn Quantum bits and compute mathematical foundation.
2. To understand the evaluation of the quantum bits.
3. To learn Quantum operations by building blocks of Quantum programming.
4. To know the basics of Quantum logic gates and circuits.
5. To learn Quantum Algorithms by various Techniques.

**Course Outcomes:**

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

1. Compute basic mathematical operations on Quantum bits.
2. Will be able to execute Quantum operations of Quantum computing.
3. To build quantum programs.
4. Develop quantum Logical gates and circuits.
5. Develop the quantum algorithm.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	-	-	-	-	-	2	-	-	-	2	2
CO5	2	2	2	2	-	-	-	-	-	2	2	-	-	2	2

**UNIT-I**

**Math Foundation for Quantum Computing:** Introduction of Vector Space, Subspaces, Basis and Finite Dimensions. Vectors and orthogonality, inner product and Outer product and Hilbert Spaces. Formation of Matrices by Linear Transformation. Linear Independent and dependent Vectors. Unitary operators and projectors, Eigen values and Eigen Vectors.

**UNIT-II**

**Introduction to Quantum Computing:** Quantum Mechanics (Huygens wave theory ,Photo electric effect De-Broglie hypothesis and Heisenberg's uncertainty Principle), Origin of Quantum Computing, Overview of major concepts in Quantum Computing ,Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave

**UNIT-III**

**Building Blocks for Quantum Program:** Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product, Quantum Entanglement, Quantum Teleporation (EPR Model) and Bell State.

#### **UNIT-IV**

**Quantum Logical gates and Circuits:** Pauli, Hadamard, Phase shift, controlled gates, AND, OR and NAND gate, C-Not, CCNOT gate Introduction of Fourier Transform and Discrete Fourier transform.

#### **UNIT-V**

**Quantum Algorithms:** Z-Transform. Basic techniques exploited by quantum algorithms (Amplitude amplification, Quantum Fourier Transform, Quantum Phase estimation, Quantum walks), Major Algorithms (Shore's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm).

#### **Text Book:**

1. David McMahon, "Quantum Computing Explained", Wiley

#### **Suggested Reading:**

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.



**20ITC29**

**TECHNICAL SEMINAR**

Instruction  
CIE  
Credits

2 L Hours per week  
50 Marks  
1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Collect Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare Seminar Report in a prescribed format.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	2	3	3	3	1	2	2	2	3	3	3	3
<b>CO2</b>	-	2	2	1	1	3	3	1	1	3	2	3	2	-	1
<b>CO3</b>	3	2	2	2	1	3	3	-	1	2	1	3	3	3	3
<b>CO4</b>	3	2	2	2	1	3	3	-	1	2	1	3	2	-	1
<b>CO5</b>	3	2	1	1	2	3	3	-	1	3	2	3	2	-	1

**The seminar must be clearly structured and the power point presentation shall include following aspects:**

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Seminars are to be scheduled from 3<sup>rd</sup> week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent journal publications.

Guidelines for awarding marks		
S. No.	Description	Max Marks
1.	Contents and Relevance	10
2.	Presentation Skills	10
3.	Preparation of PPT slides	05
4.	Questions and Answers	05
5.	Report in a prescribed format	20

**20ITC30****PROJECT PART-2**

Instruction	8 Hours per Week
Duration of SEE	--
SEE	100 Marks
CIE	100 Marks
Credits	4

**Course Objectives:**

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

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

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

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	-	-	-	1	-	3	1	2	3	3	3	2
<b>CO2</b>	3	3	2	-	-	-	1	-	3	1	2	3	3	3	2
<b>CO3</b>	3	3	3	3	3	-	1	-	3	1	2	3	3	3	3
<b>CO4</b>	-	3	1	3	3	-	1	-	3	3	2	3	3	3	3
<b>CO5</b>	-	1	-	2	3	-	1	3	3	3	1	2	3	3	2

**Note:****Students are instructed to**

1. Conduct detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
2. Submit a project report in the specified format.
3. Present project seminars as per schedules.
4. Publish a paper in Conference/Journal/Patent before external viva voce

**Guidelines for awarding marks in CIE: (Max. Marks: 100)**

<b>Evaluation by</b>	<b>Max. Marks</b>	<b>Evaluation Criteria / Parameter</b>
Department Review Committee	10	Review 1
	15	Review 2
	25	Pre Submission Review
	10	Regularity and Punctuality
	10	Work Progress

Supervisor	10	Quality of the work
	10	Report
	10	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in **SEE: (Max. Marks: 100)**

<b>Evaluation by</b>	<b>Max. Marks</b>	<b>Evaluation Criteria / Parameter</b>
External and Internal Examiners	20	PowerPoint Presentation
	40	Thesis Evaluation
	20	Quality of the project <ul style="list-style-type: none"> <li>● Innovations</li> <li>● Applications</li> <li>● Live Research Projects</li> <li>● Scope for future study</li> <li>● Application to society</li> </ul>
	20	Viva-Voce