1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Have a successful professional career in industry, government, academia, military and start-ups as innovative engineers.

II. Effectively solve engineering problems associated with Cyber Physical Systems, Real Time mobility Applications, Smart systems, and Networking Applications.

III. Have the ability to think analytically and logically to understand technical problems in ubiquitous systems and provide solutions through research and lifelong learning.

IV. Adopt ethical practices to collaborate with team members and team leaders to build cutting-edge technical solutions in a connected world.

V. Strongly focus on transformative ideas and critical analysis, to innovate and be active members ready to serve the society, locally and internationally.

2. PROGRAM OUTCOMES (POs):

1. An ability to independently carry out research/investigation and development work to solve practical problems.

2. An ability to write and present a substantial technical report/document. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

3. Adapt new technologies such as 5G and beyond for developing solutions to real world problems.

4. Exhibit proficiency in pervasive computing areas for providing solutions to real world problems in industry and research establishments in the application areas of IoT, autonomous vehicles, and smart homes/Cities.

5. Excel in hybrid mobile application development with a focus on security to address business needs.
# ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. MOBILE AND PERVASIVE COMPUTING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND 1st SEMESTER SYLLABI

## SEMESTER I

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**TOTAL** 20 0 6 26 21

*Audit course is optional

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**TOTAL NO. OF CREDITS: 74**

### PROFESSIONAL ELECTIVES

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Registration for any of these courses is optional to students

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COURSE OBJECTIVES:
This course will hold the student to

- study the methods of solving a system of linear equations using matrix theory.
- learn the mathematical aspects of graph, colouring, various graph theoretic algorithms which are applicable to computer languages.
- study the linear programming models and Transportation models and various techniques to solve them.
- determination of probability and moments, distributions of discrete and continuous random variables and random processes.
- study the characteristics of queueing models and discrete Markov chains, applications of them.

UNIT I  MATRIX METHODS

UNIT II  GRAPH THEORY
Introduction to paths, trees, vector spaces - Matrix coloring and directed graphs - Some basic algorithms – Shortest path algorithms – Depth - First search on a graph – Isomorphism – Other Graph - Theoretic algorithms – Performance of graph theoretic algorithms – Graph theoretic computer languages.

UNIT III  OPTIMIZATION TECHNIQUES
Linear programming - Basic concepts – Graphical and simplex methods – Big M method - Two phase simplex method - Revised simplex method - Transportation problems – Assignment problems.

UNIT IV  PROBABILITY AND RANDOM VARIABLES
Probability – Axioms of probability – Conditional probability – Bayes theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Exponential, Normal distributions – Two dimensional random variables - Poisson process.

UNIT V  QUEUEING THEORY
Single and multiple servers - Markovian queuing models - Finite and infinite capacity queues – Finite source model – Queuing applications.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to

- apply various methods in matrix theory to solve system of linear equations.
- mathematical concepts on graph theory and various graph related algorithms.
- could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
• exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models, using discrete time Markov chains to model computer systems.

REFERENCES:

RM4151 RESEARCH METHODOLOGY AND IPR

UNIT I RESEARCH DESIGN
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

REFERENCES:

CP4151 ADVANCED DATA STRUCTURES AND ALGORITHMS

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COURSE OBJECTIVES:
- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY

ANALYSIS

UNIT II HIERARCHICAL DATA STRUCTURES


UNIT III GRAPHS


UNIT IV ALGORITHM DESIGN TECHNIQUES


UNIT V NP COMPLETE AND NP HARD


TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES:
1. Write an algorithm for Towers of Hanoi problem using recursion and analyze the
complexity (No of disc-4)
2. Write any one real time application of hierarchical data structure
3. Write a program to implement Make_Set, Find_Set and Union functions for Disjoint Set Data Structure for a given undirected graph G(V,E) using the linked list representation with simple implementation of Union operation
4. Find the minimum cost to reach last cell of the matrix from its first cell
5. Discuss about any NP completeness problem

COURSE OUTCOMES:
CO1: Design data structures and algorithms to solve computing problems.
CO2: Choose and implement efficient data structures and apply them to solve problems.
CO3: Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
CO4: Design one's own algorithm for an unknown problem.
CO5: Apply suitable design strategy for problem solving.

REFERENCES:

MP4151 EMBEDDED SYSTEMS AND IIOT L T P C 3 0 2 4

COURSE OBJECTIVES:
• To learn the internal architecture of an embedded processor including timers and interrupts.
• To learn and use embedded C programming.
• To provide exposure on architecture and components of IIOT.
• To introduce the communication protocols of IIOT.
• To study about visualization and data processing of IIOT.

UNIT I EMBEDDED PROCESSOR

UNIT II EMBEDDED C PROGRAMMING
Programming Embedded Systems in C - Memory And I/O Devices Interfacing - Implementing Timers, Interrupts and Serial communication in embedded C- Need For RTOS - Multiple Tasks
and Processes – Context Switching - Priority Based Scheduling Policies.

UNIT III INTRODUCTION & ARCHITECTURE OF IIOT


UNIT IV COMMUNICATION TECHNOLOGIES OF IIOT

Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, M2M etc. Need of protocols; Communication Protocols: Wi-Fi, Wi-Fi direct, IEEE 802.15.4, Zigbee, Z wave, BLE, SPI, RFID, Industry standards communication technology (COAP, LoRAWAN, OPC UA, MQTT AMQP IIOT), connecting into existing Modbus and Profinbus technology, wireless network communication.

UNIT V VISUALIZATION OF IIOT

Cloud platforms: Overview of cots cloud platforms, predix, thingworx, azure etc. Front-end EDGE devices, Enterprise data for IIOT, Emerging descriptive data standards for IIOT, Cloud database, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

SUGGESTED ACTIVITIES:

1. A Study on the various embedded processors like virtual watches, PDAS, digital cameras, mp3 players
2. Develop an application using embedded C programming in arduino
3. Build a project using IIOT components
4. Study of communication protocols and technology in IIOT
5. Presentation on most prominent IIOT visualization tools

PRACTICAL EXERCISES:

1. Experiments on Arduino, ESP8266, raspberry Pi
5. Demonstration of MQTT communication
6. Demonstration of LoRa communication.

HARDWARE/SOFTWARE REQUIREMENTS

1. Arduino
2. ESP8266
3. Raspberry Pi
COURSE OUTCOMES:

CO1: Describe the internal architecture of an embedded processor including timers and interrupts.
CO2: Write the embedded C programming.
CO3: Use the components of IIOT for building applications.
CO4: Demonstrate and perform the communication by using the protocols.
CO5: Explain about visualization and data processing of IIOT.

TOTAL: 75 PERIODS

REFERENCES:

CP4153 NETWORK TECHNOLOGIES L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

UNIT I NETWORKING CONCEPTS 9

UNIT II WIRELESS NETWORKS 9
Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT III MOBILE DATA NETWORKS 9

UNIT IV SOFTWARE DEFINED NETWORKS 9

UNIT V NETWORK FUNCTIONS VIRTUALIZATION 9
Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV and SDN –Network virtualization – VLAN and VPN

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Explain basic networking concepts
CO2: Compare different wireless networking protocols
CO3: Describe the developments in each generation of mobile data networks
CO4: Explain and develop SDN based applications
CO5: Explain the concepts of network function virtualization

SUGGESTED ACTIVITIES:
1. Execute various network utilities such as tracert, pathping, ipconfig
2. Implement the Software Defined Networking using Mininet
3. Implement routing in Mininet
4. Install a virtual machine and study network virtualization
5. Simulate various network topologies in Network Simulator

REFERENCES:
2. HoudaLabiod, Costantino de Santis, HossamAfifi, “Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 (UNIT 2)
MP4152 WIRELESS COMMUNICATIONS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand the impact of digital modulation techniques in fading.
- To get exposed to diversity techniques in wireless communication.
- To acquire knowledge in multicarrier systems.

UNIT I CELLULAR CONCEPTS

UNIT II THE WIRELESS CHANNEL
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS

UNIT IV DIVERSITY TECHNIQUES

UNIT V MULTICARRIER MODULATION
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.
SUGGESTED ACTIVITIES:
1: Survey on various features of cellular networks
2: Study the nature of cellular networks
3: A comparative study on the performance of different digital modulation techniques
4: Perform a review of various diversity techniques in wireless communication
5: Presentation on design of multicarrier systems for 5G

COURSE OUTCOMES:
CO1: Design solutions for cellular communication
CO2: Determine the capacity of wireless channels
CO3: Analyze the performance of the digital modulation techniques in fading channels
CO4: Apply various diversity techniques in wireless communication
CO5: Design multicarrier systems in wireless communication

TOTAL: 45 PERIODS

REFERENCES:

CP4161 ADVANCED DATA STRUCTURES AND ALGORITHMS
LABORATORY

COURSE OBJECTIVES:
• To acquire the knowledge of using advanced tree structures
• To learn the usage of heap structures
• To understand the usage of graph structures and spanning trees
• To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
• To understand the necessary mathematical abstraction to solve problems.

LIST OF EXPERIMENTS:
1: Implementation of recursive function for tree traversal and Fibonacci
2: Implementation of iteration function for tree traversal and Fibonacci
3: Implementation of Merge Sort and Quick Sort
4: Implementation of a Binary Search Tree
5: Red-Black Tree Implementation
6: Heap Implementation
7: Fibonacci Heap Implementation
8: Graph Traversals
9: Spanning Tree Implementation
10: Shortest Path Algorithms (Dijkstra’s algorithm, Bellman Ford Algorithm)
11: Implementation of Matrix Chain Multiplication
12: Activity Selection and Huffman Coding Implementation

HARDWARE/SOFTWARE REQUIREMENTS
1: 64-bit Open source Linux or its derivative
2: Open Source C++ Programming tool like G++/GCC

COURSE OUTCOMES:
CO1: Design and implement basic and advanced data structures extensively
CO2: Design algorithms using graph structures
CO3: Design and develop efficient algorithms with minimum complexity using design techniques
CO4: Develop programs using various algorithms.
CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

TOTAL: 60 PERIODS

REFERENCES:

MP4251 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

UNIT II CLOUD PLATFORM ARCHITECTURE 12
UNIT III  AWS CLOUD PLATFORM - IAAS


UNIT IV  PAAS CLOUD PLATFORM


UNIT V  PROGRAMMING MODEL

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

TOTAL: 45 PERIODS

REFERENCES

MP4292 MOBILE APPLICATION DEVELOPMENT L T P C 3 0 2 4

COURSE OBJECTIVES:
- To facilitate students to understand android SDK
- To help students to gain basic understanding of Android application development
- To understand how to work with various mobile application development frameworks
- To inculcate working knowledge of Android Studio development tool
- To learn the basic and important design concepts and issues of development of mobile applications

UNIT I MOBILE PLATFORM AND APPLICATIONS 9

UNIT II INTRODUCTION TO ANDROID 9

UNIT III ANDROID APPLICATION DESIGN ESSENTIALS 9

UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA 9
User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT V ANDROID APIs 9
Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS: (30)
1. Develop an application that uses GUI components, Font, Layout Managers and event listeners.
2. Develop an application that makes use of databases
3. Develop a native application that uses GPS location information
4. Implement an application that creates an alert upon receiving a message
5. Develop an application that makes use of RSS Feed.
6. Create an application using Sensor Manager
7. Create an android application that converts the user input text to voice.
8. Develop a Mobile application for simple and day to day needs (Mini Project)
COURSE OUTCOMES:
CO1: Identify various concepts of mobile programming that make it unique from programming for other platforms
CO2: Create, test and debug Android application by setting up Android development
CO3: Demonstrate methods in storing, sharing and retrieving data in Android applications
CO4: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO5: Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

TOTAL: 45+30=75 PERIODS

REFERENCES
4. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009

MP4291 CYBER PHYSICAL SYSTEMS L T P C 3 0 2 4

COURSE OBJECTIVES:
- To learn about the principles of cyber-physical systems
- To familiarize with the basic requirements of CPS.
- To know about CPS models
- To facilitate the students to understand the CPS foundations
- To make the students explore the applications and platforms.
- To provide introduction to practical aspects of cyber physical systems.
- To equip students with essential tools to implement CPS.

UNIT I INTRODUCTION TO CYBER-PHYSICAL SYSTEMS 6

UNIT II CPS - REQUIREMENTS 12
UNIT III CPS MODELS

UNIT IV CPS FOUNDATIONS
Symbolic Synthesis for CPS- Security in CPS-Synchronization of CPS-Real-Time Scheduling for CPS

UNIT V APPLICATIONS AND PLATFORMS

LIST OF EXPERIMENTS (30)
1. Installation of Xilinx SDK, LABVIEW, MatLab and Cybersim
2. Installation of, myRIO iRobot Create Wiring, Kobuki Wiring
3. CPS Design with the iRobot Create
4. CPS Design with the Kobuki.
5. Write a program in MATLAB to implement open loop system stability.
6. Write a program in MATLAB to implement timed automation.

COURSE OUTCOMES:
CO1: Explain the core principles behind CPS
CO2: Discuss the requirements of CPS.
CO3: Explain the various models of CPS.
CO4: Describe the foundations of CPS.
CO5: Use the various platforms to implement the CPS.

TOTAL: 45+30=75 PERIODS

REFERENCES
7. documentation | KOBUKI (yujinrobot.com)
COURSE OBJECTIVES:
- To learn the fundamentals of cryptography and its application to network security.
- To understand the mathematics behind cryptography.
- To learn about the security issues in internet protocol.
- To understand the security issues in other layers.
- To study about intrusion detection and prevention system and wireless hacking.

UNIT I INTRODUCTION TO NETWORK SECURITY

UNIT II SYMMETRIC AND ASYMMETRIC CIPHERS

UNIT III SECURITY ISSUES IN INTERNET PROTOCOL

UNIT IV SECURITY IN OTHER LAYERS

UNIT V INTRUSION DETECTION AND PREVENTION SYSTEM(IDPS) AND WIRELESS HACKING

COURSE OUTCOMES:
CO1: To design cryptographic algorithms and carry out their implementation.
CO2: To carry out cryptanalysis on cipher.
CO3: To be able to design and implement security based internet protocols.
CO4: To carry out system security for other layers.
CO5: To understand the importance of intrusion detection and prevention system and wireless hacking.

TOTAL: 45 PERIODS

REFERENCES

MP4211 TERM PAPER WRITING AND SEMINAR L T P C
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.

Activities to be carried out

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<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
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<tr>
<td>Selection of area of interest and Topic</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>3 % Based on clarity of thought, current relevance and clarity in writing</td>
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<td>Stating an Objective</td>
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</table>
| Collecting Information about your area & topic | 1. List 1 Special Interest Groups or professional society  
2. List 2 journals  
3. List 2 conferences, symposia or workshops  
4. List 1 thesis title  
5. List 3 web presences (mailing lists, forums, news sites)  
6. List 3 authors who publish regularly in your area | 3rd week        | 3% (the selected information must be area specific and of international and national standard)                                          |
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<tr>
<th>7. Attach a call for papers (CFP) from your area.</th>
<th>Collection of Journal papers in the topic in the context of the objective – collect 20 &amp; then filter</th>
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<tr>
<td>You have to provide a complete list of references you will be using. Based on your objective - Search various digital libraries and Google Scholar</td>
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<tr>
<td>- When picking papers to read - try to:</td>
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<tr>
<td>- Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,</td>
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<td>- Favour papers from well-known journals and conferences,</td>
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<tr>
<td>- Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),</td>
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<td>- Favour more recent papers,</td>
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<td>- Pick a recent survey of the field so you can quickly gain an overview,</td>
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<td>- Find relationships with respect to each other and to your topic area (classification scheme/categorization)</td>
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<td>- Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered</td>
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<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>6% (the list of standard papers and reason for selection)</td>
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<tr>
<th>Reading and notes for first 5 papers</th>
<th>Reading Paper Process</th>
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<tr>
<td>For each paper form a Table answering the following questions:</td>
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<tr>
<td>What is the main topic of the article?</td>
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<tr>
<td>What was/were the main issue(s) the author said they want to discuss?</td>
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<td>Why did the author claim it was important?</td>
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<tr>
<td>How does the work build on other’s work, in the author’s opinion?</td>
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<tr>
<td>What simplifying assumptions does the author claim to be making?</td>
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<tr>
<td>What did the author do?</td>
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<td>How did the author claim they were going to evaluate their work and compare it to others?</td>
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<tr>
<td>What did the author say were the limitations of their research?</td>
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<td>5&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
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<tr>
<td>Task</td>
<td>Activity</td>
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<tr>
<td>Reading and notes for next 5 papers</td>
<td>Repeat Reading Paper Process</td>
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<tr>
<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
</tr>
<tr>
<td>Draft outline: 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification / categorization diagram</td>
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<tr>
<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
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<tr>
<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
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<tr>
<td>Sections of the paper</td>
<td>Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey</td>
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<tr>
<td>Your conclusions</td>
<td>Write your conclusions and future work</td>
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<tr>
<td>Final Draft</td>
<td>Complete the final draft of your paper</td>
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<tr>
<td>Seminar</td>
<td>A brief 15 slides on your paper</td>
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**TOTAL: 30 PERIODS**

**NE4261 NETWORK SECURITY LABORATORY**

**L T P C**

0 0 2 1

**COURSE OBJECTIVES:**

- To explore the digital signature standard.
- Learn to implement security algorithms using Wireshark.
- To analyze the effectiveness of intrusion detection system.
- To learn the security issues in Virtual Private Network.
- To identify mechanism for secured Email communication.

**SUGGESTED ACTIVITIES:**

1. Implement the SIGNATURE SCHEME - Digital Signature Standard
2. Implement how to capture and analyze packets using Wireshark.
3. To Analysis Network using Wireshark for
   - Traffic Monitoring (TCP slow down and HTTP slow down)
   - Packet Sniffing
4. To perform man in middle attack using DNS spoofing.
5. To Perform HTTP Session Hijacking through Cookie stealing.
7. Demonstrate intrusion detection system (ids) using any tool (snort or any other software).
8. Create a Virtual Private Network and evaluate application response time in the presence and absence of a firewall.
9. Implementation of Email incoming and outgoing authenticity controls and malware filtration and attachment security.

**COURSE OUTCOMES:**

**CO1:** Implement the digital signature scheme.
**CO2:** Develop the various security algorithms using wireshark.
**CO3:** Use different open source tools for network security and analysis.
**CO4:** Develop an Virtual Private Network with security.
**CO5:** Addressing the Email secured communication.

**TOTAL: 30 PERIODS**
COURSE OBJECTIVES:
- To learn about Fundamentals of IoT and Security
- To know about IoT applications in Industry
- To learn about RFID Pervasive networks
- To gain fundamental concepts in 5G and Next Gen networks
- To know about IoT implementation

UNIT I TOWARDS THE IOT UNIVERSE

UNIT II IOT APPLICATIONS — VALUE CREATION FOR INDUSTRY

UNIT III RFID PERVERSIVE NETWORKS

UNIT IV INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS
Industrial Internet- Key IIoT Technologies- Innovation and the IIoT - Key Opportunities and Benefits - The Digital and Human Workforce - Logistics and the Industrial Internet- IOT Innovations in Retail - Cyber Physical Systems (CPS) – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog

UNIT V IIOT ARCHITECTURE AND DESIGNING INDUSTRIAL INTERNET SYSTEMS

COURSE OUTCOMES:
After completion of the course, the student will be able to:
CO1: Describe the core principles of IoT Network Management
CO2: Identify the applications of IoT in Industry
CO3: Explain the basic concepts in RFID and Pervasive Networks
CO4: Discuss the fundamental concepts in IIoT, CPS and Network Virtualization.

CO5: Design Industrial Internet Systems

REFERENCES:
4. Gilchrist, Alasdair, “Industry 4.0 The Industrial Internet of Things”, Apress, 2017. (Unit IV and Unit V)

MP4094  WEB SERVICES AND API DESIGN  L T P C
         3 0 0 3

COURSE OBJECTIVES:
- To learn the basics of Web service.
- To become familiar with the Web Services building blocks
- To learn to work with RESTful web services.
- To implement the RESTful web services using Spring MVC framework.
- To understand resource oriented Architecture.

UNIT I  INTRODUCTION TO WEB SERVICE  9

UNIT II  WEB SERVICE BUILDING BLOCKS  9
Introduction to SOAP: SOAP Syntax - Sending SOAP Messages - SOAP Implementations - Introduction to WSDL: WSDL Syntax - SOAP Binding - WSDL Implementations - Introduction to UDDI: The UDDI API - Implementations - The Future of UDDI

UNIT III  RESTFUL WEB SERVICES  9

UNIT IV  IMPLEMENTATION OF RESTFUL WEB SERVICES  9
UNIT V  RESOURCE ORIENTED ARCHITECTURE

Resource- URIs - Addressability - Statelessness - Representations - Links and Connectedness - 
The Uniform Interface- Designing Read-Only Resource-Oriented Services : Resource Design - 
Turning Requirements Into Read-Only Resources - Figure Out the Data Set- Split the Data Set into 
Resources- Name the Resources - Design Representation- Link the Resources to Each Other- The 
HTTP Response

COURSE OUTCOMES:
CO1: Explain how to write XML documents.
CO2: Apply the web service building blocks such as SOAP, WSDL and UDDI
CO3: Describe the RESTful web services.
CO4: Implement the RESTful web service with Spring Boot MVC
CO5: Discuss Resource-oriented Architecture.

TOTAL: 45 PERIODS

REFERENCES
1. Leonard Richardson and Sam Ruby, RESTful Web Services, O'Reilly Media, 2007
3. Lindsay Bassett, Introduction to JavaScript Object Notation, O'Reilly Media, 2015
5. Raja CSP Raman, Ludovic Dewailly, “Building A RESTful Web Service with Spring 5”, 
guide to designing and building RESTful APIs using Java”, Ingram short title, 3rd Edition, 
2017.
7. Mario-Leander Reimer, “Building RESTful Web Services with Java EE 8: Create modern 
RESTful web services with the Java EE 8 API", Packt publishing, 2018.

BD4251  BIG DATA MINING AND ANALYTICS  L T P C

COURSE OBJECTIVES:
- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data
- To analyse and interpret streaming data
- To learn how to handle large data sets in main memory and learn the various clustering 
techniques applicable to Big Data

UNIT I  DATA MINING AND LARGE SCALE FILES
Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – 
Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – 
UNIT II  SIMILAR ITEMS

UNIT III  MINING DATA STREAMS

UNIT IV  LINK ANALYSIS AND FREQUENT ITEMSETS

UNIT V  CLUSTERING

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.
CO2: Design algorithms for Big Data by deciding on the apt Features set .
CO3: Design algorithms for handling petabytes of datasets
CO4: Design algorithms and propose solutions for Big Data by optimizing main memory consumption
CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

REFERENCES:

WEB REFERENCES:
1. https://swayam.gov.in/nd2_arp19_ap60/preview

ONLINE RESOURCES:
1. https://examupdates.in/big-data-analytics/
COURSE OBJECTIVES:

- To learn the foundations of Human Computer Interaction.
- Understanding Interaction Styles and to become familiar with the design technologies for individuals and persons with disabilities.
- To understand the process of Evaluation of Interaction Design.
- To clarify the significance of task analysis for ubiquitous computing.
- To get insight on web and mobile interaction.

UNIT I FOUNDATIONS OF HCI


UNIT II INTERACTION STYLES


UNIT III EVALUATION OF INTERACTION

Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models. Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models

UNIT IV MODELS AND THEORIES

Task analysis, dialog notations and design, Models of the system, Modeling rich interaction, Ubiquitous computing

UNIT V WEB AND MOBILE INTERACTION

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions-Lookup patterns-Feedback patterns Mobile apps, Mobile navigation, content and control idioms, Multi-touch gestures, Inter-app integration, Mobile web

COURSE OUTCOMES:

CO1: Understand the basics of human computer interactions via usability engineering and cognitive modeling.

CO2: Understand the basic design paradigms, complex interaction styles.

CO3: Understand the models and theories for user interaction.

CO4: Examine the evaluation of interaction designs and implementations.
CO5: Elaborate the above issues for web and mobile applications.

REFERENCES


MP 4001 ENERGY AWARE COMPUTING

COURSE OBJECTIVES:
- To understand the fundamentals of Energy Efficient Computing.
- To become familiar with the concept of Energy Efficient Storage Systems.
- To introduce the various types of scheduling algorithms in energy efficient computing.
- To introduce the concept of Green Networking.
- To study Energy Aware Computing Applications.

UNIT I INTRODUCTION

UNIT II ENERGY EFFICIENT STORAGE

UNIT III ENERGY EFFICIENT SCHEDULING ALGORITHMS

UNIT IV INTRODUCTION TO GREEN NETWORKING
Power-Aware Middleware for Mobile Applications -Energy Efficiency of Voice-over-IP Systems - Intelligent Energy-Aware Networks - Green TCAM-Based Internet Routers

UNIT V ENERGY AWARE COMPUTING APPLICATIONS
Energy Awareness in Video Codec Design-Overview of H.264/AVC Video Codec Design- Energy
COURSE OUTCOMES:
CO1: Explain the power efficient storage architecture.
CO2: Analyze the different types of Energy Efficient Storage systems.
CO3: Design the schedule algorithms for Energy Efficient Systems.
CO4: Identify the different types of Green Networking schemes in the energy efficient computing.
CO5: Explore the applications of Energy Aware Computing.

REFERENCES:

IF4095 SOCIAL NETWORK ANALYSIS  L T P C  3 0 0 3

COURSE OBJECTIVES:
- Formalise different types of entities and relationships as nodes and edges and represent this information as relational data.
- Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks.
- Understand the basic concepts and principles of different theoretical models of social networks analysis.
- Transform data for analysis using graph-based and statistics-based social network measures.
- Choose among social network designs based on research goals.

UNIT I GRAPH THEORY AND STRUCTURE  10

UNIT II SOCIAL NETWORK GRAPH ANALYSIS  9
Social network exploration/ processing and properties: Finding overlapping communities, similarity between graph nodes, counting triangles in graphs, neighborhood properties of graphs. Pregel.
paradigm and Apache Giraph graph processing system.

UNIT III      INFORMATION DIFFUSION IN SOCIAL NETWORKS  9

UNIT IV      CASCADING IN SOCIAL NETWORKS  8

UNIT V      LINK ANALYSIS & COMMUNITY DETECTION  9

SUGGESTED ACTIVITIES:
1: Twitter Intelligence project performs tracking and analysis of the Twitter
2: Large-Scale Network Embedding as Sparse Matrix Factorization
3: Implement how Information Propagation on Twitter
4: Social Network Analysis and Visualization software application.
5: Implement the Structure of Links in Networks

COURSE OUTCOMES:
CO1: Plan and execute network analytical computations.
CO2: Implement mining algorithms for social networks
CO3: Analyze and evaluate social communities.
CO4: Use social network analysis in behavior analytics
CO5: Perform mining on large social networks and illustrate the results.

REFERENCES
1. Practical Social Network Analysis with Python, Krishna Raj P. M. Ankith Mohan and K. G. Srinivasa. Springer, 2018
2. SOCIAL NETWORK ANALYSIS: METHODS AND APPLICATIONS, STANLEY WASSERMAN, and KATHERINE P’ AUST. CAMBRIDGE UNIVERSITY PRESS, 2012

TOTAL : 45 PERIODS
COURSE OBJECTIVES:

- To familiarize Use the Innovation Canvas to justify potentially successful products.
- To learn various ways in which to develop a product idea.
- To understand about how Big Data can play vital role in Cognitive Computing.
- To know about the business applications of Cognitive Computing.
- To get into all applications of Cognitive Computing.

UNIT I FOUNDATION OF COGNITIVE COMPUTING

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition. Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services.

UNIT II NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web. Applying Natural language technologies to Business problems. Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

UNIT III BIG DATA AND COGNITIVE COMPUTING

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data. Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics.

UNIT IV BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING

Preparing for change , advantages of new disruptive models , knowledge meaning to business, difference with a cognitive systems approach , meshing data together differently, using business knowledge to plan for the future , answering business questions in new ways , building business specific solutions , making cognitive computing a reality , cognitive application changing the market. The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing.

UNIT V APPLICATION OF COGNITIVE COMPUTING

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data. Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record. Using cognitive application to improve clinical teaching.
COURSE OUTCOMES:
CO1: Explain applications in Cognitive Computing.
CO2: Describe Natural language processor role in Cognitive computing.
CO3: Explain future directions of Cognitive Computing
CO4: Evaluate the process of taking a product to market
CO5: Comprehend the applications involved in this domain.

TOTAL: 45 PERIODS

REFERENCES

MP4002 RFID AND SENSOR TECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVES:
- Know the fundamentals of identification systems and RFID
- Understand the principles of RFID
- Learn sensor technologies and design RFID enabled sensors

UNIT I FUNDAMENTALS OF RFID

UNIT II PRINCIPLES OF RFID
UNIT III  DESIGN OF RFID


UNIT IV  SENSOR TECHNOLOGIES


UNIT V  DESIGN OF RFID ENABLED SENSORS


COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Demonstrate the fundamentals of identification systems.
CO2: Illustrate the basic principles of RFID.
CO3: Design and customize RFID based applications.
CO4: Understand the basic sensor technologies.
CO5: Develop interactive applications using RFID enabled sensors.

REFERENCES
COURSE OBJECTIVES:
- To give the knowledge of Body area Networks.
- To know the hardware requirement of BAN.
- To understand the communication and security aspects in the BAN.
- To introduce the coexistence issues with BAN.
- To know the applications of BAN in the field of medicine.

UNIT I  INTRODUCTION  9
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction

UNIT II  HARDWARE FOR BAN  9

UNIT III  COMMUNICATIONS AND NETWORKS  9
Wireless Communication and Network RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand -Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV  COEXISTENCE ISSUES WITH BAN  9
Coexistence Issues with Ban Interferences - Intrinsic - Extrinsic, Effect on transmission, Counter measures-on physical layer and data link layer, Regulatory issues Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection

UNIT V  APPLICATIONS OF BAN  9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

COURSE OUTCOMES:
After completion of the course, the student will be able to:
- CO1: Apply various soft computing concepts for practical applications.
- CO2: Explain about the working of Body Area Network and discuss about the hardware required for implementation.
- CO3: Assess the efficiency of communication and the security parameters.
- CO4: Describe the issues associated with BAN.
- CO5: Design a BAN for appropriate application in medicine.

TOTAL: 45 PERIODS

REFERENCES:
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, —Body Area

CP4091 AUTONOMOUS SYSTEMS

COURSE OBJECTIVES:
- To impart knowledge on the functional architecture of autonomous vehicles
- To impart knowledge on Localization and mapping fundamentals
- To impart knowledge on process end effectors and robotic controls
- To learn Robot cell design, Robot Transformation and Sensors
- To learn Micro/Nano Robotic Systems

UNIT I INTRODUCTION AND FUNCTIONAL ARCHITECTURE
Functional architecture - Major functions in an autonomous vehicle system, Motion Modeling - Coordinate frames and transforms, point mass model, Vehicle modeling (kinematic and dynamic bicycle model - two-track models), Sensor Modeling - encoders, inertial sensors, GPS.

UNIT II PERCEPTION FOR AUTONOMOUS SYSTEMS
SLAM - Localization and mapping fundamentals, LIDAR and visual SLAM, Navigation – Global path planning, Local path planning, Vehicle control - Control structures, PID control, Linear quadratic regulator, Sample controllers.

UNIT III ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL

UNIT IV ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN

UNIT V MICRO/NANO ROBOTICS SYSTEM
Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in
targeted drug delivery system.

**COURSE OUTCOMES:**

**CO1:** Understand architecture and modeling of autonomous systems.

**CO2:** Employ localization mapping techniques for autonomous systems

**CO3:** Design solutions for autonomous systems control.

**CO4:** Analyze Robot Transformations, Sensors and Cell Design

**CO5:** Explain the working principles of Micro/Nano Robotic system

**TOTAL:** 45 PERIODS

**REFERENCES**


**MP4093**

**SOFT COMPUTING TECHNIQUES**

**L T P C**

3 0 0 3

**COURSE OBJECTIVES:**

- To give the knowledge of soft computing theories fundamentals
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To familiarize the ideas of fuzzy sets, fuzzy logic, use of heuristics and Fuzzy Logic Control Systems
- To introduce the mathematical background for genetic algorithms
- To expose the hybrid soft computing systems and its applications

**UNIT I**

**SOFT COMPUTING FUNDAMENTALS**


**UNIT II**

**NEURAL NETWORKS**

Fundamental Models of ANN: McCulloch- Pitts Model –Hebb Network – Linear Separability

function optimization.

UNIT III FUZZY COMPUTING AND MODELING 9

UNIT IV GENETIC ALGORITHM AND APPLICATIONS 9

UNIT V HYBRID SOFT COMPUTING AND APPLICATIONS 9

COURSE OUTCOMES:
After completion of the course, the student will be able to:
CO1: Apply various soft computing concepts for practical applications
CO2: Choose and design suitable neural network for real time problems
CO3: Use fuzzy logic rules and reasoning to handle uncertainty and develop decision making and expert system
CO4: Describe the importance of genetic algorithms for solving combinatorial optimization problems
CO5: Analysis the various hybrid soft computing techniques and apply in real time problems

TOTAL: 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:
- To learn the basics of unity for Game development.
- To become familiar with the Unity & C# and popular tools & plugins
- To learn to work with 2D Game development.
- To understand 3D Graphics and principles for development
- To implement a larger, demo-able game project

UNIT I  BASICS OF UNITY  9
Introduction, Modes of unity, Scene view, Project View, Game View, Scripting Game Dev Basics, Scenes, Game Objects, Components.

UNIT II  WORKING 2D GRAPHICS AND USER INTERFACE CONCEPTS  9
Unity & C# - Camera - Sprites and Texture Atlases - Animation – Scrolling, – Mobile Game Input; Designing for Mobile - Basic Touch and Multi-Touch Gestures - Accelerometer - Virtual joypads - Usability and Game case studies - Designing for the impatient gamer

UNIT III  GAME DESIGN PRINCIPLES AND BUILDING 2D GAME  9
Game Genres, Game Worlds, Character Development, Story Telling, User Experience, Core MEchanics, Game Balancing, Level Design, Gnome on a Rope , Getting Started Building the Game, Preparing for Gameplay, building Gameplay with Traps and Objectives, Polishing the Game, Final Touches on Gnome’s Well,

UNIT IV  3D GRAPHICS AND AND GAME ENGINE  9
Math and Physics; - Quick overview of vector math - Physics principles - 3D math primer - Basics of the 3D world - 3D rendering essentials - Collision and Rigid body dynamics animation systems- Using Unity for 3D development, Creating GUIs in Unity, Particle Effects - Cross-platform game engines - Platform specific game creation tools

UNIT V  BUILDING A 3D GAME  9
Building a Space Shooter, Input and Flight Control, Adding Weapons and Targeting, Asteroids and Damage, Audio, Menus, Death, and Explosions!, Lighting and Shaders, Making a Custom Wizard- Custom Editor Window- Custom Property Drawer- Custom Inspector, The Unity Services Ecosystem, Deployment

COURSE OUTCOMES:
CO1: Work with the Unity environment for building a game from scratch.
CO2: Can work with 2D Graphics and build the UI
CO3: Use the Game Design Principles for Designing Games
CO4: Use 3D Graphics and the Game engine properties to build 3D Games.
CO5: Designing and Building 3D game with Unity/ equivalent open source tool

TOTAL PERIODS: 45

REFERENCES
2. Jonathon Manning and Paris Buttfield-Addison, “Mobile Game Development”, O’Reilly Media,

MP4005 FULL STACK MOBILE APPLICATION DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:
• Know the fundamentals of Android programming using the Android SDK
• Understand KOTLIN programming
• Learn Android programming concepts like activities and intents, designing user interface using views, data persistence, content providers, messaging and networking, location-based services, and developing android services etc.
• Understanding android databases
• Learn to develop Android Apps

UNIT I INTRODUCTION

UNIT II KOTLIN PROGRAMMING
Introduction to KOTLIN programming - Basics of Kotlin, Operations and Priorities, Decision Making. Loop Control, Data Structures(Collections), Functions, Object Oriented Programming: Inheritance, abstract, interface, super and this, visibility modifiers.

UNIT III INTRODUCTION TO ANDROID
Basics of an ANDROID application, introduction to manifest, externalizing resources, application lifecycle, ANDROID activities, Widgets: Button, TextView, ImageView, Progressbar, ListView, EditText, Calendar, DateTime etc, Working with Intent and Files.

UNIT IV PREFERENCES, DATABASE AND CONTENT PROVIDER
Creating, saving and retrieving shares preferences, Including static files as resources, Introducing ANDROID databases, Content values and cursors, Working with SQLite databases, Creating content providers, Using content providers, Native ANDROID Content providers. Introduction and addition of action bar, Menus and dialogs, drawable and gradients, Using location-based services, Selecting a location provider, Finding your current location, and Creating map-based activities.
Introduction of recycle view and card view. Playing audio and video, manipulating raw audio, using camera to take pictures, recording video, adding media to media store, Hardware support for telephony, using telephony, introducing SMS and MMS, Signing and publishing applications, introduction to monetizing applications

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Demonstrate the fundamentals of Full Stack mobile application development.
CO2: Illustrate the basic concepts of KOTLIN programming.
CO3: Develop and customize application user interfaces
CO4: Develop interactive applications using Maps, Location based services, UI-UX.
CO5: Create and deploy interactive applications in android using databases with multiple activities including audio, video and notifications

TOTAL:45 PERIODS

REFERENCES
3. https://kotlinlang.org/
COURSE OBJECTIVES:
- To impart the fundamental concepts of Healthcare data analytics
- To give the knowledge about the Health care Data Sources.
- To familiarize Advanced Data Analytics for Healthcare
- To learn the Health IoT data analytics
- To implement the Applications and Practical Systems for Healthcare.

UNIT I  INTRODUCTION  9
Introduction- Healthcare Data Sources and Basic Analytics - Healthcare Data Sources : Electronic Health Records: Components of HER- Coding system- Biomedical Image Analysis: Biomedical Imaging Modalities- Object Detection- Image Segmentation- Image Registration- Feature Extraction- Mining of Sensor Data in Healthcare: Mining Sensor Data in Medical Informatics: Scope and Challenges- Sensor Data Mining Applications

UNIT II  HEALTHCARE DATA SOURCES  9
Biomedical Signal Analysis: Types of Biomedical Signals- ECG Signal Analysis- Denoising of Signals- Multivariate Biomedical Signal Analysis- Cross-Correlation Analysis- Methods to Study Connectivity- Genomic Data Analysis for Personalized Medicine: Genomic Data Generation- Methods and Standards for Genomic Data Analysis- Types of Computational Genomics Studies towards Personalized Medicine

UNIT III  ADVANCED DATA ANALYTICS FOR HEALTHCARE  9

UNIT IV  HEALTH IOT DATA ANALYTICS  9
Internet of things in the healthcare industry- IoT healthcare architecture- Characteristics of IoT health data- Health data analytics using Internet of things- Computational intelligence in Internet of things for future healthcare applications.

UNIT V  APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE  9

COURSE OUTCOMES:
CO1: Describe the basics of healthcare data analytics.
CO2: Explain the Healthcare Data Sources.
CO3: Discuss the Advanced Data Analytics for Healthcare.
CO4: Express the Health IoT data analytics.
CO5: Apply the practical Systems for Healthcare.

TOTAL: 45 PERIODS

REFERENCES
NE4091 HAPTIC TECHNOLOGY

COURSE OBJECTIVES:
- To provide an overview of Haptic technology
- To learn the concepts of Haptic rendering system.
- To analyze the effectiveness of multimedia haptic in real time applications.
- To enable the student to create applications in a collaborative environment.

UNIT I INTRODUCTION

UNIT II HUMAN HAPTIC PERCEPTION AND MACHINE HAPTICS

UNIT III COMPUTER HAPTICS
Haptic Rendering Subsystem-Polygon based Representation and Scene Graph-Collision Detection Techniques and Bounding Volumes-Penetration Depth and Collision Response-Haptic Rendering of Surface Properties-Haptic Rendering of other Representation methods- Haptic Rendering of more than 3-DOF-Control Methods for Haptic systems-Benchmarking Haptic Rendering systems-Haptic Software Frameworks

UNIT IV MULTIMEDIA HAPTICS

UNIT V TOUCHING THE FUTURE: CHALLENGES AND TRENDS
COURSE OUTCOMES:
CO1: Demonstrate knowledge in human perception, Machine and Multimedia Haptics.
CO2: Create integrated and collaborative haptic systems
CO3: Identify and representation of Haptic Rendering subsystem
CO4: Analyze and characterize Multimedia Haptics
CO5: Learn the challenges, recent trends and applications of Haptic Technology

TOTAL: 45 PERIODS

REFERENCES
2. http://haptic.mech.nwu.edu

CP4252  MACHINE LEARNING  L T P C
3 0 2 4

COURSE OBJECTIVES:
- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

UNIT I  INTRODUCTION AND MATHEMATICAL FOUNDATIONS  9

UNIT II  SUPERVISED LEARNING  9

UNIT III  UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING  9
UNIT IV  PROBABILISTIC METHODS FOR LEARNING-


UNIT V  NEURAL NETWORKS AND DEEP LEARNING

Neural Networks – Biological Motivation - Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

45 PERIODS

SUGGESTED ACTIVITIES:

1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

PRACTICAL EXERCISES:

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?" (use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit-learn’s KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.

1. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
2. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
3. You are free to use any third-party ideas or code that you wish as long as it is publicly available.

47
4. You must properly provide references to any work that is not your own in the write-up.
5. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)
1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

COURSE OUTCOMES:
Upon the completion of course, students will be able to
CO1: Understand and outline problems for each type of machine learning
CO2: Design a Decision tree and Random forest for an application
CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
CO4: Use a tool to implement typical Clustering algorithms for different types of applications.
CO5: Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

REFERENCES
COURSE OBJECTIVES:
- To learn and understand biometric technologies and their functionalities.
- To learn the role of biometric in the organization
- To learn the computational methods involved in the biometric systems.
- To expose the context of Biometric Applications
- To learn to develop applications with biometric security

UNIT I INTRODUCTION 9+3

UNIT II FINGERPRINT, FACE AND IRIS AS BIOMETRICS 9+3
Fingerprint biometrics – Fingerprint recognition system – Minutiae extraction – Fingerprint indexing – experimental results – Biometrics using vein pattern of palm – Advantages and disadvantages – Basics of hand geometry
Background of face recognition – Design of face recognition system – Neural network for face recognition – Face detection in video sequences – Challenges in face biometrics – Face recognition methods – Advantages and disadvantages

UNIT III PRIVACY ENHANCEMENT AND MULTIMODAL BIOMETRICS 9+3

UNIT IV WATERMARKING TECHNIQUES & BIOMETRICS: SCOPE AND FUTURE 9+3

UNIT V IMAGE ENHANCEMENT TECHNIQUES & BIOMETRICS STANDARDS 9+3
Current research in image enhancement techniques – Image enhancement algorithms–
LIST OF EXPERIMENTS (Experiments can be designed with similar use cases as below):
1. Student school smart card
2. Secure lab access using card scanner plus face recognition
3. Student bus pass with barcode card scan
4. Student bus pass with webcam scan
5. Employee attendance system by Qr scan
6. Student examination data card
7. School student attendance system by barcode scan
8. School student attendance system by Qr scan
9. School student attendance with fingerprint reader
10. Fingerprint voting system project
11. Employee hourly attendance by barcode scan
12. Visual product identification for blind

COURSE OUTCOMES:
CO1: Identify the various biometric technologies.
CO2: Design of biometric recognition for the organization.
CO3: Develop simple applications for privacy.
CO4: Understand the need of biometric in the society
CO5: Understand the research in biometric techniques.

REFERENCES:

DEEP LEARNING

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing
UNIT I  DEEP LEARNING CONCEPTS  6

UNIT II  NEURAL NETWORKS  9

UNIT III  CONVOLUTIONAL NEURAL NETWORK  10

UNIT VI  NATURAL LANGUAGE PROCESSING USING RNN  10

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING  10

LIST OF EXPERIMENTS:  30
1: Feature Selection from Video and Image Data
2: Image and video recognition
3: Image Colorization
4: Aspect Oriented Topic Detection & Sentiment Analysis
5: Object Detection using Autoencoder

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL: 45+30 PERIODS

REFERENCES
1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc. 2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017

CP4071 BIO INFORMATICS

COURSE OBJECTIVES:
- Exposed to the need for Bioinformatics technologies
- Be familiar with the modeling techniques
- Learn microarray analysis
- Exposed to Pattern Matching and Visualization
- To know about Microarray Analysis

UNIT I INTRODUCTION
Need for Bioinformatics technologies – Overview of Bioinformatics technologies
Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System.

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS
Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

UNIT III MODELING FOR BIOINFORMATICS

UNIT IV PATTERN MATCHING AND VISUALIZATION

UNIT V MICROARRAY ANALYSIS
LIST OF EXPERIMENTS:
1. Manipulating DNA strings
2. Use Protein Data Bank to visualize and Analyze the Proteins from protein database
3. Explore the Human Genome with the SciPy Stack
4. Hidden Markov Model for Biological Sequence
5. Molecular Modeling using MMTK package
6. Sequence Alignment using Biopython, Pairwise and multiple sequence alignment using ClustalW and BLAST
7. Simple generation and manipulation of genome graphs
8. DNA data handling using Biopython
9. Chaos Game Representation of a genetic sequence
10. Visualize the microarray data using Heatmap

COURSE OUTCOMES:
CO1: Understand the different Data formats
CO2: Develop machine learning algorithms.
CO3: Develop models for biological data.
CO4: Apply pattern matching techniques to bioinformatics data – protein data
      genomic data.
CO5: Apply microarray technology for genomic expression study. 

TOTAL: 45+30=75 PERIODS

REFERENCES
1. Yi-Ping Phoebe Chen (Ed), “BioInformatics Technologies”, First Indian Reprint, Springer
   Verlag, 2007.
   2019

CP4072 BLOCKCHAIN TECHNOLOGIES L T P C
3 0 2 4

COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like
  application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart
  contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN 9
What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins,
Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as
Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTOCURRENCY 9
What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin
Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-
Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT III INTRODUCTION TO ETHEREUM 9

UNIT IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10

UNIT V BLOCKCHAIN APPLICATIONS 8
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:
1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum Block Chain.
4. Build Hyperledger Fabric with Smart Contract.
5. Create Case study of Block Chain being used in illegal activities in real world.
6. Using Python Libraries to develop Block Chain Application.

TOTAL: 30 PERIODS

SUPPLEMENTARY RESOURCES:
- NPTEL online course: https://nptel.ac.in/courses/106/104/106104220/#
- Udemy: https://www.udemy.com/course/build-your-blockchain-az/
- EDUXLABS Online training: https://eduxlabs.com/courses/blockchain-technology-training/?tab=tab-curriculum

TOTAL: 75 PERIODS

COURSE OUTCOMES:
After the completion of this course, student will be able to

CO1: Understand and explore the working of Blockchain technology (Understanding)
CO2: Analyze the working of Smart Contracts (Analyze)
CO3: Understand and analyze the working of Hyperledger (Analyze).
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum (Apply)
CO5: Develop applications on Blockchain

REFERENCES:
MU4291  MIXED REALITY    L T P C
3 0 2 4

COURSE OBJECTIVES:
- To study about Fundamental Concept and Components of Virtual Reality
- To study about Interactive Techniques in Virtual Reality
- To study about Visual Computation in Virtual Reality
- To study about Augmented and Mixed Reality and Its Applications
- To know about I/O Interfaces and its functions.

UNIT I  INTRODUCTION TO VIRTUAL REALITY 9

Suggested Activities:
- Flipped classroom on uses of MR applications.
- Videos – Experience the virtual reality effect.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:
- Tutorial – Applications of MR.
- Quizzes on the displayed video and the special effects

UNIT II  INTERACTIVE TECHNIQUES IN VIRTUAL REALITY 9

Suggested Activities:
- Flipped classroom on modeling three dimensional objects.
- External learning – Collision detection algorithms.
- Practical – Creating three dimensional models.

Suggested Evaluation Methods:
- Tutorial – Three dimensional modeling techniques.
- Brainstorming session on collision detection algorithms.
- Demonstration of three dimensional scene creation.

UNIT III  VISUAL COMPUTATION IN VIRTUAL REALITY 9
Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object

**Suggested Activities:**
- External learning – Different types of programming toolkits and Learn different types of available VR applications.
- Practical – Create VR scenes using any toolkit and develop applications.

**Suggested Evaluation Methods:**
- Tutorial – VR tool comparison.
- Brainstorming session on tools and technologies used in VR.
- Demonstration of the created VR applications.

**UNIT IV**

**AUGMENTED AND MIXED REALITY**

9

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

**Suggested Activities:**
- External learning - AR Systems

**Suggested Evaluation Methods:**
- Brainstorming session different AR systems and environments.

**UNIT V**

**I/O INTERFACE IN VR & APPLICATION OF VR**

9

Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML, Input -- Tracker, Sensor, Digitalglobe, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices. VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

**Suggested Activities:**
- External learning – Different types of sensing and tracking devices for creating mixed reality environments.
- Practical – Create MR scenes using any toolkit and develop applications.

**Suggested Evaluation Methods:**
- Tutorial – Mobile Interface Design.
- Brainstorming session on wearable computing devices and games design.
- Demonstration and evaluation of the developed MR application.

**COURSE OUTCOMES:**

**CO1:** Understand the Fundamental Concept and Components of Virtual Reality

**CO2:** Able to know the Interactive Techniques in Virtual Reality

**CO3:** Can know about Visual Computation in Virtual Reality

**CO4:** Able to know the concepts of Augmented and Mixed Reality and Its Applications

**CO5:** Know about I/O Interfaces and its functions.
PRACTICALS:
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection methods by handling the camera.
3. Download objects from asset stores and apply various lighting and shading effects.
4. Model three dimensional objects using various modeling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
10. Develop simple MR enabled gaming applications.

REFERENCES

AUDIT COURSES
AX4091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0
COURSE OBJECTIVES:
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
UNIT II PRESENTATION SKILLS

UNIT III TITLE WRITING SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

AX4092 DISASTER MANAGEMENT

COURSE OBJECTIVES:
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
UNIT II   REPERCUSSIONS OF DISASTERS AND HAZARDS  6

UNIT III DISASTER PRONE AREAS IN INDIA  6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT  6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT  6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES:
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

COURSE OBJECTIVES:
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution 1917 And its impact on the initial drafting of the Indian Constitution.

UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV  ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION

UNIT VI  ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India,1950(Bare Act),Government Publication.
UNIT I

சங்க இலக்கியம் 6
1. தேர்கள் காலத்தில் மூன்று குழுக்களில்
   - சுருக்கம், மற்றும், பாடல்
2. அத்தியாணத் (82)
   - மூத்தல் முக்கியமான அற்புதம்
3. குறிப்பிட்டு பாடல்கள், பாடல்கள்
4. பதிப்பு (95,195)
   - பதால் திண்மம் சந்தமை

UNIT II

அதிசயத் தமிழ் 6
1. அவதாராத் திருவாரத்
   - அதை வேளையில், அவதாராத் குழு, அண்மை மூலம்
2. பிற அவதாரம் - திருவாரத்
   - பெண், சிவப்புமாறு, சிரித், அவதாராத் (குழுப் பாடல் மோழை முன்பொருள்)

UNIT III

முன்ளை கல்பியங்கள் 6
1. கல்பியங்கள் புருஷம்
   - திங்களிகள் முழுக்கு காலம்
2. சுருக்கம் திறக்கியேன் முழுக்குகலம்
   - சிகிச்சாக்கள் அதிகாரம் முழுக்குகலம்

UNIT IV

அருள்நநறித் தமிழ் 6
1. சிறுப்பொருள் படைம
   - பொருள், முழுக்கு காலத்தில், பெண் முழுக்கு பொருள்
   காலத்தில், அருங்கள் செலுத்தல் திறக்கினை, அருங்கள் செலுத்தல் திறக்கினை, அருங்கள் பொருள்
2. குறித்தவம
   - அருங்கள் செலுத்தல் குறிப்பிட்டு
3. குறிப்பிட்டு (617, 618)
   - விளக்கம் விளக்கம் முடிவு
4. திறக்கியேன் காலம் திறக்கியேன் முழுக்கு
5. பதிப்பு
   - சிகிச்சாக்கள் முழுக்கு காலம்
6. அத்தியாணத் (4)
   - முதல்
   - குறிப்பிட்டு (11)
   - குறிப்பிட்டு (11)
   - பாடல், புன்னா
   - குருதிகள் 50 (27)
   - பாடல்
   - அருங்கள் பொருள் சமூகம்
UNIT V

நவீன தமிழ் இலக்கியம்

1. உகரநகடத் தமிழ்
   - தமிழின் முதல் புதினம்
   - தமிழின் முதல் சிறுககத
   - கட்டுகர இலக்கியம்
   - பயண இலக்கியம்
   - டைகே

2. தொட்டுவிடுத்தகமும் தமிழ் இலக்கியமும்

3. முதோய விடுத்தகமும் தமிழ் இலக்கியமும்

4. தபண் விடுத்தகமும் விளிம்பு நிகிலயினரின் பம்பொட்டில் தமிழ் இலக்கியமும்

5. அறிவியல் குழு

6. தர்மபுர ஆதீன தவளியீடு

7. குருக்கர் பெம்பப்புத் தமிழ் இலக்கியமும்

TOTAL: 30 PERIODS

தமிழ் இலக்கியம் வகைப்படுத்தல் / பதக்ககள்

1. தமிழ் தொலைக்காட்சி கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org

2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia)
   - https://ta.wikipedia.org

3. குருப்பு அத்திகசம் தமிழிதழ்

4. பாணிகள் கேந்திரிய
   - தமிழ்ப் பாணிகள் கேந்திரிய, தொண்டலூர்

5. தமிழ்ப் பல்கலைக்கழகம்
   - தமிழ்ப் பல்கலைக்கழகம், தொண்டலூர்

6. அறிவியல் கேந்திரிய
   - தமிழ்ப் பல்கலைக்கழகம், தொண்டலூர்