ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. COMPUTER SCIENCE AND ENGINEERING (WITH SPECIALIZATION IN NETWORKS)
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Acquire core competence and excel in computing and networking based industries.

II. Analyze and understand the foundations of networking as well as advanced techniques and tools so as to build or improve current techniques to a higher standard.

III. Possess creativity and understanding to build innovative and research-oriented systems, and provide solutions of varying complexity.

IV. Effectively communicate technical information, function effectively on teams, and apply computer engineering solutions within a global, societal, and environmental context.

V. Provide consultancy and offer networking solutions for establishments.

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. To use mathematical, algorithmic and theoretical foundations in the study of computing systems.

4. To adapt to emerging generations of networking technologies to design, build and dream up innovative interconnected systems.

5. To acquire in-depth knowledge of core and emerging technologies of Computer Networks and apply them to various situations for classifying networks, analyzing performance and implementing new technologies.

PEO/PO Mapping:

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(3-High, 2- Medium, 1- Low)
## Mapping of Course Outcomes and Programme Outcomes

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REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

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*Audit course is optional

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**TOTAL NO. OF CREDITS: 75**

### PROFESSIONAL ELECTIVES

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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**Research Methodology and IPR Courses (RMC)**

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COURSE OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To enable students to understand the concepts of Probability and Random Variables.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the central limit theorem.
- To apply the small / large sample tests through Tests of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I  LINEAR ALGEBRA  12

UNIT II  PROBABILITY AND RANDOM VARIABLES  12

UNIT III  TWO DIMENSIONAL RANDOM VARIABLES  12
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV  TESTING OF HYPOTHESIS  12
Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V  MULTIVARIATE ANALYSIS  12
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.

COURSE OUTCOMES:

At the end of the course, students will be able to
CO1: apply the concepts of Linear Algebra to solve practical problems.
CO2: use the ideas of probability and random variables in solving engineering problems.
CO3: be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
CO4: use statistical tests in testing hypotheses on data.
CO5: develop critical thinking based on empirical evidence and the scientific approach to knowledge development.
REFERENCES:

RM4151 RESEARCH METHODOLOGY AND IPR

UNIT I  RESEARCH DESIGN 6
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 6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.
Data - Preparing, Exploring, examining and displaying.

UNIT III  DATA ANALYSIS AND REPORTING 6
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 6

UNIT V  PATENTS 6

TOTAL : 30 PERIODS

REFERENCES
CURSE 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:

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CP4152 DATABASE PRACTICES

COURSE OBJECTIVES
- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT I  RELATIONAL DATA MODEL  15

**Suggested Activities:**
- Data Definition Language
  - Create, Alter and Drop
  - Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
  - Creating Views
- Data Manipulation Language
  - Insert, Delete, Update
  - Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
  - Aggregate Functions
  - Set Operations
  - Nested Queries
- Transaction Control Language
  - Commit, Rollback and Save Points

UNIT II  DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY  15

**Suggested Activities:**
- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing a Relational Database using PHP, Python and R

UNIT III  XML DATABASES  15

**Suggested Activities:**
- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational databases
- Extracting XML Documents from Relational Databases
- XML Querying

UNIT IV  NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS  15
Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

**Suggested Activities:**
- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
- Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

**UNIT V DATABASE SECURITY**


**SUGGESTED ACTIVITIES:**
Implementing Access Control in Relational Databases

**TOTAL : 75 PERIODS**

**COURSE OUTCOMES**
At the end of the course, the students will be able to
- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
- Understand and write well-formed XML documents
- Be able to apply methods and techniques for distributed query processing.
- Design and Implement secure database systems.
- Use the data control, definition, and manipulation languages of the NoSQL databases

**REFERENCES:**

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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 Use Cases- 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, HosamAfifi –“Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 ( UNIT 2 )

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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 9

UNIT II  THE WIRELESS CHANNEL 9
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 9

UNIT IV  DIVERSITY TECHNIQUES 9

UNIT V  MULTICARRIER MODULATION 9
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

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### 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

TOTAL : 60 PERIODS

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.

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NETWORKS LABORATORY

NE4111 (Experiments using NS2/ QUALNET /NS3/ OMNET/ equivalent)

COURSE OBJECTIVES:
- To understand the functioning of various protocols in wired and wireless environments.
- To perform real time experiments using the existing infrastructure.
- To impart programming skills using NS2/QUALNET.
- To gain knowledge in constructing LAN, WLAN, and VLAN in a real-time environment.
- To understand the security algorithms for networks.
LIST OF EXPERIMENTS:
1. AODV/DSR routing
2. Security algorithms in wired networks
3. MAC protocols wired and wireless networks
4. Configuration of LAN
5. Configuration of VLAN- Tunnelling
6. Configuration of WLAN
7. Mini Project

HARDWARE/SOFTWARE REQUIREMENTS
1: C/Java/Python
2: NS2/ QUALNET /NS3/ OMNET/ equivalent

TOTAL : 60 PERIODS

COURSE OUTCOMES:
CO1: Design MAC and routing protocols in Wired and Wireless Environment using NS2/QUALNET.
CO2: Acquire the technical competence to meet out the industry expectation on the state – of the art wired / wireless technologies.
CO3: Acquire the ability to design WLAN/ LAN systems meeting out real time requirements.
CO4: Design and configure a network.
CO5: Design VLAN for secured communication.

REFERENCES:
4. ns-3 Manual
5. OMNeT++ - Simulation Manual

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CO-PO Mapping
COURSE OBJECTIVES:

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry Pi and experiment simple IoT application on it

UNIT I INTRODUCTION

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS


UNIT III IoT PROTOCOLS AND TECHNOLOGY


UNIT IV CLOUD ARCHITECTURE BASICS

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google Appcloud platform in industry

UNIT V IOT PROJECTS ON RASPBERRY PI

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

SUGGESTED ACTIVITIES:

1. Develop an application for LED Blink and Pattern using arduino or Raspberry Pi
2. Develop an application for LED Pattern with Push Button Control using arduino or Raspberry Pi
3. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5. Develop an application for home intrusion detection web application
6. Develop an application for Smart parking application using python and Django for web application

COURSE OUTCOMES:

CO1: Understand the various concept of the IoT and their technologies
CO2: Develop the IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing
CO5: Develop and deploy the IoT application into cloud environment

TOTAL: 75 PERIODS

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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
UNIT II SUPERVISED LEARNING

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING

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

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 Neighbours. 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.
   a. 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.
   b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
   c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
   d. You must properly provide references to any work that is not your own in the write-up.
   e. 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.

TOTAL:75 PERIODS

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NE4251 NETWORK SECURITY

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

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

CO-PO Mapping

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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

<table>
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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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| 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  
7. Attach a call for papers (CFP) from your area.                                                                 | 3rd week        | 3% (the selected information must be area specific and of international and national standard)    |
| Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter | You have to provide a complete list of references you will be using. Based on your objective - Search various digital libraries and Google Scholar  
- When picking papers to read - try to:  
  - 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,  
  - Favour papers from well-known journals and conferences,  
  - Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),  
  - Favour more recent papers,  
  - Pick a recent survey of the field so you can quickly gain an overview,  
  - Find relationships with respect to each other and to your topic area (classification scheme/categorization)  
  - Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered | 4th week | 6%  
( the list of standard papers and reason for selection) |
|---|---|---|---|
| Reading and notes for first 5 papers | Reading Paper Process  
- For each paper form a Table answering the following questions:  
  - What is the main topic of the article?  
  - What was/were the main issue(s) the author said they want to discuss?  
  - Why did the author claim it was important?  
  - How does the work build on other’s work, in the author’s opinion?  
  - What simplifying assumptions does the author claim to be making?  
  - What did the author do?  
  - How did the author claim they were going to evaluate their work and compare it to others?  
  - What did the author say were the limitations of their research?  
  - What did the author say were the important directions for future research?  
Conclude with limitations/issues not addressed by the paper ( from the | 5th week | 8%  
( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
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<th>Week</th>
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<th>Notes</th>
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<td>Reading and notes for next 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>6th</td>
<td>8%</td>
<td>(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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<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>7th</td>
<td>8%</td>
<td>(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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<td>Draft outline 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification / categorization diagram</td>
<td>8th</td>
<td>8%</td>
<td>(this component will be evaluated based on the linking and classification among the papers)</td>
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<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th</td>
<td>6%</td>
<td>(Clarity, purpose and conclusion)</td>
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<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
<td>10th</td>
<td>5%</td>
<td>(Clarity)</td>
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<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>
<td>11th</td>
<td>10%</td>
<td>(this component will be evaluated based on the linking and classification among the papers)</td>
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<td>Your conclusions</td>
<td>Write your conclusions and future work</td>
<td>12th</td>
<td>5%</td>
<td>(conclusions – clarity and your ideas)</td>
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<td>Final Draft</td>
<td>Complete the final draft of your paper</td>
<td>13th</td>
<td>10%</td>
<td>(formatting, English, Clarity and linking)</td>
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<td>Seminar</td>
<td>A brief 15 slides on your paper</td>
<td>14th &amp; 15th</td>
<td>10%</td>
<td>(based on presentation and Viva-voce)</td>
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COURSE OBJECTIVES:
- To practice LAN and WAN design
- To learn network programming in UNIX C and Python
- Establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration
- Establish a internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration
- Establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration

SUGGESTED ACTIVITIES:
1: Develop a C program that demonstrates inter process communication
2: Develop a TCP client/server application
3: Develop a UDP client/server application
4: Develop an Iterative UDP server with 2 or 3 clients
5: Develop a concurrent TCP server with 2 or 3 clients
6: Develop a multiprotocol server with TCP and UDP and 2 clients
7: Develop simple Python programs that use frequently used syntactic constructs
8: Build client applications for major APIs (Amazon S3, Twitter etc) in Python
9: Develop an application that interacts with e-mail servers in python
10: Develop applications that work with remote servers using SSH, FTP etc in Python

COURSE OUTCOMES:
CO1: Design and implement LANs and internetworks
CO2: Develop network based applications in UNIX C and Python
CO3: Develop TCP UDP servers with multiple clients
CO4: Build client applications for major API in Python
CO5: Develop applications that interact with e-mail server, remote servers

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TOTAL: 30 PERIODS

TOTAL: 60 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
   (a) Traffic Monitoring (TCP slow down and HTTP slow down)
   (b) Packet Sniffing
4. To perform man in middle attack using DNS spoofing
5. To Perform HTTP Session Hijacking through Cookie stealing
6. To Configure AAA (TACACS+) on Packet Tracer for User Authentication
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

TOTAL: 30 PERIODS

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

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COURSE OBJECTIVES:

- To recapitulate the fundamentals of networking and understand the requirements for multimedia communication.
- To learn guaranteed service model.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the support provided for multimedia communication in 3G and 4G networks.
- To study about VoIP and real time multimedia network applications.

UNIT I  INTRODUCTION

Suggested Activities:

- Flipped classroom on network externalities and Economies of scale.
- External learning – Inter-continental backbone network and Autonomous Systems model of the Internet.
- Assignments on computing the playout time of packets.

Suggested Evaluation Methods:

- Quiz and discussion on network externalities and economies of scale.
- Assignments on proprietary protocols used in IoT and M2M.
- Assignments on problems related to playout time of multimedia applications.

UNIT II  GUARANTEED SERVICE MODEL

Suggested Activities:

- Flipped classroom on IntServ and DiffServ networks.
- External learning – Exploring the ways of using DSCP in IP header.
- Assignments on finish time problems related to WFQ and its variants.

Suggested Evaluation Methods:

- Quiz and discussion on IntServ and DiffServ networks.
- Assignments on configuring a router in such a way that DSCP fielder is exploited to provide QoS.
- Assignments on problems related to the virtual finish and actual finish of packets in WFQ and its variants.
UNIT III  MULTIMEDIA TRANSPORT


Suggested Activities:
- External learning – Exploring various media players available and the ways to customize them.
- Exploring the ways to configure RTP.
- Flipped classroom on RTP and RTCP.

Suggested Evaluation Methods:
- Assignments on media players available and configuring them.
- Configuring RTP and RTSP.
- Quiz and discussion on RTP and RTCP.

UNIT IV  MULTIMEDIA OVER WIRELESS NETWORKS


Suggested Activities:
- Flipped classroom on IMSVoLTE architecture.
- External learning – Multimedia support in 5G networks.
- Analyzing the protocols of IP media subsystem.

Suggested Evaluation Methods:
- Quiz and discussion on IMSVoLTE architecture.
- Assignments on multimedia support in 5G networks.
- Assignments on analyzing the headers of IP multimedia subsystem.

UNIT V  MULTIMEDIA NETWORKED APPLICATIONS


Suggested Activities:
- Flipped classroom on SCIBus and S.100.
- External learning – Multimedia access networks and edge networks.
- Exploring the ways to configure SIP.
Suggested Evaluation Methods:
- Quiz and discussion on SCIBus and S.100.
- Assignments on multimedia access networks and edge networks.
- Configuring SIP using suitable commands.

TOTAL: 45 PERIODS

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

CO1: Deploy the right multimedia communication models.

CO2: Apply QoS to multimedia network applications at the network level with efficient scheduling and routing techniques.

CO3: Apply QoS to multimedia network applications at the end system level with efficient scheduling and routing techniques.

CO4: Understand IP multimedia subsystem and IP initiatives in cellular networks to support multimedia traffic.

CO5: Design and implement VoIP based solutions for multimedia transport.

CO6: Develop the real-time multimedia network applications.

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COURSE OBJECTIVES:

- To learn about the issues in the design of wireless ad hoc networks
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks
- To expose the students to different aspects in sensor networks
- To understand various security issues in ad hoc and sensor networks and solutions to the issues

UNIT I  WIRELESS SENSOR NETWORK ARCHITECTURE  9
Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards - Physical layer and transceiver design considerations.

UNIT II  MAC & ROUTING IN WIRELESS SENSOR NETWORKS  9

UNIT III  TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS  9

UNIT IV  SECURITY IN AD HOC AND SENSOR NETWORKS  9

UNIT V  TOOLS FOR WSN  9

COURSE OUTCOMES:

CO1: Identify different issues in wireless ad hoc and sensor networks
CO2: To analyze protocols developed for ad hoc and sensor networks
CO3: To identify and understand security issues in ad hoc and sensor networks
CO4: To learn the significance of Transport layer and QoS in wireless sensor networks.
CO5: To analyze the tools used for Wireless Sensor Networks

TOTAL: 45 PERIODS

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**Course Objectives:**
- Understand the concepts of optical components and networks.
- To gain an understanding of various issues in designing a high speed, and huge bandwidth optical network.
- To acquire knowledge of architecture and standards of optical networks.
- Thorough knowledge about the routing and access mechanism in optical networks.
- Thorough understanding of the scientific and engineering principles underlying the photonics technology.

**Unit I: Optical System Components**

**Unit II: Optical Network Architectures**
Introduction to Optical Networks; WDM networks, SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks- Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture. WOBAN and OTDM networks. Introduction to ASON.
UNIT III WAVELENGTH ROUTING NETWORKS 9
The Optical layer, Node Designs, Optical layer cost tradeoff, Routing and Wavelength Assignment algorithms, Virtual Topology design, Architectural variations

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

UNIT V NETWORK DESIGN AND MANAGEMENT 9
Transmission system Engineering-system model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, wavelength stabilization; overall design consideration; Control and Management-Network management functions, Configuration management, Performance management, Fault management. Optical safety, Service interface.

COURSE OUTCOMES:
On completion of the course the student will be
CO1: able to design state-of-the-art optical networks.
CO2: able to implement optical network protocols.
CO3: able to design high speed networks using optical fibers
CO4: able to simulate access network
CO5: able to design the optical network infrastructure and network management methods.

REFERENCES

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TOTAL: 45 PERIODS
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  9

UNIT II  HUMAN HAPTIC PERCEPTION AND MACHINE HAPTICS  9

UNIT III  COMPUTER HAPTICS  9
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  9

UNIT V  TOUCHING THE FUTURE: CHALLENGES AND TRENDS  9

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

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IF4095 SOCIAL NETWORK ANALYSIS

UNIT I

GRAPH THEORY AND STRUCTURE


UNIT II

SOCIAL NETWORK GRAPH ANALYSIS

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.

TOTAL : 45 PERIODS

REFERENCES
1. Practical Social Network Analysis with Python, Krishna Raj P. M. Ankith Mohan and K. G. Srinivasa. Springer, 2018
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### NE4001 IoT ARCHITECTURE AND PROTOCOLS

**LTCP**

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<td>- To learn about the basics of IoT</td>
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<td>- To study the architecture of IoT with its reference model</td>
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<td>- To discuss the various IoT network layer protocols.</td>
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<td>- To identify the various IoT application layer protocols with its features</td>
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<td>- To develop various IoT-based real time applications.</td>
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#### UNIT I BASICS OF IoT

Introduction to IoT - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates- Domain Specific IoTs - IoT and M2M - Applications of IoT, Use cases of IoT

#### UNIT II IoT ARCHITECTURE


#### UNIT III IoT NETWORK LAYER PROTOCOL


#### UNIT IV IOT APPLICATION LAYER PROTOCOLS


#### UNIT V APPLICATIONS AND CASE STUDY

Real world design constraints – Applications: Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - Case study : Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.
COURSE OUTCOMES:
CO1: Comprehend the essentials of IoT and its applications
CO2: Understand the concepts of IoT Architecture Reference model and IoT reference architecture
CO3: Use of IoT network layer protocols with security challenges.
CO4: Analyze various IoT Application layer Protocols
CO5: Design IoT-based systems for real-world problems

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TOTAL: 45 PERIODS

COURSE OBJECTIVES:
- To learn the fundamental principles and practices associated with each of the agile development methods
- To apply the principles and practices of agile software development on a project of interest and relevance to the student.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand Agile development and testing.

UNIT I AGILE SOFTWARE DEVELOPMENT
Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile,
stakeholders, Challenges . Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality

UNIT II AGILE AND SCRUM PRINCIPLES 9

UNIT III AGILE PRODUCT MANAGEMENT 9
Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

UNIT IV AGILE REQUIREMENTS AND AGILE TESTING 9

UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS 9

COURSE OUTCOMES:
CO1: Analyze existing problems with the team, development process and wider organization
CO2: Apply a thorough understanding of Agile principles and specific practices
CO3: Select the most appropriate way to improve results for a specific circumstance or need
CO4: Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems
CO5: Evaluate likely successes and formulate plans to manage likely risks or problems

TOTAL: 45 PERIODS

REFERENCES
CP4094 MOBILE AND PERVERSIVE COMPUTING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the basics of Mobile Computing and Personal Computing
- To learn the role of cellular networks in Mobile and Pervasive Computing
- To expose to the concept of sensor and mesh networks
- To expose to the context aware and wearable computing
- To learn to develop applications in mobile and pervasive computing environment

UNIT I INTRODUCTION 9

UNIT II 3G AND 4G CELLULAR NETWORKS 9

UNIT III SENSOR AND MESH NETWORKS 9
UNIT IV  CONTEXT AWARE COMPUTING & WEARABLE COMPUTING


UNIT V  APPLICATION DEVELOPMENT

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone

COURSE OUTCOMES:
CO1: Design a basic architecture for a pervasive computing environment
CO2: Design and allocate the resources on the 3G-4G wireless networks
CO3: Analyze the role of sensors in Wireless networks
CO4: Work out the routing in mesh network
CO5: Deploy the location and context information for application development
CO6: Develop mobile computing applications based on the paradigm of context aware computing and wearable computing

TOTAL:45 PERIODS

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SE4151  ADVANCED SOFTWARE ENGINEERING  L T P C
3 0 0 3

COURSE OBJECTIVES:
• To understand the rationale for software development process models
• To understand why the architectural design of software is important;
• To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
• To understand the basic notions of a web service, web service standards, and service-oriented architecture;
• To understand the different stages of testing from testing during development of a software system

UNIT I  SOFTWARE PROCESS &MODELING  9

UNIT II  SOFTWARE DESIGN  9

UNIT III  SYSTEM DEPENDABILITY AND SECURITY  9

UNIT IV  SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING  9
UNIT V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT


SUGGESTED ACTIVITIES
1. Comparatively analyzing different Agile methodologies.
2. Describing the scenarios where ‘Scrum’ and ‘Kanban’ are used.
3. Mapping the data flow into suitable software architecture.
4. Developing behavioural representations for a class or component.
5. Implementing simple applications as RESTful service.

COURSE OUTCOMES:
The Students will be able to
CO1: Identify appropriate process models based on the Project requirements
CO2: Understand the importance of having a good Software Architecture.
CO3: Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
CO4: Understand the basic notions of a web service, web service standards, and service-oriented architecture;
CO5: Be familiar with various levels of Software testing

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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  9
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  9
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  9
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  9
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  9
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

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**NE4002**  
**HIGH SPEED SWITCHING ARCHITECTURES**

**COURSE OBJECTIVES:**

- To learn the basics of switching
- To explore the various space division switches
- To evaluate the performance of various switching architectures
- To study the architecture of IP routers
- To study about MPLS switches

**UNIT I**  
**SWITCHING BASICS**

Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals
UNIT II  SWITCHING ARCHITECTURES

UNIT III  PACKET QUEUES AND DELAY ANALYSIS
Little's theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – Pollaczek Khintchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV  P ROUTER ARCHITECTURE
Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors – Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non critical data path processing – fast and slow path.

UNIT V  MPLS ROUTERS

COURSE OUTCOMES:
CO1: Apply switching concepts to build networks.
CO2: Deploy the network with appropriate type of switches.
CO3: Analyze the queuing disciplines and delay analysis
CO4: Select and configure the appropriate type of IP router
CO5: Design and implement MPLS networks

TOTAL: 45 PERIODS

REFERENCES
1. Damitri P Bertsekas and Gallager, Data NetworksII, 2nd edition, PHI, 1992
5. Luc De Ghein, MPLS FundamentalsII, Cisco Press 2014

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COURSE OBJECTIVES:

- Be exposed to the software quality factors, Quality Assurance (SQA) architecture and SQA components.
- Understand the integration of SQA components into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality.
- Be familiar with the Quality standards, certifications and assessments.

UNIT I  INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE  9
Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall’s quality model – SQA system components – Pre project quality components – Development and quality plans.

UNIT II  SQA COMPONENTS AND PROJECT LIFE CYCLE  9
Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participants contribution – CASE tools for software quality Management.

UNIT III  SOFTWARE QUALITY INFRASTRUCTURE  9
Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.

UNIT IV  SOFTWARE QUALITY MANAGEMENT & METRICS  9
Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model

UNIT V  STANDARDS, CERTIFICATIONS & ASSESSMENTS  9

COURSE OUTCOMES:
CO1: Utilize the concepts of SQA in software development life cycle
CO2: Demonstrate their capability to adopt quality standards.
CO3: Assess the quality of software products.
CO4: Apply the concepts in preparing the quality plan & documents.
CO5: Ensure whether the product meets company's quality standards and client's
expectations and demands

TOTAL: 45 PERIODS

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CP4095 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9

UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9
UNIT III  MULTI-SERVER AND MULTI-QUEUE SYSTEMS
Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke’s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV  REAL-WORLD WORKLOADS

UNIT V  SMART SCHEDULING IN THE M/G/1

TOTAL : 45 PERIODS

COURSE OUTCOMES :
Upon completion of this course, the students should be able to
CO1:Identify the need for performance evaluation and the metrics used for it
CO2:Distinguish between open and closed queuing networks
CO3:Apply Little’e law and other operational laws to open and closed systems
CO4:Use discrete-time and continuous-time Markov chains to model real world systems
CO5:Develop analytical techniques for evaluating scheduling policies

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NE4003 SIMULATION OF COMPUTER SYSTEMS AND NETWORKS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand how simulators are built.
- To understand the statistical models used in simulations.
- To learn different ways of generating random numbers.
- To learn modeling of the data given as input to simulators.
- To understand how computer networks are simulated using case studies.

UNIT I STATISTICAL AND QUEUING MODELS 9

UNIT II RANDOM NUMBER AND RANDOM VARIATE GENERATION 9
Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation

UNIT III ANALYSIS OF SIMULATION DATA 9
Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models

UNIT IV SIMULATION OF COMPUTER NETWORKS 9

UNIT V CASE STUDIES OF NETWORK SIMULATORS 9

COURSE OUTCOMES:
CO1: Understand the modeling and development of simulations and simulators
CO2: Differentiate the different ways in which simulators are designed
CO3: Analyze how computer networks are simulated
CO4: Use simulators like ns-3
CO5: Compare the features of different simulators

TOTAL: 45 PERIODS

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NE4004 NEXT GENERATION NETWORKS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand evolution of technologies of 4G and beyond.
- To learn the fundamentals of 5G internet.
- To explore NGN architecture and management activities.
- To gain the knowledge of Cooperation for Next Generation Wireless Networks
- To learn security risks in 5G networks.

UNIT I 4G AND BEYOND

UNIT II 5G INTERNET

UNIT III NGN ARCHITECTURE AND MANAGEMENT
Evolution towards NGN-Technology requirements - NGN functional architecture- Transport stratum, service stratum - NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management - Service and control manage

UNIT IV COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS
UNIT V SECURITY AND SELF ORGANISING NETWORKS


COURSE OUTCOMES:

CO1: Understand the issues and challenges of wireless domain in future generation network design.
CO2: To be able to explore the LTE concepts and technologies.
CO3: Gain the knowledge in Architecture of NGN and its management activities.
CO4: Explore the Cooperation for Next Generation Wireless Networks.
CO5: Analyze the security risks in 5G networks.

TOTAL: 45 PERIODS

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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  9
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  9
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  9

UNIT IV  ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN  9

UNIT V  MICRO/NANO ROBOTICS SYSTEM  9
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
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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
Safety Specifications: Specifications, Verifying Invariants, Enumerative Search, Symbolic Search-
Liveness Requirements: Temporal Logic, Model Checking, Proving Liveness

UNIT III  CPS MODELS  9
Dynamical Systems: Continuous, Linear Systems-Time Models, Linear Systems, Designing
Controllers, Analysis Techniques- Timed Model: Processes, Protocols, Automata- Hybrid
Dynamical Models

UNIT IV  CPS FOUNDATIONS  9
Symbolic Synthesis for CPS- Security in CPS-Synchronization of CPS-Real-Time Scheduling for
CPS

UNIT V  APPLICATIONS AND PLATFORMS  9
Medical CPS- CPS Built on Wireless Sensor Networks- CyberSim User Interface- iClebo Kobuki -
iRobot Create- myRIO- Cybersim- Matlab toolboxes - Simulink.

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
1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley
   Professional, 2016
3. Lee, Edward Ashford, and Sanjit Arunkumar Seshia. Introduction to embedded systems: A
cyber physical systems approach. 2nd Edition, 2017
4. André Platzer, Logical Analysis of Hybrid Systems: Proving Theorems for Complex
5. Jean J. Labrosse, Embedded Systems Building Blocks: Complete and Ready-To-Use
6. Jensen, Jeff, Lee, Edward, A Seshia, Sanjit, An Introductory Lab in Embedded and Cyber-
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**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**

Microarray technology for genome expression study – image analysis for data extraction –

**TOTAL:45 PERIODS**

**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

**TOTAL:30 PERIODS**

**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 micro array technology for genomic expression study.

**TOTAL: 45+30=75 PERIODS**

**REFERENCES**

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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

UNIT II Neural Networks

UNIT III Convolutional Neural Network

UNIT IV Natural Language Processing Using RNN

UNIT V Deep Reinforcement & Unsupervised Learning

LIST OF EXPERIMENTS:
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 PERIODS:** 45+30=75 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

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**MP4292**

**MOBILE APPLICATION DEVELOPMENT**

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**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

UNIT II  INTRODUCTION TO ANDROID

UNIT III  ANDROID APPLICATION DESIGN ESSENTIALS

UNIT IV  ANDROID USER INTERFACE DESIGN & MULTIMEDIA
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
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.

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

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BC4291 ETHICAL HACKING

COURSE OBJECTIVES:
- To understand and analyze security threats & countermeasures related to ethical hacking.
- To learn the different levels of vulnerabilities at a system level.
- To gain knowledge on the different hacking methods for web services and session hijacking.
- To understand the hacking mechanisms on how a wireless network is hacked.

UNIT I ETHICAL HACKING OVERVIEW & VULNERABILITIES
Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking

UNIT II FOOTPRINTING & PORT SCANNING
Footprinting - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase, Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS &
Linux OS

UNIT III SYSTEM HACKING 9
Aspect of remote password guessing, Role of eavesdropping ,Various methods of password cracking, Keystroke Loggers, Understanding Sniffers ,Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.

UNIT IV HACKING WEB SERVICES & SESSION HIJACKING 9
Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers. Understanding Session Hijacking, Phases involved in Session Hijacking,Types of Session Hijacking, Session Hijacking Tools

UNIT V HACKING WIRELESS NETWORKS 9
Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLANScanners, WLANSniffers, Hacking Tools, Securing Wireless Network

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:
1: Study of Guessing username and passwords using Hydra
2: Experiment on Recovering password Hashes
3: Implementation to crack Linux passwords
4: Experiments on SQL injections
5: Analysis of WEP flaws
6: Experiments on Wireless DoS Attacks
7: Implementation of Buffer Overflow Prevention
8: Prevention against Cross Site Scripting Attacks
9: Experiments on Metasploit Framework
10: Implementation to identify web vulnerabilities
11. Wireshark: Experiment to monitor live network capturing packets and analyzing over the live network
12. LOIC: DoS attack using LOIC
13. FTK: Bit level forensic analysis of evidential image and reporting the same.
14. Darkcomet : Develop a malware using Remote Access Tool Darkcomet to take a remote access over network
15. HTTrack: Website mirroring using Httrack and hosting on a local network.
16. XSS: Inject a client side script to a web application
17. Emailtrackerpro: Email analysis involving header check, tracing the route. Also perform a check on a spam mail and non-spam mail

TOTAL:30 PERIODS

COURSE OUTCOMES:
CO1: Understand vulnerabilities, mechanisms to identify vulnerabilities/threats/attacks
CO2: Use tools to identify vulnerable entry points
CO3: Identify vulnerabilities using sniffers at different layers
CO4: Handle web application vulnerabilities
CO5: Identify attacks in wireless networks

TOTAL:45+30=75 PERIODS
REFERENCES
1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010
5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003

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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  6
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  6
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  6
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  L T P C
2 0 0 0

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  6
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
Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines,
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.

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

1. சங்க இலக்கியம்
   - சங்காத்மா தகவல், பாண்டி
   2. அகநொனூறு (82)
   - திவநல் இலக்கியத்தின் அருங்கள்
   3. குறிச்சிப் பொட்டியின் மலர்க்கொட்சி
   4. புறநொனூறு (95,195)
   - புறநொனூறு திவநல் கல்விப்பாடு

UNIT II

1. அறநநறி தமிழ்
   - அறநநறி வகுத்ததின் வரலாறு
   - அறநநறி வகுத்ததின் வரலாறு
   2. பிற அறநூல்கள் - திறந்த முக்கிய
   - திறந்த முக்கியம், திறந்த விளக்கங்கள் (காப்பியங்கள் மற்றும்)

UNIT III

1. இரட்டைக் காப்பியங்கள்
   - கணயகிரியின் புரட்சி
   - கணயகிரியின் புரட்சி
   2. மூக்கவிலக்கியம்
   - மூக்கவிலக்கியம் அறக்கொட்டம்

UNIT IV

1. அருள்நநறி தமிழ்
   - மலர்க்கொட்சி பொரிக் கல்விப்பாடு
   - மலர்க்கொட்சி பொரிக் கல்விப்பாடு
   2. திறக்கும்
   - அசைக்கொரியம் புரட்சியின் தொடர்
   3. சிறும்பதினர் (617, 618)
   - சிறும்பதினர் தொடர்
   4. தர்மக்கொள்ளும் தொடர் வல்லலொர்
   5. புறநொனூறு
   - புறநொனூறு திறக்கொரியம்
   6. அகநொனூறு (4) - என்று
   குறிச்சிக் (11) - நூல்
   குறிச்சிக் (11) - பாண்டி, புறா
UNIT V INTEGRATED WATER RESOURCES MANAGEMENT

1. OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.
UNIT II  WATER ECONOMICS

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III  LEGAL AND REGULATORY SETTINGS

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV  WATER AND HEALTH WITHIN THE IWRM CONTEXT

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V  AGRICULTURE IN THE CONCEPT OF IWRM

Water for food production: ‘blue’ versus ‘green’ water debate – Water footprint - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy— scope to relook pricing.

OUTCOMES

- On completion of the course, the student is expected to be able to

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO3 Apply law and governance in the context of IWRM.

CO4 Discuss the linkages between water-health; develop a HIA framework.

CO5 Analyse how the virtual water concept pave way to alternate policy options.

REFERENCES:


OBJECTIVES:
• Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT

UNIT IV GOVERNANCE
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)- Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:
CO1 Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2 Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
CO3 Critically analyse and articulate the underlying common challenges in water, sanitation and health.
CO4 Acquire knowledge on the attributes of governance and its say on water sanitation and health.
CO5 Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

REFERENCES


OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT LT PC 3 0 0 3

OBJECTIVES:
- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES

UNIT II PRINCIPLES AND FRAMEWORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS
Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity – Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable
Transportation — Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms

UNIT V ASSESSING PROGRESS AND WAY FORWARD


TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

  CO1 Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.

  CO2 Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals

  CO3 Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption

  CO4 Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.

  CO5 Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES:


OCE434 ENVIRONMENTAL IMPACT ASSESSMENT

OBJECTIVES:

- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.
UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. Factors and methodologies - individual and family level impacts. Communities in transition-rehabilitation.

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN

UNIT V CASE STUDIES
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to
  CO1 Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles
  CO2 Understand various impact identification methodologies, prediction techniques and model of impacts on various environments
  CO3 Understand relationship between social impacts and change in community due to development activities and rehabilitation methods
  CO4 Document the EIA findings and prepare environmental management and monitoring plan
  CO5 Identify, predict and assess impacts of similar projects based on case studies

REFERENCES:
1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional
Countries. Chichester: Willey

OME431 VIBRATION AND NOISE CONTROL STRATEGIES

OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT- I BASICS OF VIBRATION

UNIT- II BASICS OF NOISE
Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT- III INSTRUMENTATION FOR VIBRATION MEASUREMENT

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS
Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT- V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL
OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:
- To learn the present energy scenario and the need for energy conservation.
- To understand the different measures for energy conservation in utilities.
- Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
- To identify the energy demand and bridge the gap with suitable technology for sustainable habitat.
- To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement.

UNIT I     ENERGY SCENARIO

UNIT II     HEATING, VENTILLATION & AIR CONDITIONING
UNIT III LIGHTING, COMPUTER, TV

UNIT IV ENERGY EFFICIENT BUILDINGS

UNIT V ENERGY STORAGE TECHNOLOGIES
Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:
6. (Could be downloaded from www.energymanagertraining.com)
UNIT II  DESIGN FOR ADDITIVE MANUFACTURING  9

UNIT III  VAT POLYMERIZATION  9

UNIT IV  MATERIAL EXTRUSION AND SHEET LAMINATION  9

POWDER BASED PROCESS

UNIT V  CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES  9

TOTAL: 45 PERIODS

REFERENCES:
UNIT I  NEED FOR ELECTRIC VEHICLES
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II  ELECTRIC VEHICLE ARCHITECHTURE
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III  ENERGY STORAGE
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV  ELECTRIC DRIVES AND CONTROL
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor - drives and control, AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V  DESIGN OF ELECTRIC VEHICLES

TOTAL: 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

- Applying the principles of generic development process; and understanding the organization structure for new product design and development.
- Identifying opportunity and planning for new product design and development.
- Conducting customer need analysis; and setting product specification for new product design and development.
- Generating, selecting, and testing the concepts for new product design and development.
- Applying the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT

UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION & TESTING

UNIT V INDUSTRIAL DESIGN & PROTOTYPING

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

- Apply the principles of generic development process; and understand the organization structure for new product design and development.
- Identify opportunity and plan for new product design and development.
- Conduct customer need analysis; and set product specification for new product design and development.
- Generate, select, and test the concepts for new product design and development.
• Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

REFERENCES:

OBA431 SUSTAINABLE MANAGEMENT LT P C
3 0 0 3

COURSE OBJECTIVES:
• To provide students with fundamental knowledge of the notion of corporate sustainability.
• To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY 9
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION 9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.
UNIT V  SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.

CO2: An understanding of corporate sustainability and responsible Business Practices

CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.

CO4: Knowledge of innovative practices in sustainable business and community management

CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:

4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT

COURSE OBJECTIVES

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS


UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY

Management and Leadership – employee assessments – Tuckman's stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR
management in small and large firms - Importance of coaching and how to apply a coaching model.

Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS 9
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION 9
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.
UNIT II PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
- CO1: Understanding of intellectual property and appreciation of the need to protect it
- CO2: Awareness about the process of patenting
- CO3: Understanding of the statutes related to IPR
- CO4: Ability to apply strategies to protect intellectual property
- CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.

OBA434 ETHICAL MANAGEMENT
L T P C 3 0 0 3

COURSE OBJECTIVE
- To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.
UNIT III  STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV  INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V  PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

COURSE OBJECTIVES:
• To study about Internet of Things technologies and its role in real time applications.
• To introduce the infrastructure required for IoT
• To familiarize the accessories and communication techniques for IoT.
• To provide insight about the embedded processor and sensors required for IoT
• To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.
UNIT II   IOT ARCHITECTURE  9

UNIT III   PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT  9
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCle GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV   IOT PROCESSORS  9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT: Introduction to Python programming -Building IOT with RASPBERRY PI and Arduino.

UNIT V   CASE STUDIES  9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

TOTAL: 45 PERIODS

REFERENCES:

ET4072 MACHINE LEARNING AND DEEP LEARNING L T P C
3 0 0 3

COURSE OBJECTIVES:
The course is aimed at
- Understanding about the learning problem and algorithms
- Providing insight about neural networks
- Introducing the machine learning fundamentals and significance
- Enabling the students to acquire knowledge about pattern recognition.
- Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1-Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1: Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:

PX4012 RENEWABLE ENERGY TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:
To impart knowledge on
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION 9
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO₂ Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS 9

UNIT III PHOTOVOLTAIC SYSTEM DESIGN 9
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.
UNIT IV WIND ENERGY CONVERSION SYSTEMS

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz’s limit-
Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical
axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power
curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C
and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based
WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy
systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy,
Geothermal Energy Resources.

TOTAL : 45 PERIODS

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

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point
tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources

REFERENCES:
1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford UniversityPress,
2009.

PS4093 SMART GRID L T P C
3 0 0 3

COURSE OBJECTIVES
• To Study about Smart Grid technologies, different smart meters and advanced metering
infrastructure.
• To know about the function of smart grid.
• To familiarize the power quality management issues in Smart Grid.
• To familiarize the high performance computing for Smart Grid applications
• To get familiarized with the communication networks for Smart Grid applications
UNIT I   INTRODUCTION TO SMART GRID  9
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II   SMART GRID TECHNOLOGIES  9
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation , Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III   SMART METERS AND ADVANCED METERING INFRASTRUCTURE  9
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV   POWER QUALITY MANAGEMENT IN SMART GRID  9

Unit V   HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS  9
Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES
COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA

UNIT II SEARCH METHODS AND VISUALIZATION

UNIT III MINING DATA STREAMS

UNIT IV FRAMEWORKS
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V R LANGUAGE

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL: 45 PERIODS
**REFERENCE:**

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<th>NC4201</th>
<th>INTERNET OF THINGS AND CLOUD</th>
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**COURSE OBJECTIVES:**
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

**UNIT I  FUNDAMENTALS OF IoT**

**UNIT II PROTOCOLS FOR IoT**

**UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS**
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

**UNIT IV CLOUD COMPUTING INTRODUCTION**

**UNIT V IoT AND CLOUD**

**COURSE OUTCOMES:**
At the end of the course, the student will be able to:
- CO1: Understand the various concept of the IoT and their technologies..
- CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073  MEDICAL ROBOTICS  L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To explain the basic concepts of robots and types of robots
2. To discuss the designing procedure of manipulators, actuators and grippers
3. To impart knowledge on various types of sensors and power sources
4. To explore various applications of Robots in Medicine
5. To impart knowledge on wearable robots

UNIT I  INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II  MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III  SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV  REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based...
Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

VE4202 EMBEDDED AUTOMATION

COURSE OBJECTIVES:
• To learn about the process involved in the design and development of real-time embedded system
• To develop the embedded C programming skills on 8-bit microcontroller
• To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
• To learn about the tools, firmware related to microcontroller programming
• To build a home automation system
UNIT - I  INTRODUCTION TO EMBEDDED C PROGRAMMING
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II  AVR MICROCONTROLLER
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III  HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Converters - Interfacing Digital To Analog Converters - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV  VISION SYSTEM

UNIT – V  HOME AUTOMATION
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

REFERENCES:
UNIT I  INTRODUCTION  9
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II  CONCEPT OF SUSTAINABILITY  9
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III  SIGNIFICANCE OF BIODIVERSITY  9
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV  POLLUTION IMPACTS  9
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V  ENVIRONMENTAL ECONOMICS  9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES
composites and composite design requirements

UNIT IV TESTING
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

REFERENCES

NT4002 NANOCOMPOSITE MATERIALS

UNIT I BASICS OF NANOCOMPOSITES

UNIT II METAL BASED NANOCOMPOSITES
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY

TOTAL : 45 PERIODS

REFERENCES:
5. The search for novel, superhard materials- Stan Veprjek (Review Article) JVST A, 1999

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP L T P C 3 0 0 3

UNIT I IPR 9

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES 9

UNIT III BIOSAFETY 9

UNIT IV GENETICALLY MODIFIED ORGANISMS 9
Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations
and relevant International Agreements including Cartagena Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

TOTAL : 45 PERIODS

REFERENCES