Shirpur Education Society's

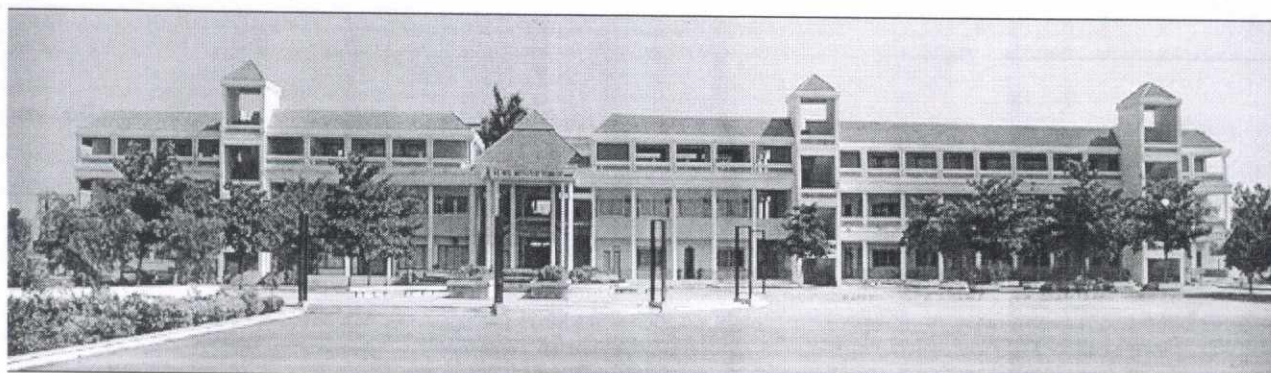# R. C. Patel Institute of Technology, Shirpur
### (An Autonomous Institute)

# Course Structure and Syllabus

## Final Year B. Tech
## Computer Science and Engineering (Data Science)

With effect from Year 2025-26



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

## Final Year B. Tech Computer Science and Engineering (Data Science) Semester-VII (w.e.f. 2025-26)

| Sr | Course Category | Course Code | Course Title | Teaching Scheme | | | Continuous Assessment (CA) | | | | ESE | Total | | Credit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | TA | Term Test 1 (TT1) | Term Test 2 (TT2) | Average of (TT1 & TT2) | | [A+B+C] | | | |
| | | | | | | | [A] | | | [B] | [C] | | | | |
| 1 | PC | 22PCCS7010T | Language Models | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | 4 |
| | PC | 22PCCS7010L | Language Models Laboratory | | | 2 | 25 | | | | | 25 | | 1 | |
| 2 | PC | 22PCCS7020T | Information Security | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | 4 |
| | PC | 22PCCS7020L | Information Security Laboratory | | | 2 | 25 | | | | 25 | 50 | | 1 | |
| 3 | PC | 22PCCS7030L | Applied Data Science Laboratory | 1 | | 2 | 50 | | | | | 50 | | 2 | 2 |
| 4@ | PE | 22PECS7041T | Parallel Computing | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | 4 |
| | | 22PECS7041L | Parallel Computing Laboratory | | | 2 | 25 | | | | | 25 | | 1 | |
| | | 22PECS7042T | Geo-Spatial Data Science | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22PECS7042L | Geo-Spatial Data Science Laboratory | | | 2 | 25 | | | | | 25 | | 1 | |
| | | 22PECS7043T | Advanced Internet of Things | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22PECS7043L | Advanced Internet of Things Laboratory | | | 2 | 25 | | | | | 25 | | 1 | |
| | | 22PECS7044T | Adversarial Machine Learning | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22PECS7044L | Adversarial Machine Learning Laboratory | | | 2 | 25 | | | | | 25 | | 1 | |
| 5# | OE | 22OECS7051T | Product Life Cycle Management | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | 3 |
| | | 22OECS7052T | Management Information System | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7053T | Operations Research | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7054T | Cyber Security and Laws | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7055T | Personal Finance Management | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7056T | Energy Audit and Management | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7057T | Disaster Management and Mitigation Measures | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7058T | Science of Well-being | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS7059T | Research Methodology | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| | | 22OECS70510T | Public Systems and Policies | 3 | | | 25 | 10 | 10 | 10 | 65 | 100 | | 3 | |
| 6 | PJ | 22PJCS7060L | Project Stage-II | | | 8 | 25 | | | | 25 | 50 | | 4 | 4 |
| 7 | HM | 22HMCS7070L | Employability Skill Development Program-III | | | 2 | 25 | | | | 25 | 50 | | 1 | 1 |
| | | | Total | 13 | | 18 | 275 | | | 40 | 335 | 650 | | | 22 |

@Any 1 Professional Elective Course
#Any 1 Open Elective Course

Prepared by:
Dr. P. S. Sanjekar

Checked by:
Prof. S. P. Salunkhe

Prof. Dr. U. M. Patil
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

| Program: Computer Science & Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Language Models (22PCCS7010T) | | |
| Language Models Laboratory (22PCCS7010L) | | |

**Prerequisite:** Machine Learning-I, Machine Learning-II, Foundations of Data Analysis, Statistics for Data Science, Natural Language Text Processing

**Course Objective(s):** To introduce the fundamentals of neural language models, pre-training, fine-tuning, and evaluation techniques. The course aims to provide hands-on experience in developing and deploying large language models (LLMs) while addressing ethical concerns and safety measures.

## Course Outcomes:
On completion of the course, the learner will be able to:

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Understand the architecture and working principles of modern language models such as Transformers, BERT, and GPT. | L2 | Understand |
| CO2 | Apply pre-training and fine-tuning techniques to optimize language models for real-world applications. | L3 | Apply |
| CO3 | Analyze various evaluation metrics to assess the performance and reliability of language models. | L4 | Analyze |
| CO4 | Develop applications using large language models for tasks such as text generation, question answering, and multimodal AI. | L6 | Design |

# Language Models (22PCCS7010T)
## Course Contents

## Unit-I                                                                    06 Hrs.

**Natural Language Generation:**

Limitations of RNNs & LSTMs in Language Modeling, Encoder-Decoder Models, Attention Mechanism: Motivation & Evolution, Seq2Seq with Attention.

**Transformers:**

Self-Attention Mechanism: Query-Key-Value Representation ,Scaled Dot-Product Attention , Multi-Head Attention, Positional Encoding, Transformer-based Encoder-Decoder Architectures..

## Unit-II                                                                   08 Hrs.

**Large Language Models Architectures:**

**Encoder Models:** BERT architecture and working, BERT variants: RoBERTa, ALBERT, Distil-BERT, Applications: Text Classification, Named Entity Recognition (NER).

**Decoder Models (Autoregressive LLMs):** GPT Family (GPT-3, GPT-4, GPT-4 Turbo).

**Open-source model:** LLaMA.

## Unit-III                                                                  08 Hrs.

**Pre-training & Fine-tuning of LLMs:**

**Pre-training Strategies:** Self-Supervised Learning in LLMs, Next Token Prediction (Auto-regressive) vs.Masked Language Models (Auto-encoding), Pre-training Methods: Causal LM, Prefix LM, Sequence-to-Sequence Pre-training.

**Fine-tuning Techniques:** Supervised Fine-tuning & Transfer Learning, Parameter-efficient Fine-tuning (LoRA, Adapter Layers), gradient accumulation, fine-tuning. gradient check pointing, quantization, Few-shot, Zero-shot, and Multi-Task Learning

**Prompt Engineering & Adaptation:** Instruction Tuning, Chain-of-Thought (CoT) Prompting ,Self-consistency & ReAct (Reasoning + Acting) ,Prompt-aware Training Methods.

## Unit-IV                                                                   05 Hrs.

**Evaluation Metrics:**

Traditional Evaluation Metrics BLEU, ROUGE, METEOR, BERTScore, GLUE, SQuAD, MMLU (Massive Multitask Language Understanding), LLM-Specific Evaluation Methods, Embedding-based Metrics, GPT-Score, AI Arena, HELM(Holistic Evaluation of Language Models), TruthfulQA for Factual Accuracy.

## Unit-V                                                                        05 Hrs.

**Real-World Applications & Future Trends:**

Question Answering Systems:IR-based vs. Knowledge-based QA, Retrieval-Augmented Generation (RAG) using Langchain, LLMs for Legal & Medical NLP.

**AI Agents & Autonomous LLMs:** OpenAI's AutoGPT, BabyAGI, Agentic Workflows & Planning LLMs

## Unit-VI                                                                        08 Hrs.

**Reinforcement Learning with Human Feedback (RLHF) & Safety:**

**RLHF Process in Modern LLMs:** Reward Modelling for LLM Alignment, Reinforcement Learning Techniques: Proximal Policy Optimization (PPO), Comparative Ranking & Preference Learning, Group Relative Policy Optimization (GRPO).

**RLAF:** Reinforcement Learning through Agent Feedback (RLAF), How RLAF works, Difference between RLAF and RLHF.

**LLM Alignment & Bias Mitigation:**

Ethical Risks: Bias, Misinformation, Hallucinations, Adversarial Attacks on LLMs, Safety in Large Models: Constitutional AI, Red-teaming.

# Language Models Laboratory (22PCCS7010L)
## List of Laboratory Experiments

**Suggested Experiments (Any 08):**

1. Implementing Sequence-to-Sequence (Seq2Seq) Models for performing language translation.

2. Implementing Transformer Models for Natural language Processing Tasks.

3. Fine-Tuning BERT for performing Natural language Processing Tasks.

4. Implement LoRA and Adapter Layers for Fine-Tuning Pre-trained language Models.

5. Implement techniques to elicit desired behaviours from LLMs using prompts.

6. Implementing and Comparing Evaluation Metrics for LLMs.

7. Developing Question Answering System using Information Extraction.

8. Developing Retrieval-Augmented Generation (RAG) Systems using Langchain.

9. Using GRPO to Train a Model for Reasoning.

10. Building Autonomous AI Agents with LLMs.

11. Efficient Inference and Deployment of Large Language Models.

12. Mini Project

## Text Books:

1. Jurafsky and Martin, "Speech and Language Processing", $3^{rd}$ Edition, Prentice Hall, 2020.

2. Uday Kamath, "Deep Learning for NLP and Speech Recognition", $1^{st}$ Edition, 2019.

## Reference Books:

1. Jelinek, F., "Statistical Methods for Speech Recognition", The MIT Press, 2022.

2. Yuli Vasiliev "Natural Language Processing with Python and spaCy - A Practical Introduction", No Starch Press, 2022.

3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems", $1^{st}$ Edition, O'Reilly, 2020.

## Web Links:

1. NPTEL link: Introduction to Large Language Models (LLMs) - - Announcements

2. NPTEL Course: https://csc.iitm.ac.in/ñitcshk/llm-coursc.html

3. NPTEL Course: https://onlinecourses.swayam2.ac.in/imb24_mg116/preview

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Information Security (22PCCS7020T) | | |
| Information Security Laboratory (22PCCS7020L) | | |

**Prerequisite:** Computer Communication and Networks.

## Course Objective(s):

1. Gain a comprehensive understanding of cyber threats, defence strategies, cryptographic principles, and modern security practices to safeguard digital assets.

2. Learn symmetric and asymmetric cryptography, key management, hashing techniques, and authentication protocols to ensure data confidentiality, integrity, and authentication.

3. Examine various network attacks, security mechanisms like firewalls, IDS, IPS, and encryption protocols to design and implement robust network defence strategies.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Analyse different types of cyber threats, cryptographic techniques, and their role in securing data and communication systems. | L4 | Analyze |
| CO2 | Apply cryptographic algorithms like AES, RSA, and Diffie-Hellman for secure key management and data encryption. | L4 | Analyze |
| CO3 | Evaluate the effectiveness of authentication methods, including Kerberos, biometrics, and digital certificates, in ensuring system integrity. | L3 | Evaluate |
| CO4 | Develop and Implement security solutions using firewalls, IDS, IPSec, and SSL protocols to mitigate network-based cyber threats. | L4 | Analyze |

# Information Security (22PCCS7020T)
# Course Contents

## Unit-I                                                        04 Hrs.

### Introduction:

Cyber Attacks, Defense, Strategies and Techniques, Guiding Principles of Modern Security Practices. OSI security model.

## Unit-II                                                       06 Hrs.

### Number Theory:

Modulo Arithmetic, Euclid's Algorithm, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Cipher Properties, Substitution Ciphers – Mono-alphabetic Ciphers, Polyalphabetic Ciphers, Transposition Ciphers.

## Unit-III                                                      08 Hrs.

### Symmetric Cryptography:

Block Cipher, Fiestel Structure, Block Cipher Modes of Operation, S-DES, Double DES, Triple DES, AES Algorithm.

## Unit-IV                                                       07 Hrs.

### Asymmetric Cryptography:

Private Key and Public Key Cryptography, The RSA algorithm, Key Management, Diffie-Hellman Key Exchange, Key Exchange Algorithm.

## Unit-V                                                        07 Hrs.

### Integrity and Authentication:

Hashing: Properties of cryptographic hash, message digest, MD-5, SHA-1. Public Key Infrastructure (PKI), One way and mutual authentication, Needham- Schroeder Protocol, Authentication methods, Kerberos Authentication Protocol, Biometrics, Digital Certificates: X.509.

## Unit-VI                                                       07 Hrs.

### Network Security:

Network attacks, DoS and DDoS attack, Sniffing, Session hijacking, Spoofing, Phishing, Cross-site Scripting (XSS), IPSec Protocol, SSL Handshake Protocol, Firewalls, IDS Prevention and Detection.

# Information Security Laboratory (22PCCS7020L)

## List of Laboratory Experiments

**Suggested Experiments: (Any 08)**

1. Implement Playfair Cipher with key entered by user.

2. Implement polyalphabetic Cipher.

3. Implement Simple and Advanced Columner Transposition technique.

4. Implement Simplified DES.

5. Implement Simple RSA Algorithm with small numbers..

6. Implement Diffie-Hellman Key Exchange.

7. Implement DoS and DDoS attack using Hping.

8. Implement phishing attack using HTTrack Website Cloning.

9. Implement static code analysis using Flawfinder Python Distribution.

10. Implement packet sniffing using Wireshark and TCP Dump.

11. Implement cross site request forgery in a controlled virtual environment using DVWA Web Server.

12. Implement firewalls using IP tables.

13. Implement Network Intrusion Detection System (NIDS).

14. Implement Host based Intrusion Detection System (HIDS).

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

**Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.**

## Text Books:

1. William Stallings, "Cryptography and Network Security Principles and Practices", 8th Edition, Pearson/PHI, 2023.

2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security of 3rd Edition, McGraw Hill, 2017.
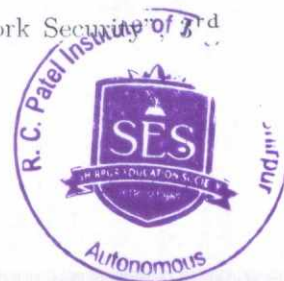
## Reference Books:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in Computing – Prentice Hall of India, 5th Edition, 2015.

2. Atul Kahate, Cryptography and Network Security, McGraw Hill, 3rd Edition, 2013.

3. Bernard Menezes, Network Security and Cryptography, Cengage Learning, 2nd Edition, 2011.

4. Wade Trappe, Lawrence C. Washington, Introduction to Cryptography with Coding Theory, Pearson, 2nd Edition, 2006.

5. W. Mao, Modern Cryptography – Theory and Practice, Pearson Education, 1st Edition, 2003.

## Web Links:

1. Damn Vulnerable Web Application (DVWA): http://dvwa.co.uk

2. Open Web Application Security Project: https://owasp.org

3. Web penetration testing: https://pentesterlab.com

4. Penetration Testing: https://kali.org

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Applied Data Science Laboratory (22PCCS7030L) | | |

**Prerequisite:** Machine Learning, Data Engineering.

**Course Objective(s):** To bridge the gaps between industry and academia. Give the exposure of production system and applied data science.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Relate to production systems available in the industry. | L2 | Understand |
| CO2 | Debug various problems occurred in a data science production system. | L3 | Apply |

# Applied Data Science Laboratory (22PCCS7030L) Course Contents

## Unit-I                                                                04 Hrs.
**Converting Business problem into Data Science Problem:**

- Bridging the Qualitative-to-Quantitative Gap in Data Science

- Right Data Available with the Right Level of Granularity

- Repeatability and Reproducibility: Consistency in Labelled Data for Accurate AI Systems

## Unit-II                                                               06 Hrs.
**Agile Methodology:**

- Work Breakdown structure for Agile Models

- Scrum/XP modelling of Data Science Projects

- Agile Tools for Project Management

## Unit-III                                                              04 Hrs.
**Data Preparation Best Practice:**

- Gathering suitable data for Data Science problem

- Determine all Key Performance Indicators (KPIs)

- Business stakeholders POC Dashboard

## Unit-IV                                                               06 Hrs.
**Data Modelling:**

- Selection of appropriate tool

- Data Modelling with Incremental Data

- Robust model design.

- Data Modelling with different data formats

## Unit-V                                                                06 Hrs.
**Model Building Best Practice:**

- One hot encoding

- Selecting right metrics to evaluate the model

- SHAP and LIME for interpretability of model.

## Unit-VI    04 Hrs.
### Model Compression:

- Quantization

- Pruning

- Knowledge Distillation

## Unit-VII    02 Hrs.
### Modelling and Optimization Trade-off:

- Need of Optimization

- Different methods of Optimization

- Development

- Rest APIs

## Unit-VIII    02 Hrs.
### Data Science Project Architecture:

- Functions of MLOps/DevOps

- Difference between MLOps and DevOps

- Collaboration, Scalability and Reusability

## Unit-IX    04 Hrs.
### Project Deployment:

- Flask

- Docker

- Kubernetes

## Unit-X    02 Hrs.
### A/B Testing:

- Formulate Hypothesis

- Create Test Group

- Compare Results

## Text Books:

1. Probyto Data Science and Consulting Pvt. Ltd, Data Science for Business Professionals, bpb publications, 2020.

2. Emmanuel Ameisen, Building Machine Learning Powered Applications, O'Reilly, 2020.

## Reference Books:

1. Valliappa Lakshmanan, Sara Robinson and Michael Munn, Machine Learning Design Patterns, O'Reilly, 2021.

2. Emily Robinson and Jacqueline Nolis, Build a career in Data Science, Manning, 2020.

3. Andriy Burkov, Machine Learning Engineering, True Positive Inc, 2020.

## Web References:

1. Coursera course: IBM Data Science Professional Certificate — Coursera

2. https://www.coursera.org/specializations/data-science-python?msockid=0a3d4df1db7a6b8909345878dac86aa5

3. https://onlinecourses.nptel.ac.in/noc21_cs23/preview

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Parallel Computing (22PECS7041T) | | |
| Parallel Computing Laboratory (22PECS7041L) | | |

**Prerequisite:** System Fundamentals

**Course Objective(s):** To familiarize students with the fundamental concepts, techniques and tools of parallel computing.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Understand different structures of Parallel Computers. | L2 | Understand |
| CO2 | Apply parallel algorithms in problem solving. | L3 | Apply |
| CO3 | Evaluate the performance of parallel computing models and algorithms. | L5 | Evaluate |

# Parallel Computing (22PECS7041T)
## Course Contents

## Unit-I                                                                08 Hrs.

### Introduction:

Introduction to Parallel computing, Abstract model of serial & parallel computation, pipelining, data parallelism, control parallelism, scalability, topologies in processor organization, parallel computing design consideration, parallel algorithms & parallel architectures, speedup and efficiency, supercomputers.

## Unit-II                                                               06 Hrs.

### System Architecture:

Shared memory multiprocessors (UMA-Uniform memory Access), Distributed memory multiprocessors (NUMA- Non-Uniform memory Access), SIMD, Systolic processor, Cluster computing, Grid computing, Multicore Systems.

## Unit-III                                                              06 Hrs.

### Parallel Algorithms:

Introduction to parallel algorithms, parallel algorithm models, Decomposition Techniques, characteristics of tasks & interactions, mapping techniques for load balancing, methods for containing interaction overheads.

## Unit-IV                                                               08 Hrs.

### Parallel Algorithm Applications:

Matrix multiplication, parallel reduction, parallel sorting (Bubble sort, Quick sort), Graph algorithm (Minimum Spanning Tree - Prim's Algorithm), Fast Fourier Transform (serial and transpose algorithm).

## Unit-V                                                                08 Hrs.

### Parallel Programming:

Parallel programming models, point to point communication, synchronous and asynchronous communication, shared memory programming, message passing programming, MPI, PVM, Threads.

## Unit-VI                                                               05 Hrs.

### Applications of Parallel Programming:

Issues and challenges, scope of parallel computing, applications in data mining, computer and cryptography, medicine and human organ modelling.

# Parallel Computing Laboratory (22PECS7041L)
## List of Laboratory Experiments

**Suggested Experiments: (Any 08)**

1. To implement the parallel construct in OpenMP that creates a parallel region in a C++ code.

2. To write an OpenMP program for illustrating the Fork Join model.

3. To implement SIMD (Single Instruction Multiple Data) parallel program in OpenMP.

4. To write a simple OpenMP program to demonstrate the sharing of loop iteration by a number of threads. (Take chunk size of 10).

5. To write an OpenMP program for finding prime numbers.

6. To write an OpenMP program to demonstrate sharing of section work by performing arithmetic operations on a one-dimensional array.

7. To write an OpenMP program to perform dot product of two one-dimensional arrays.

8. To implement the program for Matrix addition and Matrix multiplication using OpenMP.

9. To implement the program for sorting algorithms (Bubble sort, Quick sort) in OpenMP.

10. To implement the program to create a Minimum Spanning Tree using Prim's algorithm.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

## Text Books:

1. Thomas Rouber, Gudula Rünger, "Parallel Programming for Multicore and Cluster Systems", 2$^{nd}$ Edition, Springer, 2020.

2. Steven Brawer, "Introduction to Parallel Programming", 1$^{st}$ Edition, Academic Press Inc, 2000.

3. M.Sasikumar, Dinesh Shikhare, P. Ravi Prakash, "Introduction to Parallel Processing", 2$^{nd}$ Edition, Prentice Hall, 2014.

## Reference Books:

1. David Bader, " Handbook of Parallel Computing: Models, Algorithms and Applications", 1$^{st}$ Edition, CRC Press, 2023.

2. Fayez Gebali , "Algorithms and Parallel Computing", 1$^{st}$ Edition, Wiley Series, 2011.

3. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "An Introduction to Parallel Computing: Design and Analysis of Algorithms", $2^{nd}$ Edition, Pearson Publication, 2004.

## Web Links:

1. NPTEL course: https://archive.nptel.ac.in/courses/106/102/106102163/

2. Parallel Programming:Introduction to Parallel Computing Tutorial — HPC @ LLNL

| Program: Computer Science & Engineering (Data Science) | T. Y. B.Tech. | Semester: V |
|---|---|---|
| Geo-Spatial Data Science (22PECS7042T) | | |
| Geo-Spatial Data Science Laboratory (22PECS7042L) | | |

**Prerequisite:** Data Visualization, Machine Learning and Artificial Intelligence.

## Course Objective(s):

1. To understand geospatial data sources, students will explore satellite imagery, GPS, and open datasets.

2. To effectively work with spatial data, they will learn pre-processing, cleaning, and geocoding techniques for seamless integration.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Apply tools and techniques used to analyze and visualize geospatial data. | L3 | Apply |
| CO2 | Applying data science methods to solve real-world problems with geospatial data. | L3 | Apply |
| CO3 | Analyze geospatial large data models and ethical issues. | L4 | Analyze |

# Geo-Spatial Data Science (22PECS7042T)
## Course Contents

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## Unit-I                                                                06 Hrs.
### Introduction to Geospatial Data:

Introduction to Geographic Information Systems (GIS), Data Collection and Sources, Remote sensing and satellite imagery, GPS data and tracking, Coordinate systems and projections, Overview of geospatial data: Coordinates, attributes, temporal information; static and dynamic data, Spatial Data Types: vector and raster data, network data and Spatial Data Formats: shape files, geodatabases. Spatial data structures: Geometric objects (Points, lines and polygon), qualitative binary relation between geometrics and GSD applications.

## Unit-II                                                               08 Hrs.
### Geospatial Data Modeling:

Feature based approach: point, curve, surface, geometry collection; Algebra and calculi of qualitative spatial relations, topological relations, RCC-8, cardinal directions, Field based approach. Spatial regression, clustering, and optimization, Geo statistics and spatial modeling, Predictive modeling with geospatial data, Case study: Predicting property values, Spatial Analysis, Buffer analysis, spatial joins, spatial econometrics and geographically weighted regression (GWR).

## Unit-III                                                              09 Hrs.
### Linked Geospatial Data:

Visualizing Linked Geospatial Data, Querying Geospatial Data Expressed in RDF, Transforming Geospatial Data into RDF, SPARQL, Interlinking Geospatial Data Sources, Incomplete Geospatial Information, Geospatial RDF stores, Geospatial Knowledge Graphs, Question Answering Engines for Geospatial Knowledge Graphs, choropleth mapping.

## Unit-IV                                                               06 Hrs.
### Geospatial Visualization:

Introduction to data visualization libraries (e.g., Matplotlib, Folium, Plotly), Creating basic maps and charts, customizing geospatial visualizations, creating maps and charts, Customizing geospatial visualizations Python toolkits Geospatial Visualization. Spatial Data, GIS, Geospatial Data, Geospatial Analysis, Data Visualization

## Unit-V                                                                05 Hrs.
### Data Ingestion & Big Data:

web scraping and APIs, distributed computing frameworks (e.g., Google Earth Engine, Hadoop,

GeoSpark, and Dask for geospatial data), and Google BigQuery GIS for scalable processing; Streaming Geospatial Data: IoT devices, GPS tracking, weather stations, and OpenStreetMap live updates.

**Spatial Analysis:**

Spatial queries and operations; Spatial Data Indexing: Quadtrees, R-trees, and Hilbert Curves to optimize geospatial queries. Spatial Relationships & Topology: topological consistency (e.g., via OGC Simple Features Specification). Spatial Statistics: spatial autocorrelation (Moran's I, Geary's C), and spatial interpolation techniques (Kriging, IDW).

# Unit-VI                                                    05 Hrs.

### GIS Softwares

Introduction to web mapping tools (e.g., Leaflet), Exploring GIS software (e.g., QGIS, ArcGIS), Introduction to geospatial libraries (e.g., Geopandas, Fiona, Shapely), Building interactive web maps, Geospatial big data and distributed computing, Machine learning for geospatial data, Geo Spatial Data Ethics, Ethical considerations in geospatial data analysis.

## Geo-Spatial Data Science Laboratory (22PECS7042L)
### List of Laboratory Experiments

**Suggested Experiments:(Any 08)**

1. Apply cyberGIS techniques to analyze and visualize big geospatial data in Python using advanced cyberinfrastructure and high-performance computing.

2. Apply Python tools for developing high-performance geospatial computing. solutions. Optimize and speed up geospatial computation using Python libraries like Numba, Cython and Dask, Ray, or PySpark for large-scale geospatial processing.

3. Implement open source mapping and large-scale geospatial visualization libraries such as Leaflet, D3,Plotly Kepler.gl, Deck.gl and Cesium.js for 3D geospatial applications and mash up these libraries to create interactive and dynamic visualization tools and GIS applications.

4. Apply tools to investigate and identify patterns, clusters, classes, and anomalies based on various types of geospatial data and apply these techniques to a variety of geospatial applications.

5. Apply advanced techniques of spatial analysis, including spatial autocorrelation, trend surface analysis, grouping and regionalization procedures, and point pattern analysis to solve geospatial problems. spatial clustering methods (e.g., DBSCAN, K- Means with spatial constraints, HDBSCAN) and spatial econometrics modeling(spatial lag and spatial error models)

6. Solve given geospatial problem using ESRI ArcGIS solutions stack.

7. Identify right tool to interlink dataset to transform unlinked geospatial data into link using geospatial semantic technologies (geospatial ontologies, stRDF, stSPARQL, GeoSPARQL,

OBDA mappings techniques. thing (e.g., a dataset containing information about roads in Crete can be interlinked with a dataset containing land cover information about Crete).

8. Analyze and visualize the data with the help of appropriate linked data tools using a sequence of GeoSPARQL queries.

9. Geospatial science in forestry and watershed management
Geospatial science in urban planning and resource management

10. Use geospatial libraries for Geospatial Data Analysis with Python (e.g., Geopandas, Fiona, Shapely for Analyzing and visualizing geospatial data in Python.

11. Demonstrate the use of Apache, Jena and Stardog for managing large-scale geospatial knowledge graphs.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

## Text Books:

1. "Geospatial Data Science: A Hands-on Approach for Building Geospatial Applications Using Linked Data Technologies", June 2023.

2. David S. Jordan, "Applied Geospatial Data Science with Python", Feb 2023.

3. Janahan Gnanachandran, "Geospatial data analysis on AWS", ACM Publisher, 2023.

4. Paul A. Zandbergen, "Geospatial Data Science Techniques and Applications", 2020.

5. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw-Hill Education, 2019.

## Reference Books:

1. Chris Garrard, "Geoprocessing with Python", Manning Publisher, 2016.

2. Michael J. de Smith, Michael F. Goodchild, and Paul A. Longley, "Geospatial Analysis: A Comprehensive Guide", Winchelsea Press, 2018.

3. "The Ultimate Guide to Geospatial Data Science, Geospatial Data Science Explained: A Full Guide", Aya Data

## Web Links:

1. The Ultimate Guide to Geospatial Data Science, Geospatial Data Science Explained: A Full Guide - Aya Data
https://www.ayadata.ai/the-ultimate-guide-to-geospatial-data-science/

2. https://www.safegraph.com/guides/geospatial-data

| Program: Computer Science & Engineering (Data Science) | B.Tech. | Semester: V |
|---|---|---|
| Advanced Internet of Things (22PECS7043T) | | |
| Advanced Internet of Things Laboratory (22PECS7043L) | | |

**Prerequisite:** Basic Programming Knowledge, Networking Fundamentals, Microcontrollers & Embedded Systems Basics.

## Course Objective(s):

1. To Introduce Advanced IoT Concepts and Architectures.

2. To Provide In-Depth Knowledge of IoT Communication Protocols.

3. To Develop Skills in IoT Hardware and Software Integration.

4. To Address IoT Security, Privacy, and Ethical Issues.

5. To Design and Develop Industrial IoT (IIoT) and Smart Applications.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Understand Advanced IoT Architectures & Communication Protocols. | L2 | Understand |
| CO2 | Design and Develop IoT Systems and apply. | L3 | Apply |
| CO3 | Integrate Cloud, Edge, and Fog Computing in IoT Solutions. | L3 | Apply |
| CO4 | Apply Big Data Analytics and AI/ML Techniques in IoT. | L3 | Apply |

# Advanced Internet of Things (22PECS7043T)
## Course Contents

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### Unit-I                                                                 09 Hrs.

**Introduction to Advanced IoT**Evolution from traditional IoT to Advanced IoT, IoT ecosystem overview

**IoT Architecture and Design** Drivers behind new network architecture , comparing IoT architectures: The oneM2M IoT Standardized Architecture. The core IOT functional stack

**IoT Data Management and Compute Stack:**Fog and Edge Computing in IoT.

**Smart objects:** The Things in IoT Sensors, Actuators, Microelectro Mechanical system

**Connecting Smart Objects:** Communication criteria, IoT access

technologies: IEEE 802.15.4, physical Layer ,MAC Layer, Topolgy, Security

### Unit-II                                                                05 Hrs.

**Sensors, Endpoints and Power system**

Sensors, Actuators, PIR sensors and Smart Objects, Thermocouples and temperature sensing, LiDAR an active sensing system, MEMS sensors, Smart IoT endpoints, Sensor fusion, functional examples, Energy sources and power management

**Communication and Information Theory:** Communication theory, Information Theory, radio structure

### Unit-III                                                               05 Hrs.

**Cloud and Fog Topologies:**

Cloud service Model ,Public ,private and hybrid cloud Openstack cloud architecture constraints of cloud architecture for IoT Fog computing.

**IoT edge to cloud protocols:** MQTT,MQTT-SN, Constrained Application protocol, other protocols.

### Unit-IV                                                                09 Hrs.

**Power Line communication Technology:**

Overview of PLC technologies ans standards, Architecture for home network technologies, IoT using PLC Technology.

**IoT Security:** Common challenges in OT Security,Cyber security vernacular, Anatomy of IoT cyber atttacks, Physical and hardware security, blockchains and cryptocurrencies in IoT.

**IP as IoT Network Layer:** The Business case for IP.The need for optimization. optimizing IP for IOT,Formal risk analysis structures: OCTAVE and FAIR.The phased application of security in an operational environment.

**Public safety:** Overview, An IoT Blueprint for Public Safety,IoT Public safety Information Processing.

# Unit-V                                                                     06 Hrs.

**Data Analytics for IoT :** Visualizing the power of Data from IoT:Data analysis, Machine Learning, Model building process,Modeling algorithms, Model Performance, Big data platform, Big data Pipeline.

**IoT System Management with NETCONF-YANG:** Need for IoT system Management, SNMP, Network operator requirements, NETCONF,YANG

**Artificial Intelligence of Things (AIoT):** Combining AI with IoT for smarter applications.

# Unit-VI                                                                    05 Hrs.

**Mining:** Mining today and its challenges, Challenges for IoT in modern mining, An IoT strategy for mining ,An architecture for IoT in Mining.

**Advanced Applications of IoT:**

Home automation, Smart Cities, Healthcare, Practical Applications of Edge/Fog Computing, Agriculture, Logistics,Retail,Smart Medication Management System, Smart Factory System.

# Advanced Internet of Things Laboratory (22PECS7043L)
## List of Laboratory Experiments

**Suggested Experiments:(Any 08)**

1. Creating first Raspberry Pi project.

2. Publishing Information Using MQTT.

3. Creating HTTP Server.

4. Creating XMPP sensor server.

5. Configuring the IOT Gateway.

6. Adding CoAP to our devices.

7. Running the IoT Gateway project.

8. Set up an IoT device (e.g., ESP8266/ESP32) to publish and subscribe to MQTT messages.

9. Send IoT sensor data to AWS IoT Core and visualize it.

10. Perform real-time processing of sensor data on an edge device.

11. Implement SSL/TLS encryption in an MQTT-based IoT setup.

12. Control access to IoT devices using authentication mechanisms.

13. Process real-time traffic data at the fog layer instead of the cloud.

14. Collect and analyse heart rate data from a wearable IoT device.

15. Demonstrate the vulnerability of insecure OT protocols.

16. Store IoT data on a blockchain to ensure immutability.

17. Detect unusual patterns in IoT sensor data using AI.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

## Text Books:

1. David Hanes,Gonzalo Salgueiro,Patrick Grossetete,,Rob Barton,Jerome Henry, "IoT Fundamentals", Cisco Press ,June 2017.

2. Shriram Vasudevan, Abhishek Nagarajan, "Internet of Things", $2^{nd}$ Edition, Wiley.

3. Arshdeep Bagha, Vijay Madisetti, "Internet of Things", Universities Press.

4. Peter Waher, "Mastering Internet of Things",Published by Packt.

5. "Advanced IoT Technologies and Applications in the Industry 4.0 Digital Economy", CRC Press ,2024.

6. "Internet of Things: Technological Advances and New Applications", Apple Academic Press,2024.

## Reference Books:

1. "Smart Home and Industrial IoT Devices: Critical Perspectives on Cyber Threats, Frameworks, and Protocols", Bentham Science Publishers,2024.

2. "IoT Security: Advances in Authentication", Springer,2023.

## Web Links:

1. Introduction to internet of things By Prof. Sudip Misra , IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc21_cs17/preview

2. Introduction To Industry 4.0 And Industrial Internet Of Things By Prof. Sudip Misra , IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc25_cs43/preview

3. https://thingspeak.mathworks.com/

4. https://app.arduino.cc/iot/

| Program: Computer Science & Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Adversarial Machine Learning (22PECS7044T) | | |
| Adversarial Machine Learning Laboratory (22PECS7044L) | | |

**Prerequisite:** Mathematics for Intelligent System, Machine Learning – I, Information Security.

## Course Objective(s):

The Course provide an in-depth understanding of adversarial machine learning (AML), focusing on the security vulnerabilities of machine learning models and defenses against adversarial attacks. Students will explore foundational concepts in supervised, unsupervised, and reinforcement learning, along with adversarial settings in each. The course will cover various categories of attacks, including causative and evasion attacks, and introduce frameworks for secure learning. Through case studies and hands-on implementations, students will analyze real-world AML applications in cybersecurity, computer vision, and NLP. The course will also explore open challenges, defensive strategies, and applications beyond security, such as model programming and data augmentation.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Analyze and apply fundamental machine learning and deep learning techniques to adversarial settings, understanding their vulnerabilities and potential threats. | L4 | Analyse |
| CO2 | Identify and categorize different adversarial attacks on machine learning models, evaluating their impact on security-critical applications. | L4 | Analyze |
| CO3 | Assess and compare various defense strategies against adversarial attacks, demonstrating an understanding of security frameworks for robust learning models. | L5 | Evaluate |
| CO4 | Investigate real-world applications of adversarial machine learning in cybersecurity, autonomous systems, and NLP, proposing innovative defensive mechanisms based on research findings. | L6 | Create |

# Adversarial Machine Learning (22PECS7044T)
## Course Contents

## Unit-I                                                                05 Hrs.

**Machine Learning Preliminaries:**

Supervised Learning, Supervised Learning in Adversarial Settings, Unsupervised Learning, Unsupervised Learning in Adversarial Settings, Reinforcement Learning in Adversarial Settings, Categories of Attacks on Machine Learning .

**Deep Learning Overview:**

Machine learning basics, Introduction to deep learning, Elements of neural networks (NNs), Training NNs, NN architectures.

**Introduction to Adversarial Machine Learning:**

Adversarial Machine Learning Taxonomy and History, Statistical Machine Learning, A Framework for Secure Learning: Analyzing the Phases of Learning. Framework, Security Analysis, Exploratory Attacks, Causative Attacks.

## Unit-II                                                               08 Hrs.

**Causative Attacks on Machine Learning:**

Availability Attack Case Study: SpamBayes, The SpamBayes Spam Filter, Threat Model for Spam Bayes, The Reject on Negative Impact (RONI) Defense Causative Attacks on Machine Learning: Integrity Attack.

**Case Study:**

PCA Detector, PCA Method for Detecting Traffic Anomalies, Corrupting the PCA Subspace, Corruption-Resilient Detectors.

## Unit-III                                                              08 Hrs.

**Evasion Attacks:**

Evasion Attacks against White box: Fast gradient sign method (FGSM) attack. Projected gradient descent (PGD) attack, DeepFool attack Black box adversarial attacks: Query based attacks, Transfer based attacks or transferability attacks, Attacks on Real Models.

**Defences Against Evasion Attacks:**

Adversarial examples detection, Gradient masking/obfuscation, Robust optimization.

## Unit-IV                                                               08 Hrs.

Adversarial Machine Learning in Cyber Security:

Malware Detection and Classification: Machine Learning in cybersecurity. Taxonomy of ML attacks in cybersecurity, Malware detection and classification. Adversarial attacks on ML-based malware class

sifiers, Malware Detection and Classification.

**Network Intrusion Detection:**

Network intrusion detection, Datasets for network intrusion detection, Anomaly detection with Machine Learning, Adversarial attacks on ML-based NIDS.

## Unit-V                                                                05 Hrs.

**Adversarial Machine Learning Challenges:**

Discussion and Open Problems, Unexplored Components of the Adversarial Game, Development of Defensive Technologies.

## Unit-VI                                                               05 Hrs.

**Practical Applications:**

Adversarial Machine Learning in Computer Vision, Adversarial Machine Learning in Natural Language Processing (NLP), Adversarial Machine Learning in Autonomous Systems.

**Applications beyond attack and defence:**

Model Programming, Contrastive explanations, model watermarking and fingerprinting, Data augmentation for unsupervised Learning.

# Adversarial Machine Learning Laboratory (22PECS7044L)
## List of Laboratory Experiments

**Suggested Experiments:(Any 08)**

1. Implement non-targeted white-box evasion attacks against the deep learning models: Fast Gradient Sign Method (FGSM), and Projected Gradient Descent (PGD)

2. Implement targeted white-box evasion attacks against the deep learning models.

3. Implement a PGD attack on the DL model ResNet50, and investigate if the adversarial examples transfer to the other conventional ML models.

4. Implement a non-targeted PGD attack on the logistic regression model for the set of 120 images.

5. Implement adversarial defenses for white-box evasions attacks against deep learning-based classification models.

6. Get familiar with ML classification models used in cybersecurity applications and implement adversarial attacks against such models.

7. Attacks on ML systems for Network Intrusion Detection

8. Attacks on ML systems for Malware Detection

9. ML systems for Spam Filtering

10. Mini Project

## Text Books:

1. Anthony D. Joseph, Blaine Nelson, "Adversarial Machine Learning", © Cambridge University Press 2019, ISBN: 978-1-107-04346-6.

2. A. Zhang, Z. Lipton, and A. Smola, "Dive into Deep Learning".

3. Soma Halder, "Hands-On Machine Learning for Cybersecurity: Safeguard your system by making your machines intelligent using the Python ecosystem", Packt Publishing ltd.

## Reference Books:

1. Yevgeniy Vorobeychik and Murat Kantarcioglu, "Adversarial Machine Learning", Copyright © 2018 by Morgan & Claypool.

2. Pin-Yu Chen and Cho-Jui Hsieh, "Adversarial Robusteness for MAchine Learning", Academic Press an imprint of Elsevier.

3. Shuhe Wang, Kuan-Chieh Wang, "Adversarial Machine Learning" Springer Series in Advanced Machine Learning.

## Web Links:

1. Goodfellow (2014) Explaining and Harnessing Adversarial Examples

2. Carlini (2017) Towards Evaluating the Robustness of Neural Networks

3. Brendel (2017) Decision-Based Adversarial Attacks: Reliable Attacks Against Black-Box Machine Learning Models

4. Bhagoji (2017) Exploring the Space of Black-box Attacks on Deep Neural Networks

5. Xu (2019) Adversarial Attacks and Defenses in Images, Graphs and Text: A Review

6. Tramer (2018) Ensemble Adversarial Training: Attacks and Defenses

7. Rosenberg (2021) Adversarial Machine Learning Attacks and Defense Methods in the Cyber Security Domain

8. Severi (2021) Explanation-Guided Backdoor Poisoning Attacks Against Malware Classifiers

9. Kuleshov (2018) Adversarial Examples for Natural Language Classification Problems

10. Erba (2019) Constrained Concealment Attacks against Reconstruction-based Anomaly Detectors in Industrial Control Systems
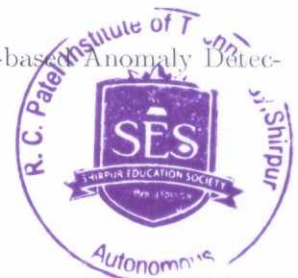
| Program: Computer Science & Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Product Life Cycle Management (22OECS7051T) | | |

**Prerequisite:** Knowledge of basic concepts of Management

## Course Objective(s):

1. To familiarize the students with the need, benefits and components of PLM.

2. To acquaint students with Product Data Management & PLM strategies.

3. To give insights into new product development program and guidelines for designing and developing a product.

4. To familiarize the students with Virtual Product Development.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation. | L2 | Understand |
| CO2 | Illustrate various approaches and techniques for designing and developing products. | L3 | Apply |
| CO3 | Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc. | L3 | Apply |
| CO4 | Acquire knowledge in applying virtual product development tools for components. machining and manufacturing plant. | L2 | Understand |

# Product Life Cycle Management (22OECS7051T)
# Course Contents

## Unit-I                                                    09 Hrs.

**Introduction to Product Lifecycle Management (PLM):**

Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications

**PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM

## Unit-II                                                   08 Hrs.

**Product Design:**

Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process.

## Unit-III                                                  08 Hrs.

**Product Data Management (PDM):**

Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation

**Virtual Product Development Tools:**

For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies

## Unit-IV                                                   07 Hrs.

Integration of Environmental Aspects in Product Design:

Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, ful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strat

the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.

## Unit-V                                                                    07 Hrs.

**Life Cycle Assessment and Life Cycle Cost Analysis:**

Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis.

## Text Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004.

2. Guido La Rosa, Antonino Risitano, Taylor & Francis, "Product Design for the environment-A life cycle approach", Fabio Giudice, 2006.

## Reference Books:

1. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, 2009.

2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006.

3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", Wiley, 2010.

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Management Information System (22OECS7052T) | | |

## Course Objective(s):

1. The course is blend of Management and Technical field.

2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.

3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.

4. Identify the basic steps in systems development.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Explain how information systems Transform Business. | L2 | Understand |
| CO2 | Identify the impact information systems have on an organization. | L3 | Apply |
| CO3 | Describe IT infrastructure and its components and its current trends. | L2 | Understand |
| CO4 | Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making. | L2 | Understand |
| CO5 | Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses. | L3 | Apply |

# Management Information System (22OECS7052T)
## Course Contents

## Unit-I                                                           03 Hrs.

**Foundation Concepts:**

Information Systems in Business, Functional Area Information System, The Components of Information Systems, Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.

## Unit-II                                                          07 Hrs.

**Information Technologies:** Hardware and Software

**Computer Systems:** End User and Enterprise Computing

**Computer Peripherals:** Input, Output, and Storage Technologies

**Application Software:** End User Applications

**System Software:** Computer System Management

**Data Resource Management:** Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management.

**Networks:** The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models.

## Unit-III                                                         08 Hrs.

**MIS Tools and applications for Decision making:** ERP and ERP support of Business Process Reengineering.

**Business intelligence (BI):** Managers and Decision Making, BI for Data analysis and Visualization.

**Artificial Intelligence Technologies in Business**

## Unit-IV                                                          06 Hrs.

**Security and Ethical Challenges:** Security, Ethical, and Societal Challenges of IT Security Management of Information Technology

## Unit-V                                                           07 Hrs.

**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.

# Unit-VI                                                                08 Hrs.

**Information System within Organization:** Acquiring Information Systems and Applications: Various System development life cycle models.

**Enterprise and Global Management of Information Technology:** Managing Information Technology, Managing Global IT.

## Reference Books:

1. James A O'Brien, George M., RameshBehl, "Management Information Systems", 11$^{th}$ edition.

2. Kelly Rainer, Brad Prince, "Management Information Systems", Wiley.

3. K.C. Laudon and J.P. Laudon, "Management Information Systems: Managing the Digital Firm", 10$^{th}$ Ed., Prentice Hall, 2007.

4. D. Boddy, A. Boonstra, "Managing Information Systems: Strategy and Organization", Prentice Hall, 2008.

| Program: Computer Science & Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Operations Research (22OECS7053T) | | |

**Prerequisite:** Basic Knowledge of Algebra, Probability and Statistics.

## Course Objective(s):

1. To formulate a real-world decision problem as a mathematical programming model.

2. To learn the mathematical tools that are employed to solve mathematical programming models.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Convert a real-world problem in to a Linear Programming Problem and analyse the solution obtained using Simplex method or other algorithms. | L4 | Analyze |
| CO2 | Identify real-world problems as Transportation Problem and Assignment Problem and Solve the decision problem by choosing appropriate algorithm. | L3 | Apply |
| CO3 | Identify the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations. | L3 | Apply |
| CO4 | Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations. | L2 | Understand |
| CO5 | Understand the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games. | L2 | Understand |
| CO6 | Describe concept of simulation and apply Monte Carlo Simulation technique to systems such as inventory, queuing and recommend solutions for them. | L2 | Understand |
| CO7 | Understand need for right replacement policy and determine optimal replacement age. | L2 | Understand |

# Operations Research (22OECS7053T)
# Course Contents

## Unit-I                                                    10 Hrs.

**Introduction to Operations Research:**

Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization

**Linear Programming Problem:**

Mathematical Formulation. Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.

## Unit-II                                                   08 Hrs.

**Assignment Problems:**

Mathematical Formulation, Finding optimal solution - Hungarian Method

**Transportation problem:**

Mathematical Formulation, Finding initial basic feasible solution – Northwest corner rule, row minima, column minima, least cost method and Vogel's approximation method.

**Optimality test:**

The stepping stone method and MODI method. Improving the solution.

## Unit-III                                                  05 Hrs.

**Dynamic Programming:**

Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem

## Unit-IV                                                   10 Hrs.

**Queuing Models:**

Characteristics of queuing models. Single Channel – Single and multi-phase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity. Multichannel – Single phase server - Poisson arrivals, exponential service time with infinite population.

**Game Theory:**

Introduction. Minimax & Maximin Criterion and optimal strategy. Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle. Approximate methods - Iterative method. m x 2 & 2 x n games -Graphical method and method of sub-games. Expressing game as LPP.

# Unit-V

**Simulation:**

Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages.

**Replacement Models:**

Replacement of items that deteriorate with time - when money value is not counted and counted, Replacement of items that fail suddenly – individual and group replacement policy

## Text Books:

1. Sharma J. K.,"Operations Research", Trinity Press.

2. Gupta P. K., Hira D. S.,"Operations Research", S. Chand Limited.

## Reference Books:

1. Taha, H.A."Operations Research - An Introduction", Prentice Hall

2. Ravindran, A, Phillips, D. T and Solberg, J. J.,"Operations Research: Principles and Practice", John Willey and Sons

3. Hiller, F. S. and Liebermann, G. J.,"Introduction to Operations Research", Tata McGraw Hill

4. Pradeep Prabhakar Pai,"Operations Research Principles and Practice", Oxford University Press

5. R. Panneerselvam, "Operations Research", PHI Publications.

6. A. M. Natarajan, P. Balasubramani, A. Tamilarasi,"Operations Research", Pearson Education.

7. Kanti Swarup, P. K. Gupta and Man Mohan,"Operations Research", Sultan Chand & Sons.

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Cyber Security and Laws (22OECS7054T) | | |

## Course Objective(s):

1. To understand and identify different types cybercrime and cyber offences.

2. To recognized Indian IT Act 2008 and its latest amendments.

3. To learn various types of security standards compliances.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Understand the different types of cybercrime and security issues E Business. | L2 | Understand |
| CO2 | Analyses different types of cyber threats and techniques for security management. | L4 | Analyze |
| CO3 | Explore the legal requirements and standards for cyber security in various countries to regulate cyberspace. | L4 | Analyze |
| CO4 | Impart the knowledge of Information Technology Act and legal frame work of right to privacy, data security and data protection. | L2 | Understand |

# Cyber Security and Laws (22OECS7054T)
## Course Contents

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## Unit-I                                                                 10 Hrs.

**Introduction to Cybercrime:**

Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus & Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Deface- ments, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow,, Phishing Identity Theft (ID Theft) ,How criminal plan the attacks, Social Engineering, Cyber stalking .

## Unit-II                                                                06 Hrs.

**Cyber Threats Analysis**

Knowledge of Dynamic and Deliberate Targeting

Knowledge of Indications and Warning

Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions

Knowledge of Key Cyber Threat Actors and their Equities

Knowledge of Specific Target Identifiers and Their Usage

## Unit-III                                                               06 Hrs.

### Electronic Business and legal issues

Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic Business, pa- per vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E- Cheque, E-Cash, E-Payment, Threats & Protections, Security for E-Commerce.

## Unit-IV                                                                08 Hrs.

### Indian IT Act

Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments

### Security aspect in cyber Law

The Contract Aspects in Cyber Law , The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law ,The Evidence Aspect in Cyber Law ,The Criminal Aspect in Cyber Law.

## Unit-V                                                                 09 Hrs.

Security Industries Standard Compliances

IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber secu-

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rity, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI- DSS. OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet Security Controls).

## Reference Books:

1. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, New Delhi.

2. Suresh T. Vishwanathan, "The Indian Cyber Law",Bharat Law House New Delhi.

3. "The Information Technology Act", Bare Act- Professional Book Publishers, New Delhi, 2000.

4. Anup K. Ghosh, "E-Commerce Security and Privacy", Springer Science and Business Media, 2012.

5. Izzat Alsmadi, "The NICE Cyber Security Framework Cyber Security Intelligence and Analytics", Springer.

6. Advocate Prashant Mali,"Cyber Law & Cyber Crimes", Snow White Publications, Mumbai

7. Nina Godbole, "Information Systems Security", Wiley India, New Delhi.

8. Kennetch J. Knapp, "Cyber Security & Global Information Assurance" Information Science Publishing.

9. William Stallings, "Cryptography and Network Security", Pearson Publication

## Web Links:

1. The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in

2. A Compliance Primer for IT professional:
   https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Personal Finance Management (22OECS7055T) | | |

**Prerequisite:** Basic Knowledge of Algebra, Probability, and Statistics.

## Course objective(s):

1. To create awareness and educate consumers about access to financial services.

2. To make the students understand the basic concepts, definitions, and terms related to direct taxation.

3. Help students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.

4. To familiarize students with microfinance to accelerate the expansion of local micro-businesses.

## Course outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Use a framework for financial planning to understand the overall role finances play in his/her personal life. | L2 | Understand |
| CO2 | Compute income from salaries, house property, business/profession, capital gains and income from other sources. | L3 | Apply |
| CO3 | Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit. . | L3 | Apply |
| CO4 | Understand how Microfinance can help in financial inclusion. | L2 | Understand |

# Personal Finance Management (22OECS7055T)
## Course Contents

## Unit-I                                                    07 Hrs.

**Overview of Indian Financial System:**

Characteristics, Components, and Functions of Financial System. Financial Instruments and Financial Markets, Financial Inclusion.

**Introduction to Personal Finance:**

Personal Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.

## Unit-II                                                   07 Hrs.

**Personal Financial Management:**

**Loans:**

Home, Car, Education, Personal, Loan against property, and Jewel loan.

**Insurance:**

Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance.

**Investment:**

Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning.

## Unit-III                                                  07 Hrs.

**Income Tax:**

Income Tax Act Basics- Introduction to Income Tax Act, 1961 Heads of Income and Computation of Total Income and Tax Liability- Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, set off and carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons. Tax Management, Administrative Procedures and ICDS - TDS, TCS and Advance Tax Administrative Procedures, ICDS.

## Unit-IV                                                   09 Hrs.

**Goods and Services Tax:**

GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration.

**Levy and Collection of GST:**

Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and

Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services

## Unit-V                                                                 09 Hrs.

### Introduction to Micro – finance:

Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinances, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation & Operation of Self-Help Groups (SHGs).

### Models in Microfinance:

Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges.

### Institutional Mechanism:

Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints & Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC- MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand & Supply of Microfinance Services in India. Impact assessment and social assessments of MFIs

## Reference Books:

1. Asha Singh, M.S. Gupta, "Banking and Financial Sector Reforms in India" . Serials Publication.

2. M.S. Gupta & J.B. Singh, "Indian Banking Sector: Essays and Issues",1$^{st}$ Edition, Serials Publication.

3. K.M. Bhattacharya O.P. Agarwal, "Basics Of Banking & Finance", Himalaya Publishing House.

4. S. Subba Reddy , P. Raghu Ram, "Agricultural Finance And Management".

5. Dr.Vasant Desai, "The Indian Financial System And Development", 4$^{th}$ Edition, Himalaya Publishing House.

6. Sanjay Kumar Satapathy, "Income Tax Management Simple Way of Tax Management, Tax Planning and Tax Saving".

7. Dr. R. K. Jain, "Direct Tax System Income Tax", SBPD Publications.

8. S K Mishra, "Simplified Approach to GST Goods and Services Tax", Educreation Publishing.

9. Todd A Watkins, "Introduction To Microfinance", World Scientific Publishing Company.

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Energy Audit and Management (22OECS7056T) | | |

**Prerequisite:** Nil

## Course objective(s):

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.

2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility

3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.

4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

## Course outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | To identify and describe present state of energy security and its importance. | L2, L3 | Understand, Apply |
| CO2 | To identify and describe the basic principles and methodologies adopted in energy audit of a utility. | L2, L3 | Understand, Apply |
| CO3 | To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities. | L2 | Understand |
| CO4 | To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities. | L2 | Understand |
| CO5 | To analyze the data collected during performance evaluation and recommend energy saving measures. | L4 | Analyze |

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# Energy Audit and Management (22OECS7056T)
## Course Contents

## Unit-I                                          05 Hrs.

**Energy Scenario:**

Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.

## Unit-II                                         09 Hrs.

**Energy Audit:**

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit.

**Financial analysis techniques:**

Simple payback period, NPV, Return on investment (ROI) Internal rate of return (IRR).

## Unit-III                                        10 Hrs.

**Energy Management and Energy Conservation in Electrical System:**

Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.

## Unit-IV                                         09 Hrs.

**Energy Management and Energy Conservation in Thermal Systems:**

Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation- types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.

## Unit-V                                          06 Hrs.

Energy conservation in Buildings:

Energy Conservation Building Codes(ECBC):Green Building, LEED rating

Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.

## Reference Books:

1. Geofry Stokes,"Handbook of Electrical Installation Practice", Blackwell Science.

2. Anil Valia, "Designing with light: Lighting Handbook", Lighting System.

3. W.C. Turner, "Energy Management Handbook", John Wiley and Sons.

4. A. K. Tyagi,"Handbook on Energy Audits and Management", Tata Energy Research Institute (TERI).

5. C.B. Smith,"Energy Management Principles", Pergamon Press.

6. Dale R. Patrick, S. Fardo, Ray E. Richardson, "Energy Conservation Guidebook", Fairmont Press.

7. Albert Thumann, W. J. Younger, T. Niehus, "Handbook of Energy Audits", , CRC Press.

## Web Links:

1. www.energymanagertraining.com

2. www.bee-india.nic.in

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Disaster Management and Mitigation Measures (22OECS7057T) | | |

**Prerequisite:** Nil

## Course Objective(s):

1. To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.

2. To identify extent and damaging capacity of a disaster.

3. To study and understand the means of losses and methods to overcome /minimize it.

4. To understand roles and responsibilities of individual and various organization during and after disaster.

5. To appreciate the significance of GIS, GPS in the field of disaster management.

6. To understand the emergency government response structures before, during and after disaster.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Know natural as well as manmade disaster and their extent and possible effects on the economy. | L2 | Understand |
| CO2 | Know the institutional framework and organization structure in India for disaster management and get acquainted with government policies, acts and various emergency laws. | L2 | Understand |
| CO3 | Get to know the simple dos and don'ts in such extreme events and build skills to respond accordingly. | L2 | Understand |
| CO4 | Understand the importance of disaster prevention and various mitigation measure with the exposure to disasters hotspots across the globe. | L2 | Understand |

# Disaster Management and Mitigation Measures (22OECS7057T)
## Course Contents

### Unit I                                                                    09 Hrs.

**General Information about Disaster:** Brief concept of Hazards, definition and types of Disasters – Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters, Impact of disaster on National development.

**Study of Natural disasters:** Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc.

**Study of Human/Technology Induced Disasters:** Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

### Unit II                                                                   08 Hrs.

**Disaster Management:** Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc.

**Prior, During and Post disaster management activities:** Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration.

### Unit III                                                                  07 Hrs.

**Institutional framework and Mechanism for disaster management in India:** Institutions in India for dealing with various disasters, Organizational structure, functions and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster, NGO's involved in disasters and their task, Jobs carried out by armed forces.

Financial Relief During disaster (State, National and International Disaster Assistance)

### Unit IV                                                                   08 Hrs.

**Disaster risk reduction and Mitigation Measures:** Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures, disaster risk reduction.

Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc.

Use of information management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.

## Unit V                                                          07 Hrs.

**Case studies on disaster (National /International):** Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on.

(Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)

## Reference Books & Reports:

1. Harsh K.Gupta, " Disaster Management", Universities Press Publications, 2003.

2. O.S.Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", published by Centre for land warfare studies, New Delhi, 2011.

3. Damon Copolla, "Introduction to International Disaster Management", Butterworth Heinemann Elsevier Publications 2015.

4. Jack Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis group 2008.

5. Rajdeep Dasgupta, "Disaster management & rehabilitation", Mittal Publications, New Delhi 2007.

6. R B Singh, "Natural Hazards and Disaster Management, Vulnerability and Mitigation", Rawat Publications 2006.

7. C.P.Lo Albert, K.W. Young, "Concepts and Techniques of GIS", Prentice Hall (India) Publications 2006.

8. Claudia G. Flores Gonzales, "Risk management of natural disasters", KIT Scientific Publishing 2010.

9. W. Nick Carter, "Disaster Management – a disaster manger's handbook", Asian Development Bank 2008.

10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs. GoI, New Delhi 2011.

11. Wil Mara, "The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy", Marshall Cavendish Corporation, New York, 2011.

12. Ronald Eisler, "The Fukushima 2011 Disaster", Florida, 2013. (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

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| Program: Computer Science & Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Science of Well-being (22OECS7058T) | | |

## Prerequisite: Nil

## Course Objective(s):

1. To create consciousness about importance of holistic health and physical as well as mental well-being.

2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.

3. To introduce the learners to the means of mental and physical well-being, ill effects of malpractices like alcoholism, smoking etc.

4. To equip the learners to manage and cope up with stress in their daily living.

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Describe concepts of holistic health and well-being, differentiate between its true meaning and misconceptions and understand the benefits of well-being. | L2 | Understand |
| CO2 | Recognize meaning of happiness, practice gratitude and self-compassion and analyze incidents from one's own life. | L4 | Analyze |
| CO3 | Understand the causes and effects of stress, identify reasons for stress in one's own surrounding and self. | L1,L2 | Remember, Understand |
| CO4 | Recognize the importance of physical health and fitness, assess their life style and come up with limitations or effectiveness. | L5 | Evaluate |
| CO5 | Inspect one's own coping mechanism, assess its effectiveness, develop and strategize for betterment and execute it. | L4 | Analyze |

# Science of Well-being (22OECS7058T)
# Course Contents

## Unit I                                                                06 Hrs.

**Health** and **well-being:** The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being.

Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.

## Unit II                                                               08 Hrs.

**Concepts of happiness:** Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.

## Unit III                                                              09 Hrs.

**Stress and mental health/well-being:** Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress.

Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.

## Unit IV                                                               08 Hrs.

**Physical Well-being / Health management:** concept of health behaviours, dimensions of health behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, Concept of Malnutrition, Health compromising behaviours: Alcoholism, Smoking and its effects on health.

## Unit V                                                                08 Hrs.

**Dealing with Difficult Times / Coping mechanisms:** The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders.

Concept of coping, Ways of coping and stress management, basic knowledge about stress management, various techniques of stress management, stress management programs.

Mental strengths and virtues, Hope, Optimism, Resilience – concept, pathways and models, Meditation and Self-introspection.

## Text Books:

1. Felicia Huppert, Nick Baylis, Barry Keverne, "The Science of well-being", Oxford University Press.

2. S. Ojha, U. Rani Srivastava, Shobhna Joshi, "Health and Well-Being: Emerging Trends", Global Vision Publishing House.

3. Shane J. Lopez, Jennifer Teramoto Pedrotti, Charles Richard Snyder, "Positive psychology: The scientific and practical explorations of human strengths", Sage Publications.

## Reference Books:

1. Kitayama S. & Markus H. R, "The pursuit of happiness and the realization of sympathy: Cultural patterns of self, social relations, and well-being.", Culture and subjective well-being, The MIT Press.

2. Dubos R., "Man Adapting", New Haven: Yale University Press.

3. McMahon D. M., "Happiness a history", Atlantic Monthly Press.

4. D. Kahneman, E. Diener & N. Schwarz, "Well-being: The foundations of hedonic psychology", New York: Russell Sage.

5. Selye H., "The Stress of Life." New York; McGraw-Hill; 1984.

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Research Methodology (22OECS7059T) | | |

**Prerequisite:** Basic knowledge of Probability and Statistics

## Course Objective(s):

1. To understand Research and research Process.

2. To acquaint learners with identifying problems for research and develop research strategies

3. To familiarize learners with the techniques of data collection, analysis of data and interpretation

## Course Outcomes:

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

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Prepare a preliminary research design for projects in their subject matter areas. | L3 | Apply |
| CO2 | Accurately collect, analyze and report data. | L4 | Analyze |
| CO3 | Present complex data or situations clearly. | L2 | Understand |
| CO4 | Review and analyze research findings. | L4 | Analyze |
| CO5 | Write report about findings of research carried out. | L3 | Apply |

# Research Methodology (22OECS7059T)
## Course Contents

### Unit-I                                                              07 Hrs.
Basic Research Concepts:

Meaning of research, Objectives of research, Types of research, Significance of research Research process.

### Unit-II                                                             09 Hrs.
Research Methodology:

Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.

### Unit-III                                                            09 Hrs.
Research and Sample Design::

Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs

### Unit-IV                                                             09 Hrs.
Data Collection and Data Analysis:

Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data

### Unit-V                                                              05 Hrs.
Interpretation and Report Writing:

Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues

## Reference Books:

1. Dawson, Catherine, 2002, "Practical Research Methods", UBS Publishers Distributors, New Delhi, 2002.

2. Kothari, C.R., "Research Methodology-Methods and Techniques",Wiley Eastern Limited,New Delhi, 1985.

3. Kumar, Ranjit, "Research Methodology-A Step-by-Step Guide for Beginners", Pearson Education, 2nd edition, Singapore, 2005.

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Public Systems and Policies (22OECS70510T) | | |

**Prerequisite:** Basic Knowledge of Social Science and Current Affairs

## Course Objective(s):

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.

2. To understand public systems in a fast-changing environment in the global context.

3. To provide an in-depth understanding of the ills prevailing in the society and aids to identify the solutions for them.

4. To explain public policy and its operations with special focus on policy relating to Government finance.

5. To analyze and evaluate the impact of the public policy on firms and economy at large.

## Course Outcomes:

| CO | Course Outcomes | Bloom's Level | Bloom's Description |
|---|---|---|---|
| CO1 | Understand the importance of public systems in a fast-changing environment in the global context. | L2 | Understand |
| CO2 | Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field. | L4 | Analyze |
| CO3 | Explain public policy and its operations with special focus on policy relating to Government finance. | L3 | Explain |
| CO4 | Make policies and know about the happenings in the world, in the nation and those in their locality. | L3 | Apply |
| CO5 | Analyze and evaluate the impact of the public policy on firms and economy at large and work under various fields as policymakers. | L4 | Analyze |

# Public Systems and Policies (22OECS70510T)
## Course Contents

### Unit I                                                                    09 Hrs.

**Introduction and Overview of Public Systems:** Ideology of Public Systems Problem Solving: Mechanistic and Organic view of society and individuals, the legal framework; federal government; state and local governments; government growth; The size of government.

### Unit II                                                                   06 Hrs.

**Public Sector in the Economic Accounts:**

Public sector in the circular flow; public sector in national income accounts.

### Unit III                                                                  07 Hrs.

**Public Choice and Fiscal Politics:**

Direct Democracy, Representative Democracy, The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

### Unit IV                                                                   11 Hrs.

**Introduction and Overview of Public Policy:**

Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.

### Unit V                                                                    06 Hrs.

**Case Studies in Expenditure Policy – Public Services:**

A) National Defense B) Highways C) Outdoor Recreation D) Education

## Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W.W. Norton & Company.

2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall.

3. Anderson J.E.,"Public Policy-Making: An Introduction", Boston, Houghton.

4. Avasthi & Maheshwari, "Public Administration", Lakshminarayan Agarwal, Agra.

5. Bhattacharya, Mohit, "New Horizons of Public Administration", Jawahar Publishers, New Delhi.

6. Henry, Nicholas, "Public Administration and Public Affairs", Prentice Hall of India, New Delhi.

7. Harvey S Rosen and Ted Gayer, "Public Finance", 10<sup>th</sup> Edition, McGraw-Hill Education, 2013.

8. Musgrave and Musgrave, "Public Finance in Theory and Practice".

| Program: Computer Science & Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Project Stage-II (22PJCS7060L) | | |

## Course Objectives:

- To implement the solution as per the problem statement.

- To develop the team building, writing, logical reasoning and management skills.

- To provide the connections between the designs and concepts across different disciplinary boundaries.

- To encourage students to become independent personnel, critical thinkers and lifelong learners

## Course Outcomes:

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tool and method. | L4 | Analyze |
| CO2 | Demonstrate project based learning that allows students to transfer existing ideas into new applications. | L2 | Understand |
| CO3 | Develop an ability to work in teams and manage the conduct of the research study. | L3 | Apply |
| CO4 | Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies. | L3 | Apply |
| CO5 | Present the research in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles. | L2 | Understand |

## Syllabus:

Project-I work done in VI semester shall be continued as Project-II in semester VII.

Students should complete remaining implementation of ideas given in synopsis/Abstract of semester VI.

Students / group must plan their execution of project, so that project work should be completed before end of semester.

Project-II involves fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing, possible results and report writing.

Each project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VII in the form of Hard bound.

Domain knowledge (any beyond) needed from the various areas in the field of Computer Science & Engineering (Data Science) for the effective implementation of the project.

The above areas can be updated based on the technological innovations and development needed for specific project.

## Guidelines:

The main purpose of this activity is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.

In the first review of this semester, each group is expected to complete 70% of project.

In the second review of this semester, each group is expected to complete 100% of project.

The students may use this opportunity to learn different computational techniques towards development of a product.

Interaction with alumni mentor will also be appreciated for the improvement of project.

## Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).

- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

- The candidate must bring the Project Stage-I report and the final report completed in all respect while appearing for End Semester Examination.

- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.

**Prescribed project report guidelines:**

Every group should prepare hard bound report (preferrable LaTeX) of about minimum 40 pages on the work carried out by a batch of students in respect of the project work done during semester-VII. Project Report should include appropriate content for:

- Title

- Abstract

- Introduction

- Problem identification and project objectives

- Literature Survey

- Related Theory

- Project design and Implementation details

- Case study/Analysis/Design Methodology

- Project Outcomes

- Result and Conclusion

- Future scope

- References

**Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:**

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Table 1: Log Book Format

| Sr | Week (Start Date:End Date) | Work Done | Sign of Guide | Sign of Coordinator |
|----|----------------------------|-----------|---------------|---------------------|
| 1 |  |  |  |  |
| 2 |  |  |  |  |

Table 2: Continuous Assessment Table

| Sr | Exam Seat No | Name of Student | Student Attendance | Log Book Maintain | Literature Review | Depth of Understanding | Report | Total |
|----|------|------|------|------|------|------|------|------|
|  |  |  | 5 | 5 | 5 | 5 | 5 | 25 |

**Assessment criteria for the departmental committee (including project guide) for End Semester Exam:**

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress

- Documentation/Technical paper writing

- Key findings

- Validation of results

- Product Development

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Table 3: Evaluation Table

| Sr | Exam Seat No | Name of Student | Project Selection | Design/ Methodology | Fabrication/ Modeling/ Simulation | Result Verification | Presentation | Total |
|----|------|------|------|------|------|------|------|------|
|  |  |  | 5 | 5 | 5 | 5 | 5 | 25 |

| Program: Computer Science and Engineering (Data Science) | Final Year B.Tech | Semester: VII |
|---|---|---|
| Employability Skill Development Program-III (22HMCS7070L) | | |

## Course Objective(s):

- To build a solid foundation in programming fundamentals.

- To enhance problem-solving abilities through mathematical reasoning.

- To develop algorithmic thinking.

- To provide hands-on experience with essential data structures.

## Course Outcomes:

| CO | Course Outcomes | Blooms Level | Blooms Description |
|---|---|---|---|
| CO1 | Apply basic programming skills to write and debug simple programs using conditions, loops, and functions | L3 | Apply |
| CO2 | Analyze mathematical problems and use techniques like number theory and modular arithmetic in problem-solving. | L4 | Analyze |
| CO3 | Design and implement algorithms to solve real-world problems using methods like recursion, greedy, and sorting. | L6 | Create |
| CO4 | Use common data structures such as arrays, strings, sets, and maps effectively in programming tasks. | L3 | Apply |

# Employability Skill Development Program-III (22HMCS7070L)
## Course Contents

### Unit-I                                                           06 Hrs.
**Programming Fundamentals:**

- Basic Programming Concepts

- Conditional Statements

- Loops

- Inbuilt functions

- Data Types

- Python

### Unit-II                                                          06 Hrs.
**Mathematics:**

- Mathematics

- Basic Math

- Arithmetic

- Modular Arithmetic

- Divisibility

- Integer Division

- GCD

- Geometry

- Number System

- Binary

### Unit-III                                                         06 Hrs.
**Algorithms:**

- Algorithms

- Brute Force

- Greedy

- Constructive

- Sorting

- Simple Algos

- Recursion

- Recurrence Relation

- Observation

- Implementation

# Unit-IV                                                       08 Hrs.
### Data Structures:

- Data Structures

- Arrays

- 1D Arrays

- String

- Subsequence

- Frequency Arrays

- Maps

- Sets

## Reference Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 5th Edition, Career-Monk Publications, 2016.

2. Dr. R. S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand Publishing, 2021.

3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 4th Edition, The MIT Press, 2022.