Shirpur Education Society's

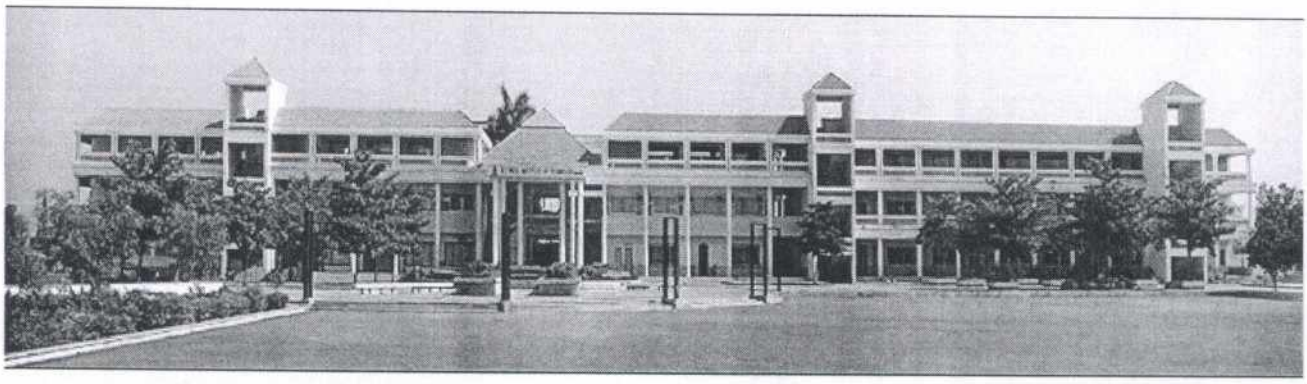
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Final Year B. Tech. (Computer Engineering)

With effect from Year 2025-26



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
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Final Year B.Tech Computer Engineering Semester-VII (w.e.f. 2025-26)

Sr.No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credits	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	22PCCO7010T	Natural Language Processing	3			25	10	10	10	65	100	3	4
	PC	22PCCO7010L	Natural Language Processing Laboratory			2	25				25	50	1	
2	PC	22PCCO7020T	Internet of Everything	3			25	10	10	10	65	100	3	4
	PC	22PCCO7020L	Internet of Everything Laboratory			2	25				25	50	1	
3@	PE	22PECO7031T	Deep Learning	3			25	10	10	10	65	100	3	4
		22PECO7031L	Deep Learning Laboratory			2	25				25	50	1	
		22PECO7032T	Software Architecture	3			25	10	10	10	65	100	3	
		22PECO7032L	Software Architecture Laboratory			2	25				25	50	1	
		22PECO7033T	Predictive Modeling	3			25	10	10	10	65	100	3	
		22PECO7033L	Predictive Modeling Laboratory			2	25				25	50	1	
		22PECO7034T	Software Testing and Quality Assurance	3			25	10	10	10	65	100	3	
		22PECO7034L	Software Testing and Quality Assurance Laboratory			2	25				25	50	1	
4	PC	22PCCO7040L	Big Data and Cloud Infrastructure Laboratory			4	50				50	100	2	
5#	OE	22OECO7051T	Product Life Cycle Management	3			25	10	10	10	65	100	3	3
		22OECO7052T	Management Information System	3			25	10	10	10	65	100	3	
		22OECO7053T	Operations Research	3			25	10	10	10	65	100	3	
		22OECO7054T	Cyber Security and Laws	3			25	10	10	10	65	100	3	
		22OECO7055T	Personal Finance Management	3			25	10	10	10	65	100	3	
		22OECO7056T	Energy Audit and Management	3			25	10	10	10	65	100	3	
		22OECO7057T	Disaster Management and Mitigation Measures	3			25	10	10	10	65	100	3	
		22OECO7058T	Science of Well-being	3			25	10	10	10	65	100	3	
		22OECO7059T	Research Methodology	3			25	10	10	10	65	100	3	
		22OECO70510T	Public Systems and Policies	3			25	10	10	10	65	100	3	
6	PJ	22PJCO7060L	Project Stage-II			8	25				25	50	4	
7	HM	22HMCO7070L	Employability Skill Development Program-III			2	25				25	50	1	
			Total	12		20	275			40	435	750	22	

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

Prepared by:
Ms. J. S. Sonawane

Checked by:
Dr. S. M. Pardeshi

Prof. Dr. R. B. Wagh
BOS Chairman

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

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

Prof. Dr. J. B. Patil
Director

R. C. Patel Institute of Technology, Shirpur
SES
Autonomous

Final Year B.Tech Computer Engineering Semester-VIII (w.e.f. 2025-26)

Sr.No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credits	
							Continuous Assessment (CA)							
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
							[A]			[B]	[C]	[A+B+C]		
1@	PE	22PECO8011T	Web Intelligence*	3			25	10	10	10	65	100	3	3
		22PECO8012T	High Performance Computing*	3			25	10	10	10	65	100	3	
		22PECO8013T	Cloud Computing*	3			25	10	10	10	65	100	3	
			NPTEL/Swayam Course#	3			25	10	10	10	65	100	3	
2@	PE	22PECO8021T	Block Chain Technology*	3			25	10	10	10	65	100	3	3
		22PECO8022T	Social Network Analysis*	3			25	10	10	10	65	100	3	
		22PECO8023T	Ethical Hacking and Digital Forensics*	3			25	10	10	10	65	100	3	
			NPTEL/Swayam Course#	3			25	10	10	10	65	100	3	
3	INT	22INTCO8030L	Internship			20	150				150	300	10	
			Total	6		20	200			20	280	500	16	

1. @ Any 1 Elective Course.
2. * Professional Elective Courses offered for the students doing Internship at institute level.
3. # Professional Elective Courses offered for the students doing Internship at Industry.
   These courses are to be studied in self study mode using NPTEL/Swayam platform.
4. Students doing internship at industry shall submit certificate of NPTEL examination OR
   They have to appear examinations conducted by institute like TT1,TT2 and ESE.
5. Students undergoing internship have the option to appear for both the NPTEL examination and the End Semester Examination (ESE) conducted by the institute for the respective course. In such cases, the better of the two scores (NPTEL or ESE) shall be considered for final grading.
6. List of NPTEL courses will be declared by concerned BOS at the beginning of the semester-VIII.

Prepared by:
Ms. J. S. Sonawane

Checked by:
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B.O.S Chairman

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C.O.E.

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Dean Academics & Dy. Director

Prof. Dr. J. B. Patil
Director

Semester - VII

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Natural Language Processing (22PCCO7010T)		
Natural Language Processing Laboratory (22PCCO7010L)		

Prerequisites: Finite Automata, Machine Learning, Probability Mathematics.

Course Objective(s):

1. To understand the theoretical foundations and basic principles of Natural Language Processing.
2. To apply preprocessing techniques, syntactic and semantic analysis to process and analyze text data.
3. To explore statistical and machine learning methods for solving NLP tasks such as classification, tagging, and translation.
4. To design and implement NLP applications using modern tools and frameworks with consideration of ethical issues.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand stages of NLP and apply morphological analysis techniques on any real world text.	L2	Understand
CO2	Apply appropriate techniques such as tokenization, POS tagging and syntactic parsing to real-world text.	L3	Apply
CO3	Apply feature extraction, word sense disambiguation and similarity for semantic analysis of text.	L3	Apply
CO4	Apply pragmatics and discourse segmentation to understand structure and context of text.	L3	Apply
CO5	Analyze advanced language models for various NLP applications.	L4	Analyze

Natural Language Processing (22PCCO7010T)
Course Contents

Unit-I — 03 Hrs.

Introduction

History of NLP, Generic NLP System, Levels of NLP, Knowledge In Language Processing, Ambiguity In Natural Language, Stages In NLP, Challenges of NLP, Applications of NLP.

Unit-II — 08 Hrs.

Word Level Analysis

Regular Expression, Finite Automata, Finite State Transducers (FST), Morphology Analysis: Survey of English Morphology, Inflectional Morphology & Derivational Morphology, Lemmatization, Morphological Parsing With FST, Lexicon Free FST Porter Stemmer, Word and Sentence Tokenization, Detection and Correction of Errors, Minimum Edit Distance with Backtracing.

N –Grams, Unigrams/Bigrams Language Models, Corpora, Computing the Probability Of Word Sequence, Training and Testing.

Perplexity And Entropy: Smoothing and Backup, Zipf's Law, Add One Smoothing, Witten-Bell Discounting, Good Turing Discounting, Back Off Methods, Class Based Models, Google N-Gram Release.

Unit-III — 08 Hrs.

Syntax Analysis

Part-Of-Speech Tagging (POS) - Open and Closed Words, Tag Set for English (Penn Treebank), Rule Based POS Tagging, Transformation Based Tagging, Stochastic POS Tagging and Issues - Multiple Tags & Words, Unknown Words.

Hidden Markov Model (HMM), Maximum Entropy, And Conditional Random Field (CRF).

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar

Parsing with CFG: Top-down parsing, Bottom-up parsing, Basic top-down parser,

Problems with the Basic Top-down Parser: Left Recursion, Ambiguity Earley parser, Probabilistic CFG, Probabilistic CYK

Unit-IV — 06 Hrs.

Semantic Analysis

Lexical Semantics, Attachment for Fragment of English- Sentences, Noun Phrases, Verb Phrases, Prepositional Phrases, Relations Among Lexemes & Their Senses: Homonymy, Polysemy, Synonymy, Hyponymy, WordNet

Feature Extraction and Word Embeddings: Vector semantics, Traditional Word Embeddings

TF-IDF

Static Word Embedding: Word2Vec - Continuous Bag of Words (CBOW), Skip-pgram, GloVe

Word Sense Disambiguation: WSD using Indirect approaches: selectional restriction-based disambiguation, selectional association-based disambiguation

WSD using Direct approaches: Supervised, Unsupervised, Bootstrapping methods

Dictionary based: Lesk algorithm; Thesaurus based: Walker's Algorithm; Word Sense Similarity using Thesaurus and Distributional methods

Unit-V 06 Hrs.

Pragmatics & Discourse Segmentation:

Introduction to Discourse, Cohesion and Coherence in Discourse, Discourse connectives, Reference Resolution, Reference Phenomena, Features for Pronominal Anaphora Resolution, Anaphora Resolution: Hobbs algorithm, Centering algorithm, Log-linear model, Co-reference resolution, Evaluation of Co-reference resolution.

Unit-VI 05 Hrs.

Large Language models and NLP applications:

Introduction to Large Language models: Types of LLMs: Auto-regressive language models – GPT3; Transformer-based models – BERT, RoBERTa (Robustly Optimized BERT Pretraining Approach); Encoder-decoder models – MarianMT (Marian Neural Machine Translation), T5; Pre-trained and fine-tuned models – ELECTRA; Multilingual models – XLM (Cross-lingual Language Model)

NLP applications: Machine Translation, Information Retrieval, Question Answers System, Categorization, Summarization, Sentiment Analysis, Named Entity Recognition.

Natural Language Processing Laboratory (22PCCO7010L)

List of Laboratory Experiments

Suggested Experiments:

1. Study of recent NLP applications
2. Performing Preprocessing steps in NLP
3. Performing Word-level analysis using bi-gram and tri-gram models.
4. Performing POS tagging using HMM.
5. Implementing parse trees from a given sentence and corpus.
6. Performing Morphological analysis to identify morphemes for regional language.

7. Word Sense Disambiguation: Identify the word senses using "synset" in NLTK

8. Implement Word2Vec, GloVe

9. Any application of NLP : Spell Check, Autocorrect, plagiarism detection, sentiment analysis, sarcasm detection or text analytics in any domain

Any other practical covering the syllabus topics and subtopics can be conducted.

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

Text Books:

1. Jurafsky and Martin, "Speech and Language Processing", 2nd Edition, Prentice Hall, January 26, 2000, ISBN: 0130950696.

2. Tanmoy Chakraborty, "Introduction to Large Language Models,Generative AI for Text", Wiley, 25th Dec 2024.

3. Denis Rothman, "Transformers for Natural Language Processing", Packt Publishing, 2nd, 2022.

Reference Books:

1. Jurafsky, D., & Martin, J. H., "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models (3rd ed., draft)", Self-published,2025

2. Manning and Schutze, "Statistical Natural Language Processing", MIT Press, 1st Edition, June 18, 1999, ISBN: 0262133601.

3. James Allen, "Natural Language Understanding", The Benajmins/Cummings Publishing Company Inc. 1994, ISBN 0-8053-0334-0.

4. Tom Mitchell, "Machine Learning", McGraw Hill, 1997, ISBN 0070428077.

5. Cover T. M. and J. A. Thomas, "Elements of Information Theory", Wiley. 1991, ISBN 0-471-06259-6.

6. Charniak E., "Statistical Language Learning", The MIT Press, 1996, ISBN 0-262-53141-0.

7. Jelinek F., "Statistical Methods for Speech Recognition", The MIT Press, 1998, ISBN 0-262-10066-5.

8. Sinan Ozdemir, "Quick Start Guide to Large Language Models: Strategies and Best Practices for Using ChatGPT and Other LLMs",Addison-Wesely Professional; 1st Edition 2023

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Internet of Everything (22PCCO7020T)		
Internet of Everything Laboratory (22PCCO7020L)		

Prerequisites: Basics of python programming, Computer Network.

Course Objective(s):

1. To understand the core concepts of the Internet of Things and explore the associated challenges.
2. To explore the design and functionality of IoT/IoE devices, their system architecture, and connectivity technologies.
3. To analyze the importance of data in IoT, including structured/unstructured data and cloud integration for analytics.
4. To gain knowledge of sensors, actuators, Arduino, and Raspberry Pi for developing IoT-based solutions.
5. To study various IoT communication and routing protocols essential for data transfer in IoT environments.
6. To develop skills to relate the IoT technologies for practical IoT applications.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamentals, evolution, and ecosystem of IoT and differentiate between IoT, IoE, and M2M.	L2	Understand
CO2	Demonstrate an understanding of IoT devices, software, system architecture, and communication models.	L3	Apply
CO3	Analyze the importance of data in IoT, including structured/unstructured data and cloud integration for analytics.	L4	Analyze
CO4	Apply knowledge of sensors, actuators, Arduino and Raspberry Pi for developing IoT-based solutions.	L3	Apply
CO5	Identify and explain various IoT communication and routing protocols for efficient data transfer.	L2	Understand
CO6	Analyze and evaluate IoT applications across different sectors through case studies and propose suitable solutions.	L5	Evaluate

Internet of Everything (22PCCO7020T)
Course Contents

Unit-I — 06 Hrs.

Internet Evolution

Introduction – Overview of IoT, IoT Evolution, Characteristics of IoT, IoT Stack, Application areas of IoT, IoT Challenges.

M2M Technology, Understanding IoE-IoE Pyramids, IoT 2.0. IoE Benefits, Disambiguation of IoT vs IoE vs M2M vs others.

Unit-II — 06 Hrs.

IoE Devices

Introduction – IoT Devices, IoT Software, IoT Device Management Platform and Software, IoT System Architecture, IoT connectivity technologies, Physical design of IoT, Logical design of IoT- IoT Communication model, IoT Levels and Deployment Templates.

Unit-III — 06 Hrs.

Pillars of IoE

Internet of everything Devices –Introduction, common devices, connecting devices, sensors, RFID in Internet of Things.

Data as IoE Piller-Introduction, structured and unstructured data, cloud data, virtualization, data center, big data integration, IoT analytics: from data collection to deployment and operationalization.

Unit-IV — 08 Hrs.

Elements of IoT

Introduction to Sensors, Actuators, Transducers and their types.

Arduino- Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board and its types.

Raspberry Pi - Introduction, Comparison of various Rpi Models, Pin Description of Raspberry Pi, On-board components of Rpi.

Unit-V — 08 Hrs.

IoT Communication Protocols

IoT Protocols- MQTT, XMPP, DDS, AMQP, COAP, REST, IPv6, 6LoWPAN.

IoT Routing Protocols, Data-centric and Flat-Architecture Protocols, Flooding, Gossiping, Sensor Protocols for Information via Negotiation (SPIN), SPIN PP, SPIN EC (Energy Conserve), SPIN BC (Broadcast).SPIN RL(Reliable), LEACH Protocol.

Unit-VI

05 Hrs.

IoT Case Studies

IoT Case Studies based on Home Automation, Cities, Environment, Transportation, Retail, Logistics, Agriculture, Industry, Healthcare.

Internet of Everything Laboratory (22PCCO7020L)

List of Laboratory Experiments

Suggested Experiments:

1. Interfacing with LED
2. Traffic Simulation
3. Interfacing with IR/PIR Sensor
4. Interfacing with LDR Sensor
5. Interfacing with Ultrasonic Sensor
6. Interfacing with Smoke Sensor
7. Interfacing with 7 Segment Display
8. Interfacing with DHT11 Sensor
9. Interfacing with Servo Motor
10. Interfacing with Soil Moisture Sensor

Any other practical covering the syllabus topics and subtopics can be conducted.

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

Text Books:

1. Dr. Prateek Jain and Dr. Archana Sharma, "Transitioning to Internet of Everything (IoE) Key Technology Application and Recent Trends", BFC Publications, 2024.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", 1st Edition, Universities Press, 2016.

Reference Books:

1. Hang Song, "Internet of Everything: Key Technologies, Practical Applications and Security of IoT", World Scientific, Tsinghua University Press, 2023.

Online Resources:

Coursera

Introduction to Internet of Things by Prof. Rajbabu Velmurugan

https://www.coursera.org/learn/introduction-to-internet-of-things

NPTEL

Introduction To Internet of Things By Prof. Sudip Misra, IIT Kharagpur

https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Deep Learning (22PECO7031T)		
Deep Learning Laboratory (22PECO7031L)		

Prerequisites: Artificial Intelligence, Machine Learning.

Course Objective(s):

1. To understand Hyper parameter Tuning.
2. To explore Deep Learning Techniques with different learning strategies.
3. To design Deep Learning Models for real time applications.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and Apply Hyper parameters Tuning.	L2	Understand
CO2	Create and interpret deep learning Models.	L6	Create
CO3	Investigate suitable deep learning models for various applications.	L3	Analyze

Deep Learning (22PECO7031T)
Course Contents

Unit I — 04 Hrs.

Introduction to Deep Learning

Overview of Neural Network, Deep learning and human brain, Why is Deep Learning taking off?, Deep Learning applications.

Overview of Tools: Torch, TensorFlow, Keras.

Unit II — 09 Hrs.

Convolutional Neural Network

Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications.

ConvNet Architectures

Discussions on famous convnet architectures: AlexNet, VGG, GoogLeNet, ResNet.

Unit III — 05 Hrs.

Hyperparameter Tuning, Batch Normalization

Tuning Process, Using an Appropriate Scale to pick Hyperparameters, Hyperparameters Tuning in Practice: Pandas vs. Caviar, Normalizing Activations in a Network, Fitting Batch Norm into a Neural Network, why does Batch Norm work, Batch Norm at Test Time.

Unit IV — 10 Hrs.

Sequential models

Introduction to Sequence Models and RNNs, Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs: Unfolded RNNs, Seq2Seq RNNs, Long Short-Term Memory (LSTM), Bidirectional RNN, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), RNN applications, Sequence models and attention mechanism, Attention over Images, Hierarchical Attention.

Unit V — 10 Hrs.

Adversarial Networks

Introduction to adversarial Networks, Auto encoders (standard, denoising, contractive, etc.), Variational Auto encoders, Generative Adversarial Networks, Diffusion Models: Basics of Diffusion models, Advantages of over GANs, Popular Diffusion tools: Stable Diffusion, DALL-E, Midjourney, Applications of Adversarial Networks.

Unit VI 04 Hrs.

Deep Learning Case Studies

Image Processing, Natural Language Processing, Speech Recognition, Video Analytics.

Deep Learning Laboratory (22PECO7031L)

List of Laboratory Experiments

Suggested Experiments:

1. Building own Neural Network from scratch.
2. To implement EBPTA algorithm.
3. Understanding ANN using Tensor Flow.
4. Visualizing Convolutional Neural Network using Tensor Flow with Keras Data.
5. Object detection using RNN using Tensor Flow.
6. Students are supposed to complete any one mini project not limited to following list of projects.
    - Sequence Prediction
    - Object Detection
    - Traffic Sign Classification
    - Automatic Music Generation
    - Music Genre Classification
    - Text Summarizer
    - Gender and Age Detection Using Voice
    - Chatbot Using Deep Learning
    - Neural Style Transfer
    - Face Aging
    - Driver Drowsiness Detection
    - Language Translator
    - Image Reconstruction

Any other practical covering the syllabus topics and subtopics can be conducted.

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

Text Books:

1. Goodfellow I., Bengio Y., and Courville A., "Deep Learning", MIT Press, 2016.
2. Umberto Michelucci, "Advanced Applied Deep Learning: Convolutional Neural Networks and Object Detection", 2019.
3. Michael Nielsen (Goodreads Author), "Neural Networks and Deep Learning", 2015.
4. Gulli and Kapoor, "TensorFlow 1.x Deep Learning Cookbook", Packt Publishing, 2017.

Reference Books:

1. Yegnanarayana, B., "Artificial Neural Networks", PHI Learning Pvt. Ltd, 2009.
2. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education, 2004.
3. Raúl Rojas, "Neural Networks: A Systematic Introduction", 1996.
4. David Foster, "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", O'Relly, 2019.
5. Maxim Lapan, "Deep Reinforcement Learning HandsOn: Apply modern RL methods, with deep Q-networks, value iteration, policy gradients, TRPO, AlphaGo Zero and more", Packt Publishing, 2018.
6. Santanu Pattanaya K., "Pro Deep Learning with TensorFlow A Mathematical Approach to Advanced Artificial Intelligence in Python", APress, 2017.

Online Resources:

1. **NPTEL:**

   Deep Learning, By Prof. Prabir Kumar Biswas, IIT Kharagpur.

   https://onlinecourses.nptel.ac.in/noc22_cs22/preview

2. **Coursera:**

   Deep Learning Specilization, By DeepLearning.AI

   https://www.coursera.org/specializations/deep-learning#courses

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Software Architecture (22PECO7032T)		
Software Architecture Laboratory (22PECO7032L)		

Prerequisites: Object Oriented Concepts, Software Engineering.

Course Objective(s):

1. To learn and use the Software Architecture with modern tools and techniques.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Specify and evaluate software architectures	L5	Evaluate
CO2	Select and use appropriate architectural styles.	L2	Understand
CO3	Select and use appropriate software design patterns.	L2	Understand
CO4	Understand and perform a design review with agile project architecture.	L2	Understand

Software Architecture (22PECO7032T)
Course Contents

Unit-I — 05 Hrs.

Basic Concepts

Concepts of Software Architecture, Models, Processes, Stakeholders.

Designing Architectures:

The Design Process, Architectural Conception.

Refined Experience in Action: Styles and Architectural Patterns, Architectural Conception in Absence of Experience.

Unit-II — 06 Hrs.

Connectors

Connectors in Action: A Motivating Example, Connector Foundations, Connector Roles, Connector Types and Their Variation Dimensions, Example Connectors.

Unit-III — 04 Hrs.

Modeling: Modeling Concepts, Ambiguity, Accuracy, and Precision.

Complex Modeling: Mixed Content and Multiple Views, Evaluating Modeling Techniques, Specific Modeling Techniques.

Unit-IV — 08 Hrs.

Analysis: Analysis Goals, Scope of Analysis, Architectural Concern being Analyzed, Level of Formality of Architectural Models, Type of Analysis, Analysis Techniques.

Unit-V — 08 Hrs.

Implementation and Deployment

Concepts, Existing Frameworks, Software Architecture and Deployment, Software Architecture and Mobility.

Conventional Architectural styles: Pipes and Filters, Event- based, Implicit Invocation, Layered systems, Repositories, Interpreters, Process control.

Unit-VI — 07 Hrs.

Agile methodology software architecture

Fundamentals of Agile Architecting: Object Orientation Achieving the Vision, Shortcomings of the Models, DCI as a new Paradigm, DCI and Architecture.

Refactoring Software Architecture: Code Refactoring, Refactoring to Patterns, Language [illegible]

ware Architecture in Agile Projects.

Unit-VII

04 Hrs.

Analyzing Architectures: The ATAM, The CBAM, The World Wide Web.

Moving from one System to Many: Software Product Lines, CelsiusTech (Case Study), J2EE/EJB (Case Study), Service-Oriented Architecture (SOA) (Case Study).

Software Architecture Laboratory (22PECO7032L)

List of Laboratory Experiments

Suggested Experiments:

1. Modeling using xADL
2. Visualization using xADL 2.0
3. Integrate software components using a middleware
4. Use middleware to implement connectors
5. Wrapper to connect two applications with different architectures
6. Creating and analyzing web service
7. Domain specific architecture development.
8. Case Study on Agile Methodology Architecture
9. Case Study on Service-Oriented Architecture (SOA

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

Text Books:

1. Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, "Software Architecture: Foundations, Theory and Practice", ISBN: 978-0-470-16774-8.
2. M. Shaw, "Software Architecture Perspectives on an Emerging Discipline", Prentice- Hall.
3. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Pearson.
4. Muhammad Ali Babar, Alan W. Brown, Ivan Mistrik, "Agile Software Architecture", Morgan Kaufmann Publisher(s). ISBN: 9780124078857.

Reference Books:

1. Frank Buchnan etal., "Pattern Oriented Software Architecture", Wiley India.

2. Stephen T. Albin, "The Art of Software Architecture".

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Predictive Modelling (22PECO7033T)		
Predictive Modelling Laboratory (22PECO7033L)		

Prerequisites: Data Mining, Python programming.

Course Objective(s):

1. To learn, how to develop models to predict categorical and continuous outcomes.
2. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction and use the predictive analytics to aid in decision making

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for various business applications.	L2	Understand
CO2	Apply regression, neural network, decision tree in predictive modeling	L3	Apply
CO3	Model assessment and compare the underlying predictive modeling techniques..	L6	Create

Predictive Modelling (22PECO7033T)
Course Contents

Unit-I — 05 Hrs.

Introduction: Identifying the business problem, Designing the model, Preparing the data,Selecting features, How to choose a model, Interpreting the output, Sharing the output.

Unit-II — 05 Hrs.

Working with Data: Understanding and Preparing the Data, Retrieving data from different sources, Visualizing the data and finding the relationship among the data variables, Handling the missing data, Applying distributions and summary statistics. Applying Segmentation, Sampling, Outlier analysis, Aggregating the data.

Unit-III — 08 Hrs.

Prediction Methods and Models: Mathematical Methods, Distance Methods, Logic Methods, Modern heuristic Methods, Additional considerations, Evaluation of Models, Hybrid Systems for prediction, CRISP-Data Mining, Applying to Marketing Campaigns, Manufacturing, Investment Strategies, Emergency Response Services, Credit Card Fraud

Developing and Using Models: Model selection for data, Model development, Model evaluation and validation, comparing and combining models, Deploying Model, Assessing Model Performance, Updating a model.

Unit-IV — 06 Hrs.

Building Decision Tree model to predict Response and Risk Overview of Decision tree and development of decision tree, cultivating decision trees, optimizing the complexity of decision trees, understanding additional diagnostic tools

Unit-V — 10 Hrs.

Predictive Modeling with Neural Networks and Regression: Introduction to neuralnetwork models, Neural Network model to predict loss frequency in Auto Insurance,Comparison of alternative built in architectures of the Neural Network node.

Regression: Regression using exploratory data analysis, producing correlations, understanding the concepts of multiple regression, building and interpreting models, describing all regression techniques, exploring stepwise selection techniques, Logistic regression for predictive response to a mail Campaign, Regression for a continuous target

Unit-VI

05 Hrs.

Comparing and combination of different Models: Introduction, Models for Binary targets, Models for Ordinal Targets, Comparison of all three accidents risk models, Boosting and combining predictive models, comparing the models.

Predictive Modelling Laboratory (22PECO7033L)

List of Laboratory Experiments

Suggested Experiments:

1. Case Study: Identify types of data, Data cleansing and interpreting the data from data visualization.
2. Relationship between attributes: Covariance, Correlation Coefficient, Chi Square, Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts. Using Box Plots to compare distribution) and other statistical graphs.
3. Applying statistical distributions and outlier analysis on data to summarize the data.
4. Applications of Time Series in financial markets to find Moving Averages, Trend, Cyclical and Seasonal analysis.
5. Case study to demonstrate and build a Decision tree.
6. Demonstration of Predictive Modelling using Regression.
7. Demonstration of Predictive modelling using Neural Network.
8. Mini Project.

Any other practical covering the syllabus topics and subtopics can be conducted.

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

Text Books:

1. D. Abbott, *Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst*, 1st ed., Wiley, 2014.
2. Z. Michalewicz, M. Schmidt, M. Michalewicz, and C. Chiriac, *Adaptive Business Intelligence*, 1st ed., Springer, 2006 (softcover reprint 2010).
3. *Applied Analytics Using SAS Enterprise Miner*, SAS Institute Inc.

Reference Books:

1. K. S. Sarma, *Predictive Modeling with SAS Enterprise Miner: Practical Solutions for Business Applications*, 2nd ed., SAS Institute, 2013.
2. E. W. Frees, G. Meyers, and R.A. Derrig (Eds.), *Predictive Modeling Applications in Actuarial Science: Volume 2, Case Studies in Insurance*, Cambridge University Press, 2014.
3. K. P. Murphy, *Machine Learning: A Probabilistic Perspective*, 2nd ed., MIT Press, 2021.
4. *Predictive and Advanced Analytics*, IBM ICE Publication, [latest available edition].

Online Resources:

1. **Coursera:** Regression Modeling Fundamentals
   https://www.coursera.org/learn/regression-modeling-sas
2. **Coursera:** Predictive Modeling with Logistic Regression using SAS
   https://www.coursera.org/learn/sas-predictive-modeling-using-logistic-regression

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Software Testing and Quality Assurance (22PECO7034T)		
Software Testing and Quality Assurance Laboratory (22PECO7034L)		

Prerequisite: Software Engineering.

Course Objective(s):

1. To understand practices that support the production of quality software.
2. To determine and use software testing techniques and quality models.
3. To identify & evaluate defects, test cases, and test results.
4. To determine strategies for units, integration, system, and acceptance testing.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use various Software testing techniques to produce quality software	L3	Apply
CO2	Identify Learn Life-cycle models for requirements.	L1	Remember
CO3	Design process models for units, integration, system, and acceptance testing.	L6	Create
CO4	Identify various Quality Models.	L4	Analyze

Software Testing and Quality Assurance (22PECO7034T) Course Contents

Unit-I

04 Hrs.

Introduction: Software Quality, Role of testing, verification and validation, objectives and issues of testing, testing activities and levels, Sources of Information for Test Case Selection, Introduction to Testing techniques, Introduction to Testing strategies, Test Planning and Design, Monitoring and Measuring Test Execution, Test Tools and Automation, Test Team Organization and Management.

Unit-II

08 Hrs.

System testing techniques and strategies

Unit Testing: Concept of Unit Testing, Static Unit Testing, Defect Prevention, Dynamic Unit Testing, Mutation Testing, Debugging, Unit Testing in extreme Programming.

System Integration Testing: Concept of Integration Testing, Different Types of Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Software and Hardware Integration, Test Plan for System Integration, Off-the-Shelf Component Integration, Off-the-Shelf Component Testing, Built-in Testing.

Acceptance Testing: Types of Acceptance Testing, Acceptance Criteria, Selection of Acceptance Criteria, Acceptance Test Plan, Acceptance Test Execution, Acceptance Test Report, Acceptance Testing in extreme Programming.

Unit-III

10 Hrs.

Control Flow Testing: Outline of Control Flow Testing, Control Flow Graph, Paths in a Control Flow Graph, Path Selection Criteria, All-Path Coverage Criterion, Statement Coverage Criterion, Branch Coverage Criterion, Predicate Coverage Criterion, Generating Test Input, Examples of Test Data Selection.

Data Flow Testing: Data Flow Anomaly, Overview of Dynamic Data Flow Testing, Data Flow Graph, Data Flow Terms, Data Flow Testing Criteria, Comparison of Data Flow Test Selection Criteria, Feasible Paths and Test Selection Criteria, Comparison of Testing Techniques.

Unit-IV

10 Hrs.

System Test Categories: Basic Tests, Functionality Tests, Robustness Tests, Interoperability Tests, Performance Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Documentation Tests.

System Test Execution: Preparedness to Start System Testing, Metrics for Tracking System Test, Metrics for Monitoring Test Execution, Beta Testing, First Customer Shipment, System Test Report.

Product Sustaining, Measuring Test Effectiveness.

Functional Testing: Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, Random Testing, Error Guessing, Category Partition.

System Test Design: Test Design Factors, Requirement Identification, Characteristics of Testable Requirements, Test Design Preparedness Metrics, Test Case Design Effectiveness.

Unit-V 06 Hrs.

System Test Planning and Automation: Structure of a System Test Plan, Introduction and Feature Description, Assumptions, Test Approach, Test Suite Structure, Test Environment, Test Execution Strategy, Test Effort Estimation, Scheduling and Test Milestones, System Test Automation, Evaluation and Selection of Test Automation Tools, Test Selection Guidelines for Automation, Characteristics of Automated Test Cases, Structure of an Automated Test Case, Test Automation Infrastructure.

Unit-VI 04 Hrs.

Software Quality: Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard ISO 9000:2000 Fundamentals, ISO 9001:2000 Requirements.

Software Testing and Quality Assurance Laboratory (22PECO7034L)

List of Laboratory Experiments

Suggested Experiments:

1. Prepare a test case verification document for a given scenario
2. Detailed Test Plan in IEEE format for given case study
3. White Box Testing on Units/Modules of Income Tax Calculator
4. Black Box Testing on Units/Modules of Income Tax Calculator
5. To design test cases for given problem statement based on Decision Table Testing method
6. Study of Automation Software Testing with JUnit
7. To study software Automation Testing with JMeter
8. To study software Automation Testing tool WinRunner for Setting Up the GUI Map
9. To study software Automation Testing tool WinRunner for Checking GUI Objects

10. To study software Automation Testing tool WinRunner Creating Data-Driven Tests

Any other practical covering the syllabus topics and subtopics can be conducted.

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

Text Books:

1. Sagar Naik, University of Waterloo, Piyu Tripathy, "Software Testing and Quality Assurance: Theory and Practice", 9th Edition, Wiley, 2008.

2. Roger Pressman, "Software Engineering: A Practitioners Approach", McGraw-Hill Publications, 2011.

Reference Books:

1. William Perry, "Effective methods for Software Testing", Wiley.

2. Paul C. Jorgensen, "Software Testing - A Craftsmans Approach", CRC Press, 1995.

3. Rajnikant Puranik, "The Art of Creative Destruction", SPD.

4. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing", Pearson Education 2006.

5. Louis Tamres, "Introducing to Software Testing", 1st Edition, Addison Wesley Publications.

6. Glenford J. Myers, John Wiley & Sons, "The Art of Software Testing", 1979.

7. Robert V. Binder, "Testing Object-Oriented Systems: Models Patterns and Tools", Addison Wesley, 2000.

8. Boris Beizer, Van Nostrand Reinhold, "Software Testing Techniques", 2nd Edition, 1990.

9. Daniel Galin, "Software Quality Assurance", Pearson Education.

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Big Data and Cloud Infrastructure Laboratory (22PCCO7040L)		

Prerequisites: Database Management System, Python Laboratory.

Course Objective(s):

1. To equip students with hands-on experience in designing, deploying, and managing cloud-based infrastructure using industry-standard tools and platforms.
2. To enable students to implement and configure distributed data processing systems including Hadoop, Spark, and streaming solutions for handling large-scale datasets.
3. To train students to create complete data processing workflows from ingestion to storage, processing, analysis, and visualization in cloud environments.
4. To apply infrastructure-as-code methodologies and implement robust security measures for cloud-based big data applications.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Successfully architect and implement scalable cloud infrastructure for big data applications using services from major cloud providers.	L2	Understand
CO2	Apply distributed computing frameworks to efficiently analyze and transform large datasets using both batch and real-time processing techniques.	L3	Apply
CO3	Create automated provisioning, deployment, and scaling solutions for complex big data systems using infrastructure-as-code tools.	L6	Create
CO4	Configure comprehensive security controls and monitoring solutions for big data applications while optimizing performance and resource utilization.	L6	Create

Big Data and Cloud Infrastructure Laboratory (22PCCO7040L) Course Contents

Unit-I — 04 Hrs.

Cloud Fundamentals and Storage

Introduction to big data concepts and cloud computing platforms

- Setting up cloud environments (AWS/Azure/GCP)
- Working with cloud storage solutions (S3/Blob Storage/GCS)
- Data transfer protocols and management techniques
- Storage optimization, security, and access control
- Cost Management: cost monitoring tools and budgeting strategies

Unit-II — 04 Hrs.

Virtualization and Container Orchestration

- Virtual machine deployment and management
- Docker containerization for big data applications
- Container orchestration fundamentals
- HDFS architecture and implementation
- Basic MapReduce paradigm and application

Unit-III — 06 Hrs.

Distributed Processing Frameworks

- Advanced Hadoop ecosystem components
- YARN resource management
- Apache Spark architecture and programming
- RDD operations and Spark SQL
- Stream processing with Kafka/Kinesis and Spark Streaming
- Building end-to-end data pipelines

Unit-IV — 04 Hrs.

Cloud-Based Data Management

- NoSQL database deployment (MongoDB, Cassandra)
- Data modeling for distributed environments
- Cloud data warehousing solutions
- ETL processes in cloud environments
- Analytics and visualization platform

Unit-V

04 Hrs.

Advanced Cloud Technologies

- Machine learning on distributed systems
- Model training and deployment at scale
- Infrastructure as Code with Terraform
- Configuration management with Ansible
- CI/CD pipelines for infrastructure and applications

Unit-VI

04 Hrs.

Security, Monitoring, and Project Implementation

- Identity and access management in cloud environments
- Network security configuration
- Monitoring and logging solutions
- Performance optimization techniques

List of Laboratory Experiments

Suggested Experiments:(Any 10)

1. Configure cloud provider accounts and create resource groups.
2. Implement data storage strategies using object storage.
3. Create Docker images for Hadoop and Spark environments.
4. Implement container orchestration for distributed applications.
5. Configure and operate HDFS clusters.
6. Develop MapReduce applications for data processing.
7. Process structured and unstructured data using Spark RDDs.
8. Implement SparkSQL for complex data transformations.
9. Deploy and configure MongoDB and Cassandra clusters.
10. Implement CRUD operations and analyze performance.
11. Design and implement ETL workflows.
12. Preprocess large datasets for ML using distributed computing.
13. Train ML models on cloud infrastructure.

14. Develop Terraform scripts for infrastructure provisioning.

15. Implement Ansible playbooks for configuration management.

16. Configure identity and access management policies.

17. Implement network security controls and encryption.

18. Implement data pipelines across multiple services.

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

Text Books:

1. **"Hadoop: The Definitive Guide"** by Tom White, 4th Edition, 2015, O'Reilly Media, ISBN: 978-1491901632.

2. **"Learning Spark: Lightning-Fast Data Analytics"** by Jules Damji, Brooke Wenig, Tathagata Das, and Denny Lee, 2nd Edition, 2020, O'Reilly Media, ISBN: 978-1492050049.

3. **"Data Science on AWS"** by Chris Fregly and Antje Barth, 1st Edition, 2021, O'Reilly Media, ISBN: 978-1492079385.

4. **"Designing Data-Intensive Applications"** by Martin Kleppmann, 1st Edition, 2017, O'Reilly Media, ISBN: 978-1449373320.

5. **"Cloud Native DevOps with Kubernetes"** by John Arundel and Justin Domingus, 1st Edition, 2019, O'Reilly Media, ISBN: 978-1492040767.

Reference Books:

1. **"Cloud Computing Black Book"**by Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, 1st Edition, 2014, Dreamtech Press, ISBN: 9789351194187 .

2. **"Cloud Computing: A Practical Approach for Learning and Implementation"** A. Srinivasan, J. Suresh, Pearson, 2014, ISBN: 9788131776513 .

3. **"Infrastructure as Code: Managing Servers in the Cloud"**by Kief Morris, 2nd Edition, 2020, O'Reilly Media, ISBN: 978-1098114671.

4. **"Kafka: The Definitive Guide"** by Neha Narkhede, Gwen Shapira, and Todd Palino, 2nd Edition, 2021, O'Reilly Media, ISBN: 978-1492043089.

5. **"NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence"** by Pramod J. Sadalage and Martin Fowler, 1st Edition, 2012, Addison-Wesley Professional, ISBN: 978-0321826626.

6. **"Docker: Up & Running"** by Sean P. Kane and Karl Matthias, 3rd Edition, 2022, O'Reilly Media, ISBN: 978-1098131821.

7. **"Terraform: Up & Running"** by Yevgeniy Brikman, 3rd Edition, 2022, O'Reilly Media, ISBN: 978-1098116743.

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Product Life Cycle Management (22OECO7051T)		

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	L4	Analyze

Product Life Cycle Management (22OECO7051T) 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, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into 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 Engineering	Final Year B.Tech.	Semester: VII
Management Information System (22OECO7052T)		

Prerequisite: Knowledge of basic concepts of Management

Course Objective(s):

1. The course is blend of Management and Technical field.
2. To discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. To define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. To 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 (22OECO7052T) 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., Ramesh Behl, "Management Information Systems", 11^{th} Edition, Tata McGraw Hill, 2019.

2. Kelly Rainer, Brad Prince, "Management Information Systems", 2^{nd} Edition, Wiley, 2013.

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

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

Program: Computer Engineering	Final Year B.Tech	Semester: VII
Operations Research (22OECO7053T)		

Prerequisites: 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 into a Linear Programming Problem and analyse the solution obtained using Simplex method or other algorithms.	L3	Apply
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.	L4	Analyze
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.	L4	Analyze
CO5	Understand the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.	L5	Evaluate
CO6	Describe concept of simulation and apply Monte Carlo Simulation technique to systems such as inventory, queuing and recommend solutions for them.	L3	Apply
CO7	Understand need for right replacement policy and determine optimal replacement age.	L3	Apply

Operations Research (22OECO7053T)
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 and 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 and 2 x n games -Graphical method and method of sub-games.

Expressing game as LPP.

Unit-V

06 Hrs.

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. J. K. Sharma, "Operations Research: Theory & Applications", 6th Edition, New Delhi: Trinity Press (an imprint of Laxmi Publications), 2017.
2. P. K. Gupta and D. S. Hira, "Operations Research", 7th Edition, New Delhi: S.Chand, 2022.

Reference Books:

1. H. A. Taha, *Operations Research: An Introduction*, 10th Edition, Pearson, 2016.
2. A. Ravindran, D. T. Phillips, and J. J. Solberg, *Operations Research: Principles and Practice*, 2nd Edition, John Wiley & Sons, 1991.
3. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research*, 11th Edition, Tata McGraw Hill, 2024.
4. Pradeep Prabhakar Pai, *Operations Research: Principles and Practice*, 1st Edition, Oxford University Press, 2012.
5. R. Panneerselvam, *Operations Research*, 2nd Edition, PHI Publications, 2006.
6. A. M. Natarajan, P. Balasubramani, and A. Tamilarasi, *Operations Research*, 2nd Edition, Pearson Education, 2014.
7. Kanti Swarup, P. K. Gupta, and Man Mohan, *Operations Research*, Sultan Chand & Sons.

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Cyber Security and Laws (22OECO7054T)		

Prerequisite: Knowledge of basic concepts of security.

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 in 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 (22OECO7054T)
Course Contents

Unit-I — 10 Hrs.

Introduction to Cybercrime: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus and Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, 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 EquitiesKnowledge 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, paper 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 and 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 security, 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, 2012.
2. Suresh T. Vishwanathan, "The Indian Cyber Law", 3rd Edition, Bharat Law House, New Delhi, 2022.
3. "The Information Technology Act, 2000", Bare Act- Professional Book Publishers, New Delhi, 2022.
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", 1st Edition, Springer, 2019.
6. Advocate Prashant Mali, "Cyber Law & Cyber Crimes", 2nd Edition, Snow White Publications, Mumbai, 2015.
7. Nina Godbole, "Information Systems Security", 2nd Edition, Wiley India, New Delhi, 2017.
8. Kennetch J. Knapp, "Cyber Security & Global Information Assurance", Information Science Publishing.
9. William Stallings, "Cryptography and Network Security", 8th Edition, Pearson Publication, 2023.

Web Resources:

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 Engineering	Final Year B.Tech.	Semester: VII
Personal Finance Management (22OECO7055T)		

Prerequisites: Basic Knowledge of Algebra, Probability and Statistics.

Course Objective(s):

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familarise the students with microfinance for accelerating the expansion of local microbusinesses.

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.	L3	Apply
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
(22OECO7055T)
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: Person 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 for the Future.

Unit-III — 07 Hrs.

Income Tax Act Basics : Introduction to Income Tax Act, 1961.

Heads of Income and Computation of Total Income and Tax Liability:

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 and 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 and 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 and Assumptions, Types of Microfinance, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation and Operation of Self Help Groups (SHGs).

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

Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints and Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand and 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", 1st Edition, Serials Publication.
3. K. M. Bhattacharya, O. P. Agarwal, "Basics Of Banking & Finance", 3rd Edition, Himalaya Publishing House.
4. S. Subba Reddy , P. Raghu Ram, "Agricultural Finance And Management".
5. Dr. Vasant Desai, "The Indian Financial System And Development", 4th 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", 2021-22 Edition, 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 Engineering	Final Year B.Tech.	Semester: VII
Energy Audit and Management (22OECO7056T)		

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	Understand
CO2	To identify and describe the basic principles and methodologies adopted in energy audit of a utility.	L2	Understand
CO3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.	L3	Apply
CO4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.	L3	Apply
CO5	To analyze the data collected during performance evaluation and recommend energy saving measures.	L4	Analyze

Energy Audit and Management (22OECO7056T) 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. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science.
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System.
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons.
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B. Smith, Pergamon Press.
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press.
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press.
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Disaster Management and Mitigation Measures (22OECO7057T)		

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.	L1	Remember
CO2	Know the institutional framework and organization structure in India for disaster management and get acquainted with government policies, acts and various emergency laws.	L1	Remember
CO3	Get to know the simple dos and don'ts in such extreme events and build skills to respond accordingly.	L3	Apply
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 (22OECO7057T) 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, functionsand 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'sinvolved 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 for disaster risk reduction. Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality

ity, 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 and Reports:

1. H. K. Gupta, "Disaster Management", Universities Press, 2003.
2. O. S. Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", Centre for Land Warfare Studies, New Delhi, 2011.
3. Damon Copolla, "Introduction to International Disaster Management", Butterworth-Heinemann, Elsevier, 2015.
4. Jack Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis Group, 2008.
5. R. Dasgupta, "Disaster Management and 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 and A. K. W. Yonng, "Concepts and Techniques of GIS", Prentice Hall (India), 2006.
8. C. G. F. Gonzales, "Risk Management of Natural Disasters", KIT Scientific Publishing, 2010.
9. W. Nick Carter, "Disaster Management – A Disaster Manager's Handbook", Asian Development Bank, 2008.
10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs, Government of India, 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. Riane Eisler, "The Fukushima 2011 Disaster", Taylor and Francis, Florida, 2013.

(Learners are expected to refer to reports published at national and international levels and updated information available on authentic websites.)

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Science of Well-being (22OECO7058T)		

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 mal-practices 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.	L2	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 (22OECO7058T)
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, 2005.
2. S. Ojha, U. Rani Srivastava, Shobhna Joshi, "Health and Well-Being: Emerging Trends", Global Vision Publishing House, 2010.
3. Charles Richard Snyder, Shane, J. Lopez, Jennifer Teramoto Pedrotti, "Positive psychology: The scientific and practical explorations of human strengths", 2nd Edition, Sage Publications, 2011.

Reference Books:

1. Kitayama S. and 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, 2000.
2. Dubos R., "Man Adapting New Haven", Yale University Press, 1980.
3. McMahon D. M., "Happiness a history", Atlantic Monthly Press, 2006.
4. D. Kahneman, E. Diener and N. Schwarz, "Well-being: The foundations of hedonic psychology", New York: Russell Sage Foundation, 1999.
5. Selye H., "The Stress of Life", New York, McGraw-Hill, 1984.

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Research Methodology (22OECO7059T)		

Prerequisites: 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.	L5	Evaluate
CO4	Review and analyze research findings.	L4	Analyze
CO5	Write report about findings of research carried out.	L6	Create

Research Methodology (22OECO7059T)
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. Catherine Dawson, "Practical Research Methods",New Delhi, UBS Publishers Distributors, 2002.
2. C. R. Kothari, "Research Methodology-Methods and Techniques", New Delhi, Wiley Eastern Limited., 1985.
3. Ranjit Kumar, "Research Methodology-A Step-by-Step Guide for Beginners", 2nd Edition, Pearson Education, Singapore, 2005.

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Public Systems and Policies (22OECO70510T)		

Prerequisites: 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:

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

CO	Course Outcomes	Blooms Level	Blooms 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.	L2	Understand
CO4	Make policies and know about the happenings in the world, in the nation and those in their locality.	L6	Create
CO5	Analyze and evaluate the impact of the public policy on firms and economy at large and work under various fields as policymakers.	L5	Evaluate

Public Systems and Policies (22OECO70510T)
Course Contents

Unit-I — 09 Hrs.

Introduction and Overview of Public Systems: Ideology of Public Systems; 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 Economics Accounts: Public Sector in the circular flow; Public Sector in the 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 and 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. Introduction to Public Policy by Charles Wheelan, W.W. Norton and Company.
2. Understanding Public Policy by Thomas R. Dye, Prentice Hall.
3. Public Policy-Making: An Introduction by Anderson J.E., Boston, Houghton.
4. Public Administration by Avasthi and Maheshwari, Lakshminarayan Agarwal, Agra.
5. New Horizons of Public Administration by Bhattacharya, Mohit, Jawahar Publishers, New Delhi.

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

7. Public Finance 10th Edition by Harvey S Rosen and Ted Gayer, McGraw-Hill Education, 2013.

8. Public Finance in Theory and Practice by Musgrave and Musgrave.

Program: Computer Engineering	Final Year B.Tech.	Semester: VII
Project Stage-II (22PJCO7060L)		

Course Objective(s):

1. To understand the basic concepts and principles in the development of solution.
2. To formulate solution of the problem statement.
3. To implement the solution as per the problem statement.
4. To develop team building, writing, logical reasoning and management skills.
5. To validate the proposed solution with different test cases.
6. To become independent person with ethical values and lifelong learning skills.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To identify the basic concepts and principles in the development of solution for the problem considering cultural, social, environmental and economic factors using appropriate tools and methods.	L4	Analyze
CO2	Demonstrate project based learning that allows students to transfer existing ideas into new applications.	L3	Apply
CO3	Develop an ability to work in teams and manage to conduct the project development activity.	L6	Create
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L6	Create
CO5	Present the project development in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles.	L4	Analyze

Syllabus:

The primary objective is to meet the milestones formed in the overall project plan decided in Project Stage-I. The idea presented in Project Stage-I should be implemented in Project Stage-II with results, conclusion and future work.

Guidelines:

- Each student group is required to maintain a separate log book for documenting various activities of the project (Refer Table 1).
- 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 50% of project stage-II.
- In the second review of this semester, each group is expected to complete 100% of project stage-II.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit a Project Stage-II completion report in the prescribed format for assessment to the departmental committee.
- Assessment of the project stage-II (at the end of the semester) will be done by the departmental committee.
- Oral examination shall be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project stage-II.

Prescribed Project Stage-II Report Guidelines:

The size of the report shall be of minimum 45 pages (excluding the cover and front pages). The Project Stage-II report should include appropriate content for:

- **Abstract**
- **Introduction**
  - Background
  - Motivation
  - Problem Statement
  - Objectives
  - Scope

- **Literature Survey**
  - Review of Existing System(s)
  - Limitations of Existing System(s)
- **Proposed System**
  - Analysis/Framework/ Algorithm
  - Details of H/W and S/W required
  - Design details
  - Methodology (your approach to solve problem)
- **Coding / Implementation**
- **Testing**
- **Conclusion**
- **References**

Assessment criteria for Continuous Assessment:

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

Assessment criteria for End Semester Exam:

Departmental committee will evaluate project as per Table 3.

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 Sheet

Sr	PRN	Name of Student	Student Attendance (5 Marks)	Log Book Maintenance (5 Marks)	Implementation (5 Marks)	Testing (5 Marks)	Report (5 Marks)	Total (25 Marks)

Table 3: Evaluation Sheet

Sr	PRN	Name of Student	Depth of understanding (5 Marks)	Implementation (5 Marks)	Testing (5 Marks)	Report (5 Marks)	Presentation (5 Marks)	Total (25 Marks)

Program: Computer Engineering	Final Year B.Tech	Semester: VII
Employability Skill Development Program-III (22HMCO7070L)		

Course Objective(s):

1. To build a solid foundation in programming fundamentals.
2. To enhance problem-solving abilities through mathematical reasoning.
3. To develop algorithmic thinking.
4. To provide hands-on experience with essential data structures.

Course Outcomes:

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

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 (22HMCO7070L) 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.

Semester - VIII

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
Web Intelligence (22PECO8011T)		

Prerequisites: Statistics, Machine Learning, Data Mining.

Course Objective(s):

1. To gain a background in Web mining techniques.
2. To extract knowledge from the social web for web analytics.
3. To enable students to solve complex real-world problems for sentiment analysis and Recommendation systems.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Interpret the terminologies and perspectives of Web Mining.	L2	Understand
CO2	Perform social network analysis to identify communities and network properties in social media sites.	L3	Apply
CO3	Extract and Integrate information from the web for real-world scenarios.	L4	Analyze
CO4	Design new solutions to opinion extraction and sentiment classification problems.	L5	Create
CO5	Provide solutions to the emerging problems with social media using Recommendation systems.	L5	Evaluate

Web Intelligence (22PECO8011T)
Course Contents

Unit-I — 04 Hrs.

Introduction: World Wide Web, History of the Web and the Internet, what is Data Mining? What is Web Mining? Introduction to Association Rule Mining, Supervised Learning & Unsupervised Learning. Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval Models, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression, Latent Semantic Indexing, Web Search, Meta-Search: Combining Multiple Rankings, Web Spamming.

Unit-II — 08 Hrs.

Social Network Analysis: Social Network Analysis: Introduction, Co-Citation and Bibliographic Coupling, Page Rank, HITS Algorithm, Community Discovery.

Web Crawling: A Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers, Evaluation, Crawler Ethics and Conflicts.

Unit-III — 07 Hrs.

Structured Data Extraction: Wrapper Generation, Preliminaries, Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation Problems, String Matching and Tree Matching, Building DOM Trees, Extraction Based on a Single List Page, Extraction Based on Multiple Pages.

Unit-IV — 07 Hrs.

Information Integration: Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema-Level Matching, Domain and Instance-Level Matching, Combining Similarities, Integration of Web Query Interfaces, Constructing a Unified Global Query Interface.

Unit-V — 07 Hrs.

Opinion Mining and Sentiment Analysis: The Problem of Opinion Mining, Document Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect- Based Opinion Mining, Opinion Search and Retrieval, Opinion Spam Detection.

Unit-VI — 06 Hrs.

Web Usage Mining: Data Collection and Pre-Processing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Recommender Systems and Collaborative Filtering, Query Log Mining, Computational Advertising.

Text Books:

1. Bing Liu, "Web Data Exploring Hyperlinks, Contents, and Usage", Springer-Verlag, Berlin, Heidelberg, 2nd Edition, 2009.

2. Priti Srinivas Sajja, Rajendra Akerkar, "Intelligent Technologies for Web Applications" CRC Press, Publisher: Taylor & Francis, 3rd Edition, 2019.

3. Rajendra Akerkar, Pawan Lingras, "Building an Intelligent Web Theory and Practice" Jones & Bartlett Learning, 2nd Edition, 2010.

4. Avinash Kaushik "Web Analytics: An Hour a Day", Publisher: Sybex, USA, 2007.

Reference Books:

1. Jiawei Han, Micheline Kamber,Jian Pei, "Data Mining: Concepts and Techniques", Elsevier Publications, Morgan Kaufmann Publishers Inc.,San Francisco, CA, USA 3rd Edition, 2011.

2. Anthony Scime, "Web Mining: Applications and Techniques", Publisher:Idea Group Pub., IGI, 1st Edition, 2005.

3. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Publisher: Morgan Kaufmann Publishers Inc.,San Francisco, CA, USA, 1st Edition, 2002.

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
High Performance Computing (PECO8012T)		

Prerequisites: Operating System, Computer Organization.

Course Objective(s):

1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming.
3. To design parallel programs on high performance computing.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Comprehend fundamental concepts parallel processing approaches.	L2	Understand
CO2	Describe different parallel processing platforms involved in achieving High Performance Computing.	L2	Understand
CO3	Understand different design issues in parallel programming.	L2	Understand
CO4	Develop efficient and high-performance parallel programming.	L6	Create
CO5	Understand parallel programming using message passing paradigm using open-source APIs and shared address space platforms.	L2	Understand

High Performance Computing (PECO8012T)
Course Contents

Unit-I — 06 Hrs.

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function).

Classification Models: Architectural Schemes (Flynn's, Shore's, Feng's, Handler's) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory).

Parallel Architectures: Pipeline Architecture, Array Processor, Multiprocessor Architecture.

Unit-II — 06 Hrs.

Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines.

Unit-III — 08 Hrs.

Parallel Algorithm Design

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads. Parallel Algorithm Models, Basic Communication operations: Broadcast and Reduction Communication types.

Unit-IV — 08 Hrs.

Performance Measures: Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahls Law, Gustavsons Law, Performance Bottlenecks.

Unit-V — 06 Hrs.

Programming Using the Message-Passing Paradigm

Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations.

Unit-VI — 08 Hrs.

Programing Shared Address Space Platform

Thread Basics, The POSIX Thread API, Synchronization Primitives in Pthreads, Controlling Threads and Synchronization attributes, Thread Cancellation, OpenMP: a Standard for Directi[illegible]ar-

allel Programming.

Text books:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Pearson Education, 2nd Edition, 2007.

2. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill International Editions, Computer Science Series, 2008.

Reference Books:

1. Laurence T. Yang, MinyiGuo, "High- Performance Computing: Paradigm and Infrastructure", Wiley, 2006.

2. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

3. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", 2nd Edition, McGraw Hill, 2010.

Web Resources:

1. Coursera Course on 'Parallel, Concurrent, and Distributed Programming in Java Specialization'.

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
Cloud Computing (PECO8013T)		

Prerequisites: Information Security, Web programming.

Course Objective(s):

1. To capture the state-of-the-art in Cloud Computing technologies and applications.
2. To cover a series of current cloud computing technologies, including technologies for Virtualization, Infrastructure as a Service, Platform as a Service and Software as a Service.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the fundamental concepts of cloud computing.	L2	Understand
CO2	Explore the virtualization at various layers of cloud infrastructure.	L6	Create
CO3	Analyse various cloud security concerns and mechanisms.	L3	Apply
CO4	Assess the need and then migrate to cloud.	L5	Evaluate
CO5	Explain Hadoop File System and role of HDFS in cloud.	L2	Understand

Cloud Computing (PECO8013T)
Course Contents

Unit-I — 04 Hrs.

Introduction to Cloud Computing

What is cloud computing?, Properties & Characteristics, Service models, Deployment models.

Unit-II — 08 Hrs.

Infrastructure as a Service (IaaS)

Introduction to IaaS, Resource Virtualization (Server, Storage, Network).

Unit-III — 06 Hrs.

Platform as a Service (PaaS)

Introduction to PaaS, Cloud platforms & Management (Computation and Storage), Case studies.

Unit-IV — 10 Hrs.

Software as a Service (SaaS)

Introduction to SaaS, Web services, Web 2.0, Web OS.

Unit-V — 10 Hrs.

Hadoop

Hadoop distributed file system, distributed computations with MapReduce, Hadoop's data and I/O building blocks. Hadoop in the cloud.

Unit-VI — 05 Hrs.

Cloud Security

Cloud Security reference model, governance and enterprise risk management, compliance and audit management,information management and data security.

Unit-VII — 02 Hrs.

Migration to Cloud

Cloud models suitable for different categories of users, Considerations for choosing applications suitable for cloud, Different phases to adopt the cloud.

Text Books:

1. Raj Buyya, Christian Vecchiola, S. Selvi, "Mastering Cloud Computing", TMH, 2013.
2. RajkumarBuyya, James Broberg, Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley India, 2013.

Reference Books:

1. Tom white, "Hadoop: The Definitive Guide", Ed. O'Reilly, 2012.
2. Chuck Lam, "Hadoop in action", Dreamtech Press, 2011.
3. Dr. Kumar Saurabh, "Cloud Computing: Insights into New-Era Infrastructure", 1st Edition, Wiley India, 2011.
4. Anthony T. Velte, "Cloud Computing: A Practical approach", TMH, 2009.
5. Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, "Cloud Computing For Dummies", Wiley India, 2009.

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
Blockchain Technology (22PECO8021T)		

Prerequisites: Knowledge of Information Security and Network Fundamentals.

Course Objective(s):

1. To understand emerging abstract models for Blockchain Technology and its relevance with cryptography.
2. To identify major research challenges and technical gaps existing between theory and practice in crypto currency domain.
3. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
4. To apply hyperledger Fabric and Etherum platform to implement the Block chain Application.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Acquire basic knowledge of Blockchain technology and Analyze various algorithms used in Blockchain.	L2	Understand
CO2	Introduce cryptocurrency and various regulations.	L2	Understand
CO3	Aware of privacy and security issues and applications in Blockchain.	L3	Apply
CO4	Design and understand various applications using Blockchain and Distributed Foundation and case studies	L6	Create

Blockchain Technology (22PECO8021T)
Course Contents

Unit I Distributed Computing Foundations and the Emergence of Blockchain Technology: 07 Hrs.

Introduction to Distributed Systems, Challenges in Distributed Record Keeping

Fault Tolerance: Crash vs Byzantine Failures

The Byzantine Generals Problem and Consensus

Scalability of Consensus Algorithms, Nakamoto Consensus and the Genesis of Blockchain,

Core Technologies in Blockchain: Hash Pointers Merkle Trees, Consensus Mechanisms (PoW, PoS), Byzantine Fault Tolerance, Digital Cash and Cryptographic Security

Atomic Broadcast and Blockchain Consistency.

Unit II Basic Crypto primitives and Blockchain 1.0 07 Hrs.

Cryptographic Building Blocks: Hash Functions: Pre-image resistance, Puzzlefriendliness, Collision Resistance, Public Key Cryptography and Digital Signatures, Verifiable Random Functions, Zero-Knowledge Proofs (Intro and Relevance in Privacy),

Bitcoin and Blockchain 1.0: Overview of Bitcoin Blockchain, Challenges in Bitcoin: Scalability, Energy, Transaction Throughput, Solutions and Workaroumds (SegWit, Lightning Network, etc.),

Consensus Mechanisms: Proof of Work: How and Why it Works, Proof of Stake and Other Alternatives, Trade-offs: Security, Scalability, Decentralization, Bitcoin Scripting: Basics of Bitcoin Script, Use Cases: Multi-sig, Time locks, Escrow, Limitations and Future Extensions

Unit III Blockchain 2.0 07 Hrs.

Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts.

Unit IV Blockchain 3.0 07 Hrs.

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain. The Linux Foundations Hyperledger Fabric and Microsoft Azures Blockchain as a Service.

Unit V Privacy, Security Issues in Blockchain 07 Hrs.

Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains such as Sybil attacks, selfish mining, 51% attacks advent of algorand, and Sharding based consensus algorithms to prevent these attacks.

Unit VI Blockchain Applications and DiFi Foundations 07 Hrs.

Applications of Blockchain in Healthcare, Automotive, Government, Insurance, Media and Entertainment. Distributed Ledger Technology: Governance and Regulations, Applications in Governance, Global Perspectives, Case Study:– Estonian block chains transform paying, trading, and signing. DiFi Foundations, Role of quantum computing in crypto ecosystem. a key ingredient for Distributed Finance. Introduction to Web 3.0: Decentralized web concepts, protocols, and impact Tokenization: Types of tokens (fungible, non-fungible).

Text Books:

1. Josh Thompson, "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Create Space Independent Publishing Platform, 2017.
2. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, "Blockchain Technology: Cryptocurrency and Applications", Oxford University Press, 2019.

Reference Books:

1. Dr. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger", Yellow paper, 2014.
2. Antony Lewis, "Basics of Bitcoins and Blockchain", Mango Publishing, 2018.

Web Resources:

1. Centre of Excellence, IIT Bombay (https://isrdc.iitb.ac.in/blockchain/coe/areas.html, portal accessed on 15.11.2021).
2. Course Link by IIT Kanpur (https://www.cse.iitk.ac.in/pages/CS731.html, portal accessed on 15.11.2021)
3. Course Link by Coursera (https://www.coursera.org/learn/decentralized-finance-infrastructure-duke, portal accessed on 10.11.2021).
4. Course Link by Coursera (Bitcoin and Cryptocurrency Technologies — Coursera, portal accessed on 09.11.2021).

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
Social Network Analysis (22PECO8022T)		

Prerequisites: Discrete Mathematics, Machine Learning.

Course Objective(s):

1. To introduce students to the fundamental concepts of social networks and graph theory.
2. To Design graph-based models for representing social data and apply network analysis techniques to reason about social relationships and interactions.
3. To familiarize students with ontological modeling, knowledge representation, and reasoning in social networks.
4. To develop practical skills in applying algorithms and visualization techniques to study network dynamics, information diffusion, and community evolution in real-world social networks.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and explain the foundational concepts of social networks, including their structure, evolution, and applications using graph theory.	L2	Understand
CO2	Construct ontological models and perform reasoning over social data to support semantic web applications.	L6	Create
CO3	Evaluate dynamic behaviors such as cascades and community evolution in large-scale social networks.	L5	Evaluate
CO4	Extract, analyze, and visualize web-based social network data using matrix, graph-based, and hybrid visualization techniques.	L4	Analyse

Social Network Analysis (22PECO8022T)
Course Contents

Unit-I — 05 Hrs.

Introduction to Social Networks: Introduction, History of social network analysis, Development of Social Network Analysis, measures in network analysis, Social Networks vs. Link Analysis, The Power of Informal Networks, The Power of Social Networks, Applications of Social Networks in Real Life.

Unit-II — 08 Hrs.

Basics of Graph Theory and Structure: Choice of Representation, Degree of a Vertex, Degree Distribution, Average Degree of a Graph, Complete Graph, Regular Graph, Bipartite Graph, Graph Representation, Edge Attributes, Path, Cycle, Path Length, Distance, Average Path Length, Connectedness of Graphs, Clustering Coefficient, Average Clustering Coefficient, Algorithms, First Set of Experiments—Degree Distributions, Second Set of Experiments—Connected Components, Third Set of Experiments—Number of Breadth First Searches, Rank Exponent R, Out-Degree Exponent O, Hop Plot Exponent H, Eigen Exponent E, Permutation Model, Random Graphs with Prescribed Degree Sequences.

Unit-III — 06 Hrs.

Knowledge Representation, Modelling and aggregating: Introduction to semantic Web, Ontologies and their role in the Semantic Web, Ontology languages for the Semantic Web, State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Building Semantic Web applications with social network features.

Unit-IV — 06 Hrs.

Cascading in Social Networks: Decision Based Models of Cascade: Collective Action, Cascade Capacity, Co-existence of Behaviours, Cascade Capacity with Bilinguality, Probabilistic Models of Cascade, Branching Process, Basic Reproductive Number, SIR Epidemic Model, SIS Epidemic Model, SIRS Epidemic Model, Transient Contact Network, Cascading in Twitter.

Unit-V — 08 Hrs.

Extracting and Analyzing Web Social Networks: Extracting Evolution of Web Community from a Series of Web Archive: Types of Changes, Evolution Metrics, Web Archives and Graphs, Evolution of Web Community Charts, Temporal Analysis on Semantic Graph using Three-Way Tensor Decomposition: Background, Algorithms, Examples of Formed Community, Analysis of Communities

and Their Evolutions in Dynamic Networks: Motivation, Problem Formulation, Algorithm, Community Discovery Examples, Socio-Sense: A System for Analyzing the Societal Behavior from Web Archive: System Overview, Web Structural Analysis, Web Temporal Analysis, Consumer Behavior Analysis.

Unit-VI 06 Hrs.

Visualizing Social Networks: Introduction, A Taxonomy of Visualizations: Structural Visualization , The value of network layout in visualization, Node-link diagrams, Matrix Oriented Techniques, Hybrid Techniques, Semantic and Temporal Visualization: Ontology-based visualization, Temporal Visualization, Statistical Visualization, The Convergence of Visualization, Interaction and Analytics: Visualization and Analysis, Visualization and Interaction, Structural and Semantic Filtering with Ontologies, Centrality-based Visual Discovery and Exploration.

Text Books:

1. Maksim Tsvetovat and Alexander Kouznetsov, "Social Network Analysis for Startups", O'Reilly, 2011.
2. Krishna Raj P.M., Ankith Mohan, K.G. Srinivasa, "Practical Social Network Analysis with Python, Springer, 2018.
3. John Scott, "What is Social Network Analysis", Bloomsbury Academic, 2012.
4. Peter Mika, "Social Networks and the Semantic Web", Springer, 2007.
5. Guandong Xu, Yanchun Zhang, Lin Li, "Web Mining and Social Networking", Springer, 2011.
6. Charu C. Aggrwal, "Social Network Data Analytics", Springer, 2011.

Reference Books:

1. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications", Cambridge University Press, 1994.
2. Stephen P Borgatti, Martin G Everett and Jeffrey C Johnson, "Analyzing Social Networks", SAGE, 2013.
3. Mehmet Kaya, Reda Alhajj, "Influence and Behavior Analysis in Social Networks and Social Media", Springer, 2019.

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
Ethical Hacking and Digital Forensics (22PECO8023T)		

Prerequisite: Information Security.

Course Objective(s):

1. To understand ethical hacking concepts, hacker classifications, and hacking methodologies.
2. To understand and use basic tools and methods to find information about computer systems through footprinting, scanning, and enumeration.
3. To introduce the phases and tools used in penetration testing and system hacking.
4. To explain the fundamentals and significance of digital forensics in various domains.
5. To develop the ability to collect, preserve, and analyze digital evidence using proper techniques and tools while considering legal and anti-forensic challenges.
6. To familiarize students with modern forensic tools and techniques used in email and mobile device investigations.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain ethical hacking concepts, hacker types, legal aspects, and real-world application	L2	Understand
CO2	Use footprinting, scanning, and enumeration tools to gather system and network information.	L2	Understand
CO3	Perform penetration testing and demonstrate basic system hacking techniques.	L3	Apply
CO4	Identify digital evidence and apply file system and disk forensics tools.	L3	Apply
CO5	Apply evidence collection, hashing, and anti-forensics detection methods.	L3	Apply
CO6	Analyze network traffic, email artifacts, and mobile device data using forensic tools.	L4	Analy

Ethical Hacking and Digital Forensics (22PECO8023T) Course Contents

Unit I Introduction to Ethical Hacking Technology: 06 Hrs.

Introduction to Ethical Hacking, Classification of Hackers (White Hat, Black Hat, Grey Hat), Phases of Ethical Hacking, Cybersecurity vs Ethical Hacking, Cyber Laws and Ethical Responsibilities, Introduction to Artificial Intelligence in Cybersecurity and Hacking, Industry Certifications in Ethical Hacking, Scope and Career Opportunities in Ethical Hacking, Real-World Case Studies of Ethical Hacking.

Unit II Footprinting, Scanning, and Enumeration: 06 Hrs.

Footprinting Techniques, DNS Interrogation, Email Harvesting, Social Engineering, Footprinting Tools (Maltego, Recon-ng), Scanning Methodology, Port Scanning Types and Tools (Nmap, Netcat), Enumeration Techniques, Enumeration Tools (SNMP, SMB, LDAP), Banner Grabbing, Use of AI for Automated Reconnaissance and Threat Detection

Unit III Penetration Testing and System Hacking 07 Hrs.

Penetration Testing: Fundamentals of Penetration Testing, Types of Penetration Testing (Black Box, White Box, Grey Box), Phases of Penetration Testing, Penetration Testing Tools (Metasploit, Burp Suite, Nikto,etc)

System Hacking: Password Attacks (Brute-force, Dictionary, Rainbow Tables), Privilege Escalation Techniques, Malware and Rootkits, Executing Applications and Hiding Files, System Hacking Tools, Introduction to Dark Web and TOR Network, Dark Web-based Threat Intelligence and Anonymity Tools .

Unit IV Introduction to Digital Forensics 07 Hrs.

Definition and Scope of Digital Forensics, Types and Characteristics of Digital Evidence, Phases of a Digital Investigation, File System Forensics (FAT, NTFS), Disk Imaging and Cloning (Bit-by-Bit Copy), Data Recovery Concepts, Deleted File and Slack Space Analysis, Metadata Extraction and Timestamp Interpretation, Disk Forensics Tools (FTK Imager, Autopsy, EnCase), Role of AI and Machine Learning in Digital Forensics.

Unit V Evidence Collection and Data Analysis 07 Hrs.

Evidence Collection Techniques (Live vs Dead), Chain of Custody and Legal Considerations, Volatile and Non-Volatile Evidence Acquisition, Remote Evidence Acquisition, Hashing Algorithms (MD5, SHA1, SHA256) for Verification, Write Blockers and Imaging Devices, Anti-Forensics Techniques

(Data Hiding, Steganography, File Obfuscation), Detection and Countering Anti-Forensics, Use of AI Tools for Pattern Detection and Data Anomaly Analysis , Data Carving and Signature-Based Recovery.

Unit VI Network, Email, and Mobile Forensics 06 Hrs.

Network Forensics (Packet Capture, Flow Analysis), Live Traffic Monitoring Tools (Wireshark, TCP-Dump), Log File and Firewall Analysis, Intrusion Detection Logs, Honeynet and Sandbox Environments, Email Forensics (Header and Server Log Analysis, MIME Format), Mobile Device Forensics (Android and iOS), Acquisition Techniques (Logical, Physical, Cloud), SIM and App Data Extraction, Tools (Cellebrite, XRY, MOBILedit), Open Source Intelligence (OSINT) and Threat Attribution Techniques.

Text Books:

1. EC-Council "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning.2nd Edition, 2017
2. Rafay Boloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2014.
3. John R. Vacca, "Computer Forensics", Computer Crime Investigation Firewall Media, New Delhi. 2012
4. Nelson, Phillips, Steuart, "Guide to Computer Forensics and Investigations", CENGAGE Learning, 6th Edition, 2020.
5. E. Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet", 3rd ed. Burlington, MA, USA: Academic Press, 2011.
6. S. Davidoff and J. Ham, "Network Forensics: Tracking Hackers through Cyberspace". Upper Saddle River, NJ, USA: Prentice Hall, 2012.

Reference Books:

1. Kevin Smith, "Hacking How to Hack - The ultimate Hacking Guide", Hacking Intelligence.2018
2. Kevin Beaver, "Ethical Hacking for Dummies", Sixth Edition, Wiley, 2018.
3. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, "Real Digital Forensics", Addison- Wesley Pearson Education 2006
4. Tony Sammes and Brian Jenkinson, "Forensic Compiling", A Tractitioneris Guide, Springer International edition.
5. Christopher L.T. Brown, "Computer Evidence Collection & Presentation", Fir[illegible]

6. Jesus Mena, "Homeland Security, Techniques & Technologies", Firewall Media.

7. J. T. Luttgens, M. Pepe, and K. Mandia, "Incident Response and Computer Forensics", 3rd ed. New York, NY, USA: McGraw-Hill Education, 2014.

Program: Computer Engineering	Final Year B.Tech.	Semester: VIII
Internship (22INTCO8030L)		

Course Objective(s):

1. To expose technical students for the industrial environment, allowing them to gain real-world experience and develop into competent professionals.
2. To provide opportunities to learn and enhance the practical technical skills required for professional roles.
3. To familiarize students with current technological developments relevant to their field of study.
4. To develop technical writing skills for reports and projects.
5. To introduce students to the responsibilities and ethics of the engineering profession.
6. To develop an understanding of employee psychology, habits, attitudes, and problem-solving approaches.

Course Outcomes:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the basics of science and engineering to systematically investigate and interpret an engineering problem.	L3	Apply
CO2	Build technical knowledge to enhance the problem-solving approaches for complex problem.	L6	Create
CO3	Develop awareness about general workplace behavior and build interpersonal and team skills.	L6	Create
CO4	Develop logical reasoning, report writing, presentation and management skills.	L6	Create
CO5	Understanding of lifelong learning processes through internship experience.	L2	Understand

Internships offer valuable educational and career development opportunities by providing students with practical experience in their field of study. In Semester–VIII, students have two options for their internship: Industry Internship and In-house Internship.

1. Industry Internship

Industry Internship Guidelines:

- The Training and Placement (T&P) cell of the institute will arrange internships for students in industries/organizations after the seventh semester.
- Students are expected to accept internship offers regardless of the company, job profile, location, or stipend offered.
- Alternatively, students can individually apply by submitting "Student Internship Program Application" (available on Institute Website) for industry internships, adhering to the prescribed guidelines as follows:

    1. Only T&P department granted internship will be considered.
    2. The internship duration should be of minimum 12 Weeks.
    3. Each student needs to take prior permission from T&P department before proceeding for any internship opportunity on his/her own.
    4. Each student will be monitored twice (virtually/through online meetings) during the internship period in the presence of an industry mentor and the departmental faculty mentor and the concerned TPC.
    5. If any student wants to withdraw from the Internship, he/she can only be allowed within two weeks of joining the same. Such students will have to continue the semester VIII academic activities regularly along with In-house internship.

Expected Activity in Industry Internship:

- Students may choose to work on innovation or entrepreneurial activities resulting in start-ups or undergo internships with Industry/NGO/ Government organizations/Micro/ Small/ Medium enterprises to prepare for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him/her. The evaluation of these activities will be done twice (virtually/through online meetings) during the internship period by the committee constituted by the Head of the Department which shall include Industry mentor, faculty mentor and Department T&P Co-ordinator (TPC). The assessment criteria for continuous assessment is as per Table 4.

Table 4: Continuous Assessment for Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Skills Gained/Enhanced (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

- The ESE will be jointly evaluated by an industry mentor, faculty member and department T&P coordinator (TPC). The evaluation criteria is as per Table 5.

Table 5: Evaluation Criteria of Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Skills Gained/Enhanced (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

Industry Internship Report:

- Upon completion of the internship, students should prepare a comprehensive report that reflects their observations and learnings during the internship period. Students can consult their Industrial Supervisor, Faculty Mentor, or T&P Co-ordinator/Officer for guidance on selecting special topics and problems for the report.

- The internship report will be evaluated based on the following criteria:

  i. Adequacy and purposeful write-up.

  ii. Variety and relevance of learning experience.

  iii. Practical applications and connections with the fundamental theories and concepts covered in the course (Semester I to VII).

2. In-house Internship

The in-house internship provides students with research-oriented opportunities to cultivate a research mindset. It serves as an extension of the project completed in VI and VII semesters (Project Stage-I & II) or offers new objectives provided by the department or research guide.

1. The in-house internship can be pursued individually or as a group activity.

2. If extending a project from Stage II, at least one student in the group must have participated in Stage I & II.

3. If working on the topic offered by the department or in-house mentor, a group of fresh students can form a team.

4. The maximum group size is limited to four students.

5. In case of extension of project stage II, the outcomes should be in the form of product development/technology transfer along with patent and copyright / one research publication (UGC care listed journal/conference). Students can work jointly with any government funding agency or industry. In such cases, a detailed project report shall be submitted after verification by the in-house mentor and industry/funding agency mentor/authority. In case of standalone/non-sponsored activity, i.e. without any funding agency/industry collaboration, the detailed project report shall be submitted after verification by the in-house mentor.

6. If pursuing a Topic offered by the department or in-house mentor, the outcome of the in-house internship should include the publication of a research paper, preferably in an SCI/Scopus/UGC care listed/indexed Journal/Conference. The detailed project report must be submitted and verified by the in-house mentor.

7. All the designated work shall be submitted to the department in the form of a report in hardbound as well as soft copy.

8. **Evaluation Scheme:**

   I. Continuous Assessment:

   (a) A logbook (as per Table 6) of the work done must be maintained by each group.

   (b) Each in-house internship activity will be reviewed twice in the semester. In the first review (as per Table 7), at least 40% work shall be completed including the topic identification / introduction/ scope of the work, literature survey, problem definition and objectives. The remaining 60% of work shall be completed in the second review (as per Table 8) including implementations, key findings, publications &/ patenting &/ copyright &/ product development etc.

   II. End Semester Examination:

   End semester examination (as per Table 9) will be jointly evaluated by the faculty mentor and an external examiner appointed by the HOD in consultation with the COE.

9. **Assessment Formats:**

Table 6: Log Book Format

Sr	Week (Start Date: End Date)	Work Done	Sign of In-house mentor	Sign of Coordinator
1				

Table 7: First Review

Topic Identification & Validation (20 Marks)	Literature Survey (20 Marks)	Problem Definition (20 Marks)	Objectives (15 Marks)

Table 8: Second Review

Implementation (20 Marks)	Publications (20 Marks)	Report (20 Marks)	Presentation (15 Marks)

Table 9: End Semester Examination

Topic Identification & Validation (30 Marks)	Literature Survey & Problem Definition (30 Marks)	Objectives & Implementation or Product Development (30 Marks)	Presentation (30 Marks)	Report, Publications/Patent/IPR Documents (30 Marks)