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 2023-24

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

Semester-VII (w.e.f. 2023-24)

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)	Best of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC1	PCCO7010T	Digital Signal Processing and Applications	3			20	15	15	15	65	100	3	4
	PC1L	PCCO7010L	Digital Signal Processing and Applications Laboratory			2	25				25	50	1	
2	PC2	PCCO7020T	Distributed Computing	3			20	15	15	15	65	100	3	4
	PC2L	PCCO7020L	Distributed Computing Laboratory			2	25				25	50	1	
3@	PE	PECO7031T	Deep Learning	3			20	15	15	15	65	100	3	4
		PECO7031L	Deep Learning Laboratory			2	25				25	50	1	
		PECO7032T	Blockchain Technology	3			20	15	15	15	65	100	3	
		PECO7032L	Blockchain Technology Laboratory			2	25				25	50	1	
		PECO7033T	Predictive Modeling	3			20	15	15	15	65	100	3	
		PECO7033L	Predictive Modeling Laboratory			2	25				25	50	1	
4#	OE	OECO7041T	Product Life Cycle Management	3			20	15	15	15	65	100	3	3
		OECO7042T	Management Information System	3			20	15	15	15	65	100	3	
		OECO7043T	Operations Research	3			20	15	15	15	65	100	3	
		OECO7044T	Cyber Security and Laws	3			20	15	15	15	65	100	3	
		OECO7045T	Personal Finance Management	3			20	15	15	15	65	100	3	
		OECO7046T	Energy Audit and Management	3			20	15	15	15	65	100	3	
		OECO7047T	Disaster Management and Mitigation Measures	3			20	15	15	15	65	100	3	
		OECO7048T	Science of Well-being	3			20	15	15	15	65	100	3	
		OECO7049T	Research Methodology	3			20	15	15	15	65	100	3	
		OECO70410T	Public Systems and Policies	3			20	15	15	15	65	100	3	
5	PJ	PJCO7050L	Project Stage-II			8	25				25	50	4	
			Total	12		14	180			60	360	600	19	

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

Semester-VIII (w.e.f. 2023-24)														
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)	Best of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1@	PE1	PECO8011T	Web Intelligence*	3			20	15	15	15	65	100	3	3
		PECO8012T	High Performance Computing*	3			20	15	15	15	65	100	3	
		PECO8013T	Cloud Computing*	3			20	15	15	15	65	100	3	
		PECO8014T	NPTEL/Swayam Course#	3			20	15	15	15	65	100	3	
2@	PE2	PECO8021T	Natural Language Processing*	3			20	15	15	15	65	100	3	3
		PECO8022T	Software Architecture*	3			20	15	15	15	65	100	3	
		PECO8023T	Software Testing and Quality Assurance*	3			20	15	15	15	65	100	3	
		PECO8024T	NPTEL/Swayam Course#	3			20	15	15	15	65	100	3	
3	INT	INTCO8030L	Internship			20	150				150	300	10	
			Total	6		20	190			30	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. List of NPTEL courses will be declared by concerned BOS at the beginning of the semester-VIII.

Prepared by: Salunkhe
Ms. S. P. Salunkhe

Checked by: Sonawane
Ms. J. S. Sonawane

Prof. Dr. Nitin N. Patil
B.O.S 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 Shirpur Education Society
Autonomous

Semester - VII

Digital Signal Processing and Applications (PCCO7010T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Engineering Mathematics-III, Engineering Mathematics- IV.

Course Objectives:

- To understand the fundamental concepts of signal processing and applications.
- To develop a thorough understanding of DFT and FFT and their applications.
- To apply image enhancement techniques.
- To apply image segmentation techniques.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand concept of digital signal processing and applications.	L2	Understand
CO2	Classify and analyze discrete time signals and systems.	L4	Analyze
CO3	Apply the efficient computing algorithms of DFT and FFT in finding the response of the system.	L3	Apply
CO4	Use the enhancement techniques for digital Image Processing.	L3	Apply
CO5	Apply digital image processing techniques for edge detection.	L3	Apply

Course Contents

Unit-I — 10 Hrs.

Discrete-Time Signal and Discrete-Time System

Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations (shifting, reversal, scaling, addition, multiplication).

Classification of Discrete-Time Signals, Classification of Discrete Systems

Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution.

Unit-II — 10 Hrs.

Discrete Fourier Transform

Introduction to DTFT, Relation between DFT and DTFT, DFT of DT signal, Inverse DFT.

Properties of the DFT: Scaling and Linearity, Symmetry for real valued signal, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals Energy Theorem.

Fast Fourier Transform

Fast Fourier Transform: Need of FFT, Radix-2 DIT-FFT algorithm.

Flow graph for N=4 and 8 using Radix-2 DIT-FFT, Inverse FFT algorithm, Comparison of complex and real, multiplication and additions of DFT and FFT.

Unit-III — 04 Hrs.

DSP Algorithms

Fast Circular Convolution Algorithm, Fast Linear Convolution Algorithm.

Linear FIR filtering using Overlap Add Algorithm and Overlap Save Algorithm and implementation using FFT.

DSP Application

Audio and speech processing, statistical signal processing, digital image processing, data compression, video coding, audio coding, image compression, signal processing for telecommunications.

Unit-IV — 04 Hrs.

Digital Image Fundamentals

Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization.

Representation of Digital Image, Connectivity, Image File Formats: BMP, TIFF and JPEG.

Unit-V 09 Hrs.

Spatial Domain Filtering

Intensity transformations, contrast stretching, histogram equalization,

Smoothing filters, sharpening filters, gradient and Laplacian.

Frequency Domain Filtering

Hotelling/KL Transform, 2D Fourier Transform, Discrete Cosine Transform, Discrete Sine Transform.

Image Compression

Fundamentals of compression, The JPEG compression algorithm.

Unit-VI 07 Hrs.

Image Segmentation

Boundary detection-based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, moving averages, Multivariable thresholding, Region based segmentation, Watershed algorithm, Use of motion in segmentation.

Text Books:

1. John G. Proakis, Dimitris and G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Edition, Pearson Education, 2014.
2. A. Anand Kumar, "Digital Signal Processing", 2nd Edition, PHI Learning Pvt. Ltd., 2015.
3. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing", 4th Edition, Pearson Education Asia, 2018.
4. S. Sridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

Reference Books:

1. Sanjit Mitra, "Digital Signal Processing: A Computer Based Approach", 3rd Edition, Tata McGraw Hill, 2014.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, "Digital Signal Processing", 1st Edition, Tata McGraw Hill Publication, 2010.
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing", Tata McGraw Hill Education Private Ltd, 2009.
4. Anil K. Jain, "Fundamentals and Digital Image Processing", 3rd Edition, Prentice Hall of India Private Ltd, 2015.

Online Resources:

1. **NPTEL**

   Digital Image Processing, By Prof. Prabir Kumar Biswas, IIT Kharagpur

   https://nptel.ac.in/courses/117/105/117105135/

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Digital Signal Processing and Applications Laboratory (PCCO7010L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

- To apply DFT and FFT algorithms to solve real world applications.
- Develop a solid understanding of fundamental image processing techniques.
- Develop practical skills in applying advanced image processing techniques.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement DFT and FFT algorithms in finding the response of the system.	L3	Apply
CO2	Perform discrete correlation and convolution operations on images using appropriate algorithms.	L4	Analyze
CO3	Apply fundamental image processing techniques to analyze and manipulate images.	L3	Apply
CO4	Implement image smoothing techniques and sharpening techniques to enhance image quality.	L3	Apply
CO5	Apply advanced image processing techniques to solve complex problems.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Sampling and Reconstruction
2. To perform Discrete Correlation and convolution
3. To perform Discrete Fourier Transform
4. To perform Fast Fourier Transform
5. Implementation of Image negative, Gray level Slicing and Thresholding.
6. Implementation of Contrast Stretching, Dynamic range compression Bit plane Slicing
7. Implementation of Histogram Processing
8. Apply DFT, DCT and DST transforms on the image
9. Implementation of Image smoothing/ Image sharpening
10. Implementation of Edge detection using Sobel and Prewitt masks
11. Suggested Mini Projects based on content of the syllabus. (Group of 2-3 students) [Real life Applications/problems].
    - License plate recognition
    - Face Emotion recognition
    - Face recognition
    - Cancer detection
    - Object detection
    - Pedestrian detection
    - Lane detection
    - Blind assistance systems
    - Face Mask Detection
    - ECG signals analysis
    - Speech Pitch Detection
    - Audio Steganography
    - Audio Fingerprinting
    - Beat Tracking
    - Audio source separation

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on PCCO7010T. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

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

Distributed Computing (PCCO7020T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Java Programming, Operating systems, Computer Network.

Course Objectives:

- To provide students with contemporary knowledge in distributed systems.
- To equip students with skills to analyze and design distributed applications.
- To provide master skills to measure the performance of distributed synchronization algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe knowledge of the basic elements and concepts related to distributed system technologies.	L2	Understand
CO2	Demonstrate the middleware technologies such as RPC, RMI.	L3	Apply
CO3	Evaluate the various techniques used for clock synchronization and mutual exclusion.	L5	Evaluate
CO4	Analyze the concepts of resource and process management and synchronization algorithms.	L4	Analyze
CO5	Explain the concepts of file systems like NFS, AFS.	L2	Understand

Course Contents

Unit-I — 04 Hrs.

Introduction to Distributed Systems

Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept.

Middleware: Services offered by middleware, Client Server model.

Unit-II — 08 Hrs.

Communication

Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI)

Message Oriented Communication, Stream Oriented Communication, Group Communication.

Unit-III — 08 Hrs.

Synchronization

Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure.

Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala's Algorithm, Maekawa's Algorithm.

Token Based Algorithms: Suzuki-Kasami's Broardcast Algorithms, Singhal's Heurastic Algorithm, Raymond's Tree based Algorithm, Comparative Performance Analysis.

Unit-IV — 08 Hrs.

Resource and Process Management

Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach, Classification of Static and Dynamic Load Balancing algorithms, Comparison of LBA.

Introduction to process management, process migration, Threads.

Unit-V — 07 Hrs.

Consistency, Replication and Fault Tolerance

Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management.

Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery.

Unit-VI 07 Hrs.

Distributed File Systems

Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication.

Case Study: Distributed File Systems (DFS), Network File System (NFS), Andrew File System (AFS).

Trends in Distributed Computing: Edge Computing, Cloud Computing, Fog Computing.

Text Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2^{nd} Edition, Pearson Education, 2017.
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 5^{th} Edition, Pearson Education, 2011.

Reference Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 3^{rd} Edition, Pearson Education, 2017.
2. M. L. Liu, "Distributed Computing Principles and Applications", 2^{nd} Edition, Pearson Addison Wesley, 2004.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Distributed Computing Laboratory (PCCO7020L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objective:

- To provide knowledge to students about designing simple distributed application, in addition with different methods/algorithms used in distributed systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Evaluate working of simple distributed application.	L3	Apply
CO2	Demonstrate communication methods used in distributed system such as IPC, Group Communication.	L3	Apply
CO3	Analyze various algorithms used in distributed system.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Client/server using RPC/RMI
2. Inter-process communication
3. Group Communication
4. Load Balancing Algorithm
5. Name Resolution protocol
6. Election Algorithm
7. Clock Synchronization algorithms
8. Deadlock management in Distributed systems
9. Distributed File System
10. Suggested Mini Projects based on content of the syllabus. (Group of 2-3 students)
    - The Global Name Service
    - Designing Distributed Systems: Google Case Study
    - The X.500 Directory Service
    - Facebook Distributed file system
    - Design And Development Of The Data Synchronization/Clock Synchronization
    - Any real world application of Distributed Computing

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on PCCO7020T. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

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

Deep Learning (PECO7031T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Artificial Intelligence, Machine Learning.

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and Apply Hyper parameters Tuning.	L2	Understand
CO2	Evaluate working of deep learning models.	L4	Analyze
CO3	Create Deep learning Models for real-world problems.	L6	Create
CO4	Investigate suitable deep learning algorithms for various applications.	L2	Understand
CO5	Understand the working of deep learning models for real world scenarios.	L2	Understand

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 — 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 III — 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 IV — 10 Hrs.

Recurrent Neural Networks

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.

Unit V — 10 Hrs.

Adversarial Networks

Introduction to adversarial Networks, Auto encoders (standard, denoising, contractive, etc.), Vibrational Auto encoders, Generative Adversarial Networks, Applications of Adversarial Networks.

Unit VI — 04 Hrs.

Deep Learning Case Studies

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

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

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Deep Learning Laboratory (PECO7031L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

- To design Neural Network.
- To summarize the working of deep learning model.
- To analyze program for intermediate code generation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To create Deep Learning Models for real time applications.	L6	Create
CO2	To Interpret working of deep learning models.	L2	Understand
CO3	To Apply Deep learning Models for real-world problems.	L4	Analyze
CO4	To develop real time application using deep learning models.	L6	Create

List of Laboratory Experiments

Suggested List of 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.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on PECO7031T. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

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

Blockchain Technology (PECO7032T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of Information Security & Network Fundamentals

Course Objectives:

- To understand emerging abstract models for Blockchain Technology and its relevance with cryptography.
- To identify major research challenges and technical gaps existing between theory and practice in crypto currency domain.
- 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.
- To apply hyperledger Fabric and Etherum platform to implement the Block chain Application.

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

Course Contents

Unit I Introduction and Basics of Distributed Computing 07 Hrs.

Need for Distributed Record Keeping, Modeling faults and adversaries Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain- hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash. Atomic Broadcast, Consensus, Byzantine Models of fault tolerance.

Unit II Basic Crypto primitives and Blockchain 1.0 07 Hrs.

Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems. Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.

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.

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).

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Blockchain Technology Laboratory (PECO7032L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

- Understand Block chain fundamentals and creating basic blocks.
- Develop Block chain applications in a structured manner.
- Develop conceptual understanding of how block chain technology can be used to innovate and improve business processes.
- Evaluate and analyse Block chain systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand basic Knowledge of Blockchain Technology.	L2	Understand
CO2	Develop Proficiency in Blockchain Development.	L2	Understand
CO3	Design and Implement Blockchain Applications.	L6	Create
CO4	Evaluation and Analysis of Blockchain Systems.	L5	Evaluate

List of Laboratory Experiments

Suggested Mini Projects:

Students are supposed to complete any one mini project not limited to the following list of projects.

1. Design and Implement Trusted Crowdfunding Platform Using a Smart Contract. A smart contract helps to block the funds within blockchain until the project or startup founder makes progress in the project.

2. Implement a system that collects location data from many interconnected systems and delivers exact location details to the customers.

3. Implement blockchain applications where both riders and drivers can get connected directly to provide safe and reliable transportation.

4. Design and Implement Fake Product Identification System, by embedded a 2D barcode on the product which is tied to a blockchain system.

5. Design and Implement Electronic voting systems where a blockchain-based system can ensure transparent and publicly verifiable elections in the country. Voting can be done using a mobile application that is attached to a blockchain system.

6. Design and Implement Transparent and Genuine Charity Application. The blockchain system can bring transparency to online charity trusts. Contributors can see the journey of the donation in realtime and confirm if it is reaching the deserving hands or not.

7. Design and Implement a Decentralized Web Hosting System. The way web hosting works today is by hosting all the web content including textual content, code and media content on a centralized location which can then be accessed over the world wide web. With blockchain, you can split website content into granules and distribute it all over the internet and then link them together using a blockchain registry.

8. Design and Implement Disk Space Renting System. The idea is to allow everybody on the planet to rent out their unused disk space which can be attached to a blockchain registry to create a massive worldwide cloud.

9. Design and Implement Loyalty Points Exchange System. With blockchain, you can implement a project that allows consumers to combine and transparently trade loyalty rewards.

10. Design and Implement Food Trackback System. Using blockchain technology, you can implement a system that can help consumers trace back the journey of fresh produce or meat to its source.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on PECO7032T. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

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

Predictive Modelling (PECO7033T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Machine Learning and Statistics.

Course Objectives:

- To Understand, how to develop models to predict categorical and continuous outcomes.
- To understand how to combine two or more models for improve prediction.
- To use best model after evaluation.
- To use the predictive analytics to aid decision making, and model implementation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the process of formulating business objectives, data selection/collection.	L2	Understand
CO2	Build predictive model for various business application.	L6	Create
CO3	Compare the underlying predictive modelling techniques.	L5	Evaluate
CO4	Apply statistical analysis to wide range of problems such as decision tree.	L3	Apply
CO5	Use Predictive Modelling with Neural Networks and Regression.	L3	Apply

Course Contents

Unit I — 04 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 — 08 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.

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 — 04 Hrs.

Building Decision Tree model to predict Response and Risk

Overview of Decision tree and development of decision tree in SAS, 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 neural network 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 — 08 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 modellings, comparing the models generated by DMNeural, AutoNeural and Dmine Regression.

Text Books:

1. Kevin P Murphy, "Machine Learning, A probabilistic perspective", IGHT Press, Aug 2012.
2. "Applied Analytics Using SAS Enterprise Miner".
3. "Predictive & Advanced Analytics", IBM ICE Publication.

Reference Books:

1. "Predictive Modeling with SAS Enterprise Miner: Practical Solutions for Business Applications", 2^{nd} Edition.
2. "Predictive Modeling Applications in Actuarial Science: Volume 2, Case Studies in Insurance" (International Series on Actuarial Science) by Edward W. Frees (Editor), Glenn Meyers (Editor), Richard A. Derrig (Editor), By Cambridge press.
3. "Predictive Modeling with Logistic Regression using SAS".
4. "Regression Modeling Fundamentals."

Web Resources:

1. Course offered by Coursera, "Predictive Modeling with Logistic Regression using SAS".
2. Course offered by Coursera, "Regression Modeling Fundamentals".

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Predictive Modelling Laboratory (PECO7033L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

- To explore and pre-process data, handle missing values, identify relevant variables, and transform data as needed for predictive modelling.
- To apply time series algorithms for analysis of financial market
- To learn how to use predictive modelling using regression and neural network.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To Analyze relationship between attributes.	L4	Analyze
CO2	To apply statistical distributions and outlier analysis on given dataset.	L3	Apply
CO3	To Build predictive model using regression.	L4	Analyze

List of Laboratory Experiments

Suggested List of 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.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on PECO7033T. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

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

Product Life Cycle Management (OECO7041T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of Management

Course Objectives:

- To recognize the need, benefits and components of product life cycle management.
- To introduce product data management & strategies.
- To give insights into new product development program and guidelines for designing and developing a product.
- To familiarize the students with virtual product development.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Apply 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	Understand applying virtual product development tools for components, machining and manufacturing plant.	L2	Understand

Course Contents

Unit-I — 10 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 — 08 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 — 08 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.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Management Information System (OECO7042T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of Management

Course Objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
- Identify the basic steps in systems development.

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

Course Contents

Unit-I — 05 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 — 08 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.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Operations Research (OECO7043T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics

Course Objectives:

- To formulate a real-world decision problem as a mathematical programming model.
- To learn the mathematical tools that are employed to solve mathematical programming models.

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

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- North-west 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 — 06 Hrs.

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

Unit-IV — 10 Hrs.

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

Multichannel- Single phase server - Poisson arrivals, exponential service time with infinite population.

Game Theory: Introduction, Minimax & Maximin Criterion and optimal strategy, Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle.

Approximate methods- Iterative method, m x 2 & 2 x n games-Graphical method and method of sub-games. Expressing game as LPP.

Unit-V — 08 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. Sharma J. K., "Operations Research", Trinity Press.
2. Gupta P. K., Hira D. S., "Operations Research", S. Chand Limited.

Reference Books:

1. Taha, H. A., "Operations Research - An Introduction", Prentice Hall.
2. Ravindran A., Phillips D. T., and Solberg J. J., "Operations Research: Principles and Practice", John Willey and Sons.
3. Hiller F. S., and Liebermann G. J., "Introduction to Operations Research", Tata McGraw Hill.
4. Pradeep Prabhakar Pai, "Operations Research Principles and Practice", Oxford University Press.
5. R. Panneerselvam, "Operations Research", PHI Publications.
6. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education.
7. Kanti Swarup, P. K. Gupta and Man Mohan, "Operations Research", Sultan Chand & Sons.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Cyber Security and Laws (OECO7044T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic concepts of security

Course Objectives:

- To understand and identify different types cybercrime and cyber offences.
- To recognized Indian IT Act 2008 and its latest amendments.
- To learn various types of security standards compliances.

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

Course Contents

Unit-I — 12 Hrs.

Introduction to Cybercrime: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus & Worm's, Email Bombing, Pornography, online gambling, Forgery, Web 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, Attacks on Wireless Networks, Phishing Identity Theft (ID Theft).

Cyber offenses: How criminal plan the attacks, Social Engineering, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector.

Unit-II — 08 Hrs.

Cyber Threats Analysis: Knowledge of Dynamic and Deliberate Targeting

Knowledge of Indications and Warning

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

Knowledge of Key Cyber Threat Actors and their Equities

Knowledge of Specific Target Identifiers and Their Usage

Cyber Security Management: Knowledge of Emerging Security Issues, Risks, and Vulnerabilities.

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 & 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 — 08 Hrs.

Security Industries Standard Compliances:

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

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

Reference Books:

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

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Personal Finance Management (OECO7045T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics

Course Objectives:

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

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

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 — 08 Hrs.

Income Tax

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

Heads of Income and Computation of Total Income and Tax Liability: Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons.

Tax Management, Administrative Procedures and ICDS: TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV — 10 Hrs.

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

Levy and Collection of GST: Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services

Unit-V 10 Hrs.

Introduction to Micro – finance

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

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

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

Reference Books:

1. Asha Singh, M. S. Gupta, "Banking and Financial Sector Reforms in India", Serials Publication.
2. M. S. Gupta & J. B. Singh, "Indian Banking Sector: Essays and Issues", 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.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Energy Audit and Management (OECO7046T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

- To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
- To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To identify and describe present state of energy security and its importance.	L1	Remember
CO2	To identify and describe the basic principles and methodologies adopted in energy audit of a utility.	L1	Remember
CO3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.	L2	Understand
CO4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.	L2	Understand
CO5	To analyze the data collected during performance evaluation and recommend energy saving measures.	L4	Analyze

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 — 10 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 — 10 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 — 07 Hrs.

Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.

Reference Books:

1. Geofry Stokes, "Handbook of Electrical Installation Practice", Blackwell Science.
2. Anil Valia, "Designing with light: Lighting Handbook", Lighting System.
3. W. C. Turner, "Energy Management Handbook", John Wiley and Sons.
4. A. K. Tyagi, "Handbook on Energy Audits and Management", Tata Energy Research Institute (TERI).
5. C. B. Smith, "Energy Management Principles", Pergamon Press.
6. Dale R. Patrick, S. Fardo, Ray E. Richardson, "Energy Conservation Guidebook", Fairmont Press.
7. Albert Thumann, W. J. Younger, T. Niehus, "Handbook of Energy Audits", CRC Press.

Web Resources:

1. www.energymanagertraining.com
2. www.bee-india.nic.in

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is **3** hrs.

Disaster Management and Mitigation Measures (OECO7047T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

- To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.
- To identify extent and damaging capacity of a disaster.
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand roles and responsibilities of individual and various organization during and after disaster.
- To appreciate the significance of GIS, GPS in the field of disaster management.
- To understand the emergency government response structures before, during and after disaster.

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

Course Contents

Unit-I — 10 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 — 08 Hrs.

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

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

Unit-IV — 08 Hrs.

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

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

Use of information management, GIS, GPS and remote sensing Mitigation measure.

Do's and don'ts in case of disasters and effective implementation of relief aids.

Unit-V 08 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), 26^{th} 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 Report:

1. Harsh K. Gupta, "Disaster Management", Universities Press Publications (2003).
2. O. S. Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", published by Centre for land warfare studies, New Delhi, 2011.
3. Damon Copolla, "Introduction to International Disaster Management", Butterworth Heinemann Elsevier Publications (2015).
4. Jack Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis group (2008).
5. Rajdeep Dasgupta, "Disaster management & rehabilitation", Mittal Publications, New Delhi (2007).
6. R. B. Singh, "Natural Hazards and Disaster Management, Vulnerability and Mitigation", Rawat Publications (2006).
7. C. P. Lo Albert, K. W. Yonng, "Concepts and Techniques of GIS", Prentice Hall (India) Publications (2006).
8. Claudia G. Flores Gonzales, "Risk management of natural disasters", KIT Scientific Publishing (2010).
9. W. Nick Carter, "Disaster Management - a disaster manger's handbook", Asian Development Bank (2008).
10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs, GoI, New Delhi (2011)
11. Wil Mara, "The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy", Marshall Cavendish Corporation, New York, 2011.

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

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Science of Well-being (OECO7048T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

- To create consciousness about importance of holistic health and physical as well as mental well-being.
- To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
- To introduce the learners to the means of mental and physical well-being, ill effects of mal-practices like alcoholism, smoking etc.
- To equip the learners to manage and cope up with stress in their daily living.

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

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 — 10 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 — 10 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.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Research Methodology (OECO7049T)

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs./week	Term Test : 15 Marks
Credits : 03	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Probability and Statistics.

Course Objectives:

- To understand Research and Research Process.
- To acquaint learners with identifying problems for research and develop research strategies.
- To familiarize learners with the techniques of data collection, analysis of data and interpretation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the fundamental concepts of research and types of research.	L2	Understand
CO2	Analyze and evaluate different research methodologies.	L4	Analyze
CO3	Apply the knowledge of research and sample design to create effective research plans.	L3	Apply
CO4	Generate and present research findings through data collection and analysis methods.	L6	Create

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 10 Hrs.

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

Unit-III 10 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 10 Hrs.

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

Unit-V 05 Hrs.

Interpretation and Report Writing: Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues.

Reference Books:

1. Dawson, Catherine, "Practical Research Methods", 1st Edition, New Delhi, UBS Publishers Distributors, 2002.
2. Kothari C. R., "Research Methodology- Methods and Techniques", 2nd Edition, New Delhi, Wiley Eastern Limited, 2004.
3. Kumar, Ranjit, "Research Methodology- A Step-by-Step Guide for Beginners", 3rd Edition, Singapore, Pearson Education, 2010.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Public Systems and Policies (OECO70410T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic Knowledge of Social science and Current affairs.

Course Objectives:

- To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
- To understand public systems in a fast-changing environment in the global context.
- To understand the ills prevailing in the society and aids to identify the solutions for them.
- To understand public policy and its operations with special focus on policy relating to Government finance.
- To analyze and evaluate the impact of the public policy on firms and economy at large.

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	Understand public policy and its operations with special focus on policy relating to Government finance.	L2	Understand
CO4	Analyze the impact of the public policy on firms and economy at large and work under various fields as policymakers.	L4	Analyze
CO5	Apply analytical skills through Expenditure Policy in public services case studies.	L3	Apply

Course Contents

Unit-I — 10 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 — 08 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 — 12 Hrs.

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

Unit-V — 06 Hrs.

Case Studies in Expenditure Policy: Public Services

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

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W. W. Norton & Company.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall.
3. Anderson J. E., "Public Policy-Making: An Introduction", Boston, Houghton.
4. Avasthi & Maheshwari, "Public Administration", Lakshminarayan Agarwal, Agra.
5. Bhattacharya, Mohit, "New Horizons of Public Administration", Jawahar Publishers, New Delhi.
6. Henry, Nicholas, "Public Administration and Public Affairs", Prentice Hall of India, New Delhi.
7. Harvey S. Rosen and Ted Gayer, "Public Finance", 10^{th} Edition, McGraw-Hill Education, 2013.

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

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Project Stage-II (PJCO7050L)

Practical Scheme
Practical : 08 Hrs./week
Credit : 04

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

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

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)

Semester - VIII

Web Intelligence (PECO8011T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Statistics, Machine Learning, Data Mining

Course Objectives:

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

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.	L4	Analyze
CO3	Extract and Integrate information from the web for real-world scenarios.	L5	Evaluate
CO4	Design new solutions to opinion extraction and sentiment classification problems.	L6	Create
CO5	Provide solutions to the emerging problems with social media using Recommendation systems.	L6	Create

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: 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 — 08 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 — 08 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 — 08 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 Book:

1. Bing Liu, "Web Data Exploring Hyperlinks, Contents, and Usage", Springer, 2nd Edition, 2011.

Reference Books:

1. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", 2nd Edition, Elsevier Publications, 2022.
2. Anthony Scime, "Web Mining: Applications and Techniques", IGI Global, 2005.
3. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kauffman Publishers, 2002.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

High Performance Computing (PECO8012T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Operating System, Computer Organization.

Course Objectives:

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

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

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 Thread and Synchronization attributes, Thread Cancellation, OpenMP: a Standard for Directive Based Parallel 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'.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Cloud Computing (PECO8013T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Information Security, Distributed Computing, Web programming

Course Objectives:

- To capture the state-of-the-art in Cloud Computing technologies and applications.
- 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.

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

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. RajkimarBuyya, 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.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Natural Language Processing (PECO8021T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Finite Automata, Deep Learning, Probability Mathematics.

Course Objectives:

- To introduce the fundamental concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
- To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.
- To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the principles and Process the Human Languages Such as English and other Indian Languages using computers.	L2	Understand
CO2	Creating CORPUS linguistics based on digestive approach (Text Corpus method).	L6	Create
CO3	Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.	L3	Apply
CO4	Apply POS tagging for a given natural language and select a suitable language modelling technique based on the structure of the language.	L3	Apply
CO5	Examine the syntactic and semantic correctness of sentences using grammars and labelling.	L3	Apply
CO6	Develop Computational Methods for Real World Applications and explore deep learning based NLP.	L6	Create

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

Morphology Analysis: Survey of English Morphology, Inflectional Morphology & Derivational Morphology, Lemmatization, Regular Expression, Finite Automata, Finite State Transducers (FST), Morphological Parsing With FST, Lexicon Free FST Porter Stemmer.

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).

CFG: Derivations, Constituency, Phrase Structure and Dependency Structure.

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, Robust Word Sense Disambiguation (WSD), Lexical Disambiguation, Resolving Lexical Ambiguity, Lexical Ambiguity Resolution.

Unit-V — 06 Hrs.

Pragmatics

Discourse –Reference Resolution, Reference Phenomenon, Syntactic & Semantic Constraints on Co Reference.

Unit-VI 06 Hrs.

Neural Models of Word Representations

Problems With SVD; Intro to Word2vec, Learning Word Representations, Recurrent Neural Networks (RNNs), RNNs On POS Tagging, Statistical Machine Translation with RNNs.

Unit-VII 05 Hrs.

Applications (Preferably for Indian Regional Languages)

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

Linguistic Modeling - Neurolinguistics Models- Psycholinguistic Models - Functional Models of Language - Research Linguistic Models- Common Features of Modern Models of Language.

Text Books:

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

Reference Books:

1. Manning and Schutze, "Statistical Natural Language Processing", MIT Press, 1st Edition, June 18, 1999, ISBN: 0262133601.
2. James Allen, "Natural Language Understanding", The Benajmins/Cummings Publishing Company Inc. 1994, ISBN 0-8053-0334-0.
3. Tom Mitchell, "Machine Learning", McGraw Hill, 1997, ISBN 0070428077.
4. Cover T. M. and J. A. Thomas, "Elements of Information Theory", Wiley. 1991, ISBN 0-471-06259-6.
5. Charniak E., "Statistical Language Learning", The MIT Press, 1996, ISBN 0-262-53141-0.
6. Jelinek F., "Statistical Methods for Speech Recognition", The MIT Press, 1998, ISBN 0-262-10066-5.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Software Architecture (PECO8022T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Object Oriented Concepts, Software Engineering.

Course Objective:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental concepts and components of software architecture.	L2	Understand
CO2	Apply different modelling techniques for software architecture design.	L3	Apply
CO3	Analyse and evaluate various software architectural styles and patterns.	L4	Aanlyze
CO4	Apply agile software architecture principles to manage and refactor architectures.	L3	Apply
CO5	Evaluate and compare software architectures using analysis techniques and case studies.	L4	Analyze

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 Managing Software 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).

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".

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Software Testing and Quality Assurance (PECO8023T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Software Engineering

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand various Software testing techniques, quality factors and criteria.	L2	Understand
CO2	Identify role of quality assurance in the software development and its impact on overall product quality.	L1	Remember
CO3	Apply various Software testing techniques to produce quality software.	L3	Apply
CO4	Analyse views of Software quality, quality Factors and Criteria.	L4	Analyze

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.

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.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

Conduction of Term Test

The two Term Tests of 15 marks will be conducted under Continuous Assessment(CA) out of which best performance among the two Term Tests will be considered.

Term Test (TT) (for 15 Marks)

Best of Two (TT-1/TT-2)

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Internship (INTCO8030L)

Practical Scheme
Practical : 20 Hrs./week
Credit : 10

Examination Scheme
Teacher Assessment : 150 Marks
End Sem Exam : 150 Marks
Total : 300 Marks

Course Objectives:

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

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.
- 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 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)

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)