



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E Computer Engineering

B.E Syllabus Semester-VII



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R-2025- BE Computer Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC701	Machine Learning	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC701	Machine Learning	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the basic concepts and techniques of Machine Learning.
- 2 To select, apply and evaluate an appropriate machine learning model for the given application.
- 3 To demonstrate ensemble techniques to combine predictions from different models.
- 4 To demonstrate learning with Classification.
- 5 To demonstrate learning with Clustering.
- 6 To demonstrate the dimensionality reduction techniques.

Course Outcomes:

- 1 To acquire fundamental knowledge of developing machine learning models.
- 2 To select, apply and evaluate an appropriate machine learning model for the given application.
- 3 To demonstrate ensemble techniques to combine predictions from different models.
- 4 To demonstrate learning with Classification.



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- 5 To demonstrate learning with Clustering.
- 6 To demonstrate the dimensionality reduction techniques.

Prerequisite: Engineering Mathematics, Data Structures, Algorithms

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Machine Learning	Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application. Training Error, Generalization error, Overfitting, Underfitting, Bias-Variance trade-off.	04	CO1
II	Learning with Regression and Trees	Learning with Regression: Linear Regression, Multivariate Linear Regression, Logistic Regression. Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index (Regression), Classification and Regression Trees (CART) Performance Metrics: Confusion Matrix, [Kappa Statistics], Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve	09	CO2



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III	Ensemble Learning	Understanding Ensembles, K-fold cross validation, Boosting, Stumping, XGBoost Bagging, Subbagging, Random Forest, Comparison with Boosting, Different ways to combine classifiers	06	CO3
IV	Learning with Classification	Support Vector Machine Constrained Optimization, Optimal decision boundary, Margins and support vectors, SVM as constrained optimization problem, Quadratic Programming, SVM for linear and nonlinear classification, Basics of Kernel trick. Support Vector Regression, Multiclass Classification	08	CO4
V	Learning with Clustering	Introduction to clustering with overview of distance metrics and major clustering approaches. Graph Based Clustering: Clustering with minimal spanning tree Model based Clustering: Expectation Maximization Algorithm, Density Based Clustering: DBSCAN	07	CO5
VI	Dimensionality Reduction	Dimensionality Reduction Techniques, Principal Component Analysis, Linear Discriminant Analysis, Singular Valued Decomposition.	05	CO6



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Text Books:

1. Peter Harrington, —Machine Learning in Action, DreamTech Press
2. Ethem Alpaydm, —Introduction to Machine Learning, MIT Press
3. Tom M. Mitchell, —Machine Learning, McGraw Hill
4. Stephen Marsland, —Machine Learning An Algorithmic Perspective, CRC Press

References:

1. Han Kamber, —Data Mining Concepts and Techniques, Morgan Kaufmann Publishers
2. Margaret. H. Dunham, —Data Mining Introductory and Advanced Topics, Pearson Education
3. Kevin P. Murphy, Machine Learning — A Probabilistic Perspective
4. Samir Roy and Chakraborty, —Introduction to soft computing, Pearson Edition.
5. Richard Duda, Peter Hart, David G. Stork, —Pattern Classification, Second Edition, Wiley Publications.

Online References:

Sr. No.	Website Name
1.	Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2.	Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
3.	Machine Learning from Coursera
4.	https://towardsdatascience.com/machine-learning/home
5.	https://onlinecourses.nptel.ac.in/noc21_cs85/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC702	Big Data Analysis	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC702	Big Data Analysis	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce big data platforms, their architecture, and real-world applications.
- 2 To explore the Hadoop ecosystem and its core components.
- 3 To develop basic programming skills using MapReduce, NoSQL, and R.
- 4 To understand techniques for scalable and streaming big data analytics.
- 5 To apply big data tools for solving real-world decision-making problems.
- 6 To gain hands-on experience in implementing practical big data solutions.

Course Outcomes:

- 1 Understand the building blocks of Big Data Analytics.
- 2 Apply fundamental enabling techniques like Hadoop and MapReduce in solving real world problems.
- 3 Understand different NoSQL systems and how it handles big data.
- 4 Apply advanced techniques for emerging applications like stream analytics.
- 5 Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications, etc.
- 6 Apply statistical computing techniques and graphics for analyzing big data.



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Prerequisite: Database, Data mining.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Big Data and Hadoop	Introduction to Big Data - Big Data characteristics and Types of Big Data Traditional vs. Big Data business approach Case Study of Big Data Solutions Concept of Hadoop, Core Hadoop Components; Hadoop Ecosystem	02	CO1
II	Hadoop HDFS and MapReduce	Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization. MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce Hadoop Limitations	08	CO2



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III	NoSQL	Introduction to NoSQL, NoSQL Business Drivers NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.	10	CO3
IV	Mining Data Streams	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data techniques in a Stream Filtering Streams: Bloom Filter with Analysis. Counting Distinct Elements in a Stream, Count-Distinct Problem, Flajolet-Martin Algorithm, Combining Estimates, Space Requirements Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.	11	CO4



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V	Real-Time Big Data Models	A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering Case Study: Product Recommendation Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph	04	CO5
VI	Data Analytics with R	Exploring Basic features of R, Exploring RGUI, Exploring RStudio, Handling Basic Expressions in R, Variables in R, Working with Vectors, Storing and Calculating Values in R, Creating and using Objects, Interacting with users, Handling data in R workspace, Executing Scripts, Creating Plots, Accessing help and documentation in R Reading datasets and Exporting data from R, Manipulating and Processing Data in R, Using functions instead of script, built-in functions in R Data Visualization: Types, Applications	04	CO6

Text Books:

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets, Cambridge University Press
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.
4. DT Editorial Services, —Big Data Black Book, Dreamtech Press
5. EMC Education Services, Data Science and Big Data Analytics, Wiley



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References:

1. Bill Franks , —Taming The Big Data Tidal Wave: Finding Opportunities In HugeData StreamsWithAdvancedAnalytics, Wiley
2. Chuck Lam, —Hadoop inAction, Dreamtech Press
3. Jared Dean, —Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley India Private Limited, 2014.
4. Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, —Data Mining and Knowledge Discovery Handbook, Springer, 2nd edition, 2010.
6. Ronen Feldman and James Sanger, —The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
7. Vojislav Kecman, —Learning and Soft Computing, MIT Press, 2010.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106104189
3.	https://www.coursera.org/specializations/big-data#courses
3.	https://www.digimat.in/nptel/courses/video/106106169/L01.html
4.	https://www.coursera.org/learn/nosql-databases#syllabus
5.	https://www.coursera.org/learn/basic-recommender-systems#syllabus



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC731	Machine Vision	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC731	Machine Vision	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand the need and significance of Machine Vision in real-world applications.
- 2 To explore the fundamental concepts and techniques of image processing.
- 3 To examine the core components and architecture of a Machine Vision System.
- 4 To study various image transformation, interpolation, and filtering techniques.
- 5 To develop the ability to apply image processing for object detection and recognition.
- 6 To build practical applications using Machine Vision tools and frameworks.

Course Outcomes:

- 1 Elaborate the components of Machine Vision Application
- 2 Perform image ,video preprocessing operations
- 3 Explain various transformations, interpolation.
- 4 Elaborate motion tracking in video.
- 5 Analyze and Implement appropriate filtering techniques for a given problem.
- 6 Develop applications based on machine vision.



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Prerequisite: Computer Graphics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Machine Vision	Computer and Human Vision Systems., The Human Eye, Computer versus Human Vision Systems, Evolution of Computer Vision, Computer/Machine Vision and Image Processing, Applications of Computer Vision	04	CO1
II	Digital Image Fundamentals	Digital Image, Monochrome and Color Images, Image Brightness and Contrast., 2D, 3D, and 4D Images, Digital Image Representation , Digital Image File Formats, Fundamental Image Operations, Points, Edges, and Vertices , Point Operations , Thresholding ,Brightness, Geometric Transformations , Spatial Transformation , Affine Transformation, Image Interpolation, Nearest-Neighbor Interpolation ,Bilinear Interpolation , Bi-cubic Interpolation ,Fundamental Steps in Digital Image Processing.	08	CO2



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III	Machine Vision and System Components	Machine Vision System, Machine Vision Camera: CCD and CMOS Image Sensors, TDI Sensor, Camera Type - Area Scan Cameras, Line Scan Cameras, Smart Cameras, Camera Lens-Resolution, Contrast and Sharpness, Lenses and their parameters: Types of Lenses, Lens Mounts, Lens Selection Examples-Field of View Much larger than Camera sensor size or Smaller or close to Camera Sensor size, Machine Vision Lighting: Lighting: Light Sources in Machine Vision, Illumination Techniques-Backlighting, Front Lighting, Diffused Lighting, Oblique Lighting, Dark Field Lighting, Infrared and Ultraviolet Light, Filters, Machine Vision Software, Machine Vision Automation, Integration of Machine Vision Components	08	CO3
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IV	Digital Image Processing for Machine Vision Applications	Preprocessing., Image Filtering, Normalized Box Filter Gaussian Filter Bilateral Filter, Comparison of Filter Techniques, Sub sampling/Scaling Histogram, Image Segmentation, Threshold- Based Segmentation Edge-Based Segmentation First-Order Derivative Edge Detection. Second-Order Derivative Operators, Comparison of Edge Detection Techniques, Region-Based Segmentation Region Growing Methods, Region Split and Merge Method, Morphological Image Processing: Dilation, Erosion, Opening, Closing, Hit-or-Miss transformation, Object Recognition. Template Matching. Blob Analysis	10	CO4
V	Motion Analysis	Differential motion Analysis, Optical Flow, Analysis based on correspondence of interest points, Detection of specific motion Patterns, Video Tracking	04	CO5
VI	Emerging Trends in Machine Vision	History of Industrial Revolution(s), Machine Vision and Industry 4.0, Emerging Vision Trends in Manufacturing, 3D Imaging, Emerging Vision Trends in Manufacturing, Applications in Machine/ Computer Vision: Face detection, face recognition, eigen faces, car on roads	05	CO6



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Text Books:

1. Sheila Anand and L.Priya , —A Guide for Machine Vision in Quality Control, Taylor & Francis Inc, Imprint CRC Press Inc, Dec 2019
2. Rafael C. Gonzalez and Richard E. Woods, —Digital Image Processing, Pearson
3. Carsten Stegar, Markus Ulrich, and Christian Wiedemann , —Machine Vision Algorithms and Applications, Second completely Revised and Enlarged Edition
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, —Image Processing Analysis and Machine Vision, Second Edition, Cengage Learning.

References:

1. Chiranji Lal Chowdhary, Mamoun Alazab, Ankit Chaudhary, Saqib Hakak and Thippa Reddy Gadekallu , Computer Vision and Recognition Systems Using Machine and Deep Learning Approaches, Fundamentals, technologies and applications , IET COMPUTING SERIES 42
2. Joe Minichino Joseph Howse , Learning OpenCV 3 Computer Vision with Python, Second Edition, Packt Publishing Ltd.
3. Alexander Hornberg,, — Handbook of Machine and Computer Vision The Guide for Developers and Users,

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/108103174
4.	https://www.coursera.org/learn/introduction-computer-vision-watson-opencv
3.	https://www.udacity.com/course/introduction-to-computer-vision--ud810
4.	https://onlinecourses.nptel.ac.in/noc21_ee23/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC732	Quantum Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC732	Quantum Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand the basic principles and concepts of quantum computing.
- 2 To explore the mathematical foundations essential for quantum computing.
- 3 To study the building blocks of quantum systems such as qubits and quantum gates.
- 4 To design and analyze simple quantum algorithms.
- 5 To understand the architecture and working principles of quantum hardware.
- 6 To explore software tools and platforms used for quantum programming and simulation.

Course Outcomes:

- 1 Understand basic concepts of quantum computing
- 2 Illustrate building blocks of quantum computing through architecture and programming models.
- 3 Appraise various mathematical models required for quantum computing
- 4 Discuss various quantum hardware building principles.
- 5 Identify the various quantum algorithms
- 6 Describe usage of tools for quantum computing.



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Prerequisite: Engineering Mathematics, Data Structures and Algorithm, Python Programming

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Quantum Computing	Motivation for studying Quantum Computing Origin of Quantum Computing Quantum Computer vs. Classical Computer Introduction to Quantum mechanics Overview of major concepts in Quantum Computing Qubits and multi-qubits states Bloch Sphere representation Quantum Superposition Quantum Entanglement Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)	07	CO1
II	Mathematical Foundations for Quantum Computing	Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.	05	CO2



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III	Building Blocks for Quantum Program	Architecture of a Quantum Computing platform Details of q-bit system of information representation: Block Sphere Multi-qubits States Quantum superposition of qubits (valid and invalid superposition) Quantum Entanglement Useful states from quantum algorithmic perceptive e.g. Bell State Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit No Cloning Theorem and Teleportation Programming model for a Quantum Computing Program Steps performed on classical computer Steps performed on Quantum Computer Moving data between bits and qubits.	08	CO3
IV	Quantum Algorithms and Error correction	Quantum Algorithms, Shor's Algorithm, Grover's Algorithm. Deutsch's Algorithm, Deutsch - Jozsa Algorithm Quantum error correction using repetition codes 3 qubit codes, Shor's 9 qubit error correction Code	06	CO4



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V	Quantum Hardware	Ion Trap Qubits ,The DiVincenzo Criteria , Lagrangian and Hamiltonian Dynamics in a Nutshell: Dynamics of a Translating Rotor Quantum Mechanics of a Free Rotor: A Poor Person's Atomic Model: Rotor Dynamics and the Hadamard Gate, Two-Qubit Gates The Cirac-Zoller Mechanism: Quantum Theory of Simple Harmonic Motion, A Phonon-Qubit Pair Hamiltonian, Light- Induced Rotor-Phonon Interactions, Trapped Ion Qubits, Mølmer- Sørensen Coupling .. Cavity Quantum Electrodynamics (cQED): Eigenstates of the Jaynes-Cummings Hamiltonian Circuit QED (cirQED): Quantum LC Circuits, Artificial Atoms, Superconducting Qubits Quantum computing with spins: Quantum inverter realized with two exchange coupled spins in quantum dots, A 2-qubit spintronic universal quantum gate.	10	CO5
VI	OSS Toolkits for implementing Quantum program	IBM quantum experience Microsoft Q Rigetti PyQuil (QPU/QVM)	03	CO6

Text Books:

1. Michael A. Nielsen, —Quantum Computation and Quantum Information, Cambridge University Press.
2. David McMahon, —Quantum Computing Explained, Wiley ,2008
3. Qiskit textbook <https://qiskit.org/textbook-beta/>
4. Vladimir Silva, Practical Quantum Computing for Developers,2018



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References:

1. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018
2. Supriyo Bandopadhyay and Marc Cahy, —Introduction to Spintronics, CRC Press, 2008
3. The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
4. La Guardia, Giuliano Gladioli —Quantum Error correction codes, Springer, 2021

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc21_cs103/preview
5.	https://www.coursera.org/courses?query=quantum%20computing
3.	https://www.cl.cam.ac.uk/teaching/1617/QuantComp/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC733	Natural Language Processing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem	Exam Duration			
		IAT-1	IAT-2	IAT-1 + IAT-2	Exam	(in Hrs)			
CMC733	Natural Language Processing	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To define natural language processing and to learn various stages of natural language processing.
- 2 To describe basic concepts and algorithmic description of the main language levels: Morphology, Syntax, Semantics, and Pragmatics & Discourse analysis.
- 3 To design and implement various language models and POS tagging techniques.
- 4 To design and learn NLP applications such as Information Extraction, Question answering.
- 5 To design and implement applications based on natural language processing.
- 6 To analyze the challenges and advancements in real-world NLP systems.



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Course Outcomes:

- 1 To describe the field of natural language processing.
- 2 To design language model for word level analysis for text processing.
- 3 To design various POS tagging techniques and parsers.
- 4 To design, implement and test algorithms for semantic and pragmatic analysis.
- 5 To formulate the discourse segmentation and anaphora resolution.
- 6 To apply NLP techniques to design real world NLP applications.

Prerequisite: Theory of Computer Science, System Programming & Compiler Construction

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to NLP	Origin & History of NLP; Language, Knowledge and Grammar in language processing; Stages in NLP; Ambiguities and its types in English and Indian Regional Languages; Challenges of NLP; Applications of NLP Self-Learning topics: Variety types of tools for regional languages pre-processing and other functionalities	03	CO1
II	Word Level Analysis	Basic Terms: Tokenization, Stemming, Lemmatization; Survey of English Morphology, Inflectional Morphology, Derivational Morphology; Regular expression with types; Morphological Models: Dictionary lookup, finite state morphology; Morphological parsing with FST (Finite State Transducer); Lexicon free FST Porter Stemmer algorithm; Grams and its variation: Bigram, Trigram; Simple (Unsmoothed) N-	09	CO2



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		grams; N-gram Sensitivity to the Training Corpus; Unknown Words: Open versus closed vocabulary tasks; Evaluating N-grams: Perplexity; Smoothing: Laplace Smoothing, Good-Turing Discounting; Self-Learning topics: Noisy channel models, various edit distance, Advance Issues in Language Modelling		
III	Syntax analysis	Part-Of-Speech tagging(POS); Tag set for English (Upenn Treebank); Difficulties /Challenges in POS tagging; Rule-based, Stochastic and Transformation-based tagging; Generative Model: Hidden Markov Model (HMM Viterbi) for POS tagging; Issues in HMM POS tagging; Discriminative Model: Maximum Entropy model, Conditional random Field (CRF); Parsers: Top down and Bottom up; Modelling constituency; Bottom Up Parser: CYK, PCFG (Probabilistic Context Free Grammar), Shift Reduce Parser; Top Down Parser: Early Parser, Predictive Parser Self-Learning topics: Evaluating parsers, Parsers based language modelling, Regional languages POS tree banks	10	CO3



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IV	Semantic Analysis	Introduction, meaning representation; Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babelnet; Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy; Semantic Ambiguity; Word Sense Disambiguation (WSD); Knowledge based approach (Lesk's Algorithm), Supervised (Naïve Bayes, Decision List), Introduction to Semi-supervised method (Yarowsky) Unsupervised (Hyperlex) Self-Learning topics: Dictionaries for regional languages, Distributional Semantics, Topic Models	07	CO4
V	Pragmatic & Discourse Processing	Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence; Anaphora Resolution using Hobbs and Canterling Algorithm Self-Learning topics: Discourse segmentation, Conference resolution	05	CO5
VI	Applications of NLP	Case studies on (preferable in regional language): Machine translation; Text Summarization; Sentiment analysis; Information retrieval; Question Answering system Self-Learning topics: Applications based on Deep Neural Network with NLP such as LSTM network, Recurrent Neural network etc.	05	CO6

Text Books:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and HinrichSchutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.



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References:

1. Siddiqui and Tiwari U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
2. Daniel M Bikel and Imed Zitouni — Multilingual natural language processing applications: from theory to practice, IBM Press, 2013.
3. Alexander Clark, Chris Fox, Shalom Lappin — The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
4. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
5. Niel J le Roux and Sugnet Lubbe, A step by step tutorial: An introduction into R application and programming.
6. Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009.

Online References:

Sr. No.	Website Name
1.	http://www.cse.iitb.ac.in/~cs626-449
2.	http://cse24-iiith.virtual-labs.ac.in/#
3.	https://nptel.ac.in/courses/106105158



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC741	Augmented and Virtual Reality	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC741	Augmented and Virtual Reality	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand the need and significance of Virtual Reality.
- 2 To explore the concepts of Virtual reality and develop 3D virtual environments.
- 3 To understand the technical and engineering aspects of virtual reality systems.
- 4 To analyze various techniques for applying virtual reality.
- 5 To understand the integration of Virtual Reality with emerging technologies.
- 6 To provide a foundation in Augmented Reality and introduce various AR devices and platforms.

Course Outcomes:

- 1 Describe how VR systems work and list the applications of VR
- 2 Elaborate geometric presentation of the virtual world and its operations.
- 3 Explain the concepts of motion and tracking in VR systems.
- 4 Design and implementation of the hardware that enables VR systems to be built.



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- 5 Describe how AR systems work and analyze the hardware requirement of AR
- 6 Analyze and understand the working of various state of the art AR devices.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Virtual Reality	What is virtual reality? ,The beginnings of VR , VR paradigms Collaboration, Virtual reality systems, Representation ,User interaction	05	CO1
II	The Geometry of Virtual Worlds	Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations	06	CO2
III	Motion in Real and Virtual Worlds	Velocities and Accelerations, The Vestibular System, Physics in the Virtual World , Mismatched Motion and Vection	06	CO3
IV	Applying Virtual Reality	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing.	07	CO4
V	Augmented Reality	Terminology, Simple augmented reality, Augmented reality as an emerging technology, Augmented reality applications, Marker detection, Marker pose, Marker types and identification: Template markers, 2D bar-code markers, Imperceptible markers: Image markers, Infrared markers, Miniature markers, Discussion on marker use, General marker detection application	08	CO5



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VI	AR Development & Applications	User interfaces, Avoiding physical contacts, Practical experiences with head-mounted displays, Authoring and dynamic content, AR applications and future visions, How to design an AR application ,Technology adoption and acceptance , Where to use augmented reality		CO6
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Text Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)ll. Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig,William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker-based augmented reality Sanni Siltanen

References:

1. AR Game Developmentll, 1st Edition, Allan Fowler, A press Publications, 2018, ISBN 978-1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
3. Learning Virtual Reality, Tony Parisi, O'Reilly Media, Inc., 2015, ISBN-9781491922835

Online References:

Sr. No.	Website Name
1.	https://freevidelectures.com/course/3693/virtual-reality
2.	https://www.vrlabacademy.com/
3.	https://arvr.google.com/ar/
4.	https://konterball.com/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC742	Blockchain	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC742	Blockchain	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 Understand the core concepts, platforms, and terminologies related to blockchain technology.
- 2 Explore the role of cryptography in ensuring security within blockchain systems.
- 3 Study the architecture and functionality of smart contracts and digital wallets.
- 4 Understand various consensus mechanisms used in blockchain networks.
- 5 Design and develop decentralized applications using blockchain technologies.
- 6 Analyze real-world use cases and challenges in blockchain adoption.

Course Outcomes:

- 1 Explain blockchain concepts.
- 2 Apply cryptographic hash required for blockchain.
- 3 Apply the concepts of smart contracts for an application.
- 4 Design a public blockchain using Ethereum.
- 5 Design a private blockchain using Hyperledger.
- 6 Use different types of tools for blockchain applications.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Blockchain	What is a blockchain, Origin of blockchain (cryptographically secure hash functions), Foundation of blockchain: Merkle trees Components of blockchain, Block in blockchain, Types: Public, Private, and Consortium, Consensus Protocol, Limitations and Challenges of blockchain	06	CO1
II	Cryptocurrency	Cryptocurrency: Bitcoin, Altcoin, and Tokens (Utility and Security), Cryptocurrency wallets: Hot and cold wallets, Cryptocurrency usage, Transactions in Blockchain, UTXO and double spending problem Bitcoin blockchain: Consensus in Bitcoin, Proof-of-Work (PoW), Proof-of-Burn (PoB), Proof-of-Stake (PoS), and Proof-of-Elapsed Time (PoET), Life of a miner, Mining difficulty, Mining pool and its methods	06	CO2



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III	Programming for Blockchain	Introduction to Smart Contracts, Types of Smart Contracts, Structure of a Smart Contract, Smart Contract Approaches, Limitations of Smart Contracts Introduction to Programming: Solidity Programming – Basics, functions, Visibility and Activity Qualifiers, Address and Address Payable, Bytes and Enums, Arrays-Fixed and Dynamic Arrays, Special Arrays-Bytes and strings, Struct, Mapping, Inheritance, Error handling Case Study – Voting Contract App, Preparing for smart contract development	08	CO3
IV	Public Blockchain	Introduction to Public Blockchain, Ethereum and its Components, Mining in Ethereum, Ethereum Virtual Machine (EVM), Transaction, Accounts, Architecture and Workflow, Comparison between Bitcoin and Ethereum Types of test-networks used in Ethereum, Transferring Ethers using Metamask, Mist Wallet, Ethereum frameworks, Case study of Ganache for Ethereum blockchain. Exploring etherscan.io and ether block structure	08	CO4



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V	Private Blockchain	Introduction, Key characteristics, Need of Private Blockchain, Smart Contract in a Private Environment, State Machine Replication, Consensus Algorithms for Private Blockchain - PAXOS and RAFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT Introduction to Hyperledger, Tools and Frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies Hyperledger Fabric Architecture, Components of Hyperledger Fabric: MSP, Chain Codes, Transaction Flow, Working of Hyperledger Fabric, Creating Hyperledger Network, Case Study of Supply Chain Management using Hyperledger	08	CO5
VI	Tools and Applications of Blockchain	Corda, Ripple, Quorum and other Emerging Blockchain Platforms, Blockchain in DeFi: Case Study on any of the Blockchain Platforms.	04	CO6

Text Books:

1. Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhillash K. A and Meena Karthikeyan, Universities Press.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing



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References:

1. Blockchain for Beginners, Yathish R and Tejaswini N, SPD
2. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
3. Blockchain with Hyperledger Fabric, Luc Venkatraman Ramakrishna, Packt Publishing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC743	Information Retrieval	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC743	Information Retrieval	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To learn the fundamentals of Information Retrieval
- 2 To analyze various Information retrieval modeling techniques
- 3 To understand query processing and its applications
- 4 To explore the various indexing and scoring techniques
- 5 To assess the various evaluation methods
- 6 To analyze various information retrieval for real world application

Course Outcomes:

- 1 Define and describe the basic concepts of the Information retrieval system.
- 2 Design the various modeling techniques for information retrieval systems.
- 3 Understand the query structure and various query operations
- 4 Analyzing the indexing and scoring operation in information retrieval systems
- 5 Perform the evaluation of information retrieval systems
- 6 Analyze various information retrieval for real world application



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Prerequisite: Data structures and algorithms.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Information Retrieval	Introduction to Information Retrieval, Basic Concepts, Information Versus Data, Trends and research issues in information retrieval. The retrieval process, Information retrieval in the library, web and digital libraries.	04	CO1
II	Modeling in Information Retrieval	Taxonomy of Information Retrieval models, Classic Information Retrieval, Alternate set: Theoretical model, Alternative Algebraic models, Alternative Probabilistic models Structured text Retrieval models, Models for browsing	08	CO2
III	Query and Operations in Information Retrieval	Query structures, Keyboard based querying, Pattern matching, Structured queries User relevance feedback, Automatic local analysis, Automatic global analysis	08	CO3



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IV	Indexing and Scoring in Information Systems	Introduction, Inverted Files, Other Indices for Text, Boolean queries and Introduction to Sequential searching Scoring, term weighting and the vector space model, Parametric and zone indexes, Weighted zone scoring, Learning weights, The optimal weight, Term frequency and weighting, Inverse document frequency, Tf-idf weighting. The vector space model for scoring, Queries as vectors, Computing vector scores, Efficient scoring and ranking, Inexact top K document retrieval	08	CO4
V	Evaluation of Information Retrieval Systems	Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing and justifying the concept of relevance System quality and user utility, System issues, Refining a deployed system	06	CO5
VI	Applications of Information Retrieval Systems	Introduction to Multimedia Information Retrieval Introduction to Distributed Information Retrieval	05	CO6

Text Books:

1. Modern information retrieval, Baeza-Yates, R. and Ribeiro-Neto, B., 1999. ACM press.
2. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
3. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons



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References:

1. Storage Network Management and Retrieval, VaishaliKhairnar
2. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman
3. Natural Language Processing and Information Retrieval by Tanveer Siddiqui, U.S Tiwarey

Online References:

Sr. No.	Website Name
1	https://web.stanford.edu/class/cs276/
2	https://www.coursera.org/learn/text-retrieval



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7501	Product Life Cycle Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7501	Product Life Cycle Management	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To familiarize students with the need, benefits, and key components of Product Lifecycle Management (PLM).
- 2 To acquaint students with Product Data Management (PDM) and PLM implementation strategies.
- 3 To provide insights into the processes involved in new product development.
- 4 To understand the guidelines and best practices for designing and developing new products.
- 5 To introduce students to the concept and tools of Virtual Product Development.
- 6 To explore the integration of PLM with modern engineering and manufacturing systems.



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Course Outcomes:

- 1 Describe the phases of Product Lifecycle Management (PLM), PLM strategies, and feasibility study methodologies.
- 2 Explain the implementation process of Product Data Management (PDM) within PLM systems.
- 3 Apply various approaches and techniques for product design and development.
- 4 Use product engineering guidelines and thumb rules for designing components in moulding, machining, and sheet metal processes.
- 5 Analyze design decisions for manufacturability and efficiency in product engineering.
- 6 Demonstrate the use of virtual product development tools for component design, machining simulation, and manufacturing plant layout.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	10	CO1
II	Product Design	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models,	09	CO2



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		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		
III	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	05	CO3
IV	Virtual Product Development Tools	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05	CO4
V	Integration of Environmental	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies,	05	CO5



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	Aspects in Product Design	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		
VI	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	05	CO6

References:

1. John Stark, —Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, —Product Design for the environment- A life cycle approach, Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, —Product Life Cycle Management, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, —Product Lifecycle Management: Driving the next generation of lean thinking, Tata McGraw Hill, 2006, ISBN: 0070636265



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7502	Reliability Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7502	Reliability Engineering	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To familiarize the students with various aspects of probability theory
- 2 To acquaint the students with reliability and its concepts
- 3 To introduce the students to methods of estimating the system reliability of simple and complex systems
- 4 To explain various types of reliability testing and data analysis techniques.
- 5 To cover the principles of Maintainability and Availability in system design.
- 6 To provide knowledge of Failure Modes and Effects Analysis (FMEA) and its application in reliability engineering.

Course Outcomes:

- 1 Understand and apply the concept of Probability to engineering problems
- 2 Apply probability theory to solve real-world engineering problems.
- 3 Explain key reliability concepts such as failure rate, MTTF, MTBF, and hazard rate.
- 4 Calculate reliability parameters for different types of systems and configurations.



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- 5 Estimate system reliability for both simple and complex systems using appropriate models.
- 6 Perform Failure Mode, Effects, and Criticality Analysis (FMECA) to assess system risk.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Probability theory	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08	CO1
II	Reliability Concepts	Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08	CO2



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III	System Reliability	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems	05	CO3
IV	Reliability Improvement	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08	CO4
V	Maintainability and Availability	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05	CO5
VI	Failure Mode, Effects and Criticality Analysis:	Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05	CO6

References:

1. L.S. Srinath, —Reliability Engineering, Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, —Reliability and Maintainability Engineering, Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, —Engineering Reliability, John Wiley & Sons, 1980.
4. P.D.T. Connor, —Practical Reliability Engg., John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, —Reliability in Engineering Design, John Wiley & Sons.
6. Murray R. Spiegel, —Probability and Statistics, Tata McGraw-Hill Publishing Co. Ltd.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7503	Management Information System	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7503	Management Information System	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the role and impact of Information Systems (IS) in organizations and society.
- 2 To understand data and knowledge management including BI, big data, data warehousing, and data marts.
- 3 To explore ethical, privacy, and security issues related to Information Systems.
- 4 To examine the role of Social Computing and its applications in e-commerce and customer relationship management.
- 5 To study computer networks, mobile computing, and cloud computing models relevant to business operations.
- 6 To understand the use of IS in organizational functions, ERP systems, and system development life cycle models.



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Course Outcomes:

- 1 Explain the importance of Information Systems and their impact on organizational strategy and society
- 2 Apply data and knowledge management techniques, including BI tools, for decision-making.
- 3 Identify security threats and describe ethical and privacy issues in Information Systems.
- 4 Analyze the use of Social Computing in marketing, CRM, and mobile commerce applications.
- 5 Differentiate between various computer network types and cloud computing models.
- 6 Design basic solutions using ERP systems and system development life cycle approaches.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction To Information Systems (IS)	Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	04	CO1
II	Data and Knowledge Management:	Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI) Managers and Decision Making, BI for Data analysis and Presenting Results	07	CO2
III	Ethical issues and Privacy	Information Security. Threat to IS, and Security Controls	07	CO3
IV	Social Computing (SC)	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRME-business and E-commerce – B2B B2C. Mobile commerce.	07	CO4



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V	Computer Networks	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	06	CO5
VI	Information System within Organization	Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	08	CO6

References:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7504	Design of Experiments	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7504	Design of Experiments	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the strategy of experimentation and its applications in engineering and scientific problems.
- 2 To understand the process of fitting regression models and performing diagnostic analysis.
- 3 To study the design and analysis of two-level and multi-level factorial experiments.
- 4 To explore fractional factorial designs and their relevance in reducing experimental runs.
- 5 To understand and apply response surface methodology for optimization of processes.
- 6 To introduce the Taguchi approach for robust parameter design and quality improvement.



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Course Outcomes:

- 1 Explain the strategy of experimentation and identify appropriate experimental designs for given applications.
- 2 Fit and analyze linear and multiple regression models, including hypothesis testing and prediction.
- 3 Design and evaluate full and fractional factorial experiments to study the effects of multiple factors.
- 4 Apply response surface methodology to optimize and interpret second-order experimental models.
- 5 Use center points, blocking, and split-plot designs to handle complex experimental conditions.
- 6 Analyze Taguchi designs using signal-to-noise ratios and recommend robust design improvements.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06	CO1
II	Fitting Regression Models	Linear Regression Models Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression Confidence Intervals in Multiple Regression Prediction of new response observation Regression model diagnostics Testing for lack of fit	08	CO2
III	Two-Level Factorial Designs	The 2^2 Design The 2^3 Design The General 2^k Design	07	CO3



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		A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design Split-Plot Designs		
IV	Two-Level Fractional Factorial Designs	The One-Half Fraction of the 2^k Design The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design Resolution III Designs Resolution IV and V Designs Fractional Factorial Split-Plot Designs	07	CO4
V	Response Surface Methods and Designs	Introduction to Response Surface Methodology The Method of Steepest Ascent Analysis of a Second-Order Response Surface Experimental Designs for Fitting Response Surfaces	07	CO5
VI	Taguchi Approach	Crossed Array Designs and Signal-to-Noise Ratios Analysis Methods Robust design examples	04	CO6

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley



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4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7505	Operations Research	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7505	Operations Research	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the concepts, models, and scope of Operations Research in decision-making.
- 2 To study linear programming models, duality, sensitivity analysis, and their solution techniques.
- 3 To understand transportation, assignment, and integer programming problems with solution methodologies.
- 4 To explore queuing theory models and analyze single and multi-server systems.
- 5 To apply simulation techniques, including Monte Carlo methods, in decision-making scenarios.
- 6 To study dynamic programming, game theory, and inventory models for solving real-world optimization problems.

Course Outcomes:

- 1 Formulate and solve linear programming problems using graphical, simplex, and dual methods.
- 2 Apply appropriate methods to solve transportation, assignment, and integer



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- programming problems.
- 3 Analyze queuing models to evaluate system performance in different configurations.
 - 4 Demonstrate the use of simulation techniques such as the Monte Carlo method in system analysis.
 - 5 Apply dynamic programming methods to solve multi-stage decision problems.
 - 6 Evaluate inventory models and game theory strategies for decision-making in competitive and uncertain environments.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Operations Research	Introduction, Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming, Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality , Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone	14	CO1



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		method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.		
II	Queuing models	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05	CO2
III	Simulation	Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05	CO3
IV	Dynamic programming	Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05	CO4



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V	Game Theory	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05	CO5
VI	Inventory Models	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model	05	CO6

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Wiley and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Lieberman, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, Kanti Swarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7506	Cyber Security and Laws	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7506	Cyber Security and Laws	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the fundamental concepts, history, and global perspective of cybercrime.
- 2 To explore various cyber offenses and methods used by cybercriminals in different domains.
- 3 To examine tools, techniques, and attack vectors commonly employed in cybercrimes.
- 4 To understand the legal aspects of cyberspace, including contracts, security, intellectual property, and criminal law.
- 5 To study the provisions and amendments of the Indian IT Act, 2000 and 2008.
- 6 To provide an overview of major information security compliance standards and frameworks.



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Course Outcomes:

- 1 Define and explain various types of cybercrimes and their impact on information security.
- 2 Identify different cyber offense techniques and evaluate their implications on mobile and wireless devices.
- 3 Demonstrate the use of cybercrime tools and explain how common attacks such as phishing and SQL injection are performed.
- 4 Analyze the legal dimensions of cyberspace, including contracts, privacy, and intellectual property rights.
- 5 Interpret key sections of the Indian IT Act and assess its effectiveness in addressing cybercrimes.
- 6 Compare and apply information security standards such as SOX, HIPAA, and ISO in organizational contexts.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Cybercrime	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	04	CO1
II	Cyber offenses & Cybercrime	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in	09	CO2



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		Mobile Computing Era, Laptops		
III	Tools and Methods Used in Cyberline	Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	06	CO3
IV	The Concept of Cyberspace	E-Commerce, 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, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	08	CO4
V	Indian IT Act.	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	06	CO5
VI	Information Security Standard compliances	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	06	CO6

References:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kenneth J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on : The Information



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Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>

9. Website for more information , A Compliance Primer for IT professional: <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7507	Disaster Management and Mitigation Measures	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7507	Disaster Management and Mitigation Measures	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand physics and various types of disaster occurring around the world
- 2 To identify extent and damaging capacity of a disaster
- 3 To study and understand the means of losses and methods to overcome /minimize it.
- 4 To understand role of individual and various organization during and after disaster
- 5 To understand application of GIS in the field of disaster management
- 6 To understand the emergency government response structures before, during and after disaster



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Course Outcomes:

- 1 Define and explain the types, causes, and effects of natural and manmade disasters, including global warming and climate change.
- 2 Analyze the disaster management cycle, including policy, objectives, risks, and the paradigm shift in disaster response strategies.
- 3 Identify and evaluate the roles of institutions like NDMA and NIDM in disaster preparedness and response.
- 4 Apply technologies such as GIS, GPS, remote sensing, and internet-based tools for disaster management and communication.
- 5 Explain and assess financial mechanisms, legal frameworks, and the role of national and international relief agencies.
- 6 Design and propose structural and non-structural mitigation strategies including community preparedness, training, and awareness programs.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03	CO1



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II	Natural Disaster and Manmade disasters	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09	CO2
III	Disaster Management, Policy and Administration	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06	CO3



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IV	Institutional Framework for Disaster Management in India:	Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06	CO4
V	Financing Relief Measures	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09	CO5



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VI	Preventive and Mitigation Measures	Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06	CO6
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References:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7508	Energy Audit and Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7508	Energy Audit and Management	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the present energy scenario and the need for energy conservation and efficient utilization.
- 2 To explain the principles of energy auditing, energy monitoring, and energy performance evaluation techniques.
- 3 To impart knowledge on financial analysis tools for assessing energy efficiency projects.
- 4 To familiarize students with energy conservation measures in electrical systems including lighting, motors, and drives.
- 5 To provide insights into energy conservation practices in thermal systems, HVAC, boilers, and insulation.
- 6 To create awareness of sustainable energy use in buildings through ECBC, LEED, and renewable energy integration.



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Course Outcomes:

- 1 Explain the current energy scenario, energy pricing, and energy conservation legislation such as the Energy Conservation Act-2001.
- 2 Apply principles of energy auditing and analyze energy usage using appropriate instruments and benchmarking techniques.
- 3 Evaluate energy efficiency projects using financial techniques like payback period, ROI, NPV, and IRR.
- 4 Demonstrate energy-saving measures in electrical systems such as lighting control, power factor correction, and use of energy-efficient appliances.
- 5 Analyze thermal system components including boilers, steam systems, and HVAC to identify potential energy conservation opportunities.
- 6 Design building energy systems considering ECBC compliance, green building principles, and renewable energy sources.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	04	CO1
II	Energy Audit Principles	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; Data and information-analysis.	08	CO2



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		Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)		
III	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, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10	CO3
IV	Energy Management and Energy Conservation in Thermal Systems:	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10	CO4
V	Energy Performance Assessment	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations;	04	CO5



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		Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.		
VI	Energy conservation in Buildings	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03	CO6

References:

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



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7509	Development Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7509	Development Engineering	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To gain insight into the structure, characteristics, and dynamics of rural society in India and the scope of rural development.
- 2 To examine the nature, constraints, and challenges faced in the process of rural development planning and implementation.
- 3 To understand the impact and significance of the 73rd Constitutional Amendment Act on decentralized planning and rural governance.
- 4 To explore the integration of democratic processes into rural development strategies through Panchayati Raj Institutions.
- 5 To engage with the philosophical foundations of human values and their role in shaping personal, professional, and societal ethics.
- 6 To understand the relevance of human values and ethics in planning institutions and their influence on development-oriented decision-making.

Course Outcomes:

- 1 Apply knowledge for Rural Development.
- 2 Apply knowledge for Management Issues.
- 3 Apply knowledge for Initiatives and Strategies



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- 4 Develop acumen for higher education and research.
- 5 Master the art of working in group of different nature.
- 6 Develop confidence to take up rural project activities independently

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I		Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08	CO1
II		Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee – linkage between Panchayati Raj, participation and rural development	04	CO2
III		Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special	06	CO3



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		component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.		
IV		Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04	CO4
V		Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10	CO5
VI		Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04	CO6



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References:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML706	Machine Learning Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML706	Machine Learning Lab	--	--	--	--	25	25	50

Prerequisite: Data Structures, Analysis of Algorithms

Lab Objectives:

- 1 To introduce foundational concepts and techniques of Machine Learning.
- 2 To implement core supervised learning algorithms such as Linear and Logistic Regression, and SVM.
- 3 To apply unsupervised learning techniques including DBSCAN and Graph-Based Clustering.
- 4 To gain hands-on experience with ensemble methods like Bagging and Boosting.
- 5 To implement dimensionality reduction methods such as PCA, SVD, and LDA.
- 6 To explore and construct decision trees using algorithms like CART.

Lab Outcomes:

- 1 To understand the fundamentals of regression techniques including Linear and Logistic Regression.



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- 2 To apply ensemble learning methods like Bagging and Boosting to improve prediction accuracy.
- 3 To analyze multivariate regression models and interpret relationships among multiple variables.
- 4 To implement advanced classification and dimensionality reduction techniques such as SVM, PCA, SVD, and LDA.
- 5 To evaluate clustering results using Graph-Based Clustering and DBSCAN for unsupervised learning.
- 6 To design decision tree models using CART and validate their performance on given datasets.

List of Experiments.

Sr No	List of Experiments	Hrs
01	To implement Linear Regression.	2
02	To implement Logistic Regression.	2
03	To implement Ensemble learning (bagging/boosting)	2
04	To implement multivariate Linear Regression.	2
05	To implement SVM	2
06	To implement PCA/SVD/LDA	2
07	To implement Graph Based Clustering	2
08	To implement DB Scan	2
09	To implement CART	2
10	To implement LDA	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2



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Text Books:

1. Peter Harrington, —Machine Learning in Action, DreamTech Press
2. Ethem Alpaydm, —Introduction to Machine Learning, MIT Press
3. Tom M. Mitchell, —Machine Learning, McGraw Hill
4. Stephen Marsland, —Machine Learning An Algorithmic Perspective, CRC Press

References:

1. Han Kamber, —Data Mining Concepts and Techniques, Morgan Kaufmann Publishers
2. Margaret. H. Dunham, —Data Mining Introductory and Advanced Topics, Pearson Education
3. Kevin P. Murphy, Machine Learning — A Probabilistic Perspective
4. Samir Roy and Chakraborty, —Introduction to soft computing, Pearson Edition.
5. Richard Duda, Peter Hart, David G. Stork, —Pattern Classification, Second Edition, Wiley Publications.

Online Resources:

Sr. No.	Website Name
1.	Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2.	Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
3.	Machine Learning from Coursera
4.	https://towardsdatascience.com/machine-learning/home
5.	https://onlinecourses.nptel.ac.in/noc21_cs85/preview

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML707	Big Data Analytics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML707	Big Data Analytics Lab	--	--	--	--	25	25	50

Prerequisite: C Programming Language.

Lab Objectives:

- 1 Solve Big Data problems using Hadoop and MapReduce programming techniques
- 2 Apply Sqoop for data transfer between Hadoop and relational databases effectively.
- 3 Identify and execute commands on various NoSQL databases like MongoDB, Cassandra, and HBase.
- 4 Implement data stream algorithms for real-time data analysis.
- 5 Perform analytics and visualization using Hive, PIG, R, or Tableau tools.
- 6 Design and develop mini-projects using Spark, Flume, and real-time datasets for practical big data applications.

Lab Outcomes:

- 1 To interpret business models and scientific computing paradigms, and apply software tools for big data analytics.



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- 2 To implement algorithms that uses Map Reduce to apply on structured and unstructured data
- 3 To perform data operations using NoSQL databases like MongoDB, Cassandra, and HBase.
- 4 To apply data stream algorithms such as DGIM, Bloom Filter, and Flajolet-Martin in real-time analytics.
- 5 To develop and visualize social network graphs using tools like R and Tableau.
- 6 To analyze large-scale spatio-temporal data using Spark/PySpark for exploratory insights and recommendations.

List of Experiments.

Sr No	List of Experiments	Hrs
(Select a case study and perform the experiments 1 to 8.).		
Star (*) marked experiments are compulsory.		
1*	Hadoop HDFS Practical: HDFS Basics, Hadoop Ecosystem Tools Overview. -Installing Hadoop. -Copying File to Hadoop. -Copy from Hadoop File system and deleting file. -Moving and displaying files in HDFS. -Programming exercises on Hadoop	2
2	Use of Sqoop tool to transfer data between Hadoop and relational database servers. a. Sqoop - Installation. b. To execute basic commands of Hadoop eco system component Sqoop.	2
3*	To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands	2
4	Experiment on Hadoop Map-Reduce: -Write a program to implement a word count program using MapReduce.	2
5	Experiment on Hadoop Map-Reduce: -Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc	2
6	Create HIVE Database and Descriptive analytics-basic statistics.	2
7*	Data Stream Algorithms (any one): -Implementing DGIM algorithm using any Programming Language	2



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	Implement Bloom Filter using any programming language	
	Implement Flajolet Martin algorithm using any programming language	
8	Social Network Analysis using R (for example: Community Detection Algorithm)	2
9	Data Visualization using Hive/PIG/R/Tableau/.	2
10	Exploratory Data Analysis using Spark/ Pyspark.	2
11*	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web). - Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc. - Recommendation System (for example: Health Care System, Stock Market Prediction, Movie Recommendation, etc.) - Spatio Temporal Data Analytics	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets, Cambridge University Press
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.
4. DT Editorial Services, —Big Data Black Book, Dream tech Press
5. EMC Education Services, Data Science and Big Data Analytics, Wiley

References:

1. Bill Franks , —Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics, Wiley
2. Chuck Lam, —Hadoop in Action, Dreamtech Press
3. Jared Dean, —Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley India Private Limited, 2014.



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4. Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, —Data Mining and Knowledge Discovery Handbook, Springer, 2nd edition, 2010.
6. Ronen Feldman and James Sanger, —The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
7. Vojislav Kecman, —Learning and Soft Computing, MIT Press, 2010.

Online Resources:

Sr. No.	Website Name
1.	https://www.coursera.org/learn/hadoop#syllabus
2.	https://www.coursera.org/learn/introduction-mongodb#syllabus
3.	https://www.coursera.org/learn/data-visualization-tableau?specialization=data-visualization#syllabus
4.	https://www.coursera.org/learn/introduction-to-big-data-with-spark-hadoop#syllabus

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML781	Machine Vision Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML781	Machine Vision Lab	--	--	--	--	25	25	50

Prerequisite: Computer Graphics, Image Processing, Python

Lab Objectives:

- 1 To perform basic image processing operations
- 2 To explore different preprocessing technique
- 3 To develop application related to Machine vision
- 4 To detect and recognize objects
- 5 To implement and evaluate segmentation and depth estimation techniques
- 6 To apply computer vision algorithms for real-time image/video analytics

Lab Outcomes:

- 1 Students will be able to identify and perform basic image and video file operations.
- 2 Students will apply preprocessing techniques like color space conversion and filtering.
- 3 Students will analyze and perform edge and contour detection.
- 4 Students will estimate depth using disparity maps and camera feeds.



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- 5 Students will choose and implement suitable segmentation and object detection methods.
- 6 Students will build and test models for face and object recognition using feature extraction.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Handling Files, Cameras, and GUIs Basic I/O scripts ,Reading/writing an image file ,Converting between an image and raw bytes ,Accessing image data with numpy. array ,Reading/writing a video file ,Capturing camera frames, Displaying images in a window, Displaying camera frames in a window	2
02	Processing Images with OpenCV 3 Converting between different color spaces, The Fourier Transform, High pass filter, Low pass filter,	2
03	Edge detection with Canny, Contour detection, Contours – bounding box, minimum area rectangle, and minimum enclosing circle, Contours – convex contours and the Douglas-Peucker algorithm ,Line and circle detection	2
04	Depth Estimation Capturing frames from a depth camera Creating a mask from a disparity map Masking a copy operation Depth estimation with a normal camera	2
05	Object segmentation using the Watershed and GrabCut algorithms Example of foreground detection with GrabCut Image segmentation with the Watershed algorithm	2
06	Detecting and Recognizing Faces Conceptualizing Haar cascades Getting Haar cascade data Using OpenCV to perform face detection Performing face detection on a still image	2
07	Performing face detection on video Performing face recognition Generating the data for face recognition Recognizing faces Preparing the training data Loading the data and recognizing faces Performing an Eigenfaces recognition	2
08	Retrieving Images and Searching Using Image Descriptors , Feature detection algorithms, Defining features	2



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	Detecting features – corners Feature extraction and description using DoG and SIFT Anatomy of a keypoint	
09	Detecting and Recognizing Objects Object detection and recognition techniques HOG descriptors The scale issue The location issue Non-maximum (or non-maxima) suppression Support vector machines People detection	2
10	Creating and training an object detector Bag-of-words BOW in computer vision Detecting cars in a scene	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Sheila Anand and L.Priya , —A Guide for Machine Vision in Quality Controll, Taylor & Francis Inc, Imprint CRC Press Inc, Dec 2019
2. Rafael C. Gonzalez and Richard E. Woods, —Digital Image Processing, Pearson
3. Carsten Stegar, Markus Ulrich, and Christian Wiedemann , —Machine Vision Algorithms and Applications, Second completely Revised and Enlarged Edition
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, —Image Processing Analysis and Machine Vision, Second Edition, Cengage Learning.

References:

1. Chiranji Lal Chowdhary, Mamoun Alazab, Ankit Chaudhary, SaqibHakak and Thippa Reddy Gadekallu , Computer Vision and Recognition Systems Using Machine and Deep Learning Approaches, Fundamentals, technologies and applications, IET COMPUTING SERIES 42



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2. Joe Minichino Joseph Howse ,||Learning OpenCV 3 Computer Vision with Python||, Second Edition, Packt Publishing Ltd.
3. Alexander Hornberg,, — Handbook of Machine and Computer Vision The Guide for Developers and Users,

Online Resources:

Sr. No.	Website Name
1.	Learning OpenCV 3 Computer Vision with Python Second Edition, by Joe Minichino Joseph Howse Published by Packt Publishing Ltd.
2.	http://iitk.ac.in/ee/computer-vision-lab
3.	https://nptel.ac.in/courses/108103174
4.	https://docs.opencv.org/3.4/d9/df8/tutorial_root.html

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML782	Quantum Computing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practica / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML782	Quantum Computing Lab	--	--	--	--	25	25	50

Prerequisite: Python Programming Language.

Lab Objectives:

- 1 To implement fundamental quantum computing concepts
- 2 To learn quantum computation and quantum information
- 3 To understand quantum entanglement, quantum algorithms
- 4 To understand quantum information theory and channels
- 5 To analyze entanglement using Bell and GHZ circuits.
- 6 To apply quantum computing concepts through mini-projects.

Lab Outcomes:

- 1 Implement basic quantum computing logic by building dice and random numbers using open source simulation tools.
- 2 Understand quantum logic gates using open source simulation tools.
- 3 Implement quantum circuits using open source simulation tools.



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- 4 Implement quantum algorithms using open source simulation tools.
- 5 Analyze quantum entanglement through Bell and GHZ circuits.
- 6 Design and develop a mini-project using quantum algorithms for real-world problems.

List of Experiments.

Sr No	List of Experiments	Hrs
1	Building Quantum dice	2
2	Building Quantum Random No. Generation	2
3	Composing simple quantum circuits with q-gates and measuring the output into classical bits.	2
4	Implementation of Shor's Algorithms	2
5	Implementation of Grover's Algorithm	2
6	Implementation of Deutsch's Algorithm	2
7	Implementation of Deutsch-Jozsa's Algorithm	2
8	Quantum Circuits	2
9	Qubit Gates	2
10	Bell Circuit & GHZ Circuit	2
11	Accuracy of Quantum Phase Estimation	2
12	Mini Project such as implementing an API for efficient search using Grover's Algorithms or Integer factorization using Shor's Algorithm.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2



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Text Books:

1. Michael A. Nielsen, —Quantum Computation and Quantum Information, Cambridge University Press.
2. David McMahon, —Quantum Computing Explained, Wiley, 2008
3. Qiskit textbook <https://qiskit.org/textbook-beta/>
4. Vladimir Silva, Practical Quantum Computing for Developers, 2018

References:

1. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018
2. Supriyo Bandopadhyay and Marc Cahy, —Introduction to Spintronics, CRC Press, 2008
3. The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
4. La Guardia, Giuliano Gladioli —Quantum Error correction codes, Springer, 2021

Online Resources:

Sr. No.	Website Name
1.	IBM Experience: https://quantum-computing.ibm.com/
2.	Microsoft Quantum Development Kit https://azure.microsoft.com/en-us/resources/development-kit/quantum-computing/#overview
3.	Forest SDK PyQuil: https://pyquil-docs.rigetti.com/en/stable/
4.	Google Quantum CIRQ https://quantumai.google/cirq
5.	Qiskit Labs IBM https://learn.qiskit.org/course/ch-labs/lab-1-quantum-circuits



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Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML783	Natural Language processing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML783	Natural Language processing Lab	--	--	--	--	25	25	50

Prerequisite: Data Structures, Analysis of Algorithms

Lab Objectives:

- 1 To understand the key concepts of NLP.
- 2 To learn various phases of NLP.
- 3 To design and implement various language models and POS tagging techniques.
- 4 To understand various NLP Algorithms
- 5 To learn NLP applications such as Information Extraction, Sentiment Analysis, Question answering, Machine translation etc.
- 6 To design and implement applications based on natural language processing



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Lab Outcomes:

- 1 Apply various text processing techniques.
- 2 Design language model for word level analysis.
- 3 Model linguistic phenomena with formal grammar.
- 4 Design, implement and analyze NLP algorithms.
- 5 To apply NLP techniques to design real world NLP applications such as machine translation, sentiment analysis, text summarization, information extraction, Question Answering system etc.
- 6 Implement proper experimental methodology for training and evaluating empirical NLP systems.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study various applications of NLP and Formulate the Problem Statement for Mini Project based on chosen real world NLP applications: [Machine Translation, Text Categorization, Text summarization, chat Bot, Plagiarism, Spelling & Grammar checkers, Sentiment / opinion analysis, Question answering, Personal Assistant, Tutoring Systems, etc.]	2
02	Apply various text preprocessing techniques for any given text : Tokenization and Filtration & Script Validation.	2
03	Apply various other text preprocessing techniques for any given text : Stop Word Removal, Lemmatization / Stemming.	2
04	Perform morphological analysis and word generation for any given text.	2
05	Implement N-Gram model for the given text input.	2
06	Study the different POS taggers and Perform POS tagging on the given text.	2
07	Perform Chunking for the given text input.	2
08	Implement Named Entity Recognizer for the given text input.	2
09	Implement Text Similarity Recognizer for the chosen text documents.	2
10	Exploratory data analysis of a given text (Word Cloud)	2



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11	Mini Project Report: For any one chosen real world NLP application.	2
12	Implementation and Presentation of Mini Project	2

Term Work:

1	Study various applications of NLP and Formulate the Problem Statement for Mini Project based on chosen real world NLP applications: [Machine Translation, Text Categorization, Text summarization, chat Bot, Plagiarism, Spelling & Grammar checkers, Sentiment / opinion analysis, Question answering, Personal Assistant, Tutoring Systems, etc.]
2	Apply various text preprocessing techniques for any given text: Tokenization and Filtration & Script Validation.
3	Apply various other text preprocessing techniques for any given text: Stop Word Removal, Lemmatization / Stemming.

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

References:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
2. Daniel M Bikel and Imed Zitouni — Multilingual natural language processing applications: from theory to practice, IBM Press, 2013.



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3. Alexander Clark, Chris Fox, Shalom Lappin — The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
4. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
5. Niel J le Roux and SugnetLubbe, A step by step tutorial: An introduction into R application and programming.
Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009.

Online Resources:

Sr. No.	Website Name
1.	http://www.cse.iitb.ac.in/~cs626-449
2.	http://cse24-iiith.virtual-labs.ac.in/#
3.	https://nptel.ac.in/courses/106105158

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML791	Augmented and Virtual Reality Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML791	Augmented and Virtual Reality Lab	--	--	--	--	25	25	50

Prerequisite: Data Structures, Analysis of Algorithms

Lab Objectives:

- 1 To perform installation of Unity
- 2 To explore working of VR Gadget
- 3 To develop scene VR application
- 4 Apply transformations, materials, and textures to 3D objects in a VR scene.
- 5 Implement interaction and control of objects in VR using C# scripts and controllers.
- 6 Integrate AR features such as AR plane detection and Augmented Faces into applications.

Lab Outcomes:

- 1 Students will set up Unity and Visual Studio for VR development.
- 2 Students will operate VR devices like HTC Vive and Google Cardboard.



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- 3 Students will develop interactive 3D scenes in Unity with basic objects.
- 4 Students will write C# scripts to manipulate materials and object behavior.
- 5 Students will design UI elements and implement VR-based interactions.
- 6 Students will integrate ARCore features including augmented faces and surface tracking.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.	2
02	Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.	2
03	Develop a scene in Unity that includes: i. a cube, plane and sphere, apply transformations on the 3 game objects. ii. add a video and audio source	2
04	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the colour and material/texture of the game objects dynamically on button click.	2
05	Develop a scene in Unity that includes a sphere and plane . Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using vr controller.	2
06	Develop a simple UI(User interface) menu with images, canvas, sprites and button. Write a C# program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene .	2
07	Place a three-dimensional ARCore pawn on detected AR plane surfaces	2
08	Using the Augmented Faces feature in your own apps.	2



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Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)l. Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker-based augmented reality Sanni Siltanen

References:

1. AR Game Developmentll, 1st Edition, Allan Fowler, A press Publications, 2018, ISBN 978- 1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494
3. Learning Virtual Reality, Tony Parisi, O'Reilly Media, Inc., 2015, ISBN- 9781491922835

Online Resources:

Sr. No.	Website Name
1.	https://freevideolectures.com/course/3693/virtual-reality
2.	https://www.vrlabacademy.com/
3.	https://arvr.google.com/ar/
4.	https://konterball.com/



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Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML792	Blockchain Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML791	Blockchain Lab	--	--	--	--	25	25	50

Prerequisite: Cryptography and Network Security

Lab Objectives:

- 1 Understand the fundamental concepts of blockchain and its architecture.
- 2 Explore cryptographic techniques like Merkle tree hashing.
- 3 Develop and deploy smart contracts using Solidity.
- 4 Work with blockchain platforms like Ethereum, Geth, and Ganache.
- 5 Integrate wallets and transactions in decentralized applications.
- 6 Analyze blockchain use cases and create a basic blockchain application.

Lab Outcomes:

- 1 Identify and generate cryptographic hashes using Merkle tree concepts.
- 2 Design and deploy smart contracts using Solidity and Remix IDE.
- 3 Construct blockchain transactions and manage wallets using Solidity.
- 4 Implement Ethereum blockchain using Geth for decentralized applications.
- 5 Compare features of blockchain platforms such as Ganache and Hyperledger through case studies.
- 6 Develop a basic real-world blockchain application demonstrating key blockchain principles.



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List of Experiments.

Sr No	List of Experiments	Hrs
1	Cryptography in Blockchain, Merkle root tree hash	2
2	Creating Smart Contract using Solidity and Remix IDE.	2
3	Creating Transactions using Solidity and Remix IDE	2
4	Embedding wallet and transaction using Solidity	2
5	Blockchain platform ethereum using Geth.	2
6	Blockchain platform Ganache.	2
7	Case Study on Hyperledger	2
8	Case Study on Other Blockchain platforms.	2
9	Creating a blockchain Application	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhillash K. A and Meena Karthikeyan, Universities Press.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr.Gavin Wood, O'reilly.
3. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing



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References:

1. Blockchain for Beginners, Yathish R and Tejaswini N, SPD
2. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
3. Blockchain with Hyperledger Fabric, Luc Venkatraman Ramakrishna, Packt Publishing

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML793	Information Retrieval Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML793	Information Retrieval Lab	--	--	--	--	25	25	50

Prerequisite: Java, Python

Lab Objectives:

- 1 Understand the process of query formation and execution.
- 2 Implement various information retrieval modeling techniques.
- 3 Apply pattern matching and indexing methods.
- 4 Explore and apply query expansion techniques.
- 5 Perform system evaluation for IR effectiveness.
- 6 Analyze real-world case studies related to IR systems.

Lab Outcomes:

- 1 Formulate and execute structured queries for information retrieval.
- 2 Implement various IR modeling techniques such as vector space or probabilistic models.
- 3 Apply pattern matching and query expansion methods to enhance search results.



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- 4 Construct inverted index and apply tf-idf weighting for document ranking.
- 5 Evaluate the effectiveness of IR systems using standard evaluation metrics.
- 6 Analyze case studies and generate technical reports related to information retrieval systems.

List of Experiments.

Sr No	List of Experiments	Hrs
1	To understand the query structure and execute various structured queries	2
2	To implement any IR modeling technique	2
3	To implement Pattern matching method used for IR	2
4	To execute query expansion technique (Local/Global)	2
05	To design inverted indices for any information retrieval model	2
06	To implement tf-id weighting	2
07	To evaluate the system/application under study	2
08	To understand the Case Study and generate a report for the same	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Modern information retrieval, Baeza-Yates, R. and Ribeiro-Neto, B., 1999. ACM press.
2. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
3. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons



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Online Resources:

Sr. No.	Website Name
1.	https://web.stanford.edu/class/cs276/
2.	https://www.coursera.org/learn/text-retrieval

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Credit
CML710	Major Project 1	02

Course Objectives:

- 1 To enable students to identify, define, and analyze real-world engineering problems through systematic literature review and stakeholder consultation.
- 2 To develop and apply appropriate engineering knowledge, tools, and technologies for designing feasible and efficient solutions to identified problems..
- 3 To promote teamwork and collaborative project management skills through effective planning, task delegation, and communication within multidisciplinary teams.
- 4 To encourage the integration of professional ethics, social responsibility, and sustainability principles in engineering project design and implementation.
- 5 To strengthen written and oral communication skills through documentation, presentations, and technical reporting of the project work.
- 6 To foster independent learning, critical thinking, and lifelong learning aptitude through iterative problem-solving and self-evaluation during the project lifecycle.

Course Outcomes: Learner will able

- 1 To develop the understanding of the problem domain through extensive review of literature.
- 2 To Identify and analyze the problem in detail to define its scope with problem specific data.
- 3 To know various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.
- 4 To design solutions for real-time problems that will positively impact society and environment..
- 5 To develop clarity of presentation based on communication, teamwork and leadership skills.
- 6 To inculcate professional and ethical behavior.



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Guidelines:

1. Project Topic Selection and Allocation:

- Project topic selection Process to be defined and followed:
 - Project orientation can be given at the end of sixth semester.
 - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
 - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
 - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.
- Topics can be finalized with respect to following criterion:
 - **Topic Selection:** The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
 - **Technology Used:** Use of latest technology or modern tools can be encouraged.
 - Students should not repeat work done previously (work done in the last three years).
 - Project work must be carried out by the group of at least 2 students and maximum 4.
 - The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
 - The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.
 - Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
 - Guide allocation should be done and students have to submit weekly progress report to the internal guide.
 - Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
 - In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels



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2. Project Report Format:

At the end of semester, each group needs to prepare a project report as per the guidelines issued by the University of Mumbai.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
 - Analysis/Framework/ Algorithm
 - Design details
 - Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
 - Details of Database or details about input to systems or selected data
 - Performance Evaluation Parameters (for Validation)
 - Software and Hardware Set up
- Implementation Plan for Next Semester
- Timeline Chart for Term-I and Term-II (Project Management tools can be used.)
- References

Desirable

Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.)



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Semester-VIII



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC801	Distributed Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
CMC801	Distributed Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide students with contemporary knowledge in distributed systems.
2. To explore the various methods used for communication in distributed systems.
3. To provide skills to measure the performance of distributed synchronization algorithms.
4. To provide knowledge of resource management, and process management including process migration.
5. To learn issues involved in replication, consistency, and file management.
6. To equip students with skills to analyze and design distributed applications.

Course Outcomes:

1. Demonstrate the knowledge of basic elements and concepts related to distributed system



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technologies.

2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object-based middleware.
3. Analyze the various techniques used for clock synchronization, mutual exclusion and deadlock.
4. Demonstrate the concepts of Resource and Process management.
5. Demonstrate the concepts of Consistency, Replication Management and fault Tolerance.
6. Apply the knowledge of Distributed File systems in building large-scale distributed applications

Prerequisite: Computer Networks and Operating System.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Distributed Systems	Characterization of Distributed Systems: Issues, Goals, Types of distributed systems, Grid and Cluster computing Models, Hardware and Software Concepts: NOS, DOS. Middleware: Models of middleware, Services offered by middleware.	4	CO1
II	Communication Interprocess communication (IPC)	Remote Procedure Call (RPC), Remote, Method Invocation (RMI). Message-Oriented Communication, Stream Oriented Communication, Group Communication.	4	CO2



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III	Synchronization Clock	Clock Synchronization: Physical clock, Logical Clocks, Election Algorithms Distributed Mutual Exclusion, Requirements of Mutual Exclusion Algorithms and Performance measures. Non- token Based Algorithms: Lamport, Ricart-Agrawala_s and Maekawa_s Algorithms; Token-based Algorithms: Suzuki-Kasami_s Broadcast Algorithms and Raymond_s Tree-based Algorithm; and Comparative Performance Analysis. Deadlock: Introduction, Deadlock Detection: Centralized approach, Chandy - Misra_Hass Algorithm.	10	CO3
IV	Resource and Process Management	Desirable Features of Global Scheduling algorithm, Task assignment approach, Load balancing approach and load sharing approach. Introduction to Process Management, Process Migration, Code Migration.	7	CO4



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V	Replication, Consistency and Fault Tolerance	Distributed Shared Memory: Architecture, design issues. Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management. Fault Tolerance: Introduction, Process resilience, Recovery.	8	CO5
VI	Distributed File Systems	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Network File System (NFS). Designing Distributed Systems: Google Case Study.	6	CO6

Text Books:

1. A.S. Tanenbaum & M. van Steen, Distributed Systems: Principles and Paradigms, Pearson
2. M. Singhal & N.G. Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill
3. P.K. Sinha, Distributed Operating Systems, PHI

References:

1. M.L. Liu, Distributed Computing Principles and Applications, Pearson
2. G. Coulouris et al., Distributed Systems: Concepts and Design, Pearson



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Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106107
2.	http://csis.pace.edu/~marchese/CS865/Lectures/Chap7/Chapter7fin.htm
3.	https://nptel.ac.in/courses/106106168



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC821	Deep Learning	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IA T-1	IAT-2	IAT- 1+IAT -2					
CMC821	Deep Learning	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the fundamental concepts and architecture of Neural Networks.
2. To learn various activation functions, loss functions, and optimization techniques used in Deep Learning.
3. To gain hands-on experience in training and evaluating Deep Neural Networks.
4. To explore advanced Deep Learning models such as Convolutional Neural Networks (CNNs).
5. To study specialized architectures including Autoencoders and Recurrent Neural Networks (RNNs).
6. To become familiar with recent trends, applications, and research directions in the field of Deep Learning.



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Course Outcomes:

1. Understand the basic concepts and working principles of Neural Networks.
2. Demonstrate in-depth understanding of training techniques for Deep Neural Networks.
3. Apply suitable activation functions, loss functions, and optimizers for different learning tasks.
4. Design Deep Neural Network models for supervised learning problems.
5. Develop models using Autoencoders and Recurrent Neural Networks for unsupervised and sequence learning tasks.
6. Analyze and explore recent trends and real-world applications of Deep Learning.

Prerequisite: Basic mathematics and Statistical concepts, Linear algebra, Machine Learning

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Fundamentals of Neural Network	Biological neuron, McCulloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning	4	CO1



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II	Training, Optimization and Regularization of Deep Neural Network	Training Feedforward DNN Multi Layered Feed Forward Neural Network, Learning Factors, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function Optimization Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp Regularization Overview of Overfitting, Types of biases, Bias Variance Tradeoff Regularization Methods: L1, L2 regularization, Parameter sharing, Dropout, Weight Decay, Batch normalization, Early stopping, Data Augmentation, Adding noise to input and output	10	CO2
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III	Autoencoders: Unsupervised Learning	Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders Application of Autoencoders: Image Compression	6	CO3
IV	Convolutional Neural Networks (CNN):	Convolution operation, Padding, Stride, Relation between input, output and	4	CO4



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	Supervised Learning	filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture		
V	Recurrent Neural Networks (RNN)	Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit	8	CO5
VI	Recent Trends and Applications	Generative Adversarial Network (GAN): Architecture Applications: Image Generation, DeepFake	4	CO6



Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. —Deep Learning, MIT Press Ltd, 2016 Li Deng and Dong Yu, —Deep Learning Methods and Applications, Publishers Inc.
2. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
3. JM Zurada —Introduction to Artificial Neural Systems, Jaico Publishing House
4. M. J. Kochenderfer, Tim A. Wheeler. —Algorithms for Optimization, MIT Press.

References:

1. Buduma, N. and Locascio, N., —Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc."
2. François Chollet. —Deep learning with Python —(Vol. 361). 2018 New York: Manning.
3. Douwe Osinga. —Deep Learning Cookbook, O'REILLY, SPD Publishers, Delhi.
4. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc
5. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley Indi

Online References:

Sr. No.	Website Name
1	https://nptel.ac HYPERLINK " https://nptel.ac.in/courses/106/105/106105175/ ". https://deeplearning.cs.cmu.edu/S21/index.html
2	http://www.cse.iitm.ac.in/~miteshk/CS6910.html
3	https://nptel.ac.in/courses/106/106/106106184/
4	https://www.deeplearningbook.org/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC822	Digital Forensics	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -1	IAT-2	IAT- 1+IAT -2					
CMC822	Digital Forensics	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the need for digital forensics and the fundamentals of incident response methodology.
2. To study the phases involved in digital forensic investigations.
3. To learn procedures for identification, preservation, and acquisition of digital evidence.
4. To explore forensic tools and techniques used for operating system investigations.
5. To analyze methods and tools used for malware detection and analysis in digital forensics.
6. To understand techniques used in mobile device forensics and browser/email investigation.



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Course Outcomes:

1. Discuss the phases of Digital Forensics and methodology to handle the computer security incident.
2. Describe the process of collection, analysis and recovery of the digital evidence.
3. Explore various tools to analyze malwares and acquired images of RAM/hard drive.
4. Acquire adequate perspectives of digital forensic investigation in mobile devices
5. Analyze the source and content authentication of emails and browsers.
6. Produce unambiguous investigation reports which offer valid conclusions

Prerequisite: Computer Network, Cryptography and System Security

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Digital Forensics	DigitalForensicsDefination, DigitalForensics Goals, Digital Forensics Categories - Computer Forensics, Mobile Forensics, Network Forensics, Database Forensics Introduction to Incident - Computer Security Incident, Goals of Incident Response, CSIRT, Incident Response Methodology, Phase after detection of an incident	6	CO1



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II	Digital Evidence, Forensics Duplication and Digital Evidence Acquisition	Digital evidence, Types of Digital Evidence, Challenges in acquiring Digital evidence, Admissibility of evidence, Challenges in evidence handling, Chain of Custody Digital Forensics Examination Process - Seizure, Acquisition, Analysis, Reporting. Necessity of forensic duplication, Forensic image formats, Forensic duplication techniques,.Acquiring Digital Evidence Forensic Image File Format, Acquiring Volatile Memory (Live Acquisition), Acquiring Nonvolatile Memory (Static Acquisition), Hard Drive Imaging Risks and Challenges, Network Acquisition	9	CO2
III	Forensics Investigation	Analyzing Hard Drive Forensic Images, Analyzing RAM ForensicImage, Investigating Routers Malware Analysis - Malware, Viruses, Worms, Essential skills and tools for Malware Analysis, List of Malware Analysis Tools and Techniques	4	CO3



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IV	Windows and Unix Forensics Investigation	Investigating Windows Systems - File Recovery, Windows Recycle Bin Forensics, Data Carving, Windows Registry Analysis, USB Device Forensics, File Format Identification, Windows Features Forensics Analysis, Windows 10 Forensics, Cortana Forensics Investigating Unix Systems - Reviewing Pertinent Logs, Performing Keyword Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships	8	CO4
V	Mobile Forensics	Android Forensics, Mobile Device Forensic Investigation - Storage location, Acquisition methods, Data Analysis GPS forensics - GPS Evidentiary data, GPS Exchange Format (GPX), GPX Files, Extraction of Waypoints and TrackPoints, Display the Tracks on a Map. SIM Cards Forensics - The Subscriber Identification Module (SIM), SIM Architecture, Security, Evidence Extraction.		



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VI	Browser, Email Forensic & Forensic Investigation Reporting	Web Browser Forensics, Google chrome, Other web browser investigation mail forensics - Sender Policy Framework (SPF), Domain Key Identified Mail (DKIM), Domain based Message Authentication Reporting and Confirmation (DMARC) Investigative Report Template, Layout of an Investigative Report, Guidelines for Writing a Report	4	CO6
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Text Books:

1. Kevin Mandia, Chris McGrawHill, 2006
2. Digital Forensics Basics A Practical Guide Using Windows OS — Nihad A. Hassan, APress Publication, 2019
3. Xiaodong HYPERLINK "<https://www.pdfdrive.com/search?q=Xiaodong%2BLin>" HYPERLINK "<https://www.pdfdrive.com/search?q=Xiaodong%2BLin>" Lin, —Introductory Computer Forensics: A Hands-on Practical Approach, Springer Nature, 2018

Online References:

Suggested MOOC Course Links	
1	Course on —Ethical Hacking https://nptel.ac.in/courses/106/105/106105217/
2	Course on —Digital Forensics https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
3	Course on Cyber Incident Response https://www.coursera.org/learn/incident-response



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4	Course on —Penetration Testing, Incident Responses and Forensics https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theor y	Pract.	Tut.	Total
CMC823	Applied Data Science	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Tota l
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		IAT- 1	IAT-2	IAT- 1+IA T-2					
CMC823	Applied Data Science	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental concepts and workflow of Data Science.
2. To provide knowledge of data collection, preprocessing, and cleaning techniques.
3. To develop an in-depth understanding of data exploration and visualization methods.
4. To familiarize students with various anomaly detection techniques.
5. To study and apply machine learning techniques used in data science applications.
6. To understand the use of data science techniques across various real-world domains and applications.



Course Outcomes:

1. To gain fundamental knowledge of the data science process.
2. To apply data exploration and visualization techniques.
3. To apply anomaly detection techniques.
4. To gain an in-depth understanding of time-series forecasting.
5. Apply different methodologies and evaluation strategies.
6. To apply data science techniques to real world applications.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Data Science	Introduction to Data Science, Data Science Process Motivation to use Data Science Techniques: Volume, Dimensions and Complexity, Data Science Tasks and Examples. Overview of Data Preparation, Modeling, Difference between data science and data analytics	2	CO1
II	Data Exploration	Types of data, Properties of data Descriptive Statistics:	8	CO2



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		Univariate Exploration: Measure of Central Tendency, Measure of Spread, Symmetry, Skewness: Karl Pearson Coefficient of skewness, Bowley's Coefficient, Kurtosis Multivariate Exploration: Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution Inferential Statistics: Overview of Various forms of distributions: Normal, Poisson, Test Hypothesis, Central limit theorem, Confidence Interval, Z-test, t-test, Type-I, Type-II Errors, ANOVA		
III	Methodology and Data Visualization	Methodology: Overview of model building, Cross Validation, K-fold cross validation, leave-1 out, Bootstrapping Data visualization Univariate Visualization: Histogram, Quartile, Distribution Chart Multivariate Visualization:	6	CO3



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		Scatter Plot, Scatter Matrix, Bubble chart, Density Chart Roadmap for Data Exploration Self-Learning Topics: Visualizing high dimensional data: Parallel chart, Deviation chart, Andrews Curves.		
IV	Anomaly Detection	Outliers, Causes of Outliers, Anomaly detection techniques, Outlier Detection using Statistics Outlier Detection using Distance based method, Outlier detection using density-based methods, SMOTE	6	CO4
V	Time Series Forecasting	Taxonomy of Time Series Forecasting methods, Time Series Decomposition Smoothing Methods: Average method, Moving Average smoothing, Time series analysis using linear regression, ARIMA Model, Performance Evaluation: Mean Absolute Error, Root Mean Square Error, Mean Absolute Percentage Error, Mean Absolute Scaled Error	4	CO5



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		Self-Learning Topics: Evaluation parameters for Classification, regression and clustering.		
VI	Applications of Data Science	Predictive Modeling: House price prediction, Fraud Detection Clustering: Customer Segmentation Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation	4	CO6

Textbooks:

1. Vijay Kotu, Bala Deshpande. —Data Science Concepts and Practicell, Elsevier, M.K. Publishers.
2. Steven Skiena, —Data Science Design Manuall, Springer International Publishing AG
3. Samir Madhavan. —Mastering Python for Data Sciencell, PACKT Publishing.
4. Dr. P. N. Arora, Sumeet Arora, S. Arora, Ameet Arora, —Comprehensive Statistical Methods, S.Chand Publications, New Delhi.

References:

1. Jake VanderPlas. —Python Data Science Handbookll, O'reilly Publications.
2. Francesco Ricci, LiorRokach, BrachaShapira, Paul B. Kantor, —Recommender Systems Handbook Springer.
3. S.C. Gupta, V. K. Kapoor —Fundamentals of Mathematical Statisticsll, S. Chand and Sons, New Delhi.
4. B. L. Agrawal. —Basic Statisticsll, New Age Publications, Delhi.



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Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs69/preview

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC831	Optimization in Machine Learning	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
CMC831	Optimization in Machine Learning	20	20	40	60	2.5	--	--	100

Course Objectives:

1. Understand the principles of derivative-based optimization algorithms.
2. Analyze the behavior and performance of various optimization techniques.
3. Apply derivative-based optimization algorithms to solve mathematical and engineering problems.
4. Understand and implement stochastic optimization methods.
5. Analyze and apply convex optimization techniques in the context of machine learning problems.
6. Apply evolutionary algorithms to solve real-life optimization problems effectively.



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Course Outcomes:

1. To understand foundational concepts in optimization, including gradient descent and stochastic gradient methods.
2. To study the mathematical formulation and properties of convex optimization problems.
3. To apply convex optimization algorithms to real-world scenarios.
4. To analyze and implement population-based methods in evolutionary computation.
5. To explore and apply advanced evolutionary algorithms such as Particle Swarm Optimization.
6. To understand and apply Ant Colony Optimization techniques for solving complex optimization problems.

Prerequisite: Engineering Mathematics, Algorithms and data structures

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction and Background to Optimization Theory	Basic Ingredients of Optimization Problems, Optimization Problem Classifications, Optima Types, Optimization Method Classes, Overview of Unconstrained and Constrained Optimization, Basics of convex optimization	4	CO1



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II	Derivative based Optimization	The Basics of Optimization (univariate, bivariate and multivariate optimization), Convex Objective Functions First-Order optimization Methods : Gradient Descent, Conjugate Gradient, Momentum, Nesterov Momentum, Adagrad, RMSProp, learning rate optimization Second order optimization: Newton method	10	CO2
III	Stochastic Methods	Noisy Descent, Mesh Adaptive Direct Search, Cross-Entropy Method, Natural Evolution Strategies, Covariance Matrix Adaptation	6	CO3



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IV	Convex Optimization	Optimization problems, Convex optimization, Linear optimization problems, Quadratic optimization problems, Geometric programming, Overview of Generalized inequality constraints and Vector optimization	6	CO4
V	Evolutionary Methods	Introduction to Evolutionary Computation: Generic Evolutionary Algorithm, Representation: The Chromosome, Initial Population, Fitness Function, Selection: Selective Pressure, Random Selection, Proportional Selection, Tournament Selection, Rank-Based Selection, Elitism and Evolutionary Computation versus Classical Optimization, Stopping conditions Canonical Genetic Algorithm, Binary Representations of Crossover and Mutation: Binary Representations, Control Parameters	8	CO5



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VI	Advance Evolutionary Methods	Basic Particle Swarm Optimization, Global Best PSO, Local Best PSO, g-best versus l-best PSO, Velocity Components, Geometric Illustration, Algorithm Aspects, Social Network Structures Ant Colony Optimization Meta-Heuristic, Foraging Behavior of Ants, Stigmergy and Artificial Pheromone, Simple AntColony Optimization, Ant System, Ant Colony System	5	CO6
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Textbooks:

1. Mykel J. Kochenderfer, Tim A. Wheeler, Algorithms for Optimization, MIT Press (2019)
2. Andries P Engelbrecht, Computational Intelligence-An Introduction, Second-Edition, Wiley publication
3. Charu C. Aggarwal, Linear Algebra and Optimization for Machine Learning, , Springer, 2020.

References:

1. Suvrit Sra, Sebastian Nowozin, Stephen J. Wright, Optimization for Machine Learning, The MIT Press
2. Xin-She Yang Middlesex, Optimization techniques and applications with examples, Wiley
3. A.E. Eiben, J. E. Smith, Introduction to Evolutionary Computing, Springer



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Online References:

Sr. No.	Website Name
1	onvex HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ " HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ " optimization HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ " HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ "(NPTEL)
2	Constrained HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ "and HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ "Unconstrained HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ "optimization HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " (NPTEL)



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3	Machine-learning-model-performance (Coursera)
4	Deep-neural-network HYPERLINK "https://www.coursera.org/learn/deep-neural-network" HYPERLINK "https://www.coursera.org/learn/deep-neural-network"optimization HYPERLINK "https://www.coursera.org/learn/deep-neural-network" (Coursera



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC832	High Performance Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT-2	IAT- 1+IA T-2					
CMC832	High Performance Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental concepts of High-Performance Computing (HPC) architecture and parallel computing.
2. To understand the design and analysis of parallel algorithms for computational efficiency.
3. To study various parallel programming models and paradigms.
4. To develop and implement parallel algorithms using MPI (Message Passing Interface).



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5. To explore parallelization using OpenMP, OpenCL, and CUDA frameworks.
6. To introduce the use of High-Performance Computing in cloud environments and related applications.

Course Outcomes:

1. Understand parallel and pipeline processing approaches
2. Design a parallel algorithm to solve computational problems and identify issues in parallel programming.
3. Analyze the performance of parallel computing systems for clusters in terms of execution time, total parallel overhead, speedup.
4. Develop efficient and high-performance parallel algorithms using OpenMP and message passing paradigm
5. Develop high-performance parallel programming using OpenCL and CUDA framework
6. Perform the range of activities associated with High Performance Computing in Cloud Computing

Prerequisite: Computer Architecture, Operating System, Cloud Computing



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Parallel Computing	Classification Models: Architectural Schemes(Flynn's, Shore's, Feng's, Handler's) Memory Access: Distributed Memory, Shared Memory, Hybrid Distributed Shared Memory Parallel Architecture: Pipeline Architecture: Arithmetic pipelines, Floating Point, Array Processorism (What, Why, Applications), Levels of parallelism(instruction, transaction, task, thread, memory, function)	5	CO1
II	Parallel Programming Platform and Algorithm Design	Parallel Programming Platform: Physical Organization of Parallel Platforms Communication Costs in Parallel Machines Algorithm Design: Preliminaries Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	11	CO2



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III	Performance Measures	Performance Measures: Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks, The Karp Flatt Metric	3	CO3
IV	HPC Programming: OpenMP and MPI HPC Programming: OpenMP	Introduction: Threads, Share memory Architecture, Multi-core processors and Hyperthreading, Fork and join model. OpenMP directives: #pragma omp parallel, Hello world with openMP, #pragma omp for, #pragma omp for schedule. Serial vs Parallel PI program. Synchronisation: Introduction, Private vs Shared variables. Critical section, #pragma omp critical, #pragma omp atomic, #pragma omp barrier, #pragma omp reduction HPC Programming: MPI Introduction: Processes, Multiprocessor programming model, Distributed system programming model, Inter-process communication using message passing: Asynchronous and Synchronous MPI Programming: Hello world problem, mpi_initMPI_sendMPI_Recv, Synchronisation: MPI_Barrier Hybrid (MPI + OpenMP) programming, Hardware requirement, Threads inside Processes, Hybrid Matrix multiplication	10	CO4



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		Message passing vs Share memory communication: Advantages and disadvantage		
V	Parallel programming using accelerators	An Overview of GPGPUs, Introduction to CUDA, Introduction to Heterogeneous Computing using OpenCL, An Overview of OpenCL API, Heterogeneous Programming in OpenCL.	4	CO5
VI	High Performance Computing in the Cloud	Virtualization and Containerization, Parallel Computing Frameworks, Scaling, HPC in the Cloud Use Cases.	4	CO6

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar —Introduction to Parallel Computing, 2nd edition, Addison Wesley, 2003.
2. Shane Cook, Morgan Kaufmann —CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, 2012.
3. M. R. Bhujade —Parallel Computing, 2nd edition, New Age International Publishers, 2009.
4. Kai Hwang, Naresh Jotwani, —Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill, Second Edition, 2010.
5. Georg Hager, Gerhard Wellein, Chapman —Introduction to High Performance Computing for Scientists and Engineers, Hall/CRC Computational Science Series, 2011.



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References:

1. Michael J. Quinn —Parallel Programming in C with MPI and OpenMPI by, McGraw Hill Education, 2008.
2. Kai Hwang ,Zhiwei, —Scalable Parallel Computing: Technology, Architecture, Programming, McGraw-Hill Education, 1998.
3. Laurence T. Yang, Minyi Guo, —High-Performance Computing: Paradigm and Infrastructure, by, Wiley, 2006.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112105293
2	https://archive.nptel.ac.in/courses/128/106/128106014/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC833	Social Media Analytics	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- -1	IAT- 2	IAT- 1+IAT -2					
CMC833	Social Media Analytics	20	20	40	60	2.5	--	--	100

Course Objectives:

1. Familiarize the learners with the concept of social media.
2. Familiarize the learners with the concept of social media analytics and understand its significance.
3. Enable the learners to develop skills required for analyzing the effectiveness of social media.
4. Familiarize the learners with different tools of social media analytics.
5. Familiarize the learner with different visualization techniques for Social media analytics.
6. Examine the ethical and legal implications of leveraging social media data.



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Course Outcomes:

1. Understand the concept of Social media
2. Understand the concept of social media Analytics and its significance.
3. Learners will be able to analyze the effectiveness of social media
4. Learners will be able to use different Social media analytics tools effectively and efficiently.
5. Learners will be able to use different effective Visualization techniques to represent social media analytics.
6. Acquire the fundamental perspectives and hands-on skills needed to work with social media data.

Prerequisite: Graph Theory, Data Mining, Python/R programming



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Social Media Analytics: An Overview	Core Characteristics of Social Media, Types of Social Media, Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations. purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools	6	CO1
II	Social Network Structure, Measures & Visualization	Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph Layout, Visualizing Network features, Scale Issues. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks,	6	CO2



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		Common Network Terminologies, Network Analytics Tools.		
III	Social Media Text, Action & Hyperlink Analytics	Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools	8	CO3
IV	Social Media Location & Search Engine Analytics	Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools	6	CO4
V	Social Information Filtering	Social Information Filtering - Social Sharing an filtering , Automated Recommendation systems, Traditional Vs social Recommendation Systems Understanding Social Media and Business Alignment, Social Media KPI, Formulating a	6	CO5



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		Social Media Strategy, Managing Social Media Risks		
VI	Social Media Analytic Applications and Privacy	Social media in public sector - Analyzing public sector social media, analyzing individual users, case study. Business use of Social Media - Measuring success, Interaction and monitoring, case study. Privacy - Privacy policies, data ownership and maintaining privacy online.	7	CO6

Textbooks:

1. Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan,(ISBN-10: 1507823207).
2. Analyzing the Social Web 1st Edition by Jennifer Golbeck
3. Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites, Matthew A Russell, O'Reilly
4. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

References:

1. Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, AvinashKohirkar, IBM Press
2. Social Media Analytics Strategy_ Using Data to Optimize Business Performance, Alex Gonçalves, APress Business Team -
3. Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulos (2019), Wiley, ISBN 978-1-118-82485-6



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Online References:

Useful Links	
1	https://cse.iitkgp.ac.in/~pawang/courses/SC16.html
2	https://onlinecourses.nptel.ac.in/noc20_cs78/preview
3	https://nptel.ac.in/courses/106106146
4	https://7layersanalytics.com/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8401	Project Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT- 2	IAT- 1+IAT -2					
OEC8401	Project Management	20	20	40	60	2.5	--	--	100

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Course Objectives:

1. To introduce students to the fundamentals of project management and the importance of a structure approach in handling unique projects.
2. To develop an understanding of project management concepts, frameworks, and industry best practices.
3. To provide hands-on exposure to various tools and techniques used in planning, executing, and monitoring projects.
4. To explain the complete Project Management Life Cycle, including initiation, planning, execution, monitoring, and closure.
5. To enable students to identify and address project risks, scope, cost, time, and quality constraints.
6. To prepare students for real-world project environments by enhancing their decision-making, leadership, and team collaboration skills.

Course Outcomes:

1. Apply appropriate selection criteria to evaluate and choose the most suitable project from multiple alternatives.
2. Develop a Work Breakdown Structure (WBS) and construct a project schedule based on it.
3. Analyze project risks by identifying potential opportunities and threats, and formulate strategic responses.
4. Apply project monitoring and control techniques, including Earned Value Management (EVM), to assess and forecast project performance.
5. Document and communicate key findings and experiences from various project phases for continuous improvement.
6. Demonstrate the ability to integrate planning, execution, and evaluation skills for successful project completion.

Prerequisite: Basic knowledge of software engineering, management principles, and analytical skills.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Project Management Foundation	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5	CO1
II	Initiating Projects	How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6	CO2



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III	Project Planning and Scheduling	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8	CO3
IV	Planning Projects	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6	CO4



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V	Executing Projects	Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit Project Contracting Project procurement management, contracting and outsourcing	8	CO5
VI	Project Leadership and Ethics	Introduction to project leadership, ethics in projects, Multicultural and virtual projects Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study	6	CO6

Text Books:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mante^{7th} Edition, Wiley India
2. Project Management, Gido Clements, Cengage Learning



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3. Project Management, Gopalan, Wiley India

References:

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide),

Online Reference :

1. Project Management Institute (PMI) – <https://www.pmi.org>



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8402	Finance Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
OEC8402	Finance Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide an overview of the Indian financial system, including its structure, instruments and markets.
2. To introduce fundamental concepts such as the time value of money, risk, and return.
3. To explain the principles and practices of corporate finance.
4. To understand the components and management of working capital.
5. To explore various sources of finance available to businesses.
6. To study financial decision-making areas such as capital structure and dividend policy.



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Course Outcomes :

1. Understand the structure and functioning of the Indian financial system and its key components.
2. Apply the concept of the time value of money in evaluating financial decisions.
3. Analyze risk and return to support sound investment decisions.
4. Demonstrate knowledge of corporate finance principles in business contexts.
5. Effectively manage working capital to maintain business liquidity and operations.
6. Make informed decisions related to capital structure and dividend distribution.

Prerequisite: Basic knowledge of accounting, economics, and business mathematics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Overview of Indian Financial System:	Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions:	6	CO1



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		Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges		
II	Concepts of Returns and Risks:	Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	6	CO2
III	Overview of Corporate Finance:	Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	9	CO3



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IV	Capital Budgeting	Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's	10	CO4
		Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.		
V	Sources of Finance	Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of	5	CO5



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		Optimal Capital Structure		
VI	Dividend Policy	Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	3	CO6

Text Books:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8403	Entrepreneurship Development and Management	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8403	Entrepreneurship Development and Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamentals of entrepreneurship and its role in business development.
2. To develop understanding of various forms of business ownership and entrepreneurial functions.
3. To provide insights into the Indian entrepreneurial ecosystem and its regulatory environment.
4. To explain the concept and structure of Entrepreneurship Development Programs (EDP).
5. To familiarize students with the significance and functioning of Micro, Small, and Medium Enterprises (MSMEs).



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6. To enable students to analyze the contribution of government and financial institutions in promoting entrepreneurship.

Course Outcomes (Learner will be able to):

1. Understand the core concepts of entrepreneurship and various business ownership models.
2. Prepare and evaluate business plans covering key managerial and financial aspects.
3. Interpret relevant laws and legal procedures applicable to Indian entrepreneurs.
4. Analyze government policies and institutional support systems for entrepreneurs and MSMEs.
5. Apply knowledge of EDPs and their role in skill development and business support.
6. Recognize challenges in entrepreneurship and propose suitable strategies for business growth and sustainable.

Prerequisite: Basic knowledge of business studies and economics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping



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I	Overview Of Entrepreneurship	Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	4	CO1
II	Business Plans And Importance Of Capital To Entrepreneurship:	Preliminary and Marketing Plans Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance Suppliers and Risks Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development Starting a New Business,	9	CO2



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		Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance Business Operations		
III	Women's Entrepreneurship Development	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	5	CO3
IV	Indian Environment for Entrepreneurship	key regulations and legal aspects, MSME Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	8	CO4
V	Effective Management of Business	Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	8	CO5



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VI	Achieving Success In The Small Business	stages of the small business life cycle, four type of firm-level growth strategies, Options harvesting or closing small business Critical Success factors of small business	5	CO6
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Text Books:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House

References:

1. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
2. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
3. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
4. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication

Online References:

1. Laghu Udyog Samachar
2. www.msme.gov.in
3. www.dcmesme.gov.in
4. www.msmetraining.gov.in



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8404	Human Resource Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
OEC8404	Human Resource Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamental concepts and principles of Human Resource Management (HRM).
2. To explain key HRM techniques and practices used in modern organizational settings.
3. To provide a comprehensive understanding of HRM functions such as recruitment, selection, training, and performance management.
4. To explore the challenges and changes in HRM in the context of evolving organizational dynamics.
5. To familiarize students with the latest trends and technological advancements in HRM.
6. To develop awareness of interpersonal and intergroup behavioral skills essential for



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future engineers, managers, and leaders.

Course Outcomes :

1. Understand the core concepts and techniques of Human Resource Management.
2. Analyze various HRM functions and apply them in the context of organizational processes.
3. Evaluate the challenges and opportunities in HRM in today's rapidly changing business environment.
4. Identify and interpret current developments and trends in HRM practices.
5. Demonstrate effective interpersonal and team-building skills within professional settings.
6. Integrate behavioral understanding with HRM concepts to contribute effectively as future professionals.

Prerequisite: Basic understanding of management principles, organizational behavior, and communication skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to HR	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing,	5	CO1



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		Empowerment, TQM, Managing ethical issues		
II	Organizational Behaviour (OB)	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study		



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III	Organizational Structure & Design	- Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. - Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.		
IV		Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.		
V	Human resource Planning	- Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale - Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning - Training & Development: Identification of Training Needs, Training Methods		
VI	Emerging Trends in HR	- Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment - Cross Cultural Leadership and Decision Making; Cross Cultural Communication and diversity at work, Causes of diversity,		



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		managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation		
		HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries) Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labor Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act		

Text Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013.
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011

References:

1. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 5th Ed, 2015, Himalaya Publishing, 15th edition, 2015
2. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013,



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Himalaya Publishing

3. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8405	Professional Ethics and Corporate Social Responsibility (CSR)	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n(in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
OEC8405	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental principles of professional ethics in business.
2. To develop an understanding of ethical decision-making and moral responsibility in organizational settings.



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3. To recognize the scope and significance of Corporate Social Responsibility (CSR) in modern business.
4. To understand the rights and duties of businesses toward various stakeholders.
5. To explore the role of law in shaping and enforcing CSR practices.
6. To promote ethical leadership and responsible corporate behavior.

Course Outcomes :

1. Understand and apply the principles of professional ethics in business contexts.
2. Identify and evaluate the rights and responsibilities of businesses in a societal framework.
3. Analyze various aspects and dimensions of corporate social responsibility.
4. Demonstrate awareness of legal and regulatory aspects related to CSR.
5. Make ethically sound decisions in professional and organizational settings.
6. Promote socially and environmentally responsible behavior as future professionals and leaders.

Prerequisite: Basic knowledge of business management, ethics, and legal framework



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Professional Ethics and Business:	The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	4	CO1
II	Professional Ethics in the Marketplace:	Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	8	CO2



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III	Professional Ethics of Consumer Protection:	Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	6	CO3
IV	Introduction to Corporate Social Responsibility:	Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	5	CO4
V	Corporate Social Responsibility :	Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	8	CO5



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VI	Corporate Social Responsibility in Globalizing India:	Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	8	C06
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Text Books:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.

References:

1. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
2. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Online References:

1. <https://www.ethics.org> – The Ethics & Compliance Initiative (ECI)
2. <https://www.csrwire.com> – News and reports on Corporate Social Responsibility.
3. <https://www.globalreporting.org> – Global Reporting Initiative (GRI) for CSR frameworks



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OECS406	Research Methodology	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n(in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
OECS406	Research Methodology	20	20	40	60	2.5	--	--	100

Course Objectives:



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1. To introduce the basic concepts and significance of research in academic and professional contexts.
2. To explain the research process, including various types and approaches to research.
3. To guide students in identifying suitable research problems and formulating research questions.
4. To develop skills in designing effective research strategies and methodologies.
5. To familiarize students with data collection methods and tools.
6. To provide an understanding of data analysis, interpretation, and reporting of research findings.



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Course Outcomes :

1. Understand and apply the fundamental principles of research and the research process.
2. Identify and define research problems relevant to their domain.
3. Design a structured research plan with appropriate methodologies.
4. Collect, organize, and analyze data accurately using suitable tools.
5. Interpret and evaluate research data to derive meaningful conclusions.
6. Effectively present and communicate research findings in a clear and logical manner.

Prerequisite: Basic understanding of research methodology, including types of research, hypothesis formulation, and data collection techniques.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction and Basic Research Concepts	Research – Definition; Concept of Construct Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology Need of Research in Business and Social Sciences Objectives of Research Issues and Problems in Research Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	4	CO1
II	Types of Research	Types of Research • Basic Research • Applied Research • Descriptive Research • Analytical Research • Empirical Research Qualitative and Quantitative Approache	4	CO2



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III	Research Design and Sample Design	Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	10	CO3
IV	Research Methodology	Meaning of Research Methodology Stages in Scientific Research Process: Identification and Selection of Research Problem Formulation of Research Problem Review of Literature Formulation of Hypothesis Formulation of research Design Sample Design Data Collection Data Analysis Hypothesis testing and Interpretation of Data Preparation of Research Report	10	CO4
V	Formulating Research Problem	.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of	8	CO5



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		data, Generalization and Interpretation of analysis		
VI	Outcome of Research	Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	6	CO6

REFERENCES:

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



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8407	IPR and Patenting	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n (in Hrs)			
		IAT-1	IAT- 2	IAT- 1+IA T-2					
OEC8407	IPR and Patenting	20	20	40	60	2	--	--	100

Course Objectives:

1. To provide a fundamental understanding of the intellectual property rights (IPR) protection system.
2. To explain various types of intellectual property such as patents, copyrights, trademarks, and designs.
3. To promote awareness of Indian IPR laws and their relevance in business and innovation.
4. To familiarize students with international IPR treaties and procedures (e.g., WIPO, TRIPS).
5. To acquaint students with patent search tools, databases, and techniques.
6. To explain the procedures for filing patent applications and other IPR registrations.



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Course Outcomes:

1. Understand and identify various forms of intellectual property assets.
2. Explain the legal framework of IPR in India and globally.
3. Conduct basic patent and IPR-related searches using appropriate tools.
4. Describe the procedures involved in patent filing and other IPR applications.
5. Evaluate the role of IPR in fostering innovation and protecting inventions.
6. Assist individuals and organizations in building IPR awareness and compliance capabilities.

Prerequisite: Basic understanding of legal concepts and fundamentals of innovation or product Development.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Intellectual Property Rights (IPR)	Meaning of IPR, Different category of IP instruments - Patents, trademarks, Copyrights Industrial Designs, Plant variety protection Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of Development	5	CO1



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II	Enforcement of Intellectual Property Rights	Introduction, Magnitude of problem, Factor that create and sustain counterfeiting/piracy International agreements, International organizations (e.g. WIPO, WTO) active in IP enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India Indian IPR, Administrative Machinery, Major international treaties signed by India Procedure for submitting patent and Enforcement of IPR at national level etc.	7	CO2
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III	Emerging Issues in IPR	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	5	CO3
IV	Basics of Patents	Definition of Patents, Conditions of patentability Patentable and non-patentable inventions, Type of patent applications (e.g Patent of addition etc) Process Patent and Product Patent, Precaution while patenting Patent specification Patent claims Disclosure and non-disclosures, Patent rights and infringement, Method of getting a patent	7	CO4
V	Patent Rules	Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	8	CO5
VI	Procedure for Filing a Patent (National and International)	Legislation and Salient Features, Patent Search Drafting and Filing Patent Applications Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	7	CO6



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2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell.
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
7. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
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9. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
10. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
11. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company



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, Interpretation of Patent Specifications and Claims, New India Publishing Agency.
13. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
14. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8408	Digital Business Management	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IAT-1	IAT-2	IAT-1+IA T-2					
OEC8408	Digital Business Management	20	20	40	60	2	--	--	100

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Course Objectives:

1. To introduce students to the fundamental concepts of digital business.
2. To provide an understanding of the evolution and scope of e-commerce in the digital age.
3. To explore various models, tools, and platforms used in digital business environments.
4. To explain the components, infrastructure, and technologies that support e-business.
5. To analyze strategies for developing and managing successful e-business initiatives.
6. To encourage entrepreneurial thinking through the creation of digital business plans.

Course Outcomes :

1. Understand and define key concepts and drivers of digital business.
2. Distinguish between different types of e-commerce and their business models.
3. Apply digital tools and technologies for managing online business operations.
4. Analyze and evaluate e-business strategies and their implementation.
5. Demonstrate familiarity with legal, ethical, and security issues in digital business.
6. Design and present a comprehensive e-business plan.

Prerequisite: Basic knowledge of internet technologies, business processes, and information systems.



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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Digital Business-	Introduction, Background and current status of E-market places, structures, mechanism economics and impacts difference between physical economy and digital economy,	9	CO1
		drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services) opportunities and Challenges in Digital Business,		



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II	Overview of E-Commerce	-Commerce- Meaning, Retailing i e commerce-products and services consumer behavior, market research an advertisement 2B-E-commerce-selling and buying i private e-markets, public B2B exchange and support services, e-supply chains Collaborative Commerce, Intra business E and Corporate portals ther E-C models and application innovative EC System-From E- government and learning to C2C, mobile commerce an pervasive computing C Strategy and Implementation-EC strateg and global EC, Economics and Justificatio of EC, Using Affiliate marketing to promot your e-commerce business, Launching successful online business and EC project Legal, Ethics and Societal impacts of EC	6	CO2
III	Digital Business Support services	ERP as e –business backbone, knowledge Tope Apps, Information and referral system	6	CO3



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		Application Development: Building Digital business Applications and Infrastructure		
IV	Managing E-Business-	Managing Knowledge, Management skills for e-business, Managing Risks in e-business, Security Threats to e-business, Security Overview, Electronic Commerce Threats Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP SSL Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	6	CO4
V	E-Business Strategy-	E-Business Strategy-E-business Strategy formulation- Analysis of Company Internal and external environment Selection of strategy, E-business strategy into Action challenges and E-Transition Process of Digital Transformation)	4	CO5
VI	Materializing e-business:	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	8	CO6



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1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-en OECD Publishing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8409	Environmental Management	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IAT-1	IAT-2	IAT-1+IA T-2					
OEC8409	Environmental Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamentals of environmental science and the significance of environmental management in current industrial and social contexts.
2. To create awareness of global environmental challenges and the role of human activities in causing environmental degradation.
3. To develop a scientific understanding of ecological principles and ecosystem dynamics, including interdependencies among living organisms.
4. To familiarize students with the role of government and industries in environmental management and regulation.
5. To provide knowledge of environmental quality management systems, including ISO standards and Environmental Management Systems (EMS).



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6. To acquaint students with major environmental legislations and legal frameworks for sustainable and responsible development.

Course Outcomes:

1. Understand the importance of environmental management and sustainable development in addressing contemporary environmental challenges.
2. Analyze major global environmental issues such as global warming, acid rain, and biodiversity loss and their impact on ecosystems.
3. Explain key ecological concepts including ecosystems, limiting factors, food chains, and interdependencies in nature.
4. Evaluate the role of government and industries in implementing environmental management strategies and regulatory policies.
5. Demonstrate knowledge of environmental quality standards such as Total Quality Environmental Management, ISO 14000, and EMS certification.
6. Interpret the provisions and implications of major environmental legislations like the EPA, Water and Air Acts, and Wildlife Protection Act.



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Prerequisite: Basic understanding of science and awareness of current environmental issues.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction and Definition of Environment:	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10	CO1



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II	Global Environmental concerns	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	6	CO2
III	Concepts of Ecology	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	5	CO3
		Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility		
		Total Quality Environmental Management, ISO-14000, EMS certification.		
		General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.		



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IV	Scope of Environment Management	Role and functions of Government as a planning and regulating agency environment Quality Management and Corporate Environmental Responsibility	10	CO4
V	Quality Environmental Management,	Total Quality Environmental Management, ISO-14000, EMS certification.	5	CO5
VI		general overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	3	CO6



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