Hindi Seva Mandal's

Shri Sant Gadge Baba

College of Engineering & Technology,

Near Z.T.C., Bhusawal. Dist. - Jalgaon (Maharashtra) Pin - 425203.

An Autonomous Institute Accreditation By

NAAC With A+ Grade

(Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere.)

www.ssgbcoet.com

Master of Technology (M. Tech.)

in

Computer Science and Engineering

Programme Curriculum

With Effect from the Academic Year 2025-2026

2-year, 4 Semester Full time Programme Choice Based Credit

System (CBCS) and Grading System Outcome Based Education Pattern Aligned with National Education Policy (NEP) 2020

Definition of Credit**

Details	Credits
1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week - Lab	0.5 credits
2 Hours Practical(P) per week - Lab	1 credit

Sr. No.	Type of Course		Semester				Total Credits
			I	II	III	IV	
1	Program Core Course (PCC)	Program Courses	08	08	--	--	16
2	Program Elective Course (PEC)		06	03	--	--	09
3	Multidisciplinary Minor (MDM)	Multidisciplinary Courses	--	--	03	--	03
		Open Elective (OE)	--	03	03	--	06
4	Ability Enhancement Course (AEC)/ Value Education Course (VEC)	Humanities Social Science and Management (HSSM)	01	01	--	--	02
5	Indian Knowledge System (IKS)		03	--	--	--	03
6	Research Methodology	Experimental Learning Courses	--	03	--	--	03
7	Experimental Learning Courses(Seminar/Project)		02	02	14	20	38
Total			**20**	**20**	**20**	**20**	**80**

Program Educational Objectives(PEO):

No.	PEOs
PEO 1	Design, develop and test software systems for engineering applications.
PEO 2	Analyze technical solutions to computational problems and develop efficient algorithms.
PEO 3	Work in multi-disciplinary teams to specify software requirements and to achieve project goals.
PEO 4	Communicate effectively and demonstrate professional ethics with societal responsibilities.
PEO 5	Engage in lifelong learning to keep pace with changing landscape of technologies for professional advancement.

Program Outcomes (POs) :

At the end ofthe program,the students will be able to:

No.	PO
PO1	To adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.
PO2	Engage in critical thinking and pursue investigations / research and development to solve practical problems.
PO3	Communicate effectively, writes and present technical reports on complex engineering activities by interacting with the engineering fraternity and with society at large.
PO4	Learn independently and engage in lifelong learning.
PO5	Understanding and ability to use advanced computing techniques and tools.
PO6	Demonstrate higher level of professional skills to tackle multidisciplinary and complex problems related to Computer Science and Engineering.
PO7	Apply concepts of theoretical computer science to design software systems satisfying realistic, economic, social, safety and security constraints.
PO8	Design and develop processes to meet targeted needs with optimum utilization of resources.
PO9	Uderstanding of professional and ethical responsibility & communicate effectively with a wide range of audience.
PO10	Design and develop processes to meet targeted needs with optimum utilization of resources.
PO11	Develop robust, reliable, scalable techniques and tools for knowledge-based systems.
PO12	Design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society.

First Year Structure 2025-2026 as per NEP 2020											
Semester I											
Course Category	**Category under NEP**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC	Program Core	MTCS25PC101	Advances in Algorithm	3	-	-	20	20	60	100	3
PCC	Program Core	MTCS25PC102	Advanced Operating Systems	3	-	-	20	20	60	100	3
PEC	Program Elective -I	MTCS25PE103	Program Elective -I	3	-	-	20	20	60	100	3
PEC	Program Elective -II	MTCS25PE104	Program Elective -II	3	-	-	20	20	60	100	3
PCC	Program Core	MTCS25PC105L	Advanced Operating Systems Lab	-	-	4	50	-	-	50	2
ELC	Experimental Learning	MTCS25EL106S	Seminar-I	-	-	4	50	-	-	50	2
IKS	Indian Knowledge System	MTCS25IK107	IKS Bucket	3	-	-	20	20	60	100	3
AEC	Ability Enhancement course	MTCS25AE108	YOGA for Stress Management	-	-	2	50	--	--	50	1
			Total	**15**		**10**	**250**	**100**	**300**	**650**	**20**

Course Code	Program Elective-I	Course Code	Program Elective-II
MTCS25PE103A	Data Analysis and Visualizations	MTCS25PE104A	Introduction to Machine Learning
MTCS25PE103B	Block chain Technology	MTCS25PE104B	Artificial Intelligence Knowledge Representation and Reasoning
MTCS25PE103C	Cyber Security & Digital Forensic	MTCS25PE104C	Mathematical Foundations of Computer Science
MTCS25PE103D	Distributed System and Cloud Computing	MTCS25PE104D	Software Testing

IKS :- https://iksindia.org/courses-offered-by-iks-centers.php

Course Code	IKS Bucket : Indian Knowledge System (IKS)
MTCS25IK107A	Indian Knowledge System (IKS): Concepts and Applications in Engineering
MTCS25IK107B	Indian Knowledge System(IKS): Humanities and Social Sciences
MTCS25IK107C	Indian Knowledge System(IKS): Mathematics in India
MTCS25IK107D	Indian Knowledge System(IKS): Aarogya Samskriti – Health culture of Bharat

Semester II											
Course Category	**Category under NEP**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC	Program Core	MTCS25PC201	Advanced Database Management System	3	-	-	20	20	60	100	3
PCC	Program Core	MTCS25PC202	Software Architecture	3	-	-	20	20	60	100	3
PEC	Program Elective -III	MTCS25PE203	Program Elective -III	3	-	-	20	20	60	100	3
RM	RM	MTCS25RM204	Research Methodology and IPR	3	-	-	20	20	60	100	3
OE	Open Elective-I	MTCS25OE205	Open Elective-I	3	-	-	20	20	60	100	3
PCC	Program Core	MTCS25PC206L	Advanced Database Management System Lab	-	-	4	50	-	-	50	2
ELC	Experiential Learning	MTCS25EL207P	Mini Project	-	-	4	50	-	-	50	2
Audit	Ability Enhancement course	MTCS25AE208	Disaster Management	-	-	2	50	-	-	50	1
			Total	**15**		**10**	**250**	**100**	**300**	**650**	**20**

Course Code	Program Elective -III	Course Code	Open Elective-I
MTCS25PE204A	Web Engineering	MTCS25OE205A	Intellectual Property Rights
MTCS25PE204B	Artificial Neural Network	MTCS25OE205B	Quantum Computing Fundamentals
MTCS25PE204C	Deep Learning	MTCS25OE205C	Bioinformatics
MTCS25PE204D	Secure Software Design and Enterprise Computing	MTCS25OE205D	Optimization Techniques

Second Year Structure 2025-2026 as per NEP 2020

Semester III

Course Category	Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
				L	T	P	CA	MSE	ESE	Total	
OE	Open Elective-II	MTCS25OE301	Open Elective-II	3	-	-	20	20	60	100	3
MDM	Multidisciplinary Minor	MTCS25MM302	Multidisciplinary Minor	3	-	-	20	20	60	100	3
ELC	Experiential Learning	MTCS25EL303S	Seminar-II	-	-	4	50	-	50	100	2
ELC	Experiential Learning	MTCS25EL304P	Project-I	-	-	-	100	-	100	200	12
			Total	**06**		**04**	**190**	**40**	**270**	**500**	**20**

Course Code	Open Elective-II	Course Code	Multidisciplinary Minor
MTCS25OE301A	Cost Management of Engineering Projects	MTCS25MM302A	Innovation & Creativity
MTCS25OE301B	High-Performance Computing	MTCS25MM302B	Cyber Forensics and Cyber Laws
MTCS25OE301C	Financial Technology	MTCS25MM302C	Computational Economics
MTCS25OE301D	Operations Research	MTCS25MM302D	Sustainable Energy Conversion System

Semester- IV

Course Category	Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
				L	T	P	CA	MSE	ESE	Total	
ELC	Experiential Learning	MTCS25EL401	Project-II	-	-		100		100	200	20
			Total				100		100	200	20

CREDIT DISTRIBUTION

SEM I	SEM II	SEM III	SEM IV	Total
20	**20**	**20**	**20**	**80**

ABBREVIATIONS

- PEO: Program Educational Objectives
- PO: Program Outcomes
- CO: Course Outcomes
- L: No. of Lecture hours (per week)
- T: No. of Tutorial hours (per week)
- P: No. of Practical hours (per week)
- C: Total number of credits
- PCC: Professional Core Course
- OEC: Open Elective Course
- ELC : Experimental Learning Courses
- PEC: Programme Elective Course
- IKS: Indian Knowledge Society MDM: Multidisciplinary Min

MTCS25PC101	Advances in Algorithm	PCC	3-0-0	3 Credits

Mid Semester Exam	Continuous Assessment	End-Semester Exam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-Understanding :

1 Algorithm analysis

2 Advanced algorithm design paradigms

3 Problem-solving skills

4 practical implementation skills

5 Explore the connection between algorithms and real-world applications

Course Outcomes:-

CO1 Ability to analyze algorithm performance

CO2 Proficiency in applying algorithmic techniques

CO3 Skill in designing efficient algorithms

CO4 Understanding of algorithm complexity

CO5 Ability to implement and test algorithms

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2	✔	✔		✔							✔	
CO3		✔			✔				✔			
CO4							✔					
CO5	✔									✔		✔

SYLLABUS

Unit I **08 Hours**

Algorithm Fundamentals Basic Concept, Analysis of Algorithm, Growth of Functions, Master's Theorem. Analysis of algorithms for classic problems in various domains.

Unit II **08 Hours**

Randomized Algorithm Introduction to Probabilistic Analysis and Randomized Algorithms, Quick sort randomized version, searching in linear time.

Unit III **08 Hour**

Advance Design and Analysis Techniques: Dynamic Programming, Greedy Algorithms, Branch and bound, Back Tracking: Case studies

Unit IV **08 Hours**

Computational Geometry Introduction to Computational Geometry, NP-Completeness. Introduction to Approximation Algorithms.

Unit V **08 Hours**

Parallel Algorithm Performance Measures of Parallel Algorithms, Parallel Merging/Sorting Algorithms on CREW/EREW, and Parallel searching algorithms.

Text Books

1. DonaldF.StanatandDavidF. McAllister, Discrete mathematics in ComputerScience.
2. ThomasKoshy,ElementarynumbertheorywithApplications,Elsevier
3. I.N. Herstein, Topicsin Algebra.JOHNWiley&SONS.1990.
4. SheldonM.Ross,IntroductiontoProbabilityModels,Elsevier.

Reference Book:-

1. H.Cormen,C.E.Leiserson,R.L.Rivest,CStein,IntroductiontoAlgorithms,PrenticeHall, India
2. Sara Baase and AlanVanVan Gelder.ComputerAlgorithms: Introduction toDesignand Analysis. Addison—Wiley,2000.
3. G.Chartrandand P.Zhang,IntroductiontoGraphTheory,McGraw-HillCcompanies,
4. Douglas B.West,Introduction to Graph Theory,Prentice Hall of India.
5. LinearAlgebra2ndEdition(Paperback)by Kenneth Hoffman ,RayKunze

E-Resources:1.https://onlinecourses.nptel.ac.in/noc23cs63/preview

MTCS25PC102	Advanced Operating Systems	PCC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:- Understanding :

1 OS Structure and Design

2 Advanced Concepts

3 Process and Resource Management

4 Concurrency and Parallelism

5 File Systems and I/O

Course Outcomes:-

CO1 Analyzing OS Components

CO2 Designing Solutions

CO3 Understanding Advanced Architectures

CO4 Applying Scheduling Algorithms

CO5 Implementing Inter-Process Communication

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔				✔			✔			✔
CO2							✔				✔	
CO3		✔	✔		✔				✔			
CO4							✔					
CO5	✔									✔		

SYLLABUS

UNIT – I: OS Overview and System Structure **08 Hours**

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines;

UNIT – II: Process Management **08 Hours**

Process Management: Process concept; Process scheduling; Operations on processes. Multithreaded Programming: Overview; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms.

UNIT – III: Process Coordination **08 Hours**

Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; problems of synchronization; Monitors Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

UNIT – IV: Architectures of Distributed Systems **08 Hours**

Architectures of Distributed Systems: System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives. Theoretical Foundations: Inherent Limitations of a Distributed System, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.

UNIT – V: Distributed Mutual Exclusion **08 Hours**

Distributed Mutual Exclusion: Introduction, The Classification of Mutual Exclusion Algorithms, Non-Token – Based Algorithms: Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm, Token-Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal's Heurisric Algorithm, Raymond's Heuristic

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition,Wiley-India, 2010
2. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata McGraw- Hill Edition 2001.

REFERENCE BOOKS:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.
2. . Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall, Edition –2, 2007

E-Resources: 1. https://www.udacity.com/course/advanced-operating-systems--ud189

MTCS25PE103A	Data Analysis and Visualizations	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the concept of the Data Analytics Lifecycle

2 Develop Mathematical concepts for advanced regression

3 Understand data modeling in time series and its process

4 Create awareness about Text analytics and its applications

5 Provide an overview of Data analytics and visualization with R and Python

Course Outcomes:-

CO1 Comprehend basics of data analytics and visualization:

CO2 Apply various regression models on given datasets and perform predictions:

CO3 Demonstrate advanced understanding of Time series concepts and analysis of data using various time series models:

CO4 Analyze text data and gain insights:

CO5 Experiment with different analytics techniques and visualizations using R and Python:

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2							✔				✔	
CO3					✔				✔			
CO4				✔			✔				✔	
CO5	✔	✔								✔		✔

SYLLABUS

UNIT – I: Introduction to Data analytics and life cycle **08 Hours**

Data Analytics Lifecycle overview:Key Roles for a Successful Analytics, Background and Overview of Data Analytics Lifecycle Project Phase 1: Discovery: Learning the Business Domain, Resources Framing the Problem, Identifying Key Stakeholders. Interviewing the Analytics Sponsor, Developing Initial Hypotheses Identifying Potential Data Sources Phases

UNIT – II: Regression Models **08 Hours**

Introduction to simple Linear Regression: The Regression Equation, Fittedvalue and Residuals, Least Square Introduction to Multiple Linear Regression: Assessing the Model, Cross-Validation, Model Selection and Stepwise Regression, Prediction Using Regression, Logistic Regression: Logistic Response function and logit, Logistic Regression and GLM, Generalized Linear model, Predicted values from Logistic Regression, Interpreting the coefficients and odds ratios, Linear and Logistic Regression: similarities and Differences, Assessing the models.

UNIT – III: Time Series & Text Analytics **08 Hours**

Overview of Time Series Analysis Box-Jenkins Methodology, ARIMA Model Autocorrelation Function (ACF) ,Autoregressive Models ,Moving Average Models ,ARMA and ARIMA Models , Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions, History of text mining, Roots of text mining overview of seven practices of text analytic, Application and use cases for Text mining: extracting meaning from unstructured text, Summarizing Text. Text Analysis Steps, A Text Analysis Example , Collecting Raw Text ,Representing Text ,Term Frequency—Inverse Document Frequency (TFIDF),Categorizing Documents by Topics, Determining Sentiments , Gaining Insights

UNIT – IV: Data analytics and visualization with R **08 Hours**

Introduction to R: Data Import and Export, Attribute and Data type, Descriptive statistics. Exploratory Data Analysis: Visualization before analysis, DirtyData, visualizing single variable, examining Multiple variable, Data Exploration versus presentation.

UNIT – V: Data analytics and Visualization with Python **08 Hours**

Essential Data Libraries for data analytics:Pandas, NumPy, SciPy. Plotting and visualization with python: Introduction to Matplotlib, Basic Plotting with Matplotlib, Create Histogram, BarChart, Pie chart, Box Plot, violin plot using Matplotlib. Introduction to seaborn Library, MultiplePlots, Regressionplot, regplot .

TEXT BOOKS:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data,EMC Education services Wiley Publication
2. Data Analytics using Python: Bharati Motwani, Wiley Publications.
3. Practical Statistics for Data Scientists 50+ Essential Concepts Using R and Python, O'Reilly Publications 2nd Edition
4. Practical Text Mining and statistical Analysis for non-structured text data applications,1st edition,Grey Miner,Thomas Hill.

REFERENCE BOOKS:

1. Data Analytics using R, Bharati Motwani, Wiley Publications
2. Python for Data Analysis: 3rd Edition, Wes McKinney ,Publisher(s): O'Reilly Media, Inc.

NPTEL: Data Analytics and Visualization with MS Power BI By Dr. Anand A. Kopare | Atlas SkillTech University, Mumbai, https://onlinecourses.swayam2.ac.in/imb25_mg218/preview

Useful Links

1 http://varianceexplained.org/RData/

2 https://www.kaggle.com/code/iamleonie/time-series-interpreting-acf-and-pacf

3 https://www.geeksforgeeks.org/data-visualization-using-matplotlib/

MTCS25PE103B	Block chain Technology	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 To give students the understanding of emerging abstract models for Blockchain Technology .

2 To familiarise with the functional.

3 To familiarise with the operational aspects of cryptocurrency eco-system.

4 To explore the driving force behind the cryptocurrency Bitcoin.

5 Along with the Decentralization, Cryptography, Bitcoins with its alternative coins, Smart contracts and outside of currencies.

Course Outcomes:-

CO1 Describe the basic concepts and technology used for blockchain.

CO2 Describe the primitives of the distributed computing and cryptography related to blockchain.

CO3 Illustrate the concepts of Bitcoin and their usage.

CO4 Implement Ethereum block chain contract.

CO5 Apply security features in blockchain technologies.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			
CO2	✔			✔			✔					
CO3	✔	✔			✔				✔			✔
CO4											✔	
CO5	✔									✔		✔

SYLLABUS

UNIT-I **08 Hours**

Introduction: Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

UNIT-II **08 Hours**

Basic Distributed Computing & Crypto primitives: Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems .

UNIT-III **08 Hours**

Bitcoin basics: Bitcoin blockchain, Challenges and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use .

UNIT-IV **08 Hours**

Ethereum basics: Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts, Writing smart contracts using Solidity & JavaScript .

UNIT-V **08 Hours**

Privacy, Security issues in Blockchain: Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks .

List of References:

1. Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press.
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.
3. Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing.
4. Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols", Packt Publishing.
5. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design And Use Cases"[MOOC],

NPTEL: Blockchain and its Applications, By Prof. Sandip Chakraborty, Prof. Shamik Sural | IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc22_cs44/preview

MTCS25PE103C	Cyber Security & Digital Forensic	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understanding Cyber Security Fundamentals

2 Mastering Network Security

3 Exploring Cryptography

4 Developing Digital Forensics Expertise

5 Addressing Ethical and Legal Issues

Course Outcomes:-

CO1 Risk Assessment and Management

CO2 Incident Response

CO3 Digital Evidence Analysis

CO4 Cybercrime Investigation

CO5 Secure System Design and Implementation

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			✔
CO2							✔				✔	
CO3	✔	✔			✔							
CO4				✔			✔				✔	
CO5		✔				✔				✔		✔

SYLLABUS

UNIT – I **08 Hours**

Fundamentals of Cyber Security: Introduction to cyber security and cyber space, Types of cyber threats: malware, phishing, ransomware, DDoS, social engineering, Network security fundamentals: firewalls, IDS/IPS, VPN, Authentication methods and access control, Cyber laws and cyber ethics (Indian IT Act, GDPR overview)

UNIT – II **08 Hours**

Cryptography and Secure Communication: Principles of cryptography: confidentiality, integrity, availability, Symmetric and asymmetric encryption (AES, DES, RSA), Hashing and digital signatures, Public Key Infrastructure (PKI) and SSL/TLS,Secure protocols (HTTPS, SSH, IPsec)

UNIT –III **08 Hours**

Network and System Security: Operating system security (Linux & Windows), Security vulnerabilities and patch management, Wireless network security and Wi-Fi encryption protocols, Intrusion detection and prevention systems, Incident response and handling

UNIT – IV **08 Hours**

Digital Forensics Principles and Techniques: Introduction to digital forensics and forensic process, Types of digital evidence and rules of evidence handling, File systems and data acquisition techniques, Memory, email, mobile, and cloud forensics, Anti-forensics and encryption challenges

UNIT – V **08 Hours**

Cyber Crime Investigation and Case Studies: Phases of cybercrime investigation, Cybercrime types: identity theft, cyberstalking, cyberterrorism, Cyber forensics lab setup and tools, Legal issues in digital evidence and court admissibility, Case studies: real-world cybercrime investigations and responses

Textbooks

1.Fundamentals of Information Systems Security, 3rd Edition by David Kim, Michael G. Solomon, O'Reilly media, 2016.

2. Principles Of Information Security, Whitman M E, Herbert J. Mattord , 5th Edition, Cengage Learning, 2014 3. Fundamentals of Information Security, Nadkarni, Sanil , BPB Publications, 2020.

MTCS25PE103D	Distributed System and Cloud Computing	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understanding Distributed Systems Fundamentals:

2 Exploring Cloud Computing Concepts:

3 Gaining Practical Experience:

4 To use cloud platforms (e.g., AWS, Azure, Google Cloud)

5 Understanding Security and Performance

Course Outcomes:-

CO1 Ability to Design Distributed Systems

CO2 Proficiency in Cloud Computing Technologies

CO3 Understanding Cloud Service Models

CO4 Knowledge of Cloud Security Principles

CO5 Skills in Performance Analysis and Optimization

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔						✔			✔
CO2	✔	✔		✔			✔				✔	
CO3	✔				✔				✔			✔
CO4							✔				✔	
CO5	✔									✔		

SYLLABUS

UNIT – I **08 Hours**

Introduction to Clouds, Virtualization and Virtual Machine

Introduction to Cloud Computing: Why Clouds, What is a Cloud,Whats new in todays Clouds, Cloud computing vs. Distributed computing, Utility computing, Features of today's Clouds: Massive scale, AAS Classification: HaaS, IaaS, PaaS, SaaS, Data-intensive Computing, New Cloud Paradigms, Categories of Clouds: Private clouds, Public clouds Virtualization: What's virtualization, Benefits of Virtualization, Virtualization Models: Bare metal, Hosted hypervisor

UNIT – II **08 Hours**

Network Virtualization and Geo-distributed Clouds, Server Virtualization: Methods of virtualization: Using Docker,Using Linux containers, Approaches for Networking of VMs: Hardware approach: Single-root I/O virtualization (SR-IOV), Software approach: Open vSwitch, Mininet and its applications, Geo-distributed Cloud Data Centers: Inter-Data Center Networking, Data center interconnection techniques: MPLS, Google's B4 and Microsoft's Swan.

UNIT – III **08 Hours**

Leader Election in Cloud, Distributed Systems and Industry Systems

Lader Election in Rings (Classical Distributed Algorithms): LeLann-Chang-Roberts (LCR) algorithm, The Hirschberg and Sinclair (HS) algorithm, Leader Election (Ring LE & Bully LE Algorithm): Leader Election Problem, Ring based leader election, Bully based leader election, Leader Election in Industry Systems: Google's Chubby and Apache Zookeeper Design of Zookeeper: Race condition, Deadlock, Coordination, Zookeeper design goals, Data model.

UNIT IV **08 Hours**

Classical Distributed Algorithms and the Industry Systems

Time and Clock Synchronization in Cloud Data Centers: Synchronization in the cloud, Key challenges, Clock Skew, Clock Drift, External and Internal clock synchronization, Christians algorithm, Error bounds, Network time protocol (NTP), Berkley's algorithm, Datacenter time protocol (DTP), Logical (or Lamport) ordering, Lamport timestamps, Vector timestamps

Distributed Mutual Exclusion: Mutual Exclusion in Cloud, Central algorithm, Ring-based Mutual Exclusion, Lamport's algorithm, Ricart-Agrawala's algorithm, Quorum-based Mutual Exclusion, Maekawa's algorithm, Problem of Deadlocks, Handling Deadlocks, Industry Mutual Exclusion : Chubby

UNIT V: **Consensus, Paxos and Recovery in Clouds** **08 Hours**

Consensus in Cloud Computing and Paxos: Issues in consensus, Consensus in synchronous and asynchronous system, Paxos Algorithm ,Byzantine Agreement: Agreement, Faults, Tolerance, Measuring Reliability and Performance, Generals Problem, Lamport-Shostak-Pease Algorithm, Design of Key-Value Stores: Key-value Abstraction, Key-value/NoSQL Data Model, Design of Apache Cassandra, Data Placement Strategies, Snitches,

Text Book:

1. P. K. Sinha, Distributed Operating System, PHI Publication
2. Mastering Cloud Computing by Raj Kumar Buyya, Christian Vecchiola, and S.Thamarai Selvi from TMH 2013.

Reference Book:

1. Distributed Algorithms-Nancy Lynch
2.Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
3.Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012

MTCS25PE104A	Introduction to Machine Learning	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understanding the fundamentals

2 Exploring algorithms

3 Developing practical skills

4 Applying machine learning to real-world problems

5 Understanding the challenges

Course Outcomes:-

CO1 Algorithm selection

CO2 Model evaluation

CO3 Interpretation and analysis

CO4 Practical implementation

CO5 Critical thinking

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✔				✔						✔
CO2				✔			✔				✔	
CO3	✔	✔	✔		✔				✔			✔
CO4											✔	
CO5	✔									✔		

SYLLABUS

UNIT – I **08 Hours**

Foundations of Machine Learning

What is Machine Learning? Types: Supervised, Unsupervised, Reinforcement Learning,Applications and real-world use cases,Steps in a machine learning pipeline,Basic concepts: features, labels, training vs testing, overfitting & underfitting,Performance metrics: accuracy, precision, recall, F1-score, confusion matrix

UNIT –II **08 Hours**

Supervised Learning Algorithms: Linear Regression: model, cost function, gradient descent, Logistic Regression for classification, k-Nearest Neighbors (k-NN), Decision Trees and Random Forests, Support Vector Machines (SVM)

UNIT – III **08 Hours**

Unsupervised Learning Algorithms: Clustering: k-Means, Hierarchical Clustering, Dimensionality Reduction: PCA, t-SNE, Association Rule Learning: Apriori, FP-Growth, Evaluation of clustering models (silhouette score, inertia).

UNIT – IV **08 Hours**

Neural Networks and Deep Learning Basics, Introduction to artificial neural networks, Perceptron and multilayer networks, Backpropagation and activation functions, Overview of deep learning and popular frameworks (TensorFlow, Keras, PyTorch), Applications of deep learning (image recognition, NLP)

UNIT – V **08 Hours**

Model Evaluation, Tuning & Applications: Cross-validation and model selection, Hyperparameter tuning (grid search, random search), Bias-variance trade-off, Ethical issues in machine learning: fairness, transparency, and accountability, Capstone project idea: end-to-end ML model with evaluation.

Textbooks & References

1. Introduction to Machine Learning with Python – Andreas C. Müller & Sarah Guido
2. Pattern Recognition and Machine Learning – Christopher M. Bishop

Reference Book:-

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron
2. Scikit-learn, TensorFlow, and PyTorch official documentation

NPTEL: Introduction to Machine Learning By Prof. Balaraman Ravindran | IIT Madras, https://onlinecourses.nptel.ac.in/noc23_cs18/preview

MTCS25PE104B	Artificial Intelligence Knowledge Representation and Reasoning	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understanding Knowledge Representation

2 To learn various techniques for representing knowledge

3 Reasoning Techniques

4 Problem Solving

5 Intelligent Agents

Course Outcomes:-

CO1 Identify Appropriate AI Methods

CO2 Knowledge Representation

CO3 Reasoning Algorithms

CO4 Problem Solving with KR&R

CO5 Awareness of Applications

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔			✔	✔			✔			✔
CO2				✔							✔	
CO3	✔	✔			✔							
CO4	✔		✔				✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity.

UNIT – II **08 Hours**

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT – III **08 Hours**

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation

UNIT – IV **08 Hours**

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts,Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT – V **08 Hours**

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

TEXT BOOKS:

1. Knowledge Representation logical, Philosophical, and Computational Foundations by John F. Sowa, Thomson Learning.
2. Knowledge Representation and Reasoning by Ronald J. Brachman, Hector J. Levesque, Elsevier.

MTCS25PE104C	Mathematical Foundations of Computer Science	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the fundamentals of mathematical logic, including statements, connectives, and inference theory.

2 Familiarize students with the concepts of sets, relations, and functions, and their associated operations.

3 Develop the ability to model and solve problems using graph theory.

4 Introduce generating functions and recurrence relations for problem-solving.

5 Enable students to relate practical examples to mathematical models and interpret them in context.

Course Outcomes:-

CO1 Ability to apply mathematical logic to solve problems

CO2 Understanding of sets, relations, functions, and discrete structures

CO3 Proficiency in using logical notation

CO4 Ability to formulate and solve recurrence relations

CO5 Ability to model and solve real-world problems using graphs and trees

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			✔
CO2		✔		✔			✔				✔	
CO3	✔		✔	✔	✔				✔			
CO4							✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Functional Logic: Proposition Logic, Resolution Proof system, Predicate logic. Congruences, Fermat's theorem, Euler function, Chinese remainder theorem.

UNIT – II **08 Hours**

Groups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, Ring. Field. Linear algebra: Vector Space, Basis, Matrices and Linear Transformations, Eigen values, Orthogonality.

UNIT – III **08 Hours**

Counting, Probability, Discrete random variable, Continuous random variable, Moment generating function, Markov's inequality, Chebyshev's inequality, The geometric and binomial distributions, The tail of the binomial distribution.

UNIT – IV **08 Hours**

Graphs, Euler tours, planar graphs, Hamiltonian graphs, Euler's formula, applications of Kuratowski's theorem, graph colouring, chromatic polynomials, trees, weighted trees, the max-flow min-cut theorem.

UNIT – V **08 Hours**

Turing Machines, Recursive and Recursively Enumerable languages, Cantor's Diagonalization theorem, Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions, Approximation algorithms.

Text Books

1. Donald F. Stanat and David F. McAllister, Discrete mathematics in Computer Science.
2. Thomas Koshy, Elementary number theory with Applications, Elsevier
3. I.N.Herstein, Topics in Algebra.JOHN Wiley & SONS. 1990.
4. Sheldon M. Ross, Introduction to Probability Models, Elsevier.

Reference Book:-

1. H. Cormen, C. E. Leiserson, R. L. Rivest, C Stein, Introduction to Algorithms, Prentice Hall India.
2. Sara Baase and Alan Van Van Gelder. Computer Algorithms: Introduction to Design and Analysis. Addison – Wiley, 2000.
3. *G. Chartrand* and *P. Zhang*, Introduction to Graph Theory, McGraw-Hill Companies,
4. Douglas B. West, Introduction to Graph Theory, Prentice Hall of India.
5. Linear Algebra 2nd Edition (Paperback) by Kenneth Hoffman, Ray Kunze, PHI Learning, 2009.
6.

MTCS25PE104D	Software Testing	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understanding Testing Fundamentals

2 Mastering Testing Techniques

3 Developing Test Cases

4 Applying Testing Tools

5 Understanding Testing Processes

Course Outcomes:-

CO1 Requirement Analysis

CO2 Test Case Design and Execution:

CO3 Test Tool Proficiency

CO4 Defect Identification and Reporting

CO5 Test Evaluation and Improvement

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2	✔			✔								
CO3		✔			✔							
CO4							✔				✔	
CO5				✔						✔		✔

SYLLABUS

UNIT – I **08 Hours**

Fundamentals of Software Testing: Introduction to Software Testing,Importance and objectives of testing,Software Development Life Cycle (SDLC) and its relation to testing,Software Testing Life Cycle (STLC),Levels of testing: Unit, Integration, System, and Acceptance Testing,Manual vs Automated Testing,Testing principles and myths.

UNIT – II **08 Hours**

Testing Techniques: Static Testing: Reviews, Walkthroughs, and Inspections,Black Box Testing,Equivalence Class Partitioning,Boundary Value Analysis,Decision Table Testing,State Transition Testing,White Box Testing,Statement Coverage,Branch Coverage,Path Testing,Error Guessing

UNIT – III **08 Hours**

Test Management and Planning: Test Planning and Control,Test Analysis and Design,Test Implementation and Execution,Test Closure Activities,Test Documentation: Test Plan, Test Case, Test Data, Test Summary Report,Defect Life Cycle and Bug Tracking,Test Metrics and Measurements

UNIT – IV **08 Hours**

Automation Testing and Tools: Introduction to Automation Testing, Benefits and limitations of automation, Test automation frameworks and scripting, Overview and use of tools, Selenium WebDriver, JUnit/TestNG, QTP/UFT (Overview), Postman (for API testing),Introduction to Continuous Integration tools (e.g., Jenkins)

UNIT – V **08 Hours**

Advanced Topics and Industry Practices: Regression Testing and Retesting, Performance Testing: Load, Stress, and Volume Testing, Security Testing Basics,Usability and Compatibility esting,Testing in Agile and DevOps environments,Overview of Software Quality Assurance (SQA), International standards (ISO/IEC/IEEE) and certifications (ISTQB)

Textbooks & References

1. Software Testing: Principles and Practices – Srinivasan Desikan & Gopalaswamy Ramesh
2. Foundations of Software Testing – Dorothy Graham, Rex Black

Reference Book:-

1. Effective Software Testing – Elfriede Dustin
2. ISTQB Foundation Level Syllabus
3. Online documentation for tools (Selenium, JIRA, JUnit, Postman)

NPTEL: Software Testing, Prof. Meenakshi D'souza | IIIT Bangalore,
https://onlinecourses.nptel.ac.in/noc22_cs61/preview

MTCS25PC105L	ADVANCES IN OPERATING SYSTEMS LABORATORY	PCC	0-0-4	2 Credits

ContinuousAssessment	ESE	Total
50 Marks	50 Marks	100

List of Experiment

1. Write a program to create a new process that exec a new program using system calls fork(), execlp() & wait()
2. Write a program to display PID and PPID using system calls getpid () & getppid ()
3. Write a program using I/O system calls open(), read() & write() to copy contents of one file to another file
4. Process Management Write a program to implement multithreaded program using pthreads
5. Write program to simulate the following CPU scheduling algorithms
    a. FCFS
    b. SJF
    c. Priority
    d. Round Robin
6. Process synchronization Write a program to simulate producer-consumer problem using Semaphores
7. Deadlock Write a program to simulate Bankers algorithm for the purpose of deadlock avoidance.
8. Write a program to simulate deadlock detection.
9. Memory Management Write a C program to simulate page replacement algorithms
    a. FIFO
    b. LRU
    c. LFU
10. I/O System Write a program to simulate the following file organization techniques
    a. Single level directory
    b. Two level directory

MTCS25EL106S	Seminar-I	ELC	0-0-4	2 Credits

ContinuousAssessment	End-SemesterExam	Total
50 Marks	50 Marks	100

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The seminar shall be on the state of the art in the area of the advanced communication of student‘s choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

MTCS25IK107A	**IKS Bucket:** Indian Knowledge System (IKS): Concepts and Applications in Engineering	IKS	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-Understanding

1 Comprehending IKS

2 Historical Context

3 Foundational Texts

4 Philosophical Frameworks

5 Relevance to Contemporary Issues

Course Outcomes:-

CO1 Knowledge and Understanding

CO2 Application and Analysis

CO3 Critical Thinking

CO4 Independent Learning

CO5 Research Skills

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2				✔				✔			✔	
CO3		✔			✔				✔			
CO4								✔			✔	
CO5	✔									✔		✔

SYLLABUS

UNIT –I **08 Hours**

Indian Knowledge System – An Introduction & Vedic Corpus: What is IKS? Why do we need IKS? Organization of IKS, Historicity of IKS, Some salient aspects of IKS, Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

UNIT –II **08 Hours**

Number system & Mathematics: Number systems in India - Historical evidence, Salient aspects of Indian Mathematics, Bhūta- Saṃkhyā system, Kaṭapayādi system, Measurements for time, distance, and weight, Piṅgala and the Binary system. Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their Contributions, Algebra, Geometry, Trigonometry, Binary mathematics, and combinatorial problems in Chandaḥ Śāstra, Magic squares in India.

UNIT –III **08 Hours**

Engineering Technology: Metal & Other applications: Wootz Steel: The rise and fall of a great Indian technology, The Indian S & T heritage, Mining and ore extraction, Metals and metalworking technology, Iron and steel in India, lost wax casting of idols and artefacts, Apparatuses used for extraction of metallic components.

UNIT –IV **08 Hours**

Town Planning and Architecture: Perspective of Arthaśāstra on town planning, Vāstu-śāstra – The science of architecture eight limbs of Vāstu, town planning, temples in India: Marvelous stone architecture for eternity, temple architecture in India, Iconography.

UNIT –V **08 Hours**

Knowledge Framework and classifications: Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and Action – the driver of conjunction and disjunction, Sāmānya, viśēṣa, samavāya, Pramāṇa – the means of valid knowledge, Saṃśaya – ambiguities in existing knowledge, Framework for establishing valid knowledge.

Textbooks / References:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), ―Introduction to Indian Knowledge System: Concepts and Applications‖, PHI Learning Private Ltd. Delhi.

NPTEL: Indian Knowledge System(IKS): Concepts and Applications in Engineering By Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan | Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore, https://onlinecourses.swayam2.ac.in/imb23_mg53/preview

TCS25IK107B	(IKS): Humanities and Social Sciences	IKS	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understanding Human Behavior and Societies

2 Developing Critical Thinking Skills

3 Improving Communication Skills

4 Gaining Knowledge in Specific Disciplines

5 Fostering Ethical and Social Awareness

Course Outcomes:-

CO1 Enhanced Critical Thinking

CO2 Students can analyze information, identify biases, and form well-supported conclusions.

CO3 Improved Communication Skills

CO4 Students can express ideas clearly and effectively, both orally and in writing.

CO5 Increased Social Awareness

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			
CO2		✔		✔			✔				✔	
CO3					✔				✔			
CO4							✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT –I **08 Hours**

Indian Knowledge System – An Introduction & Vedic Corpus What is IKS? Why do we need IKS? Organization of IKS, Historicity of IKS, Some salient aspects of IKS, Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

UNIT –II **08 Hours**

Philosophical Systems An introduction to philosophical systems, development of philosophy unique features of philosophy, Sāṅkhya approach of philosophy, Introduction to Yoga, tenet of Nyāya philosophy principles of Vaiśeṣika, doctrine of Pūrva-Mīmāṃsā Darśana, thesis of Vedānta and synopsis of Advaitaphilosophy of Viśiṣṭādvaita.

UNIT –III **08 Hours**

Wisdom through ages Gateways of ancestral wisdoms, introduction to Purāṇa, the Purāṇic repository, Issues of interest in Purāṇas, Introduction to Itihāsas, Key messages in Itihāsas, Wisdom through Nītiśāstras, Wisdom through Subhāṣita.

UNIT –IV **08 Hours**

Health Wellness and Psychology: Introduction to health, Āyurveda: approach to health, Sapta-dhātavaḥ: seven-tissues, role of agni in health, tri-doṣas, Āyurveda: definition of health, Psychological aspects of health, disease management elements, Dinacaryā: daily regimen for health & wellness, Importance of sleep, Food intake methods and drugs, Approach to lead a healthy life, Indian approach to psychology, the tri guṇa system & holistic picture of the individual, the Nature of Consciousness, consciousness studies and issues.

UNIT –V **08 Hours**

Linguistics: Introduction to Linguistics, Aṣṭādhyāyī, phonetics, word generation, computational aspects, mnemonics, recursive operations, rule-based operations, sentence formation, verbs and prefixes, role of Sanskrit in natural language processing.

Textbooks

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), ―Introduction to Indian Knowledge System: Concepts and Applications‖, PHI Learning Private Ltd. Delhi.
2. Pride of India: A Glimpse into India‘s Scientific Heritage, Samskrita Bharati, New Delhi.
3. Sampad and Vijay (2011). ―The Wonder that is Sanskrit‖, Sri Aurobindo Society, Puducherry.

4. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.

Reference Book:-

5. Kapoor Kapil, Singh Avadhesh (2021). ―Indian Knowledge Systems Vol – I & II‖, Indian Institute
6. of Advanced Study, Shimla, H.P. Dasgupta,S. (1975). A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi.
7. PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA" **NPTEL platform:** NPTEL Course Name of Instructor Host Institute Link Indian Knowledge System(IKS): Humanities and Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan Indian Institute of Management Bangalore https://onlinecourses.swayam2. ac.in/imb23_mg55/preview

MTCS25IK107C	**(IKS):** Mathematics in India	IKS	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course Objectives:

This course will introduce students to some of the fundamental contributions to mathematics made in India over the course of history and examine their scientific and pedagogical significance in the modern context.

Course Outcomes:-

The students will gain an understanding of the history and development of mathematics in India. They will learn some of the important mathematical results and techniques given by Indian mathematicians, study mathematical proofs in the Indian tradition, and appreciate the pedagogical significance of the Indian approach to mathematics.

SYLLABUS

Unit 1. Origins: Vedas and Śulbasūtras Place value system, Conception of zero, Origins of geometry

Unit 2. Overview of important mathematical texts and the contributions of leading Indian mathematicians , Āryabhaṭīya of Āryabhaṭa, Brāhmasphuṭasiddhānta of Brahmagupta, Līlāvatī and Bījagaṇita of Bhāskarācārya, The Kerala school – Mādhava, Nīlakaṇṭha, Jyeṣṭhadeva, etc.

Unit 3. Mathematical proofs, teacher-disciple lineages, and transmission of knowledge Mathematical proofs given by Bhāskara-I, Nīlakaṇṭha, Jyeṣṭhadeva, Munīśvara, etc., An overview of the major teacher-disciple mathematical lineages of India, Transmission of mathematical knowledge between India and other civilizations

References:

1. The Science of the Śulba, B. Datta, University of Calcutta, 1932
2. History of Hindu Mathematics: A Source Book, B. Datta and A. N. Singh, Asia Publishing House, 1962
3. Āryabhaṭīya of Āryabhaṭa, K. S. Shukla and K. V. Sarma, Indian National Science Academy, 1976
4. Geometry in Ancient and Medieval India, T. A. Sarasvati Amma, Motilal Banarasidass, 2007
5. Gaṇita-yukti-bhāṣā of Jyeṣṭhadeva, K. V. Sarma et. al., Hindustan Book Agency, 2008
6. Studies in Indian Mathematics and Astronomy: Selected Articles of Kripa Shankar Shukla, Kolachana et. al. (eds.), Culture and History of Mathematics 12, HBA, 2019
7. Līlāvatī of Bhāskarācārya, H. T. Colebrooke, ed. by H. C. Banerji, Kitab Mahal, 1967
8. Mathematics in India: From Vedic Period to Modern Times, M. D. Srinivas and K. Ramasubramanian and M. S. Sriram.

MTCS25IK107D	**(IKS):** Aarogya Samskriti – Health culture of Bharat	IKS	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 To introduce ancient India as an Arogyasamskriti or Health Culture to the participants.

2 To familiarise participants with health information codified in non-Ayurvedic Sanskrit literature

3 To nurture health intelligence (Arogyabuddhi) in the participants in alignment with the Sustainable Development Goal 3 – ensuring healthy lives and promoting well-being for all.

Course Outcomes:-

CO1 Students will get exposed to health information classified into subject headings and subheadings corroborating with modern medical knowledge.

CO2 Students will understand India as a health culture and rooted in awareness of health.

CO3 Students will become aware of behavioural changes that can be incorporated in their lives to nurture health and well being.

CO4 Students will get awareness about the social and personal health awareness.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2				✔			✔				✔	
CO3					✔				✔			✔
CO4							✔				✔	

SYLLABUS

Unit 1.

Classification of Sanskrit Literature, Overview of health information in non-Ayurvedic Sanskrit literature.

Unit 2.

Examples of non-Ayurvedic Sanskrit texts with health information, Health topics in non-Ayurvedic Sanskrit Literature.

Unit 3.

The concept of Arogyasamskriti, The concept of Arogyabuddhi.

Unit 4.

Healthy Diet Unit, Healthy Life Style – Sleep, Daily Routine, Exercise, Meditation

Unit 5.

Mental Health, Environmental Health, Good conduct for well being.

References:

1. Vaidyakiya Subhashitam by Bhaskara Govinda Ghanekar.
2. History of Indian Medical Literature by Meulenbeld.

MTCS25AE107	YOGA for Stress Management	AEC	0-0-2	2 Credits

ContinuousAssessment	End-SemesterExam	Total
50 Marks	50 Marks	100

Course Objective:-

1 Recognize the signs and sources of stress

2 Master a variety of yoga techniques

3 Acquire relaxation strategies that promote calmness

4 Incorporate healthy habits inspired by yoga principles to foster better sleep

5 Develop practical skills to navigate and cope with stress

Course Outcomes:-

CO1 Proficiency in Yoga Practices

CO2 Stress Reduction

CO3 Mindfulness and Relaxation

CO4 Personalized Practice

CO5 Enhanced Well-being

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2	✔			✔				✔				
CO3		✔			✔				✔			✔
CO4							✔				✔	
CO5	✔									✔		

SYLLABUS

UNIT – I **08 Hours**

Introduction to Yoga for Stress Management - 1 Introduction to Yoga for Stress Management - 2 Stress according to Western perspective, Stress Eastern Perspective, Developmental process: Western and Eastern Perspective Stress Hazards and Yoga

UNIT – II **08 Hours**

Meeting the challenges of Stress - 1 Meeting the challenges of Stress - 2 Introduction to Stress Physiology Stress, Appetite and Dietary management- Modern and Yogic perspective Sleep and Stress: understanding the relationship for effective management of stress

UNIT – III **08 Hours**

Stress Assessment methods- a valuable tool toward stress management , Role of Yoga in prevention and management of stress related disorders – a summary of research evidence Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 1 Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 2 Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 3

UNIT – IV **08 Hours**

Concept of stress and its management - perspectives from Bhagavad Gita - Part 1 Concept of stress and its management - perspectives from Bhagavad Gita - Part 2 Concept of stress and its management - perspectives from Bhagavad Gita - Part 3

UNIT – V **08 Hours**

Bio-Psycho-Socio-Spiritual model of stress management Yoga practices for Stress Management Breathing practices – 1 Hands in and out breathing, Hands stretch breathing, Ankle stretch breathing Breathing practices – 2Dog Breathing, Rabbit breathing, Tiger breathing, Sashankasana breathing Breathing practices – 3 Bhujangasana breathing, Ardha Shalabhasana breathing (alternate legs), Straight leg raising (alternate legs), Straight leg raising (both legs), Sethubandhasana lumbarstretch, Instant Relaxation Technique (IRT)Loosening Practices – 1, Shoulder Rotation, Side bending, standing twist, Hip rotation, Thigh strengthening Loosening practices – 2 Chakki chalan, Bhunamasana Chalana, Alternative toe touching Loosening practices – 3 Side leg raising, Pavana muktasana kriya: Wind releasing pose movements, Quick Relaxation Technique (QRT)

Textbooks / References:

1. H R Nagendra and R Nagarathna. Yoga for Promotion of Positive Health. Swami Vivekananda Yoga Prakashana. 2011.
2. Contrada, R., & Baum, A. (Eds.). The handbook of stress science: Biology, psychology, and health. Springer Publishing Company. 2010

3. Al'Absi, M. (Ed.). Stress and addiction: Biological and psychological mechanisms. Elsevier. 2011.
4. Van den Bergh, O. Principles, and practice of stress management. Guilford Publications. 2021.

Reference Book:-

1.Swami Muktibodhananda, Hatha Yoga Pradipika, Bihar Scool of Yoga, 1998

2.Swami Satyananda Saraswati, Four Chapters on Freedom, Bihar Scool of Yoga, 1975

3.Swami Tapasyananda, Srimad Bhagavat Gita, Sri Ramakrishna Math, 2012

MTCS25PC201	Advanced Database Management System	PCC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce advanced database architectures

2 Delve into query processing and optimization

3 Explain transaction management and concurrency control

4 Explore distributed and parallel database systems

5 Discuss advanced data models and technologies

Course Outcomes:-

CO1 Analyze and evaluate various database architectures

CO2 Design and implement advanced database schemas

CO3 Formulate and optimize complex queries

CO4 Implement and manage transaction processing

CO5 Design and manage distributed database systems

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			
CO2				✔			✔				✔	
CO3		✔			✔				✔			✔
CO4							✔				✔	
CO5	✔							✔		✔		✔

SYLLABUS

UNIT – I **08 Hours**

Data base System VS file System. Data Models – the ER Model Database Languages – DDL – DML. Introduction to the Relational Model, Integrity Constraint Over relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design, Learning to Views,. Introduction of Object Database Systems, Structured Data types, operations on structured data, Encapsulation and ADTS, Inheritance.

UNIT – II **08 Hours**

Database design for ORDBMS, ORBMS implementation and challenges, OODBMS, comparison of RDBMS, OODBMS and ORDBMS. Introduction to Parallel databases, architectures for parallel databases, Parallel Query Evaluation – data partitioning and parallelising sequential operator evaluation code, Parallelizing individual operations, and parallel Query optimization.

UNIT – III **08 Hours**

Introduction to distributed databases; features of distributed databases vs centralized databases, Why distributed databases, DDBMS, levels of transparency- reference architecture for DDB, types of data fragmentation, distribution transparency for read-only and update applications, distributed database access primitives, Integrity Constraints in Distributed databases.

UNIT – IV **08 Hours**

Distributed database design: framework for distributed database design, the design of database fragmentation, allocation of fragments; Distributed Query processing: Equivalence of transformations for queries, transforming global queries into fragment queries, distributed grouping and aggregation functions, parametric queries.

UNIT – V **08 Hours**

A framework for query optimization, join queries and general queries. non-join queries in a distributed DBMS, joins in a distributed DBMS, cost based query optimization. DBMS Vs IR systems, Introduction to Information retrieval, Indexing for text search, web search engine, managing text in a DBMS, a data model for XML, Querying XML data, and efficient evaluation of XML queries.

TEXT BOOKS:

1. Raghuramakrishnan and Johannes Gehrke, “Database Management Systems”, 3rd Edition, TMH, 2006.
2. S Ceri and G Pelagatti, “Distributed databases principles and systems”, 1st Edition, TMH, 2008.

REFERENCES:

1. Silberschatz, Korth, “Database System Concepts”, 6th Edition, TMH, 2010.
2. Elmasri R, Navathe S B, Somayajulu D V L N, and Gupta S K, “Fundamentals of Database Systems”, 5th Edition, Pearson Education, 2009.
3. C. J. Date, “Introduction to Database Systems”, 8th Edition, Pearson Education, 2009.

MTCS25PC202	Software Architecture	PCC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce fundamental concepts of software architecture

2 Explore various architectural styles and patterns

3 Analyze and prioritize quality attributes

4 Develop skills in architectural design and documentation

5 Understand architectural evaluation and evolution

Course Outcomes:-

CO1 Articulate the significance of software architecture

CO2 Identify and apply appropriate architectural styles and patterns

CO3 Analyze and trade off quality attributes

CO4 Design and document software architectures using standard notations

CO5 Evaluate software architectures for quality and effectiveness Communicat architectural decisions effectively

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔				✔			✔			✔
CO2				✔			✔				✔	
CO3		✔	✔		✔	✔			✔			✔
CO4	✔						✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction to Software Architecture, Definition and importance of software architecture, Difference between software design and software architecture, Role of a software architect, Software architecture in the software development life cycle (SDLC), Quality attributes: performance, scalability, security, modifiability, usability,Architecture business cycle

UNIT – II **08 Hours**

Architectural Styles and Patterns, Layered (n-tier) architecture, Client-server, microkernel, and event-driven architectures, Service-Oriented Architecture (SOA), Pipe-and-filter, blackboard, and broker architectures, Architectural patterns: MVC, MVVM, Singleton, Factory, Repository, choosing the right architectural style

UNIT – III **08 Hours**

Architecture Design and Documentation,Design principles and guidelines,Architecture views: logical, development, process, physical (4+1 View Model),UML for architecture modeling (component, deployment, and sequence diagrams),Architecture decision-making and trade-off analysis,Documenting architecture using IEEE 1471 standard

UNIT – IV **08 Hours**

Component-Based and Service-Oriented Architecture,Component-based software engineering (CBSE) concepts,Reusability, interfaces, and component models,Web services and SOAP/REST APIs,Principles of SOA and microservices,Orchestration and choreography of services,Deployment and containerization (Docker overview)

UNIT – V **08 Hours**

Architecture Evaluation, Trends, and Case Studies, Architecture evaluation techniques (ATAM, CBAM, SAAM),Scalability and fault-tolerance in architecture,DevOps and Continuous Delivery pipelines,Cloud-based architecture (AWS/Azure overview),Modern trends: serverless, edge computing, event sourcing,Case studies from real-world systems (e.g., Netflix, Amazon, Google)

Text B**ook:-**

1. Software Architecture in Practice – Len Bass, Paul Clements, Rick Kazman
2. Designing Software Architectures – Humberto Cervantes, Rick Kazman

Reference Book:-

1. Clean Architecture – Robert C. Martin

- IEEE Software Architecture Standards and Case Study Repositories

MTCS25PE204A	Web Engineering	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the fundamentals of Web applications

2 Cover web application development lifecycle

3 Explore client-side web technologies

4 Delve into server-side web technologies

5 Discuss web application architectures and design patterns

Course Outcomes:-

CO1 Explain the core concepts and principles of the World Wide Web

CO2 Apply web engineering methodologies

CO3 Design and develop responsive client-side interfaces

CO4 Implement dynamic server-side functionalities

CO5 Integrate databases with web applications.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			
CO2		✔					✔				✔	
CO3					✔				✔			✔
CO4				✔			✔				✔	
CO5	✔	✔								✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction to Web Technologies and Web Engineering: specialties, characteristics, categories of web applications.

UNIT – II **08 Hours**

Web Architectures: multi-tier, data-centric architectures Requirement Analysis of Web Applications Specialties of Large Enterprise and Small and Medium Enterprise.

UNIT – III **08 Hours**

Web Applications Development Process of Web Applications Model-Based Web Application Design and Development, WebML Testing.

UNIT – IV **08 Hours**

Quality Management. Design of Web 2.0 and Enterprise 2.0 Applications Web Business Models Web project management Design of Mobile Web Applications Semantic Web Applications.

UNIT – V **08 Hours**

integration to Web Information Systems Web Application Models, Cloud computing Service Oriented Architectures, Web Information Systems.

TEXT BOOKS:

Kappel, G., Pröll, B., Reich, S., Retschitzegger W. (Eds.): Web Engineering: The Discipline of Systematic Development. John Wiley & Sons Inc., Chichester (2006).

Text Books:-

1. Mendes, E., Mosley, N. (Eds.): Web engineering. Springer-Verlag, Berlin (2005).
2. Programming world wide web, R.W.Sebesta, Fourth Edition, Pearson.

Reference Books:-

1.Beginning Web Programming-Jon Duckett WROX.

2. Murugesan, S., Deshpande, Y. (Eds.): Web Engineering: Managing Diversity and Complexity of Web Application Development. LNCS 2016, Springer-Verlag, Berlin (2001).

3.Internet and World Wide Web - How to program, Dietel and Nieto,Pearson.

MTCS25PE204B	Artificial Neural Network	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the biological inspiration and fundamental concepts of ANNs

2 Explain different ANN architectures

3 Delve into learning algorithms for ANNs

4 Explore activation functions and their properties

5 Discuss regularization and optimization techniques

Course Outcomes:-

CO1 Explain the fundamental principles of artificial neurons and neural networks

CO2 Differentiate and select appropriate ANN architectures

CO3 Apply and analyze different learning algorithms for ANNs

CO4 Implement neural networks using deep learning frameworks

CO5 Preprocess and prepare data for neural network training

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			
CO2				✔			✔				✔	
CO3		✔							✔			
CO4											✔	
CO5	✔					✔		✔		✔		✔

SYLLABUS

UNIT – I **08 Hours**

Basics of Artificial Neural Networks: Characteristics of Neural Networks, Historical Development of Neural Network Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws.

UNIT – II **08 Hours**

Activation and Synaptic Dynamics: Introduction, Activation Dynamics Models, Synaptic Dynamics Models, Learning Methods.

UNIT – III **08 Hours**

Feedforward Neural Network: Introduction, Analysis of Pattern Association Networks, Analysis of Pattern Classification Networks,

UNIT – IV **08 Hours**

Feedback Neural Networks: Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks.

UNIT – V **08 Hours**

Applications of ANN: Introduction, Direct Applications

Text Book(s)

1. B. Yegnanarayana - Artificial neural network PHI Publication.2005

2. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms

Reference Books

1. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005

2. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press ,1995

NPTEL: Neural Networks and Applications, IIT Kharagpur by Prof. Somnath Sengupta, https://nptel.ac.in/courses/117105084

MTCS25PE204B	Deep Learning	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the core concepts and principles of deep neural networks

2 Explore advanced deep learning architectures

3 Delve into optimization algorithms for deep learning

4 Discuss regularization and generalization techniques in deep learning

5 Cover transfer learning and fine-tuning

Course Outcomes:-

CO1 Explain the fundamental concepts and advantages of deep learning

CO2 Design and implement Convolutional Neural Networks (CNNs)

CO3 Design and implement Recurrent Neural Networks (RNNs) and their variants

CO4 Apply advanced optimization and regularization techniques.

CO5 Utilize transfer learning and fine-tuning strategies.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			
CO2				✔			✔				✔	
CO3		✔			✔				✔			
CO4											✔	
CO5		✔				✔				✔		✔

SYLLABUS

UNIT –I **08 Hours**

Introduction: What is a Neural Network?, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures, Rosenblatt‟s Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

UNIT – II **08 Hours**

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back- Propagation Algorithm Perform Better, Back Propagation and Differentiation.

UNIT – III **08 Hours**

Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning. Optimization for Training Deep Models: Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions.

UNIT – IV **08 Hours**

Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning.

UNIT – V **08 Hours**

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to- Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.

Text Book:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

NPTEL; Deep Learning By Prof. Prabir Kumar Biswas, IIT Kharagpur,
https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=VyWAvY2CF9c
- https://www.youtube.com/watch?v=7sB052Pz0sQ
- https://www.youtube.com/watch?v=Mubj_fqiAv8
- https://www.coursera.org/learn/neural-networks-deep-learning

MTCS25PE204D	Secure Software Design and Enterprise Computing	PEC	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce fundamental principles of secure software design.

2 Explore secure coding practices and defensive programming

3 Delve into secure architecture patterns and anti-patterns

4 Discuss secure development lifecycle (SDL

5 Cover security in enterprise computing environments.

Course Outcomes:-

CO1 Identify and analyze common software vulnerabilities and attack vectors.

CO2 Apply secure coding principles and best practices.

CO3 Design secure software architectures.

CO4 Integrate security into the software development lifecycle.

CO5 Implement secure authentication, authorization, and session management.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔						✔
CO2	✔			✔			✔				✔	
CO3		✔	✔		✔				✔			
CO4							✔				✔	
CO5										✔		✔

SYLLABUS

UNIT – I **08 Hours**

Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

UNIT – II **08 Hours**

Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

UNIT – III **08 Hours**

Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

UNIT – IV **08 Hours**

Troubleshooting: Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

UNIT – V **08 Hours**

Sql Injections: Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws. Case study of DNS server, DHCP configuration and SQL injection attack. At the end of the module the students.

TextBooks:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett Learning, 2013.

Reference Books :

2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley, 2015.

MTCS25RM204	Research Methodology	MDM	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course Objective:-

1 A syllabus for Research Methodology typically covers a comprehensive range of topics designed to equip students with the knowledge and skills necessary to conduct sound and ethical research.

2 While the specific details may vary depending on the discipline (e.g., social sciences, engineering, medicine) and the level of study (undergraduate, postgraduate, Ph.D. coursework)

Course Outcomes:-

CO1 Explain the ethical issues involved while undertaking research

CO2 Develop the skill set to correctly present a research work by following the protocols of writing a standard research report.

CO3 This comprehensive syllabus provides a strong foundation for conducting rigorous and ethical research across various academic and professional domains.

CO4 Student will be able to design the prototype.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			✔
CO2	✔			✔			✔				✔	
CO3	✔	✔	✔		✔				✔			✔
CO4							✔			✔	✔	

SYLLABUS

UNIT I: I **08 Hours**

Introduction to Research, Meaning and Objectives of Research, Motivation and Utility of Research, Characteristics of Good Research, Types of Research, Research Process, Ethics in Research.

UNIT II: I **08 Hours**

Formulating the Research Problem and Hypothesis, Identification of Research Problem, Defining the Research Problem, Literature Review, Hypothesis Formulation.

Unit III: I **08 Hours**

Research Design, Concept and Importance of Research Design, Features of a Good Research, Types of Research.

Unit IV: I **08 Hours**

Sampling Concepts of Population, Sample, and Sampling Frame, Sampling Error and Sample Size: Characteristics of a Good Sample, Sampling Techniques.

Unit V: I **08 Hours**

Data Collection Types and Sources of Data, Methods of Primary Data Collection, Data Collection Instruments, Data Analysis, Research Report Writing and Presentation.

Text Book

1. Creswell, J. W. (Year of latest edition). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage Publications.
2. Booth, W. C., Colomb, G. G., & Williams, J. M. (Year of latest edition). The Craft of Research. University of Chicago Press.
3. Kothari, C. R. (Year of latest edition). Research Methodology: Methods and Techniques. New Age International.

Reference Book:-

1.Kumar, R. (Year of latest edition). Research Methodology: A Step-by-Step Guide for Beginners. Sage Publications.

2.Bryman, A. (Year of latest edition). Social Research Methods. Oxford University Press.

3.Field, A. (Year of latest edition). Discovering Statistics Using [Software Name, e.g., SPSS, R, SAS]. Sage Publications.

NPTEL: Research Methodology By Prof. Edamana Prasad, Prof. Prathap Haridoss | IIT Madras, https://onlinecourses.nptel.ac.in/noc23_ge36/preview

MTCS25OE205A	Intellectual Property Rights	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce foundational concepts

2 Familiarize with different forms of IPR

3 Explain the legal framework

4 Detail registration and enforcement procedures

5 Highlight the importance of IPR in innovation and business

Course Outcomes:-

CO1 Distinguish and explain the different forms of Intellectual Property Rights

CO2 Identify and assess whether a particular creative work, invention, or business asset.

CO3 Apply statutory provisions and legal principles to protect and manage various forms of intellectual property at both national and international levels.

CO4 Analyze the rights and responsibilities of IPR holders (e.g., patentees, copyright owners, trademark owners) and understand the limitations and exceptions to these rights.

CO5 Evaluate potential IPR infringements and describe the remedies available to IPR owners, as well as the precautionary steps to prevent infringement.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔				✔			✔			
CO2				✔			✔				✔	
CO3			✔		✔							✔
CO4							✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Right Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge

UNIT – II **08 Hours**

Patent Rights and Copy Rights— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.

Copy Right—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.

UNIT – III **08 Hours**

Trade Marks— Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.

UNIT – IV **08 Hours**

Design- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.

UNIT –V **08 Hours**

Basic Tenents of Information Technology Act-2000 – IT Act - Introduction E-Commerce and legal provisions E- Governance and legal provisions Digital signature and Electronic Signature. Cybercrimes.

TEXT BOOKS:

1. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
3. IPR by P. Narayanan
4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni.

NPTEL: Intellectual Property By Prof. Feroz Ali | IIT Madras,
https://onlinecourses.nptel.ac.in/noc22_hs59/preview

MTCS25OE205B	Quantum Computing Fundamentals	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the core principles of quantum mechanics

2 Differentiate classical from quantum computing

3 Explain the quantum circuit model

4 Explore basic quantum algorithms.

5 Provide hands-on experience with quantum programming tools.

Course Outcomes:-

CO1 Explain and define key quantum mechanical phenomena like superposition, entanglement, and quantum measurement, and relate them to the behavior of qubits.

CO2 Compare and contrast the capabilities and limitations of classical and quantum computing paradigms.

CO3 Represent quantum states using Dirac notation and understand how quantum operations are described by unitary matrices.

CO4 Design and analyze simple quantum circuits using common quantum gates for specific computational tasks.

CO5 Implement basic quantum algorithms (e.g., Deutsch-Jozsa, Grover's algorithm) using a quantum programming library like Qiskit, and execute them on simulators.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			
CO2				✔			✔				✔	
CO3	✔	✔	✔						✔			
CO4	✔		✔				✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction: Elementary quantum mechanics:, linear algebra for quantum mechanics, Quantum states in Hilbert space, The Bloch sphere, Density operators, generalized measurements, no-cloning theorem.

UNIT – II **08 Hours**

Quantum correlations: Bell inequalities and entanglement, Schmidt decomposition, superdense coding, teleportation.

UNIT – III **08 Hours**

Quantum cryptography: quantum key distribution, No-cloning Theorem, Superposition, Entanglement, Heisenberg Uncertainty Principle

UNIT – IV **08 Hours**

Quantum gates and algorithms: Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, factoring

UNIT –V **08 Hours**

Programming a quantum computer: The IBMQ, coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.

Text-books :

1. Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007.
2. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press,Cambridge, 2020
3. David McMahon-Quantum Computing Explained-Wiley-Interscience , IEEE Computer Society (2008)

References:

1. Quantum Computation and Quantum Information, M. A. Nielsen &I.Chuang, Cambridge University Press (2013).
2. Quantum Computing, A Gentle Introduction , Eleanor G. Rieffel and Wolfgang H. Polak MIT press

NPTEL: Introduction to Quantum Computing: Quantum Algorithms and Qiskit, IBM and IITM, Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshasshayee Raghunathan, https://nptel.ac.in/courses/106106232

MTCS25OE205C	Bioinformatics	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce fundamental biological concepts

2 Familiarize with bioinformatics databases and tools

3 Explain sequence analysis techniques

4 Introduce structural bioinformatics

5 Explore omics data analysis

Course Outcomes:-

CO1 Identify and retrieve relevant biological data from public databases (e.g.

CO2 Perform various sequence analysis tasks including pairwise and multiple sequence alignments

CO3 Apply computational methods for analyzing high-throughput biological data

CO4 Visualize and interpret protein structures

CO5 Write basic scripts in a programming language (like Python or R) to automate data processing

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			✔
CO2				✔			✔				✔	
CO3		✔	✔	✔	✔				✔			✔
CO4							✔				✔	
CO5	✔	✔								✔		

SYLLABUS

UNIT – I **08 Hours**

Introduction to Bioinformatics data and databases: Types of Biological data:- Genomic DNA, Complementary DNA, Recombinant DNA, Expressed sequence tags, Sequence- Tagged Sites, Genomic survey sequences; Primary/Genomic Databases:- GenBank, EMBL, DDBJ; Composite Databases:-NRDB, UniProt; Literature Databases:- Open access and open sources, PubMed, PLoS, Biomed Central, NAR databases; Bioinformatics Resources:- NCBI, EBI, ExPASy, RCSB.

UNIT – II **08 Hours**

Viral genome database:-ICTVdb; Bacterial Genomes database:- Ensembl Bacteria, Microbial Genome Database-MBGD; Genome Browsers:- Ensembl, VEGA genome browser, NCBI-NCBI map viewer, KEGG, MIPS, UCSC Genome Browser; Archeal Genomics, Eukaryotic genomes with special reference to model organisms:- Yeast(SGD), Drosophila (FlyBase), C.elegans (WormBase), Rat, Mouse, Human (OMIM / OMIA), plants – Arabidopsis thaliana (TAIR), Rice, PlasmodiumDB, Phylogenetic database – eggnog, HOGENOM, OrthoDB.

UNIT – III **08 Hours**

Protein Sequence Databases: Swiss-Prot, TrEMBL, UniProt, UniProtKB, UniParc, UniRef, UniMES; Sequence motifs Databases:- Prosite, ProDom, Pfam, InterPro, Gene Ontology; Sequence file formats:- GenBank, FASTA, PIR, ALN/ClustalW2. Polymorphism and mutation databased- BioMuta, dbSNP- Database of short Genetic Variation, DMDM- Domain Mapping of Disease Mutations.

UNIT – IV **08 Hours**

Structure and derived databases: Primary structure databases:- PDB, NDB, MMDB; Secondary structure databases:-Structural Classification of Proteins –SCOP, Class Architecture Topology Homology –CATH, Families of Structurally Similar Proteins –FSSP, Catalytic Site Atlas –CSA; Molecular functions / Enzymatic catalysis databases:- KEGG ENZYME database; Protein-Protein interaction database:- STRING, BioGRID, MINT; Chemical Structure database:- Pubchem, DrugBank, ChEMBL; Gene Epression database:- GEO, SAGE.

UNIT – V **08 Hours**

Bioinformatics Database search engines: Text-based search engines (Entrez, DBGET / LinkDB). Sequence similarity based search engines (BLAST and FASTA). Motif-based search engines (ScanProsite and eMOTIF). Structure similarity based search engines (Combinatorial Extension, VAST and DALI). Proteomics tools: - ExPASy server, EMBOSS

Text Books:

1. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

2. Essential Bioinformatics by Jin xiong.,Combrridge University press,New York.2006 10

Reference Books:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

2. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999 Old editions

NPTEL: BioInformatics: Algorithms and Applications By Prof. Michael Gromiha | IIT Madras, https://onlinecourses.nptel.ac.in/noc21_bt06/preview

MTCS25OE205D	Optimization Techniques	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce fundamental concepts of optimization.

2 Teach various optimization algorithms

3 Develop problem formulation skills

4 Explore theoretical foundations

5 Provide practical experience with optimization software

Course Outcomes:-

CO1 Formulate various real-world problems into appropriate mathematical optimization models (e.g., linear programming, integer programming, nonlinear programming).

CO2 Apply and solve linear programming problems using graphical methods, the Simplex method, and duality theory.

CO3 Analyze the sensitivity of optimal solutions to changes in problem parameters for linear programming models.

CO4 Understand and apply algorithms for solving transportation and assignment problems.

CO5 Implement and solve unconstrained and constrained nonlinear optimization problems using classical methods (e.g., Lagrange multipliers, KKT conditions) and numerical iterative techniques (e.g., gradient descent, Newton's method).

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔		✔	✔						✔
CO2				✔			✔				✔	
CO3		✔			✔				✔			
CO4	✔						✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Unconstrained Optimization: Introduction, Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

UNIT – II **08 Hours**

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

UNIT – III **08 Hours**

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg- Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Liner Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real-Time Optimization.

UNIT – IV **08 Hours**

Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson‟s Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Method and the Runga-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Tranzoidal Rule and Simpson‟s 1/3 and 3/8 Rules.

UNIT –IV **08 Hours**

Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods.

Text Book:-

1. S.S. Rao, Optimization: Theory and Applications, New Age International P. Ltd.
2. G. R. Walsh: M methods of Optimization.
3. H. P. Williams: Model Building in Mathematics Programming.

Reference Book:-

4. H.P. Williams: Model Solving in Mathematics Programming.
5. G.L. Nemhauser and L.A. Wolsey: Integer and Combinational Optimization, Wiley.
6. R.G. Parker and R.L. Rardin: Discrete Optimization, Academic Press.

NPTEL: Optimization from fundamentals By Prof. Ankur A. Kulkarni | IIT Bombay, https://onlinecourses.nptel.ac.in/noc21_me10/preview

MTCS25PC206L	Advanced Database Management System Laboratary	PCC	0-0-4	2 Credits

ContinuousAssessment	ESE	Total
50 Marks	50 Marks	100

Experiment List

1. Distributed Database: Implementation of Partitions: Range, List. Self-Learning Topics : Hash Partition, Composite partition
2. OLAP with Oracle : Analytical Queries Self-Learning Topics: Cume_list, Percent_rank
3. ORDBMS : Implementation of, Abstract Data Type Reference Self-Learning Topics: Nested ADT, Inheritance
4. ETL through Pentaho: ETL Transformation with Pentaho Self-Learning Topics: Any two more transformation operation in Pentaho beyond the syllabus
5. Basics of R and Data Acquisition: Introduction to R, Data Types and Objects, Reading and writing data, Reading data from the console Packages, Loading packages, Attach, and detaching data. Loading Data from different Data Source Self-Learning Topics: Operators, Conditional Statements and Loops, Functions, Loading data from Relational Databases, XML
6. Preprocessing in R: Data preprocessing techniques in R Self-Learning Topics: Sorting, Date Conversion
7. Data Mining - Classification using RProgramming: Implementation and Analysis of -Regression, Classification Models Self-Learning Topics: Implement one classification algorithm in weka
8. Data Mining - Clustering and Association using R-Programming: Implementation of Market Basket Analysis and Clustering. Self-Learning Topics: Implementation clustering, association in Weka

MTCS25EL207P	Mini Project	ELC	0-0-4	2 Credits

ContinuousAssessment	ESE	Total
50 Marks	50 Marks	100

The mini project shall be based on the recent trends in the industry, research and open problems from the industry and society. This may include mathematical analysis, modelling, simulation, and hardware implementation of the problem identified. The mini project shall be of the student‘s choice and approved by the guide. The student has to submit the report of the work carried out in the prescribed format signed by the guide and head of the department/institute.

MTCS25AE208	Disaster Management	AEC	0-0-2	Audit

ContinuousAssessment	ESE	Total
50 Marks	50 Marks	100

Course objective:-

1 Understanding fundamental concept

2 Introduce key terms and concepts related to disaster and disaster management.

3 Analyzing disaster types and impacts

4 Provide a comprehensive understanding of natural and man-made disasters, their causes, impacts, and geographical distribution.

5 Developing analytical skills:

Course Outcomes:-

CO1 Comprehending disaster management cycle

CO2 Students should be able to understand the different phases of disaster management

CO3 Applying mitigation and response techniques

CO4 Students should be able to apply appropriate techniques for disaster preparedness, response, and recovery, including the use of tools like Remote Sensing and GIS.

CO5 Analyzing disaster scenarios

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✔			✔			✔			✔
CO2	✔	✔		✔			✔				✔	
CO3		✔			✔				✔			
CO4							✔				✔	
CO5	✔									✔		

SYLLABUS

UNIT –I **08 Hours**

Disaster Management: Disaster and Disaster Management – Concepts, Issues Concerned with Disaster Management. Disaster Management: Phases of Disaster Management, Phases of Disaster Management Types of Disasters: Bhopal Disaster: A Case Study, Types of Disasters-An Introduction, Natural Disaster, Man-made Disaster.

UNIT –II **08 Hours**

Types of Disasters: Slow onset Disasters & Rapid onset Disasters, Simple and Complex, Tsunami: A Case Study Disasters, Tsunami: A Case Study, Cyclone Phallin 2013: A Case Study

UNIT –III **08 Hours**

Disaster Management in India -An Over View: Evolution of Disaster Management in India, Disaster and Disaster Management in India, National institute of Disaster Management, National Disaster Management Act 2005.

UNIT –IV **08 Hours**

Disaster Management in India -An Over View: The National Policy on Disaster Management, 2009.
Refugee Problem: National Plan on Disaster Management 2016, Refugee Problems, Impact of Disaster on the lives of Refugees. Refugee Problem: Problems of Women and Children during disasters, Principles Of Psychosocial Care, Issues And Recovery During Emergency.
Refugee Problem: Relationship between Disasters, Development and Vulnerabilities, Relationship between Disasters, Development and Vulnerabilities.

UNIT –V **08 Hours**

Refugee Problem: Equity Issues in Disaster. Refugee Problem: Issues of Rehabilitation and Resettlement among the Disaster Survivors, Stakeholders in Disaster Relief Management - An Introduction. Stakeholders in Disaster Relief Management: Central Government. Stakeholders in Disaster Relief Management: State Government, District Administration. Armed Forces.

Textbooks :-

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi

3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi

Reference Book:-

4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Encyclopaedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
6. Encyclopaedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008
7. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur

MTCS25OE301A	Cost Management of Engineering Projects	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 To attain knowledge in Cost Management process and Costing System.

2 Ability to understand the basic concepts of Project planning, execution, and cost control

3 Discuss about Various types of costs and its behaviour along with Quality Management

4 Identify various types of Budgets involved in Cost Management process

5 Broaden the career potential of available techniques and problems available in Cost Management.

Course Outcomes:-

CO1 Discuss various construction costs to manage a construction project.

CO2 Summarize different construction activities and its application related to cost based on the field requirements.

CO3 Identify Cost Behaviour of various types of cost and Quality Management.

CO4 Identifying various construction Budgets involved Cost Management process.

CO5 Discussing various types of Techniques and Problem-solving techniques involved in Construction

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔				✔	✔			✔			
CO2				✔			✔					
CO3		✔			✔				✔			✔
CO4							✔					
CO5	✔							✔		✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT – II **08 Hours**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities.

UNIT – III **08 Hours**

Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT – IV **08 Hours**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT – V **08 Hours**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation

Text Books :-

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster, Advanced Management Accounting.

Reference Books :-

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd

MTCS25OE301B	High-Performance Computing	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understand High Performance Computing (HPC) system architectures and various computational models.

2 Learn basics of CUDA programming.

3 Apply parallel execution models and methodologies for parallel programming and parallel applications development.

4 Design and implement compute intensive applications on HPC platform.

5 Understand High Performance Computing (HPC) system architectures and various computational models.

Course Outcomes:-

CO1 Understand the usability of interactive systems.

CO2 Apply the techniques to manage the design process.

CO3 Use the appropriate interaction style for a given problem.

CO4 Design an interface for a given scenario based on the concepts of HCI.

CO5 Ability to apply HCI and principles to interaction design.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			
CO2	✔	✔		✔			✔				✔	
CO3					✔				✔			
CO4							✔				✔	
CO5			✔							✔		✔

SYLLABUS

UNIT – I **08 Hours**

INTRODUCTION TO HCI, THE HUMAN: Introduction, Input–Output Channels, Human Memory, Thinking: Reasoning and Problem Solving. The Computer: Introduction, Text Entry Devices, Positioning, Pointing And Drawing, Display Devices, Devices For Virtual Reality And 3d Interaction, Physical Controls, The Interaction: Introduction, Models Of Interaction, Ergonomics, Interaction Styles, Elements Of The Wimp Interface.

UNIT – II **08 Hours**

Design Process: Interaction Design Basics: Introduction, The Process Of Design, Navigation Design, Screen Design And Layout. HCI in the Software Process: Introduction, the Software Life Cycle, Iterative Design and Prototyping, Design Rationale. Design Rules: Introduction, Principles to Support Usability, Golden Rules and Heuristics

UNIT – III **08 Hours**

Implementation Support: Introduction, Elements of Windowing Systems, Programming the Application, User Interface Management Systems. Evaluation Techniques: Introduction, Goals of Evaluation, Evaluation through Expert Analysis, Evaluation through User Participation. Universal Design: Introduction, Universal Design Principles, and Multi-Modal Interaction, User Support: Introduction, Requirements of User Support, Approaches to User Support, Adaptive Help Systems

UNIT – IV **08 Hours**

Cognitive Models: Introduction, Goal and Task Hierarchies, Linguistic Models, Physical and Device Models. Communication and Collaboration Models: Introduction, Face-To-Face Communication, Text- Based Communication, Group Working.

UNIT – V **08 Hours**

Groupware: Introduction, Groupware Systems, Computer-Mediated Communication, Meeting And Decision Support Systems, Shared Frameworks For Groupware. Ubiquitous Computing and Augmented Realities: Introduction, Ubiquitous Computing Applications Research, Virtual and Augmented Reality. Hypertext, Multimedia and the World Wide Web: Introduction, Understanding Hypertext, Web Technology and Issues, Static Web Content, Dynamic Web Content.

Text Book:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale ―Human Computer Interaction‖, Pearson Education, 3rd Edition, 2003.

Reference Books:

1. B. Shneiderman, Designing the User Interface, Addison-Wesley Publishing Company.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, Wiley Publication, 4th Edition, 2015.
3. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press, 2015.

4. Jenifer Tidwell, Designing Interfaces, Patterns for Effective Interaction Design, O'Reilly Media, 2nd Edition, 2010.

NPTEL Course: Human Computer Interaction, Prof. K. Ponnurangam, Dept. of Computer Science and Engineering, IIIT Delhi

MTCS25OE301C	Financial Technology	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Understand how finance and technology have evolved in real life.

2 To understand transforming finance around the world.

3 To Discuss major technological trends, including cryptocurrencies, Blockchain, AI

4 Grasp the Fin-tech Platform and Technology

5 Ways to analyse and evaluate what is driving technology innovation in Finance.

Course Outcomes:-

CO1 Describe how Artificial Intelligence,

CO2 Explain the recent developments in digital financial services.

CO3 Analyse the progress of FinTech Regulations.

CO4 Big Data, Crypto currencies and Block chain is changing the Financial World.

CO5 Block chain

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✔			✔			✔			
CO2	✔			✔			✔				✔	
CO3		✔			✔				✔			
CO4							✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction to Fin-tech Evolution of Fin-tech across the world. Impact of digital disruption and innovations by Fin-tech on the Banking and Financial Sector.

UNIT – II **08 Hours**

The Technology with Fin-tech Understanding the associated technology with respect to Cloud, Blockchain &Crypto currencies, RoboAdvisors, Biometrics and IoT.

UNIT – III **08 Hours**

Fin-tech Trends Understand the key Fin-tech trends which will disrupt the Financial Sector.

UNIT – IV **08 Hours**

Fin-tech affecting different sectors Learn the effects of Fin-tech on Payment Innovations, Health, Real-Estate, and Insurance Sector.

UNIT – V **08 Hours**

Open Banking and Digital Only Banking Introduce the students to the transition to open banking and digital only banking, the technologies involved and the requirement for convenience and user experience.

Text Books: -

1. Rostogi, Fundamentals of Financial Management, Taxmann Publications
2. Fundamental of Financial Management, Sharma, Gupta, Kalyani Publishers, New Delhi.
3. Fintech: The Beginner's Guide to Financial Technology in India by Praveen Hari, Janakiraman Murugavel Published by Notion Press
4. Fintech: Financial Technology Beginner’s Guide - Learn Everything About Fintech by James Fahl Published by Independently published
4. Fintech in India by Vinish Kathuria Published by Sage Publications Pvt. Ltd.
5. Fintech: The Advent of a New Financial Ecosystem in India by Debashis Nandy, Sourav Roy Published by Notion Press

Website Reference:

1. https://www.ibm.com/industries/banking-financial-markets/resources/omnichannelbankingpaper/
2. https://thefinancialbrand.com/111080/evolution-future-digital-banking-baastransformation/

MTCS25OE301D	Operations Research	OE	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Introduce the concepts of optimization techniques

2 Formulation of LPP models

3 Basic concepts of Non-linear programming, Dynamic programming, Game theory

4 Define and formulate linear programming problems and appreciate their limitations.

5 Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.

Course Outcomes:-

CO1 Students should able to apply the dynamic programming to solve problems of

CO2 discreet and continuous variables.

CO3 Students should able to apply the concept of non-linear programming

CO4 Students should able to carry out sensitivity analysis

CO5 Student should able to model the real world problem and simulate it.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2	✔	✔		✔			✔				✔	
CO3		✔			✔				✔			✔
CO4							✔				✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction: Development of OR – Definitions-Operation Research models– applications. Resource Allocation: Linear Programming Problem Formulation –Graphical solution – Simplex method – Artificial variables techniques -Big-M method

UNIT – II **08 Hours**

Transportation Problem: Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problem –Formulation –Optimal solution - Variants of Assignment Problem-Traveling Salesman problem.

UNIT – III **08 Hours**

Theory of Games: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games -graphical method.

UNIT – IV **08 Hours**

Replacement Analysis: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement.Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed.

UNIT –V **08 Hours**

Sequencing: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines. Simulation: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages

TEXT BOOKS :

1 S.D.Sharma - Operations Research , Kedarnath, Ramnath 2015

2. Hiller &Libermann - Introduction to O.R , Mc Graw Hill 2011

3. Taha - Introduction to O.R , PHI 2010

REFERENCE BOOKS:

1. A.M.Natarajan,P.Balasubramani,A. Tamilarasi -Operations Research , Pearson . Education.

2. R.Pannerselvam - Operations Research ,PHI Publications 2006

3. J.K.Sharma- Operation Research , MacMilan 2010

MTCS25MM302A	Innovation & Creativity	MDM	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Encourage students to think critically and creatively, challenging conventional approaches and exploring new possibilities.

2 Equip students with techniques and methodologies to generate innovative solutions for complex computer science problems.

3 Provide insights into the stages of innovation, from ideation to implementation and evaluation.

4 Train students to recognize unmet needs and potential areas for innovation within the field of Computer Science.

5 Encourage students to work together, leveraging diverse perspectives and skills to drive innovation.

Course Outcomes:-

CO1 Students will be able to generate a variety of creative solutions to defined problems.

CO2 Students will be able to utilize design thinking methodologies to develop innovative products, services, or systems.

CO3 Students will be able to assess the practicality and potential benefits of their ideas.

CO4 Students will be able to articulate their ideas clearly and persuasively to various audiences.

CO5 Students will be able to create tangible representations of their innovative solutions.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			✔
CO2	✔			✔			✔				✔	
CO3	✔	✔	✔		✔				✔			✔
CO4							✔				✔	
CO5						✔				✔		✔

SYLLABUS

UNIT – I **08 Hours**

Realms of Creativity- Creativity-Concept-Convergent and Divergent Thinking Creativity Intelligence-Enhancing Creativity Intelligence-Determinants of CreativityCreativity Process-Roots of Human Creativity-Biological, Mental, Spiritual and Socia lForms of Creativity-Essence, Elaborative and Expressive- Existential, Entrepreneurial and Exponential.

UNIT – II **08 Hours**

Creative Personality-Traits Congenial to Creativity- Motivation and Creativity-Strategies for changing Motivation-Creativogenic Environment- Formative Environment and Creativity- Adult Environment- Environmental Stimulants-Blocks to Creativity-Strategies for unblocking Creativity.

UNIT – III **08 Hours**

Corporate Creativity-Creative Manager-Techniques of Creative Problem Solving- Creative Encounters and Creative Teams- Perpetual Creative Organisations Creative Management Practices-Human Resource Management, Marketing Management, Management of Operations, Management of Product Design and Growth Strategies.

UNIT – IV **08 Hours**

Creative Organization- Issues and Approaches to the Design of Creative Organisations-Policy frameworks-Organisational Design for Sustained Creativity Mechanism stimulating Organisational Creativity-Creative Diagnosing-Creative Societies-Necessity-Model of a Creative Society.

UNIT – V **08 Hours**

Management of Innovation- Nature of Innovation-Technological Innovations and their Management-Inter-Organisational and Network Innovations- Design of a Successful Innovative Organisation-Training for Innovation-Management of Innovation Agents of Innovation- Skills for Sponsoring Innovation.

Textbooks

1.Pradip Khandwalla- Lifelong Creativity- An Unending Quest, Tata McGraw Hill, 2006.

2.Pradip Khandwalla- The Corporate Creativity- The Winning Edge, Tata McGraw Hill, New Delhi

Reference Books

1. Pradip Khandwalla- The Fourth Eye, Wheeler Publishing, New Delhi.
2. Rastogi, P.N, Managing Creativity for Corporate Excellence, Macmillan, New Delhi.
3. Jone Ceserani, Peter Greatwood- Innovation and Creativity, Crest Publishing House, New Delhi.
4. Clayton, Christensen- Innovation and the General Manager, McGraw Hill.
5. Margaret,A. White & Gary D. Bruton- The Management of Technology Innovation- A Strategic Approach
6. Praveen Gupta-Business Innovations in the 21st Century, S.Chand, 2008.

MTCS25MM302B	Cyber Forensics and Cyber Laws	MDM	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course Objective:-

This course will enable students to:

1. Gain knowledge of the various aspects of cyber security and law aspects.
2. Understand effective mechanisms for forensics applications
3. Identify issues in detection and investigation of Cyber Crime.
4. Learn various acts related to cyber security world.

Course Outcomes:-

CO1 Demonstrate cyber security cybercrime and forensics.
CO2 Illustrate evidence collection and legal challenges.
CO3 Analyze the cybercrime with the support tools and methods.
CO4 Examine possible research opportunities and challenges within the cyber laws and security

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔			✔			✔			✔
CO2	✔			✔							✔	
CO3	✔		✔		✔				✔			✔
CO4							✔			✔	✔	

SYLLABUS

UNIT I: **08 Hours**

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? , Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT II: **08 Hours**

Cybercrime: Mobile and Wireless Devices: Introduction, 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, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

Unit III: **08 Hours**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Unit IV: **08 Hours**

Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyber-forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti-forensics.

Unit V: **08 Hours**

Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.

Text Books :-

1. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Pvt Ltd 2013.

2. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Introduction to information security and cyber laws, Dream tech Press 2015. References:

Reference Books:

1. Thomas J. Mowbray, Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions, John Wiley & Sons.

TCS25MM302C	Computational Economics	MDM	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 Provide a strong foundation in economic theory and principles relevant to computational analysis.

2 Teach students how to build and analyze computational models of economic systems using various techniques.

3 Equip students with the skills to analyze economic data using econometric methods and other computational tools.

4 Introduce students to optimization techniques and simulation methods used in economic modeling and policy design.

5 Provide exposure to real-world applications of computational economics in areas like market analysis, financial modeling, and policy evaluation.

Course Outcomes:-

CO1 Students will be able to model economic phenomena using computational tools and techniques.

CO2 Students will be able to apply econometric methods to analyze economic data and test economic hypotheses.

CO3 Students will be able to use optimization and simulation techniques to solve economic problems and evaluate policy options.

CO4 Students will gain a deeper understanding of how computational methods are applied in various fields of economics.

CO5 Students will be able to evaluate the strengths and limitations of different computational models in economics.

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2	✔			✔			✔				✔	
CO3		✔	✔		✔				✔			
CO4							✔				✔	
CO5						✔				✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction to Computational Economics: Scope and significance of computational methods in economics, Overview of economic modeling and simulation, Deterministic vs stochastic models, Review of relevant mathematical and statistical tools, Introduction to computational tools: Python, R, MATLAB

UNIT – II **08 Hours**

Solving Economic Models Numerically: Static models: solving systems of nonlinear equations, Root-finding algorithms: Newton-Raphson, Bisection, Optimization techniques: unconstrained and constrained, Application: Consumer and producer optimization problems, Dynamic models: difference and differential equations

UNIT – III **08 Hours**

Agent-Based and Simulation Models: Introduction to Agent-Based Modeling (ABM), Behavioral rules and interactions, Cellular automata and multi-agent systems, Applications in market imulations, policy testing, Monte Carlo simulations.

UNIT – IV **08 Hours**

Econometrics and Computational Data Analysis: Overview of regression techniques: OLS, MLE, Time series modeling: ARIMA, VAR, Machine learning methods in economics (basics), Model estimation and forecasting, Dealing with large datasets

UNIT – V **08 Hours**

Applications and Case Studies in Computational Economics: Computational general equilibrium (CGE) models, DSGE models and their implementation, Game theory and strategy simulations, Applications in finance: pricing, risk modeling, Policy evaluation and counterfactual analysis

Textbooks & References

1. Computational Economics by Kenneth L. Judd
2. Dynamic Economics by Adda & Cooper
3. A Primer in Econometric Theory by John Stachurski
4. Python/R documentation and open-source libraries (e.g., NumPy, SciPy, Statsmodels)

MTCS25MM302D	Sustainable Energy Conversion Systems	MDM	3-0-0	3 Credits

MidSemesterExam.	ContinuousAssessment	End-SemesterExam	Total
20 Marks	20 Marks	60 Marks	100

Course objective:-

1 To provide a strong foundation in the principles of various renewable energy sources

2 To explore the role of computer science and engineering in the optimization

3 To enable students to design

4 To foster an understanding of the environmental impact of energy production and consumption

5 To address the ethical

Course Outcomes:-

CO1 Students will be able to explain the principles of various renewable energy conversion processes and devices.

CO2 Students will understand the role of computer science in the optimization and control of sustainable energy systems.

CO3 Students will be able to analyze and evaluate the performance of different sustainable energy conversion systems.

CO4 Students will be able to identify and assess the environmental impact of energy production and consumption.

CO5 Students will be able to explain the principles of various energy conversion processes

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔			✔			✔			✔
CO2	✔	✔		✔			✔				✔	
CO3		✔			✔			✔	✔			
CO4											✔	
CO5	✔									✔		✔

SYLLABUS

UNIT – I **08 Hours**

Introduction to Sustainable Energy: Energy scenario: global and national trends, Need for sustainable and renewable energy sources, , Classification: renewable vs non-renewable, Environmental impacts of energy production, Principles of energy conversion and efficiency, Basic thermodynamic principles in energy systems

UNIT – II **08 Hours**

Solar Energy Conversion Systems: Solar radiation fundamentals and measurement, Photovoltaic (PV) systems: working, types, and components, Solar thermal systems: collectors, concentrators, storage, Design and analysis of solar power systems, Efficiency, performance metrics, and challenges

UNIT – III **08 Hours**

Wind and Small Hydro Power Systems: Fundamentals of wind energy and wind turbine operation, Types of wind turbines and site selection, Power curve, capacity factor, and energy yield, Basics of small hydro power: components and classifications, Turbine types and efficiency analysis, Environmental considerations and grid integration

UNIT – IV **08 Hours**

Bioenergy and Other Renewable Systems: Biomass energy conversion technologies: combustion, gasification, anaerobic digestion, Biofuels: production and applications (bioethanol, biodiesel), Geothermal energy: sources, conversion systems, Ocean energy: wave, tidal, OTEC, Comparative assessment of renewable systems

UNIT – V **08 Hours**

Energy Storage, Smart Grids, and Policy: Importance of energy storage in renewable systems, Types of storage: mechanical, chemical, thermal, electrical, Basics of smart grids and integration of renewable energy, Energy policies, incentives, and regulatory frameworks (India & global), Techno-economic analysis and lifecycle assessment, Future trends in sustainable energy technologies

Textbooks & References

1. Renewable Energy: Power for a Sustainable Future – Godfrey Boyle
2. Solar Engineering of Thermal Processes – Duffie and Beckman
3. Energy Systems Engineering – Vanek, Albright, and Angenent
4. MNRE and IRENA reports and white papers

MTCS25EL303S	Seminar-II	ELC	0-0-4	2 Credits

ContinuousAssessment	End-SemesterExam	Total
50 Marks	50 Marks	100

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The seminar shall be on the state of the art in the area of the advanced communication of student‘s choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

MTCS25EL304P	Project-I	ELC	___	12 Credits

ContinuousAssessment	End-SemesterExam	Total
100 Marks	100 Marks	200

Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

MTCS25EL401P	Project-II	ELC	___	20 Credits

ContinuousAssessment	End-SemesterExam	Total
100 Marks	100 Marks	200

In Project - II, the student shall complete the remaining part of the project which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions.

It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.