COURSE STRUCTURE

AND

SYLLABUS FOR

PG PROGRAMMES

1st year (Semester II)

(APPLICABLE FROM AY 2024-2025 ONWARDS)

CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

(Deemed to be University, MHRD, Govt. of India)

BODOLAND TERRITORIAL AREA DISTRICTS :: KOKRAJHAR :: ASSAM :: 783370

Website: www.cit.ac.in

Department of Computer Science and Engineering

M.Tech. Programme

Total Credit Points Requirements: 72

Total Credit Hours Requirements: 112

Total Number of Semesters: 4

CURRICULUM BROCHURE

(2nd semester)

Curricula of courses running since the academic year 2024-25

1st YEAR: 2nd SEMESTER (JAN-JUN)

Sl No.	Course Type	Course Code	Subjects	Scheme of Studies per Week			Credits
				L	T	P	
1.	Program Core-III	MCS201	Advanced Algorithm	3	1	0	4
2.	Program Core-IV	MCS202	Advanced Cryptography and Information Security	3	1	0	4
3.	Program Elective-III	MCS21*	MCS211/212/213/214/215	3	0	0	3
4.	Program Elective-IV	MCS21*	MCS216/217/218/219	3	0	0	3
5.	Audit Course-II	M**2A*	M**2A1/2A2/2A3	2	0	0	0
6.	Mini Project with Seminar	MCS291	Mini Project with Seminar	0	0	4	2
7.	Laboratory-III for Program Cores	MCS27*	Lab on Program Core-III/IV	0	0	4	2
8.	Laboratory-IV from Program Electives	MCS28*	Lab on Program Elective-III/IV	0	0	4	2
Total				26			20

Total Credits of 2nd Semester: 20

Program Elective-III:

MCS211: Big Data Analytics
MCS212: IoT Applications and Communication Protocols
MCS213: Distributed Ledger and Smart Contract
MCS214: Data Mining and Data Warehousing
MCS215: Remote Sensing

Program Elective-IV:

MCS216: Deep Learning
MCS217: Software Defined Network
MCS218: Blockchain Technology and Its Applications
MCS219: High Performance Computing

Paper Code: MCS201 **Credit: 4**
Paper Name: Advanced Algorithm **L-T-P: 3-1-0**
Total Contact Hours: 48

COURSE OBJECTIVE

- Introduce students to the advanced methods of designing and analyzing algorithms.
- The student should be able to choose appropriate algorithms and use it for a specific problem.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Students should be able to understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design

COURSE OUTCOMES

After completion of course, students would be able to:

- Analyze the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- Categorize the different problems in various classes according to their complexity.
- Students should have an insight of recent activities in the field of the advanced data structure

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UNIT 1 **No of lectures: 6**

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit 2 **No of lectures: 8**

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3 **No of lectures: 9**

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit 4 **No of lectures: 10**

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

Unit 5 **No of lectures: 10**

Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Examples, proof of NP-hardness and NP-completeness.
Approximation algorithms: Polynomial-time approximation schemes. Design techniques. Applications: Vertex cover, Travelling Salesman Problem, parallel machine scheduling. Hardness of approximation.
Randomised approximation algorithms: Randomised approximation achemes. Linearity of expectations and randomised rounding of linear programs. Applications: MAX3-CNF problem, weighted vertex cover, MAX-CUT.

Unit 6 **No of lectures: 5**

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text & Reference Books:

1. Cormen, T.H., Leiserson, C.D., Rivest, R.L. & Stein, C. (2009). *Introduction to Algorithms*. MIT Press (3rd ed.). ISBN 978-0-262-53305-8
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

Paper Code: MCS202 **Credit: 4**

Paper Name: Advanced Cryptography and Information Security **L-T-P: 3-1-0**
Total Contact Hours: 40

UNIT -I: Introduction and Computer Networking Primer **No of lectures: 5**

Introduction, Cyber Attacks, Defence and Strategy Techniques, Guiding Principles, Local Area Networks, Network, Layer Protocols, Transport Layer, Application Layer Protocols.

UNIT -II: Mathematical Backgrounds for Cryptography **No of lectures: 5**

Modulo Arithmetic, Greatest Common Divisor, Useful Algebraic Structures, Groups, Rings, Fields, Polynomial Fields, Chinese Remainder Theorem, Prime Number, Primer Number Generator, Theorem and Properties related to prime number, Euler Theorem, Euler Totient Function.

UNIT- III: Basics of Cryptography **No of lectures: 5**

Preliminaries, Elementary Substitution Ciphers, Elementary Transposition Ciphers, Other Ciphers Properties, Confusion, Diffusion, Block Cipher and Stream Ciphers.

UNIT -IV: Secret Key Cryptography and Public Key Cryptography **No of lectures: 5**

Product Ciphers, DES Construction, Modes of Operation, MAC and other applications, Attacks and Linear Cryptanalysis.

Public Key Infrastructure Basics, RSA Operations, Performance of RSA, Applications of PKI, Public Key Cryptography Standard (PKCS).

UNIT -V: Cryptographic Hash **No of lectures: 3**

Basics of Hashing, Types, Construction, Applications and Performances, Hash based MAC, Digital Signatures, Performance Estimates, The Birthday Attack

UNIT -VI: Discrete Logarithm and its Applications **No of lectures: 5**

Introduction, Diffie-Hellman Key Exchange, Protocols, Attacks, Choice of Diffie-Hellman Parameters, Other Applications of Discrete Algorithm, El-Gamal Encryption, El-Gamal Signatures, Related Signature Schemes.

UNIT -VII: Elliptic Curve Cryptography and AES **No of lectures: 7**

Elliptic Curve Operations, ECs over Reals, ECs over Prime Fields, ECs over Binary Fields, Discrete Logarithms on Elliptic Curves, Diffie-Hellman Key Exchange on EC Groups, Encryption

on EC Groups, EC-based Digital Signatures, Performance Security Tradeoff, Performance Optimization, Advanced Encryption Standard (AES), Construction, Key Schedule, Applications.

UNIT -VII: Key Management and Authentication **No of lectures: 5**

Digital Certificates, Certificate Types, X.509 Digital Certificate Format, Digital Certificates in Action, Public Key Infrastructure, Functions of PKI, PKI Architecture and Certificate Revocation, Identity based Encryption.

One-way Authentication, Mutual Authentication, Dictionary Attacks, Centralized Authentication, Needham-Schroeder Protocols, Kerberos, Biometrics

Text & Reference Books:

1. Network Security and Cryptography, Bernard Menezes, Cengage Learning
2. Cryptography and Network Security Principles and Practice, William Stallings, Edition Pearson & Prentice Hall
3. Network Security: Kaufman, Perlman, Speciner, Pearson Education
4. Papers from the ACM and IEEE digital libraries

Paper Code: MCS211 **Credit: 3**
Paper Name: Big Data Analytics **L-T-P: 3-0-0**
Total Contact Hours: 40

UNIT -I: **No of lectures: 7**

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT -II: **No of lectures: 6**

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema-less databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

UNIT- III: **No of lectures: 7**

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

UNIT -IV: **No of lectures: 8**

MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

UNIT -V: **No of lectures: 6**

Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.

UNIT -VI: **No of lectures: 6**

Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Text & Reference Books:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. V.K. Jain, Big Data and Hadoop, Khanna Book Publishing, Delhi, 2017
3. Anil Maheshwari, Data Analytics, McGraw, 2023
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
6. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
7. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
8. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
9. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
10. Alan Gates, "Programming Pig", O'Reilley, 2011.

Paper Code: MCS212 **Credit: 3**
Paper Name: IoT Applications and Communication Protocols **L-T-P: 3-0-0**
Total Contact Hours: 46

COURSE OBJECTIVE

- Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols, Mobile to Electronics integration, Mobile to enterprise integration
- Open source/commercial electronics platform for IoT-Raspberry Pi, Arduino, ArmMbedLPC
- Open source /commercial enterprise cloud platform for IoT-Ayla, iO Bridge, Libellium, Axeda, Cisco fog cloud

COURSE OUTCOMES

After completion of course, students would be able to:

- To understand merging technological options, platforms and case studies of IoT implementation in home & city automation.
- Determine the Market perspective of IoT.

UNIT -I: **No of lectures: 16**

Development of sensor communication protocols, Protocols: Modbus, relay, Zigbee, Zwave, X10,Bluetooth, ANT, etc.
Zigbee and Zwave — advantage of low power mesh networking. Long distance Zigbee. Introduction to different Zigbee chips.

Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Introduction of Bluetooth vendors & their review.

Wireless protocols such as Piconet and packet structure for BLE and Zigbee Other long distance RF communication link.

LORA WAN, NFC, WiFi, Cellular Data, Ethernet, Sigfox, LPWAN, IEEE802.15.4

LOS vs NLOS links, Capacity and throughput calculation. Application issues in wireless protocols:power consumption, reliability, PER, QoS, LOS

UNIT -II: **No of lectures: 4**

Introduction to Mobile app platform for IoT: Protocol stack of Mobile app for IoT, Mobile to server integration, iBeacon in IoS, Window Azure, Linkafy Mobile platform for IoT, Axeda, Xively

UNIT- III: **No of lectures: 4**

Database implementation for IoT : Cloud based IoT platforms, SQL vs NoSQL, Open sourced vs. Licensed Database, Available M2M cloud platform, AxedaXively, Omega NovoTech, Ayla Libellium, CISCO M2M platform, AT&T M2M platform, Google M2M platform

UNIT -IV: **No of lectures: 16**

Application Domains

The Industrial Internet of Things, Internet of Things for Smart Cities, Smart Connected Homes, Internet of Agriculture Things, Energy Internet of Things, The Internet of Flying Things

UNIT -V: **No of lectures: 6**

Recent trends in IoT Applications and Communication Protocols, IoT Case Studies: A Low Cost Framework for Landslide Prediction and Risk, An Internet of Things Approach to Read the Emotion of Children

Text & Reference Books:

1. Mandler, B., Barja, J., Mitre Campista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing
2. Hassan, Qusay F., ed. Internet of things A to Z: Technologies and Applications. John Wiley & Sons, 2018.

Paper Code: MCS213 **Credit: 3**
Paper Name: Distributed Ledger and Smart Contract **L-T-P: 3-0-0**
Total Contact Hours: 35

UNIT -I: Distributed Ledger Fundamentals **Contact Hours: 6**

Overview of distributed ledger technology, Bitcoin Protocol - A technical overview and history, History and evolution of blockchain, decentralization, consensus mechanisms, and cryptography.

UNIT -II: Blockchain Fundamentals **Contact Hours: 6**

Distributed identity: Public and private keys, Digital identification and wallets - Decentralized network - Permissioned distributed Ledger - Blockchain data structure - Double spending - Network consensus - Sybil attacks - Block rewards and miners - Forks and consensus chain - Finality in Blockchain Consensus - Limitation of proof-of-work - Alternatives to Proof of Work

UNIT- III: Smart Contract: **Contact Hours: 6**

Public, private, and consortium blockchains, Distributed ledger use cases, Interoperability and scalability solutions, Introduction to smart contracts, Smart contract languages: Solidity, Chaincode, Smart contract development: deployment, execution, and interaction.

UNIT -IV: Distributed Ledger and Smart Contract Development: **Contact Hours: 9**

Hands-on development of smart contracts using Solidity and Ethereum, Building decentralized applications (dApps) using Web3.js and other tools, Deploying and testing smart contracts on testnets and mainnets, Smart contract security: vulnerabilities and best practices, Smart contract optimization: gas efficiency and performance, Smart contract integration: oracles, APIs, and off-chain data.

UNIT -V: Case Studies and Applications: **Contact Hours: 8**

Kadena, Ripple, Stellar, Rootstock, Drivechain, Quorum – Decentralized Network manager: Tezos, Maidsafe, BigChainDB - Decentralized Cloud Storage: Storj. Real-world use cases: DeFi, NFTs, gaming, Industry-specific applications: finance, healthcare, and supply chain

Text & Reference Books:

1. Narayanan, A. , Bonneau, J., Felten, E., Miller, A. and Goldfeder, S. (2016). Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press.
2. Iyer, Kedar, et al. Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions., 2018, 1st edition, McGraw-Hill Education, United Kingdom.

3. Antonopoulos, A. M., & Wood, G. (2018). *Mastering ethereum: building smart contracts and dapps*. O'reilly Media.
4. Hill, B., Chopra, S., Valencourt, P., & Prusty, N. (2018). Blockchain Developer's Guide: Develop smart applications with Blockchain technologies-Ethereum, JavaScript, Hyperledger Fabric, and Corda. Packt Publishing Ltd.
5. Li, K. C., Chen, X., Jiang, H., & Bertino, E. (Eds.). (2019). Essentials of blockchain technology. CRC Press.

Paper Code: MCS214 **Credit: 3**
Paper Name: Data Mining & Data Warehousing **L-T-P: 3-0-0**
Total Contact Hours: 34

Unit-I Introduction: **Contact Hours: 3**

Overview, Motivation (for Data Mining), Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer and Human inspection),Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation

Unit-II Concept Description: **Contact Hours: 5**

Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases, Association rule mining, mining Single-Dimensional Boolean Association rules from Transactional Databases– Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multidimensional Association rules from Relational Databases

Unit-III Classification and Predictions: **Contact Hours: 8**

What is Classification & Prediction, Issues regarding Classification and prediction, Decision tree, Bayesian Classification, Classification by Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods K-nearest neighbor classifiers, Genetic Algorithm.

Unit-IV Cluster Analysis: **Contact Hours: 10**

Data types in cluster analysis, Categories of clustering methods, Partitioning methods. Hierarchical Clustering- CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods- STING, CLIQUE, Model Based Method –Statistical Approach, Neural Network approach, Outlier Analysis

Unit-V Data Warehousing: **Contact Hours: 4**

Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multidimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.

Unit-VI Advanced Topics: **Contact Hours: 4**

Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.

Text & Reference Books:

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts & Techniques" Elsevier
2. M.H.Dunham,"Data Mining:Introductory and Advanced Topics" Pearson Education
3. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems", Pearson Education
4. Mallach,"Data Warehousing System",McGraw –Hill
5. Arun K. Pujari "Data Mining Techniques", Universities Press, 01-Jul-2001

Paper Code: MCS215 **Credit: 3**
Paper Name: Remote Sensing **L-T-P: 3-0-0**
Total Contact Hours: 40

Unit-I **Contact Hours: 8**

Fundamentals of Remote Sensing: Definition of Remote Sensing**,** Principles of Remote Sensing, History of Remote Sensing. Electromagnetic Radiation, Radiation Laws, EM spectrum.

Interaction of EMR: With atmosphere, Atmospheric Windows, imaging spectrometry, Interaction with Earth. Spectral signature of various land cover features.

Unit-II **Contact Hours: 8**

Platforms: Types of platforms. Orbits of satellites, Kepler's Law, satellite characteristics, satellites for Earth observations studies, and planetary missions, manned and unmanned spacecraft's used for data acquisition.

Sensors: Types and classification of sensors, imaging modes, Characteristics of optical sensors, sensor resolution-spectral, radiometric and temporal, Characteristics of detectors.

Unit-III **Contact Hours: 16**

Data Reception, Processing and Image Interpretation:

Ground station, Data generation, Data processing & corrections. Errors and Corrections: Radiometric, Geometric and Atmospheric. Ground Investigation in support of Remote sensing. Training sets, Accuracy evaluation, test sites. Ground truth Instruments and spectral signature, Spectral Reflectance and spectral signature of vegetation Sources of RS data: Global and Indian data products, LiDAR data acquisition and processing.

Visual Image Interpretation: Basic principles of Visual Interpretation Elements of Visual Interpretation, Techniques of Visual Interpretation, Interpretation Keys.

Unit-IV: Applications **Contact Hours: 8**

Applications of Remote sensing in various Engineering and Science domains such as Agriculture, Forest, Soil, Geology, LU/LC, Water Resources, Urban, Disaster Management, etc.

Text & Reference Books:

1. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote sensing and image interpretation, John Wiley & Sons, 2008.

2. George Joseph, Fundamentals of Remote Sensing Universities Press, Hyderabad 2005
3. Kang tsung Chang, Introduction to Geographical Information System, Tata McGraw Hill, 7th edition, 2010.
4. J. R. Jensen, Remote Sensing of the Environment: An Earth Resource Perspective (2nd Ed.), Prentice Hall, 2009.
5. J. B. Campbell, and R. H. Wynne, "Introduction to Remote Sensing", 5th Ed., The Guildford Press, New York, 2011.
6. R. P. Gupta, "Remote Sensing Geology", 2nd Ed., Springer, 2003.
7. A.M. Chandra and S.K. Ghosh. Remote Sensing and Geographical Information system. Narosa Publishing House, New Delhi, 2006.

Paper Code: MCS216 **Credit: 3**
Paper Name: Deep Learning **L-T-P: 3-0-0**
Total Contact Hours: 35

UNIT -I: **No of lectures: 6**

The Perceptron, Feed-Forward Networks, and Multi-Layer Perceptron, as well as Memory-Based Networks like Boltzmann Machines and Hopfield Networks.

UNIT -II: **No of lectures: 6**

State based networks like Recurrent Neural Networks, Long Short Term Memory Networks.

UNIT- III: **No of lectures: 9**

Convolutional Neural Networks, Bidirectional Networks, Concept-Based Networks for transfer learning, Structural Networks for structured prediction, Attention-Based Networks, Auto encoders for dimensionality reduction and embedding, Generative Adversarial Networks, Deep Gaussian Processes, Deep Bayesian Networks, Deep Search Models, Deep Reinforcement Learning, and Deep Neural Recommenders.

UNIT -IV: **No of lectures: 6**

Non-convex Optimization tools for Deep Networks. Theoretical tools to describe Convolutional Neural Networks and Recurrent Neural Networks.

UNIT -V: **No of lectures: 8**

Learning theory for Deep Neural Networks. Several Applications covering operations research, computer vision, natural language processing, multi-media analytics, proof checking.

Text & Reference Books:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.

Paper Code: PCSE217 **Credit: 3**
Paper Name: Software Defined Networking **L-T-P: 3-0-0**
Total Contact Hours: 45

Unit-I: SDN Background and Motivation **Contact Hours: 9**

Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.

Unit-II: SDN Data plane and OpenFlow **Contact Hours: 9**

SDN data plane: Data plane Functions, Data plane protocols, Openflow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- OpenFlow Protocol.

Unit-III: SDN Control Plane **Contact Hours: 9**

SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers.

Unit-IV: SDN Application Plane **Contact Hours: 9**

SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and MonitoringSecurity- Data Center Networking- Mobility and Wireless.

Unit-V: Network Functions Virtualization **Contact Hours: 9**

Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements-NFV Reference Architecture: NFV Management and Orchestration.

Text & Reference Books:

1. William Stallings, “Foundations of Modern Networking”, Pearson Ltd.,2016.
2. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black,Morgan Kaufmann Publications, 2014
3. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013
4. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98.
5. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.
6. Online Resources https://www.coursera.org/learn/sdn

Paper Code: MCS218 **Credit: 3**
Paper Name: Blockchain Technology and Its Applications **L-T-P: 3-0-0**
Total Contact Hours: 40

UNIT -I: Introduction to Cryptography, Hashing and Digital Signature Contact Hours: 8

Security goals, Security services and mechanism,, Encryption and Decryption, Symmetric and Asymmetric Cryptography, Public Key Infrastructure, Brief introduction to AES and DES, RSA Algorithm, Properties of hash functions, Message Authentication Code, Digital Signatures.

UNIT- II:Fundamentals of Blockchain Technology **Contact Hours: 8**

Types of System: Centralised, Distributed, Peer-to-Peer, Decentralized, Definition of Blockchain, Properties of Blockchain, Distributed Ledgers,, Components of Blockchain, Types of Blockchain, Identifying the need of Blockchain, Applications of Blockchain Technology, Smart Contracts.

UNIT -III: Cryptocurrencies and Consensus : **Contact Hours: 8**

Definition of cryptocurrencies, cryptocurrencies v/s Digital Rupee or eINR, History of Bitcoin, Properties of Bitcoin, Economics of Bitcoin, Roles of Bitcoin Exchanges, Wallets, and its types, Wallet Security, Consensus mechanisms: Challenge-Response Based, Voting Based), Proof-of-Work, Mining and Incentives, Proof-of-Authority, Proof-of-Stake, Practical Byzantine Fault Tolerance (PBFT).

UNIT -IV: Smart Contracts: **Contact Hours: 8**

Anatomy of a Smart Contracts, Life Cycle, Usage Patterns, DLT-based smart contracts, Use Cases: Healthcare Industry and Property Transfer, Introduction to Solidity: Background of Solidity, variables, storage, memory, messages, stack operations, mappings other basic constructs, Standard Development Tools and libraries: Remix IDE, True, Ganache, Metamask, web3.js. Smart Contract Security.

UNIT -V: Blockchain Applications **Contact Hours: 8**

National Blockchain Framework, National Level Blockchain Applications: Supply Chain Management and Logistics, Land Records, Healthcare and Medical Records, e-Governance, Smart Grid applications, Digital certificates management, Blockchain for social good use cases (charity, donations), Blockchain integration with IoT, Cloud and AI.

Text & Reference Books:

1. Diedrich, H., Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations, 2016, 1st Edition, Wildfire publishing, Sydney.

2. Kevin Werbach, The Blockchain and the new architecture of trust, MIT Press, 2018.
3. Joseph J. Bambara and Paul R. Allen, Blockchain, IoT, and AI: Using the power of three to develop business, technical, and legal solutions, TataMcGraw-Hill Education 2019.
4. Lorne Lantz & Daniel Cawrey, Mastering Blockchain Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'REILLY Publications

Paper Code: MCS219 **Credit: 3**
Paper Name: High Performance Computing **L-T-P: 3-0-0**
Total Contact Hours: 40

[Prerequisites: Computer Organization and Architecture, Operating System]

Unit-I: Program execution **Contact Hours: 4**

Program, Compilation, Object files, Function call and return, Address space, Data and its representation

Unit-II: Computer organization **Contact Hours: 6**

Memory, Registers, Instruction set architecture, Instruction processing

Unit-III: Pipelined processors **Contact Hours: 4**

Pipelining, Structural, data and control hazards, Impact on programming

Unit-IV: Virtual memory **Contact Hours: 4**

Use of memory by programs, Address translation, Paging

Unit-V: Cache memory **Contact Hours: 5**

Organization, impact on programming, virtual caches

Unit-VI: Operating systems **Contact Hours: 8**

Processes and system calls, Process management, Program profiling

Unit-VII: File systems **Contact Hours: 4**

Disk management, Name management, Protection

Unit-VIII: Parallel architecture **Contact Hours: 5**

Inter-process communication, Synchronization, Mutual exclusion, Basics of parallel architecture, Parallel programming with message passing using MPI

Text & Reference Books:

1. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
2. A. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.
3. R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.

aper Code: M2A1** **Credit: 0**
Paper Name: Indian Knowledge System **L-T-P: 3-0-0**
Total Contact Hours: 30

COURSE OBJECTIVE

Explore the development and transmission of various knowledge systems throughout history. Discover the scientific methods used to uncover ancient knowledge systems, with a particular focus on gaining a comprehensive understanding of the Indian Knowledge System.

COURSE OUTCOMES

After completion of course, students would be able to: Understand the knowledge generation over time. Understand the rich heritage of the Indian subcontinent and traditional knowledge and its importance.

UNIT-I **Number of lectures: 8**

Introduction to Knowledge System, Knowledge Generated Process. Knowledge Generated Process in nomadic stage, agriculture stage, mediaeval stage and in modern era. Indian Knowledge System. Knowledge System in other civilization, and influence of Knowledge System across civilization.

UNIT –II **Number of lectures: 8**

Indus valley civilization and its time frame, Science and Technology, Political, Economic System, Art and Architecture, in Indus valley civilization. Excavation evidence in Indus Valley civilization.

UNIT –III **Number of lectures: 6**

Vedic period and its time frame. Literature and Scriptures (Vedas, Vedangas, Puranas etc) in Vedic period. Panini's Grammar and Languages. Knowledge in Mathematics, Astronomy, Ayurveda, Surgery, etc. in Vedic period.

UNIT –IV **Number of lectures: 8**

Knowledge in post Vedic era, Aryabhata, Varahamihira, etc. Knowledge generated in pre-independent and post-independent.

Text & Reference Books:

1. Acarya, P.K. (1996) Indian Architecture, Munshiram Manaharlal publishers, New Delhi.
2. Bag, A.K (1979) Mathematics in Ancient and Medieval India, Chaukhamba Orientalia, New Delhi.
3. Banerjee, P. (1916) Public Administration in Ancient India, Macmillan, London
4. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavan RN. (2022), *Introduction to Indian Knowledge System: Concepts and Applications.* PHI Learning Private Ltd.

Paper Code: M2A2** **Credit: 0**
Paper Name: Personality Development through Life Enlightenment Skill **L-T-P: 3-0-0**
Total Contact Hours: 24

Unit-I **Contact Hours: 8**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (dont's)

Verses- 71,73,75,78 (do's)

Unit-II **Contact Hours: 8**

Approach to day to day work and duties.

Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47, 48

Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5, 13, 17, 23, 35

Chapter 18-Verses 45, 46, 48.

Unit-III **Contact Hours: 8**

Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.

Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

Text & Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Paper Code: M2A3** **Credit: 0**
Paper Name: Constitution of India **L-T-P: 3-0-0**
Total Contact Hours: 30

COURSE OBJECTIVE

To realize the significance of the constitution of India. Awareness about the fundamental rights as well as fundamental duties.

COURSE OUTCOMES

Understand and explain the significance of Indian Constitution as the fundamental law of the land.

UNIT-I **Number of lectures: 8**

Significance and importance of the Constitution, the key features of Indian Constitution. Preamble of the Constitution. Fundamental rights- their meaning and limitations. An overview of the Directive Principles of State Policy and Fundamental Duties, including their enforcement and relevance.

UNIT –II **Number of lectures: 8**

Union Executive: Roles of the President, Vice-President, Prime Minister, and Council of Ministers. Union Legislature: Structure and functions of the Parliament and Parliamentary proceedings. Union Judiciary: Composition, powers, and functions of the Supreme Court of India.

UNIT –III **Number of lectures: 8**

State Executive: Roles of the Governor, Chief Minister, and Council of Ministers. State Legislature: Structure and functions of the State Legislative Assembly and State Legislative Council. State Judiciary: Overview of the High Court. Local Government: Panchayati Raj system and Urban Local Self-Government.

UNIT –IV **Number of lectures: 6**

Election Commission of India: Composition, powers, functions, and the electoral process. Types of emergencies: Grounds, procedures, duration, and effects. Constitutional amendments: Meaning, procedure, and limitations.

Text & Reference Books:

1. M.V.Pylee, “Introduction to the Constitution of India”,4th Edition, Vikas publication,2005.

2. Durga Das Basu(DD Basu) , “Introduction to the constitution of India”,(Student Edition),19th edition,Prentice-Hall EEE, 2008.
3. Constitution of India, Legislative Department (Link: https://legislative.gov.in/constitution-of-india/).

Paper Code: MCS271 **Credit: 2**
Paper Name: Advanced Algorithm Lab **L-T-P: 0-0-4**
Total Contact Hours:

LIST OF EXPERIMENTS

1. Sorting Algorithms.
2. Program on MST and Graph Matching
3. Shortest Path in Graphs: Floyd-Warshall algorithm
4. Modulo Representation of integers/polynomials
5. programs on Vertex cover
6. Traveling Salesman Problem etc.

Paper Code: MCS272 **Credit: 2**
Paper Name: Advanced Cryptography and Information Security Lab **L-T-P: 0-0-4**
Total Contact Hours: 40

Tool based:

1. Use of openssl or similar tools to encrypt and decrypt messages using various symmetric encryption/decryption techniques.
2. Use of openssl or similar tools to generate public or private keys and use them for various operational purposes including Digital Signature, Message Authentication, Message Integrity etc.
3. Use of openssl or similar tools to generate PKI keys and used for various operational purposes including authentication of machines, servers etc.
4. Explored Kali Linux for various security vulnerability scans for attacks and defenses.

Program based:

1. Develop a tool that can encrypt and decrypt messages using all the techniques discussed in the theory class.
2. Develop a tool for Message Authentication using techniques discussed in the class.
3. Develop a tool for Digital Signature using El-Gamal based, Elliptic Curve based or using RSA.
4. Develop a tool that is based on X.800 Digital Certificates using ECC, RSA or Discrete Logarithm.

Books and References:

1. Practical Cryptography in Python: Learning Correct Cryptography by Example, Seth James Nielson, Christopher K. Monson, O'reilly
2. Python GUI Programming: https://realpython.com/learning-paths/python-gui-programming/
3. Kali Linux Revealed: Mastering the Penetration Testing Distribution, Raphaël Hertzog, Jim O'Gorman, Mati Aharoni, and Joe O'Gorman, OffSec Press
4. Network Security with OpenSSL, Cryptography for Secure Communications, John Viega, Matt Messier , Pravir Chandra, O'Reily

Course structure & Syllabi

(Applicable from 2024-2025 AY onwards)

M.Tech.

in

Food Engineering and Technology

(2nd Semester)

DEPARTMENT OF

FOOD ENGINEERING AND TECHNOLOGY

CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

Programme Objectives

- To gain a comprehensive knowledge and skills in the subject of Food Engineering and Technology as collated in the curriculum, and to gain the self-learning capabilities through sustained search for knowledge

- To gain capabilities to apply knowledge in the food analyses and related analytical activities, industrial-scale operations and/or to mitigate the relevant challenges at local, regional, or global dimensions, along with the economy and sustainability of food sector.

- To gain research acumen and to develop critical thinking to generate new knowledge in innovative domains, as the process of continuous learning and improvement

- To achieve enough exposure and articulation to effectively disseminate the gained knowledge in formal or informal settings of food and related sectors

- To acquired competency in manage, and/or running or implementing a project

- To gain competency in writing ethically and scientifically sound technical reports or documents

Programme Structure

Semester II

Sl No.	CODE	SUBJECTS	Teaching Scheme (per week)			Contact hours	Credits
			L	T	P		
1	MFE201	Emerging Food Processing Technologies-I; Beverages and Dairy	3	0	0	3	3
2	MFE202	Emerging Food Processing Technologies-II; Fats, Oils, Bakery & Confectionary	3	0	0	3	3
3	MFE203	Recent Trends in Food Safety and Quality Management	2	0	0	2	2
4	MFE211*	Elective-III	3	0	0	3	3
5	MFE212*	Elective-IV (open elective)	3	0	0	3	3
6	MFE271	Emerging Food Processing Technologies-I; Beverages and Dairy Lab	0	0	2	2	2
7	MFE272	Emerging Food Processing Technologies-II; Fats, Oils, Bakery & Confectionary Lab	0	0	2	2	2
8	MFE291	Seminar-I	0	0	2	2	2
Total			**14**	**0**	**6**	**20**	**20**

Elective-III (MFE211*)

CODE	SUBJECTS
MFE2111	Utilization of Food Industries Byproducts
MFE2112	Novel Food Packaging Technologies and Regulations
MFE2113	Indigenous Fermented Food Products
MFE2114	Engineering Properties of Biological Materials

Elective-IV (Open electives) (MFE212*)

CODE	SUBJECTS
MFE2121	Waste to energy
MFE2122	Nanomaterials Synthesis and Characterization Techniques
MFE2123	Cost Management of Engineering Project
MFE2124	Industrial Safety
MFE2125	Environmental Engineering

DETAILED SYLLABUS

Subject: EMERGING FOOD PROCESSING TECHNOLOGY-I; BEVERAGES AND DAIRY

Subject Code: MFE201
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I

Fruit Juices Squashes & Cordials: Equipment for fruit juices, double operations process, Pulping equipment, flash pasteurization, hurdle technology, fruit beverage -preparation & preservation, Straining, filtration & clarification - Preservation of fruit juices by addition of sugar, freezing, carbonation, filtration, and others. Tea-Coffee-Production; processing of coffee beans into powder, instant coffee, decaffeination- Tea-Leaf processing, various classes of tea, changes during processing of tea leaves, instant tea

UNIT-II

Processing technologies of Wines; red & white table wine, sherry sparkling wine, desert wine vermouth wine, flavored wine, fruit wine etc. Non-bacterial & bacterial spoilage of wine, winery byproducts, Processing technologies of Beer –Brewing, raw material & manufacture, storage finishing & packaging, Brandy & whisky production - Composition & methods for manufacturing

UNIT-III

Composition of milk; Varieties of milk; Handling and storage of fresh milk. Rapid tests for milk purity, Pasteurization of milk; HTST and UHT techniques; Packaging of milk; Processing of milk products like evaporated milk, condensed milk, milk powder, ice cream, Infant food formula, and Indigenous dairy sweets.

UNIT-IV

Milk fermentation and fermented milk products such as- Yogurt, Curd, Cheese, Fermented milk beverages, and other, Milk plant hygiene and sanitation.

References:

1. Varman Alan, and Sakesland, Technology, Chemistry and Microbiology of food beverages, Springer (sie) Publisher, 2 nd edition, 2009 REFERENCES
2. Girdharilal and Siddappa, Preservation of Fruits and Vegetables, Kalyani Publishers, 2001.
3. W.V.Cruees, Commercial fruits and Vegetable products, Agrobios Publishers, 2009.

Subject: EMERGING FOOD PROCESSING TECHNOLOGY-II; OILS, FATS, BAKERY AND CONFECTIONARY

Subject Code: MFE 202
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I
Oils and Fats; Sources; chemical composition; physicochemical characteristics; functional and nutritional importance of dietary oils and fats, post-harvest handling storage and processing of oilseeds for directs use and consumption. Extraction of oil by mechanical expelling and solvent extraction, Processing of other plant sources of edible oils and fats like coconut, cottonseed, rice bran, maize germ, etc.

UNIT-II
Refining: Clarification, degumming, neutralization (alkali refining), bleaching, deodorization techniques / processes. Blending of oils. Processing of refined oils: Hydrogenation, fractionation, winterization, inter-esterification etc. for obtaining tailor-made fats and oils. Production of butter, lard, tallow, margarine, Cocoa butter, peanut butter, etc., Specialty fats and designer lipids for nutrition and dietetics,

UNIT-III
Current status, growth rate, and economic importance of Bakery and Confectionary Industry in India. Bakery Products: Ingredients and Processing Technologies for breads, biscuits, cookies & crackers, cakes & other baked products. Equipment used, product quality, pertinent standards & regulations for above bakery products.

UNIT-IV
Confectionary Products: Hard-boiled candies, toffees, fruit drops, chocolates and other confections: - ingredients, equipment & processing technologies, product quality, Production & quality of chewing and bubble gums, cocoa products, breakfast cereals,

References:

1. Hamm, W. and Hamilton, R. J. Edible oil Processing, (CRC Press, 2000)
2. Lawson, H. Food oils and fats: technology, utilization, and nutrition, (Chapman & Hall, 1994) 3. Rajah, K. K. Fats in Food Technology, (Sheffield Academic Press, 2002)
4. Matz, S. A. Bakery Technology and Engineering, (CBS Publications, 2003)
5. Pyler, E. J. Baking Science and Technology, (Sosland Publishing Company, 2009)
6. Fereidoon Shahidi, Bailey's Industrial Oil and Fat Products, Wiley & Sons

Subject: RECENT TRENDS IN FOOD SAFETY AND QUALITY MANAGEMENT

Subject Code: MFE 203
Credit: 02

L-T-P: 2-0-0
Syllabus Contents:

UNIT-I: Advances in scientific basis of biological, chemical, and physical hazards: Emerging toxicology, food allergens, and foodborne pathogens; Current scenario on major food safety research emphasis; Emerging areas of public health issues associated global food safety scenario

UNIT-II: Advances in food laws and regulations: FSSRs, amendments, and additions / supplements; Recently passed and/or enacted food laws and regulations (e.g. Trustea); Recent updates in pre-requisite programs for HACCP implementation – a food sector-wise overview

UNIT-III: Recent updates in global food safety standards and FSMS: ISO 22000, FSSC 22000, BRC Global Standards on Food Safety (Issue 7), etc.

UNIT-IV: Application of advanced technologies to ensure food safety and quality: On-line, rapid detection, and predictive modelling; Emerging personal hygiene and consumers' behavior towards food safety; Introduction to food safety audit and certification of FSMS

References:

1. BRC. 2016. *BRC Global Standards for Food Safety – Issue 7*
2. FSSA. 2011. *Food Safety and Standards Rule*
3. FSSC. 2010. *Food Safety System Certification 22000*. Foundation for Food Safety Certification
4. ISO. 2005. *Food Safety and Management System ISO 22000: 2005*
5. ISO. 2013. *Food safety management systems – Requirements for bodies providing audit and certification of food safety management systems*
6. Sofos, J. N. Ed. 2013. *Advances in microbial food safety*. Woodhead Publishing

Elective-III (MFE211*) Subjects

CODE	SUBJECTS
MFE2111	Utilization of Food Industry Byproducts
MFE2112	Novel Food Packaging and Regulations
MFE2113	Indigenous Fermented Foods and Beverages
MFE2114	Engineering Properties of Biological Materials

Subject: Utilization of Food Industry Byproducts

Subject Code: MFE 2111
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Introduction about Food Industry Waste Utilization; Waste from rice mill industry – agricultural waste-based furnace- types, design. Utilization of rice husk- cement preparation, ceramic materials. Utilization of rice bran - problems in processing of rice bran-stabilization methods of utilization- rice bran stabilizers-extraction of rice bran-refining uses of bran, bran oil and defatted bran.

UNIT-II: Fruit Industry Waste Utilization; Different sources of wastes from fruit and vegetable industries and their availability in India- Status and types of waste available- possible byproducts. Utilization of mango, citrus, apple, guava, grape waste-vinegar production. SCP production, organic acid production from vegetable waste. Utilization of moringa, potato, leafy vegetable waste.

UNIT-III: Tuber Crops Waste Utilization; Waste from tuber crops - effluent safe disposal-effluent treatment plant waste recycling plant - feasibility report for food industries using food waste and by products. Alcohol production from cane sugar industry waste.

UNIT-IV: Fish and Poultry Water Utilization; Fish industry by products- methods and production of fish meal, fish protein concentrate-fish and body oils. Poultry waste-recycling. Tapioca waste utilization- furfural production methods-paper making from cellulosic waste.

References:

1. P. N. Chereminoff & A.C Morresi, "Energy from Solid Wastes" 1976,
2. Chakravarthy & De, "Agricultural Waste and By Product Utilisation".
3. Bor S. Luli (ed), "Rice Production and Utilisation"
4. E. Beagle, "Rice Husk Conversion to Energy".
5. Waldron, K. Handbook of Waste Management and Co-product Recovery in Food Processing, (Woodhead Publishing, 2007)

Subject: Novel Food Packaging and Regulations

Subject Code: MFE 2112
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Introduction to Food Packaging; Packaging requirements and problems - functions of package- design of packages for various foods. Development of protective packaging- shelf-life studies using packaging materials-methods of shelf-life estimation.

UNIT-II: Food Packaging Equipment: Equipment and method- packaging equipment for solid, liquid semi-liquid food, types of fillers; filler for glass bottle, paper bottle, pouches, plastic cup, thermoforming equipment, form-fill-seal equipment, sealing equipment, labelling, capping, canning and cartooning equipment.

UNIT-III: Food Safety and Standards Act, 2006 (FSSA) - Need, Scope, and Definitions (Chapter I of FSSA, 2006)

UNIT-IV: Food Packaging Laws and Regulation; Nutritional Labelling and Health claims, Edible Oils Packaging (Regulation) Order, 1998. - Need, Scope, Functions & Enforcement

References:

1. Patricia and Curtis A, An operational Text Book, Guide to Food Laws and Regulations.
2. The Food Safety and Standards act, 2006 along with Rules & Regulations 2011, Commercial Law Publishers (India) Pvt. Ltd.

Subject: Indigenous Fermented Foods and Beverages

Subject Code: MFE 2113
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Introduction to traditional fermented foods of India, composition and nutritive values, microbial and biochemical diversity, quality, and food safety challenges,

UNIT-II: Processing & Preservation methods of Traditional fermented foods: Idli, dosa, Vada, khamman, dhokla, Dahi (Curd), Srikhand.

UNIT-III: Processing & Preservation methods of Indigenous Alcoholic Beverages,

UNIT-IV: Industrialization, Socioeconomic Conditions and Sustainability of Traditional Fermented Foods.

References:

1. Handbook of Indigenous Fermented Foods. K.H. Steinkrus (Ed), Marcel Dekkar Inc. 2nd Edition, 1998.
2. The Food of India. P. Wickramasinghe, and C. Selva Rajah (Eds), Oberoi Group,Periplus, 1st Edition, 2001

Subject: Engineering Properties of Biological Materials

Subject Code: MFE 2114
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Importance of engineering properties of biological materials, Study of different physical and thermal characteristics of important biological materials like shape, size, volume, density, roundness, sphericity, surface area, specific heat, thermal conductivity, thermal diffusivity, etc. measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.

UNIT-II: Rheological characteristics like stress, strain time effects, rheological models, and their equations. Aerodynamic characteristics and frictional properties. Application of engineering properties in handling processing machines and storage structures.

UNIT-III: Thermal, Electrical and Optical Properties; Specific heat, thermal conductivity, thermal diffusivity, electrical resistance and conductance, dielectric constant, reflectivity, transitivity, and absorptivity of incident rays.

UNIT-IV: Applications; Application of engineering properties in process development as well as design and operation of equipment and structures associated with handling, processing, and storage of raw as well as processed food products

Recommended Books

1. Rao, M. A., Rizvi, S. S. H. and Datta. A. K. Engineering Properties of Foods, (CRC Press, 2005)
2. Sahin S. and Sumnu, S. G. Physical Properties of Foods, (CRC Press, 2006)
3. Mohesenin, N. N. Thermal Properties of Foods and Agricultural Materials, (Gordon and Breach Science Publishers, 1980)

Elective-IV (Open electives) (MFE212*) Subjects

CODE	SUBJECTS
MFE2121	Waste to energy
MFE2122	Nanomaterials Synthesis and Characterization Techniques
MFE2123	Cost management of engineering project
MFE2124	Industrial Safety
MFE2125	Environmental Engineering

Subject: WASTE TO ENERGY

Subject Code: MFE 2121
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. Biomass gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers-Fluidized bed gasifiers – Design, construction, and operation

UNIT-III: Biomass Combustion: Biomass stoves – Improved challahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction, and operation - Operation of all the above biomass combustors.

UNIT-IV: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I &II, Tata McGraw Hill Publishing Co. Ltd.,
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons,

Subject: NANOMATERIALS SYNTHESIS AND CHARACTERIZATION TECHNIQUES

Subject Code: MFE 2122
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: NANODIMENSIONAL MATERIALS; 0D, 1D, 2D structures – Size Effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States – the General Methods available for the Synthesis of Nanostructures – precipitative – reactive – hydrothermal/solvothermal methods – suitability of such methods for scaling – potential Uses

UNIT-II: PHYSICO-CHEMICAL METHODS OF NANOSTRUCTURED MATERIALS Solution growth techniques of 1D-2D nano structures:- Synthesis of metallic, semiconducting and oxide nanoparticles – homo- and hetero-nucleation growth methods – template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) – Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the Need for Gas/vapor State Processing – Main Stages of Gas Phase Synthesis – Applicability of the methods.

UNIT-III: CHARACTERIZATION OF NANOPHASE MATERIALS Fundamentals of the techniques – experimental approaches and data interpretation – applications/limitations of X-ray characterization: – X-ray sources – wide angle, extended x-ray absorption technique – Electron microscopy: SEM/TEM – high resolution imaging – defects in nanomaterials – Spectroscopy: – electron energy-loss mechanisms – electron filtered imaging – prospects of scanning probe microscopes – optical spectroscopy of metal/semiconductor nanoparticles

UNIT-IV: NANOSCALE PROPERTIES Magnetism: - Magnetic Moment in clusters/Nanoparticles – Magnetic Order – coercivity – Magnetocrystalline Anisotropy – thermal activation and Superparamagnetic effects – Electronics and Optoelectronics: - Quantum Confinement of Superlattices and Quantum Wells – Dielectric Constant of Nanoscale Silicon – Doping of a Nanoparticle – Excitonic Binding and Recombination Energies – Capacitance in a Nanoparticle – Diffusion in

References:

1) C. N. R. Rao, A. Muller, A. K. Cheetham, The Chemistry of Nanomaterials Synthesis, Properties and Applications, Volume 1, Wiley-VCH, Verlag GmbH
2) Guozhong Cao, Nanostructures & Nanomaterials Synthesis, Properties G; Z: Applications, World Scientific Publishing Private, Ltd., Singapore (2004).
3) Carl C. Koch, Nanostructured Materials: Processing, Properties and Potential Applications, Noyes Publications, William Andrew Publishing Norwich, New York, U.S.A (2002).

Subject: COST MANAGEMENT OF ENGINEERING PROJECT

Subject Code: MFE 2123
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

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

UNIT-III: Cost Behaviour 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, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT-IV: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

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

Subject: INDUSTRIAL SAFETY

Subject Code: MFE 2124
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire-fighting, equipment and methods.

UNIT-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment, Types of faults in machine tools and their general causes.

UNIT-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electricalmotor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Subject: ENVIRONMENTAL ENGINEERING

Subject Code: MFE 2125
Credit: 03
L-T-P: 3-0-0

Syllabus Contents:

UNIT-I: Wastes: types and sources, Water pollution: characterization of liquid wastes and effects, Stream sanitation, Treatment methods. Indian standards for drinking water, Water borne diseases and their control.

UNIT-II: Air Pollution: Composition, Classification, and sources of air pollutants. Effects of air pollution on human, plant and animals, Air pollution control methods, equipment, and safety. Salient features of the Air (Prevention and control of pollution) Act – 1981.

UNIT-III: Solid Wastes Management: Characterization, disposal methods. Environmental Acts and Regulations.

UNIT-IV: Noise Pollution: Measurement of sound, Sources, Effects and control of noise pollution. Introduction to: "The environment (Protection) Act – 1986.

References:

1. H.S. Peavy, D.R. Rowe and G. Tchbanoglous, Environmental Engineering, McGraw Hill
2. M. L. Davis, Water and waste water Engineering, Mc Graw Hill education (India) Pvt. Ltd.
3. H.C. Parkins, Air Pollution, McGraw-Hill Pub.
4. L.W. Canter, Environmental Impact Assessment, McGraw Hill Pub.
5. M.L. Davis and D.A. Cornwell, Introduction to Environmental Engineering,
6. Metcalf and Eddy (Revised by G. Tchobanoglous Wastewater Engineering:

Subject: Emerging Food Processing Technologies-I; Beverages and Dairy Lab

Subject Code: MFE 271
Credit: 02
L-T-P: 0-0-2

Syllabus Contents:

List of Experiments:

1. Estimation of and comparison of MF and MSNF contents in various types of milk.
2. Analysis of raw milk quality through platform tests.
3. Evaluation of bacteriological standards of raw milk.
4. Detection of adulteration of milk and milk products.
5. Pasteurization of milk and checking the efficiency of pasteurization in Liquid Milk.
6. Development of new milk products and studying the changes in the quality characteristics during storage period.
7. Determination of aqueous extraction of tea/coffee
8. Determination of caffeine in beverages
9. Preparation of RTS beverage
10. Preparation of artificial lemon juice
11. Detection of sodium benzoate in beverage
12. Development of a novel beverage: Ideation and justification

Subject: Emerging Food Processing Technologies-II; Fats, Oils, Bakery & Confectionary Lab

Subject Code: MFE 272
Credit: 02
L-T-P: 0-0-2

Syllabus Contents:

1. Determination of Specific Gravity
2. Determination of Refractive Index
3. Determination of Flash Point
4. Determination of Color
5. Determination of unsaponifiable matter
6. Determination of Acid Value, Saponification Value, Iodine value, Peroxide value
7. Determination of Reichert Meisel and Polanski value
8. Determination of Cloud Point of Palmolein
9. Separation of Cholesterol by Reverse phase thin layer Chromatography
10. Test for Refined Winterized Salad Oil – Cold Test
11. Study of Physiochemical properties of wheat flour and bakery products like Moisture content, Gluten content, Ash content, Protein content, SDS-Sedimentation test, Alcoholic acidity, Water absorption capacity, Yeast activity, Dough raising capacity etc.
12. Study of sophisticated instruments used in the quality evaluation of wheat flour- Farinograph, Extensigraph, Alveograph, Amylograph, Mixograph, Amylograph, RVA, Texture analyzer etc.
13. Preparation and study of characteristics of bakery products like biscuits, breads, cakes, cookies etc.
14. Study of equipment used in production of confectionary products- confectionary moulder, mixer/blender, extruder etc.
15. Preparation and study of characteristics of confectionary products like chocolates, candy, toffee, frost, gum etc.

Course structure & Syllabi

(Applicable from 2024-2025 AY onwards)

M.Tech.

in

Green Energy Technology

(2nd Semester)

DEPARTMENT OF

INSTRUMENTATION ENGINEERING

CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

SEMESTER-II

CODE	SUBJECTS	Teaching Scheme			
		L	T	P	Credits
MGE201	Energy Auditing & Management	2	1	0	3
MGE202	Solar Energy Utilization	3	0	0	3
MGE****	Elective-III	3	0	0	3
MGE****	Elective–IV	3	0	0	3
MGE****	Elective-V	3	0	0	3
MGE271	Energy Lab II	0	0	4	2
MGE291	Seminar-I	0	0	2	1
Total		**14**	**1**	**6**	**18**

Lists of Electives: Second Semester

CODE	SUBJECTS	Teaching Scheme			Credits
		L	T	P	
MGE211	**Bio-energy & Conversion Systems**	3	0	0	3
MGE212	**Energy Resources, Economics And Environment**	3	0	0	3
MGE213	**Advanced Power Electronics**	3	0	0	3
MGE214	**Nanotechnology**	3	0	0	3
MGE215	**Energy Economics & Planning**	3	0	0	3
MGE216	**Energy and Climate Change**	3	0	0	3
MGE217	**Advanced Energy Storage Systems**	3	0	0	3
MGE218	**Geothermal and Ocean Energy**	3	0	0	3
MGE219	**Prime Movers**	3	0	0	3
MGE220	**Grid Connectivity and Smart Grids**	3	0	0	3
MGE221	**Electrical Machines**	3	0	0	3
MGE222	**Sustainable Energy & Materials**	3	0	0	3
MGE223	**Micro Electromechanical Systems**	3	0	0	3

MGE201: ENERGY AUDITING & MANAGEMENT **L-T-P:2-1-0 (Credit: 3)**

Contact Hours: 36 hrs

Overview of energy scenario, importance of energy management and auditing, Classification of energy sources, Energy conservation in different fields, Energy Conservation Act.

Energy Audit: Definition and the types; Energy management (audit) approach: energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements; Project planning techniques; case studies; Energy audit instruments; Energy Conservation Act; energy consumption – production relationship, Data and information analysis: pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Duties and responsibilities of energy managers and auditors.

Material and Energy balance: Facility as an energy system; Methods for preparing process flow; material and energy balance diagrams. Energy Action Planning : Key elements; Force field analysis; Energy policy purpose, perspective, contents, formulation, ratification; Organizing the management: location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability; Motivation of employees: Information system-designing barriers, strategies; Marketing and communicating: Training and planning. Monitoring and Targeting: Defining monitoring & targeting; Elements of monitoring & targeting; Energy management information systems; SCADA systems.

Energy Conservation and Management in Applications: Supply side: Renovation and modernization of power plants, reactive power management, HVDC, and FACTS. Demand side: conservation in motors, pumps and fan systems; energy efficient motors. Thermal energy Management: Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management.

Text Books:

1. Doty S. and Turner W. C. (2012); Energy Management Handbook, Eighth Edition, Fairmont Press.

2. Hamies,(1980); Energy Auditing and Conservation; Methods, Measurements, Management &Case study, Hemisphere, Washington

3. Smith CB, (1981); Energy Management Principles, Pergamon Press, New York.

References:

1. Krieder J. and Rabi A. (1994): Heating and Cooling of Buildings: Design for Efficiency, McGraw-Hill.

2. Archie, W Culp (1991); Principles of Energy Conservation, McGraw Hill

3. Gellings C.W. and J.H. Chamberlin (1993): Demand-Side Management Planning, Fairmont Press.

4. Murphy, W.R and G. Mckay (1982) ; Energy Management, Elsevier

5. Callaghan P. O' (1993); Energy Management, McGraw - Hill Book Company

6. Bureau of Energy Efficiency (2003); Study material for Energy Managers and Auditors Examination: Paper I to IV.

MGE202: Solar Energy Utilization **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

An overview of solar thermal applications, Systems for collecting solar thermal energy and its storage, Solar radiation, availability, measurement and estimation; Isotropic and anisotropic models; empirical relations, solar collectors and types: flat plate, concentrating solar collectors, advanced collectors and solar concentrators, Selective coatings Solar water heating, Solar cooking, Solar drying, Solar distillation and solar refrigeration, Active and passive heating and cooling of buildings, Solar Chimney, Solar drying Solar thermal power generation, Home lighting systems, Solar lanterns, Industrial process heat systems, Solar thermal power generation and sterling engine, Solar economics. Photo-voltaic cell – characteristics- cell arrays-power electric circuits for output of solar panels-choppers-inverters-batteries-charge regulators, Construction concepts. Energy Storage - Sensible, latent heat and th:

1. D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", 2ndEdition, Taylor & Francis, 2000, Indian reprint, 2003

2. G.D. Rai, Solar energy utilization, Fifth Edition, Khanna Publishers, 1995.

3. Edward E. Anderson, "Fundamentals for solar energy conversion", Addison WesleyPubl. Co., 1983.

4. Duffie J. A and Beckman, W .A., "Solar Engineering of Thermal Process", John Wiley,1991.

REFERENCE BOOKS:

1. Energy Studies, Second Edition, by W. Shepherd and D. W. Shepherd, Imperial CollegePress, London, 2004.

2. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hil, New Delhi, 1996

3. M. S. Sodha, N. K. Bansal, P. K. Bansal, A. Kumar and M. A. S. Malik, SolarPassive

4. M. A. S. Malik, G. N. Tiwari, A. Kumar and M.S. Sodha, Solar Distillation. Pergamon Press, New York, 1982.

MGE211: Bio-energy & Conversion Systems **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Renewability and sustainability of biomass, Biomass: Biomass resources; classification and characteristics; Techniques for biomass assessment; Application of remote sensing in forest assessment; Biomass estimation. Thermochemical Conversion: Different processes, direct combustion, incineration, pyrolysis, gasification and liquefaction; economics of thermochemical conversion.

Biological Conversion: Biodegradation and biodegradability of substrate; biochemistry and process parameters of biomethanation; chemical kinetics and mathematical modeling of biomethanation process, biogas digester types; digester design and biogas utilisation; economics of biogas plant with their environmental and social impacts; bioconversion of substrates into alcohol: methanol & ethanol production, organic acids, solvents, amino acids, antibiotics etc. Chemical Conversion: Hydrolysis &

hydrogenation; solvent extraction of hydrocarbons; solvolysis of wood; biocrude; biodiesel production via chemical process; catalytic distillation; transesterification methods; Fischer-Tropsch diesel: chemicals from biomass. Power generation: Utilisation of gasifier for electricity generation; operation of spark ignition and compression ignition engine with wood gas, methanol, ethanol & biogas; biomass integrated gasification/combined cycles systems. Sustainable co-firing of biomass with coal. Biomass productivity: Energy plantation and power programme. Economical impacts; food security and environmental impacts of biomass conversion to energy- energy from waste.

References:

1. Alternate Energy: Assessment & Implementation Reference Book, James J Winebrake, Springer January 2007.

2. Biofuels - Securing the Planet's Future Energy Needs, Edited by A Demirbas Springer 2009.

3. Dictionary of Renewable Resources - 2nd Edition, Revised and Enlarged, Zoebelein, Hans, Wiley-VCH, 2001.

MGE212: Energy Resources, Economics And Environment **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Overview of India and World's Energy Scenario, Energy Flow Diagram Dis-aggregation by end-use, by supply Fossil Fuel Reserves - Estimates, Energy and Environment, The Kaya Identity, Emission Factor Dis-aggregation by end-use, by supply Fossil Fuel Reserves – Estimates.

Energy Economics - Simple Payback Period, Time Value of Money, Net Present Value (NPV), Benefit/Cost Ratio (B/C), Inflation, Internal Rate of Return (IRR), Cost of Saved Energy, Cost of Energy generation and its conservation.

Energy Chain, Primary energy analysis Life Cycle Assessment, Net Energy Analysis. Environmental Impacts of energy use - Air Pollution - SOx, NOx, CO, particulates Solid and Water Pollution, Formation of pollutants, measurement and controls.

Sources of emissions, effect of operating and design parameters on emission, control methods, Exhaust emission test, procedures, standards and legislation.

Environmental audits; Emission factors and inventories Global Warming, CO_2 Emissions, Impacts, Mitigation Sustainability, Externalities, Future Energy Systems.

Text Books/ References:

1. Energy and the Challenge of Sustainability, World energy assessment, UNDP New York, 2000.

2. AKN Reddy, RH Williams, TB Johansson, Energy after Rio, Prospects and challenges, UNDP, United Nations Publications, New York, 1997.

3. Nebojsa Nakicenovic, Arnulf Grubler and Alan McDonald Global energy perspectives, Cambridge University Press, 1998

4. Fowler, J.M., Energy and the environment, 2nd Edn., McGraw Hill, New York, 1984.

MGE213: Advanced Power Electronics **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Module 1:

Basics of Power Electronic devices: Power diodes; Power transistors: BJT, MOSFET, IGBT, SIT; Thyristors: SCR, DIAC, TRIAC, SCS, MCT, UJT, PUT.

Module 2:

Basic Power Electronic Circuits: Concept of Controlled rectifier; Introduction to Chopper; Principle of Inverter operation; Cycloconverter, AC Voltage controller

Module 3:

Switching Voltage Regulators: Introduction; Linear power supply; Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, C'uk converter, Sepic Converter; Design criteria for SMPS; Multi-output switch mode regulator

Module 4:

Resonant Converters: Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero voltage switching dc-dc converters, zero current switching dc-dc converters, clamped voltage topologies

Module 5:

Multi-level converters: Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications, Introduction to carrier based PWM technique for multi-level converters

Module 6:

Control Strategies for Power Converters: Introduction, Basic Control Principles, Hysteresis Control, Application of the Hysteresis Control for dc Motor Drive, Hysteresis Control for Regulating an ac Variable, Linear Control—dc Variable Proportional Controller: RL Load, Proportional Controller: dc Motor Drive System, Proportional-Integral Controller: RL Load, Proportional-Integral Controller: dc Motor, Proportional-Integral-Derivative Controller: dc Motor, Linear Control —ac Variable, Cascade Control Strategies, Rectifier Circuit: Voltage-Current Control, Motor Drive: Speed-Current Control

Text Books:

1. Euzeli Cipriano Dos Santos Jr. and Edison Roberto Cabral Da Silva, "Advanced Power Electronics Converters: PWM Converters Processing AC Voltages", IEEE Press
2. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
3. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
4. Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc., 2006.

Reference Books:

1. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
2. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
3. P.C.Sen, "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000.
4. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009

MGE214: Nanotechnology **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Nanomaterials: Nanostructured materials: zero dimensional, one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, nanowires, nanostructured beams, and nanocomposites - artificial atomic clusters – quantum size effects – Electronic Structure of Nanoparticles-size dependent optical absorption and electron transport properties – porous materials – ionic materials - membranes – catalysts.

Nanomaterials for Energy conversion: Challenges in energy conversion – role of nanostructures & materials – nanomaterials in solar Photovoltaic Technology: Band gap engineering & optical engineering - Tandem structures - quantum well and quantum dot solar cells - photo-thermal cells – Organic solar cells. Nanomaterials for Hydrogen production & storage: Introduction to Hydrogen engine – Hydrogen production methods – Nanomaterials for hydrogen purification & storage – Hydrogen Sponge - volumetric and gravimetric storage capacities –automotive applications.

Introduction to quantum mechanics: Failures of classical mechanics, Postulates of quantum mechanics; particle and waves, Heisenberg uncertainty principle, density of states, Pauli exclusion principle, black body radiation, Photons: the quantization of light, wave particle duality, Double slit experiment and its significance, de Broglie's wavelength theory and derivation, The hydrogen atom: The Rutherford-Bohr atom, The quantum atom, Schrödinger's wave equation- Introduction to Schrodinger equation for free particle in one dimension, Barrier tunneling, linear harmonic oscillator, quantum confinement theory based on nanostructures, applications of quantum mechanics in nanostructures

Application of nanotechnology in sustainable energies: Nanotechnology applications in solar, hydrogen, wind, biomass, geothermal and tidal energies. Nano devices: Energy efficient devices –fabrication and applications of LED as light device – OLED – Semiconductor laser – single electron & single photon devices

– energy efficient electronic switches & devices – MEMS & NEMS and their energy efficiency – Nanorobotics.

Text Books:

1. Nanomaterials – An introduction to synthesis, properties and applications, D. Vollath, WileVCH, Second Edition, 2013.
2. Charles Poole and Frank Owens, "Introduction to Nanotechnology", First Edition, John Wiley India, 2006.
3. Ajoy K.Ghatak and S. Lokanathan,"Quantum Mechanics, Theory and Applications", Springer, 2004.

Reference Books:

1. Hari Singh Nalwa, "Encyclopedia of Nanotechnology", Second Edition, American Scientific Publishers, 2004.
2. Gilbert M. Masters. Renewable and Efficient Electric Power Systems. 2004. John Wiley & Sons, Inc. NJ.

MGE215: Energy Economics & Planning **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Energy economics: Basic concepts, energy data, energy cost, energy balance. Energy accounting framework; Economic theory of demand, production and cost market structure; National energy map of India, Energy subsidy – National and international perspectives.

Concepts of economic attributes involving renewable energy, Calculation of unit cost of power generation from different sources with examples, different models and methods Application of econometrics; input and output optimization; energy planning and forecasting - different methods

Evaluation of National and Regional energy policies; oil import, energy conservation, rural energy economics, integrated energy planning. Conflict between energy consumption and environmental pollution, Economic approach to environmental protection and management, Energy-Environment interactions at different levels, energy efficiency, cost-benefit risk analysis; Project planning and implementation, Planning for energy security and renewable energy innovations; Regional, National and Global aspirations and requirements; Role of Governments, Societies and NGOs.

Text Books:

1. Bhattacharyya S. C. (2011); Energy Economics, Springer

2. Ferdinand E. B. (2000); Energy Economics: A Modern Introduction, First Edition, Kluwer

Reference Books:

1. Kandpal T. C. and Garg H. P. (2003); Financial Evaluation of Renewable Energy Technology, Macmilan

2. Stoft S. (2000); Power Systems Economics, Willey-Inter Science

3. Munasinghe M. and Meier P. (1993); Energy Policy Analysis and Modeling, Cambridge University Press
4. Samuelson P. A. and William D. N. (1992); Economics, 14th edition, McGraw Hill

5. Thuesen G. J. and Fabrycky W. J. (2001); Engineering Economy, Ninth Edition, Prentice Hall India.

MGE216: Energy and Climate Change **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Introduction to the climate system, Capacity of earth in fulfilling the developmental race, Greenhouse gas emission, energy activities and the measures of its control; evidence and predictions and impacts, Clean energy technologies, Role of renewable energy, Climate Change Act, Governments policies for mitigation and adaptation,

India's action on mitigation of Climate change, Directives on the use of energy sources and industry for , Scope 3 Emissions –categorization and measurement; Carbon Foot printing, Calculating Scope 3 Emissions Carbon dioxide (CO_2) emissions ,assessment and estimation; estimation of emission from fossil fuel combustion; Adaptation to climate change: exposure, sensitivity, maladaptation, and barriers and limits UNFCCC-history, structure and action plans,

Scientific consensus and uncertainty, the IPCC science assessment, Projection of future scenarios;

Impacts of climate change: Food Security and Food Production, Human Security; Livelihoods & Poverty,

Text Books

1. Yamin F. (ed) (2005); Climate Change and Carbon Markets: A Handbook of Emissions Reduction Mechanisms, Earthscan

2. Mathez E. A. (2009); Climate Change: The Science of Global Warming and Our Energy Future, First edition, Columbia University Press

Reference Books

1. Turner, G. (2014). Is Global Collapse Imminent? University of Melbourne, Melbourne Sustainable Society Institute.

2. Global Energy Review 2021: Assessing the effects of economic recoveries on global energy demand and CO2 emissions in 2021. GlobalEnergyReview2021.pd

[3] Dessler A. (2011); Introduction to Modern Climate Change, Cambridge University Press

[4] Yamin F. (ed) (2005); Climate Change and Carbon Markets: A Handbook of Emissions Reduction Mechanisms, Earthscan.

MGE217: Advanced Energy Storage Systems **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Energy availability, Demand and storage, Need for energy storage, Different types of energy storage; Mechanical, Chemical, Electrical, Electrochemical, Biological, Magnetic, Electromagnetic, Thermal; Comparison of energy storage technologies.

Thermal energy storage: principles and applications, Sensible and Latent heat, Phase change materials; Energy and exergy analysis of thermal energy storage, solar energy and thermal energy storage, case studies.

Flywheel and compressed air storage; Pumped hydro storage; Hydrogen energy storage, Capacitor and super capacitor, Electrochemical Double Layer Capacitor: Principles, performance and applications.

Electrochemical energy storage: Battery – fundamentals and technologies, characteristics and performance comparison: Lead-acid, Nickel-Metal hydride, Lithium Ion; Battery system model, emerging trends in batteries.

Hydrogen as energy carrier and storage; Hydrogen resources and production; Basic principle of direct energy conversion using fuel cells; Thermodynamics of fuel cells Fuel cell types: AFC, PEMFC, MCFC, SOFC, Microbial Fuel cell; Fuel cell performance, characterization and modeling; Fuel cell system design and technology, applications for power and transportation.

Application of Energy Storage: Food preservation, Waste heat recovery, Solar energy storage: Greenhouse heating; Drying and heating for process industries.

Text Books:

1. Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications, Wiley

2. Huggins R. A. (2015); Energy Storage: Fundamentals, Materials and Applications. Springer

Reference Books:

1. O'Hayre R., Cha S., Colella W., and Prinz F. B. (2009); Fuel Cell Fundamentals, Second Edition, Wiley

2. Narayan R. and Viswanathan B. (1998); Chemical and Electrochemical Energy System, Universities Press
3. Rahn C. D. and Wang C. (2013); Battery Systems Engineering, First Edition, Wiley

4. Moseley P. T., and Garche J. (2014); Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Elsevier Science.

5. Miller F. P., Vandome A. F., and John M. B. (2010); Compressed Air Energy Storage, VDM Publishing.

MGE218: Geothermal and Ocean Energy **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Geothermal Energy: Geothermal sources, Origins of heat, heat transfer, geological environments, reservoir systems – conductive, convective-liquid-dominated and convectivevapor-dominated, reservoir evolution, hydrothermal resources – vapor dominated and liquid dominated systems, hybrid plants – geothermal preheat and fossil superheat; applications of geothermal energy, advantages and disadvantages of geothermal energy. Key issues in SedHeat and EGS, behaviors, fluid flow and heat transport modes, utilization of O&G technologies. Concept, resource size, characteristics, methods of stimulation and permeability evolution, history. Reservoir management and sustainability

Ocean Energy: Ocean thermal energy conversion-open cycle and closed cycle systems, energy from tides – basic principle of tidal power, components of tidal power plants, single basin and double basin systems, ocean waves – wave energy conversion systems.

Text Books/References:

1. Glassley, W.E. Geothermal Energy. Second Edition. CRC Press. 2015
2. Arthur Pecher, Jens Peter Kofoed, Handbook of Ocean Wave Energy, Springer, 2016.
3. Grant, M.A. and Bixley, P.F. Geothermal Reservoir Engineering. Second Edition. Elsevier. 2011
4. Paul A. Lynn, "Electricity from Wave and Tide: An Introduction to Marine Energy" 1st edition, Wiley, 2013.

MGE219: Prime Movers **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Properties of Steam: Formation of steam on temperature-enthalpy diagram, types of steam: wet, dry, Super-heated steam, dryness and wetness fraction, specific enthalpy, specific volume of steam

Steam Boilers: Introduction, classification of various high pressure boilers e.g. Lamont, Velox, Schmidt, Loeffler etc., their characteristics and working principle

Steam Turbines: Classification, compounding, velocity diagrams, work done, diagram and stage efficiency in impulse turbine, impulse reaction turbine, degree of reaction, governing of steam turbines, problems.

Steam Condensers: Introduction, types of condensers, vacuum efficiency, effect of vacuum, effect of air leakage, condenser efficiency, Dalton's law of partial pressure, amount of cooling water, problems Gas

Turbine: Introduction, applications, types of gas turbines, cycles, thermal efficiency, air rate, work ratio, effect of operating variables on thermal efficiency of gas turbine, methods to improve thermal efficiency of gas turbine, gas turbine fuels, starting of plant, comparison with diesel and steam power plants. Diesel

Power Plant –Introduction, diesel engine working principle, diesel fuels, diesel electric plant main components.

Hydraulic Turbines: Introduction, Classification of hydraulic turbines, Main components of Pelton wheel, Working, Work done and power produced, Efficiency, Working of Francis turbine, components, Work done & power produced, Efficiency, Working of Propeller & Kaplan Turbine, Main parts & Function of components, Governing of Impulse & Reaction Turbine, characteristics curves of impulse & reaction turbine, Draft Tube Theory.

Text Books:

1. Thomas Elliott, Kao, Chen, Robert, Swanekamp –Standard Handbook of Power Plant Engineering, 2nd edition, McGraw Hill Publication, 1996.

2. P K Nag – Power Plant Engineering, 4th Edition, TMH publication, 2017.

3. Mallick Amiya Ranjan, Practical Boiler Operation Engineering And Power Plant, 5th edition, PHI learning, 2022.

4. P C Sharma – Power plant Engineering, 1st edition, S K Kataria & Sons Publisher, 2013.

MGE220: Grid Connectivity and Smart Grids **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Introduction: Conventional power systems and Smart grid, definition of smart grid, need for smart grid, Smart grid architecture, smart grid domains, Communication architecture and protocols for smart grid, smart grid priority standards and regulation, Generation in Smart Grid: Renewable-based Distributed generations, Energy Storage Technologies, Modeling, Control of energy storage system, Short- mid -long term application of energy storage system in smart grids, smart-grid activities in India.

Smart Grid Operation and Planning: Optimal Power Flow, Load forecasting, Operation of smart grid system, Load Dispatch Centre functions, control objectives of a smart distribution system, Operational bottlenecks in smart grid. Planning Aspects of smart grid, Planning and operation Standards. Distributed Generation in Smart Grid: Renewable-based Distributed generations, Energy Storage Technologies, Modeling, Control of energy storage system, Short- mid -long term application of energy storage system in smart grids.

Smart Grid Security analysis: Concept of security, Security analysis and monitoring, factors affecting power system security, detection of network problems, an overview of security analysis.

Modelling and stability analysis of microgrid: Dynamic modelling of individual components in AC and DC microgrids, state space modal analysis and influence of system parameters on the microgrid dynamics, brief concept on the design of microgrid stabilizers to improve stability. Control of Micro Grid System:

Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System – Reactive Power Control in micro Grid. Case Studies and Test beds for the Micro Grids.

Text Books:

1. K. S. Manoj, Smart Grid : Concepts To Design, 1st edition, Notion Press, 2019.
2. Lers. T. Berger, Krzysztof Iniewski, Smart Grid Applications, Communications and Security, 2nd edition, Wiley, 2015.
3. M. Kamran, Fundamentals of Smart Grid Systems, Academic Press, 2022
4. Wiley Editorial, Smart Grid: Fundamentals, Design, Technology, Applications, Communication and Security**,** 1st edition, Wiley Publisher, 2021.

MGE221: Electrical Machines **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Electro mechanical Energy Conversion: Principles, Forces and Torques in Magnetic Field Systems, Energy Balance, Energy and Force in Singly Excited Magnetic Field System, Coenergy, Multiply Excited Magnetig Field Systems.

D.C. Generators: Principle of Operation, Constructional Features, emf Equation of a D.C.Generator, Collection and Flow of Current from Armature, Armature Reaction, Methods to Reduce Effects of Armature Reaction and Commutation Process, Armature Winding Diagram, Methods of Excitation, Generator Characteristics, Parallel Operation, Losses occur in DC Generator, Efficiency and Applications.

Speed Equations, DC Motor characteristics, Speed Control Methods of a D.C. Motors, Starting and Starters, Efficiency and Applications.

Testing of D.C. Motors: Brake Test, Swinburne's Test, Hopkinson's Test, Retardation Test, Field's Test and Separation of Losses.

Transformers: Principle of operation, Constructional features, Types of Transformers, emf equation of a Transformer, Transformer on No-Load and Load and its vector diagrams, Equivalent Circuit of a Transformers, Losses in a Transformer, Voltage Regulation and Efficiency, OC and SC Tests of a Transformer, Three Winding Transformers, Three Phase Transformer Connections,

Parallel Operation and Load Sharing, Three Phase to Two Phase Conversion and Vice-Versa.

TEXT BOOKS:

1. Electrical Machinery by DR.P.S.BIMBHRA, KHANNA PUBLISHER.

2. Electrical Machines by D P KOTHARI and I J NAGRATH, McGraw Hill Education

(India) Private Limited.

Reference Books:

1. Electrical Machines, by J B Gupta, S K Kataria& Sons

2. Electrical Machines by U A Bakshi and M V Bakshi, Technical Publications

MGE222: Sustainable Energy & Materials **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Unit 1: Silicon processing methods, dry and wet chemical processes used to develop new materials and micro-engineered products.

Unit 2: Gas-solid and liquid-solid reactions, and their role in micro engineering. Various reactors and methods of fabrication methods, such as physical and chemical vapour deposition techniques, photolithography, electroless and electrochemical deposition, etching, and through mask plating and common models to describe these processes.

Unit 3: Principles for electrochemical power sources, photovoltaics and their relevance in current energy industry. Environmental and sustainability issues for the production of high-tech components and materials

Text Books:

1. R Kirkwood and A Longley, Clean Technology and the Environment, Blackie October 1994.

2. P. White, I. Franke, P. Hindle, Integrated Solid Waste Management: A Lifecycle Inventory pub. Chapman & Hall 1994.

3. J Fiksel, Design for Environment, 2nd edition, Mcgraw Hill, 1996.

4. K. Mulder, Sustainable Development for Engineering, 1st edition, Greenleaf Publishing, 2006.

MGE223: Micro Electro Mechanical Systems **L-T-P: 3-0-0 (Credit: 3)**

Contact Hours: 36 hrs

Module1:

Intrinsic Characteristics of MEMS- Miniaturization, Microelectronics Integration, Mass Fabrication with Precision, Sensors and Actuators- Energy Domains and Transducers, Sensors, Actuators. Introduction to Micro fabrication: The Microelectronics Fabrication Process, Silicon based MEMS processes, New Materials and Fabrication Processes, Points of Consideration for Processing.

Module2:

Electrostatic Sensing and Actuation: Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitors, Applications of Parallel Plate Capacitors, Interdigitated Finger Capacitors, Applications of Comb Drive Devices. Thermal Sensing and Actuation: Introduction, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications. Magnetic Actuation: Essential Concepts and Principles, Fabrication of Micromagnetic Components, Case Studies of MEMS Magnetic Actuators.

Module3:

Piezoresistive Sensors: Piezoresistive Sensor Materials, Stress Analysis of Mechanical Elements, Applications of Piezoresistive Sensors. Piezoelectric Sensing and Actuation: Introduction, Properties of Piezoelectric Materials, Applications

Module4:

Bulk Micromachining and Silicon Anisotropic Etching: Introduction, Anisotropic Wet Etching, Dry Etching of Silicon-Plasma Etching, Deep Reactive Ion Etching (DRIE), Isotropic Wet Etching, Gas-Phase Etchants, Native Oxide, Wafer Bonding, Case Studies.

Surface Micromachining: Basic Surface Micromachining Processes, Structural and Sacrificial Materials, Acceleration of Sacrificial Etch, Stiction and Anti Stiction Methods, Assembly of 3D MEMS, Foundry Process.

Text books:

1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012
2. Eun Sok Kim, Fundamentals of Microelectromechanical Systems, TMH, 2021
3. N Mahalik, MEMS, McGraw Hill, 2017

CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

(Deemed to be University, MHRD, Govt. of India)

Civil Engineering Department

Course structure for M.Tech Programme in Water Resources and Hydraulic Engineering

Course structure

Semester II

Sl. No.	Course Code	Subject	Teaching Scheme (hr/week)			Credits
			L	T	P	C
1	MCE201	River Engineering	3	1	0	4
2	MCE202	Hydraulics of sediment transport	3	1	0	4
3	MCE21**	Elective - III	3	1	0	4
4	MCE21**	Elective - IV	3	1	0	4
5	MCE271	Water Resources Engineering Laboratory–II	0	0	4	2
6	MCE291	Seminar	0	0	4	2
Total			16	4	2	**20**

Elective - III Subjects		
Sl. No.	**Subject Code (MCE21**)**	**Subject**
1	MCE2101	Optimization techniques in Engineering
2	MCE2102	Integrated watershed management
3	MCE2103	Soft computing techniques in Engineering
4	MCE2104	Turbulent Fluid Flow

Elective - IV Subjects		
Sl. No.	**Subject Code (MCE21**)**	**Subject**
1	MCE2105	Statistical techniques and computer programming
2	MCE2106	GIS and remote sensing for land and water resources
3	MCE2107	Advanced computational hydraulics
4	MCE2108	Hydraulic structures

MCE21**: Any other subject offered from time to time with the approval of the competent authority.

Course Syllabus for M. Tech Programme

Name of the Programme: **M. Tech in Water Resources and Hydraulic Engineering**

Name of the Department: **Civil Engineering Department**

Semester II

Compulsory courses

MCE201: River Engineering **4 Credits (3-1-0)**

River characteristics; use of rivers for navigation, hydropower, water supply and irrigation; river hydraulics - water waves, flow classification, regime of flow, type of flow; formulating hydraulic studies - date requirement, calibration of hydraulic analysis models, multidimensional flow analysis, limitations of one-dimensional analysis, two-dimensional conditions, available computer programs and their applications, theory of routing models for unsteady flow, diffusion of wave and kinematic wave approximations, Muskingum-Cunge models, water surface profiles for mobile boundaries; river morphology - planform, longitudinal profile, river bends, bifurcation and confluences, quality of water; river survey - water levels, bed levels, discharge, stage-discharge relationships, sediments and water quality, introduction to scale models in rivers.

Course Outcomes: By the end of the course the student is expected to: a) know qualitative behaviour of river and estuarine dynamics (e.g. river meanders); b) know relevant hydrodynamic equations of open channel flows; c) know about sediment transport mechanics and modelling approaches.

Reference / Text Book (s):

1. River Hydraulics by U. S. Army Corps of Engineers (2004), University Press of the Pacific.

MCE202: Hydraulics of Sediment Transport **4 Credits (3-1-0)**

Sediment properties; initiation of motion; bed load; bed forms; effective bed roughness; armouring; suspended load; total load; transport of sediment due to unsteady flow; meandering of rivers; braided river; local scour at different structures; sediment sampling; density current; mathematical models of sediment transport; effect of coherent turbulence on sediment transport.

Course Outcomes: By the end of the course the student is expected to: 1) gain knowledge about nature of sediment problems, origin and properties of sediment particles, fall velocity concept. 2) have knowledge on suspended sediment, bed load and total load transport in streams. 3) have knowledge on bed form mechanics and resistance to flow, and 4) apply the knowledge in design of hydraulic systems conveying sediment-laden flow.

Reference / Text Book (s):

1. Hydraulics of Sediment Transport by Walter Hans Graf (1971), Water Resources Publication, LLC.
2. Fluvial Hydrodynamics: Hydrodynamic and Sediment Transport Phenomena by S Dey (2014), Springer.

Semester II

Elective-III courses

MCE2101:
Optimization Techniques in Engineering **4 Credits (3-1-0)**

Linear programming and duality, Network flow algorithms, Dynamic programming, Nonlinear programming, Geometric and Goal programming, Introduction to modern heuristic methods like genetic algorithm and simulated annealing, Multi-objective optimization, Applications and case studies areas of science & engineering.

Course Outcomes: By the end of the course the student is expected to: a) gain knowledge of water demand management concepts; b) use techniques to assess water demand for various sectors; c) examine various optimization techniques used for maximising allocation of water resources for satisfying water demand to various sectors.

Reference / Text Book (s):
1. Water Resource Systems Planning and Management: An Introduction to Methods, by Daniel P. Loucks and Eelco van Beek (2005), Springer.
2. Water Resources Systems: Modelling Techniques and Analysis, Vedula, S. and Mujumdar, P. P., (2005), Tata-McGraw Hill.

MCE2102: Integrated Watershed Management **4 Credits (3-1-0)**

Introduction to integrated approach for the management of watersheds. preparation of land drainage schemes; types and design of surface drainage as well as subsurface drainage in coastal and interior basins. controlling of soil erosion and soil salinity. types and design of water conservation and water harvesting structures for different types of catchments. estimation of design storm and design flood for spillways and other outlet structures. flood routing through channels and reservoirs. flood control through single purpose and multipurpose reservoir operation. Early warning systems: disaster risk knowledge; detection, monitoring, analysis, and forecasting; warning dissemination and communication; and preparedness and response capabilities. Types and design of flood forecasting and protection systems, flood damage case studies.

Course Outcomes: By the end of the course the student is expected to: a) experience in collaborative IWM, particularly in Participatory Action Research; b) know about Sustainable Land Management (SLM) knowledge sharing.

Reference / Text Book (s):
1. Integrated Watershed Management by Isobel W. Heathcote (2009), John Wiley & Sons.

MCE2103: Soft computing techniques in Engineering **4 Credits (3-1-0)**

Artificial Intelligence; Expert Systems; Artificial Neural Networks: Introduction, Training, Applications in Hydrology; Genetic Algorithms; Fuzzy Logic Systems, Fuzzy Set Theory, Predictive and Descriptive Data Mining; Classification Methods: Decision trees, NN, Bayesian, ANN, SVM, Applications; Association Analysis; Cluster Analysis - K-means, Fuzzy, Self-Organising maps; Anomaly detection; Applications in Engineering

Course Outcomes: By the end of the course the student is expected to: a) apply various optimization techniques, Fuzzy logic, Data Mining, Decision trees etc. for solving problems related to water resources engineering and management; b) learn mathematical model for various real time problem-solving.

Reference / Text Book (s):

1. Soft Computing in Water Resources Engineering: Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms by G. Tayfur. WIT Press, 2014.

MCE2104: Turbulent Fluid Flow **4 Credits (3-1-0)**

Statistical structures of turbulence; two-dimensional flow structures and effect of roughness; measurements of turbulence; three-dimensional flow structures driven by turbulence; secondary currents; diffusion and dispersion; turbulence model calculations; Coherent structures; bursting phenomena; large scale vortical motions; physical models of coherent structures; numerical simulations of coherent structures; wave boundary layer.

Course Outcomes: By the end of the course the student is expected to: a) apply various analytical methods and modelling concepts for solving real-life problems related to turbulent flow, b) gain competence in physical modelling of hydraulic structures characterized by turbulent flow.

Reference / Text Book (s):

1. Turbulent Flows by S.B. Pope. Cambridge University Press, 2000.
2. Computational Fluid Dynamics: Incompressible Turbulent Flows by Takeo Kajishima and Kunihiko Taira. Springer, 2017.

Semester II

Elective-IV courses

MCE2105: Statistical Technique & Computer Programming 4 Credits (3-1-0)

Estimation and hypothesis testing, correlation and regression, analysis of variance (one way and two way classification). Programming preliminaries, some simple program in C, numeric constants and variables, arithmetic expression, input and output conditional statements, loops, arrays, logical expressions, functions, character strings enumerated data type and stacks, structures.

Course Outcomes: By the end of the course the student is expected to: a) formulate complete, concise, and correct mathematical proofs; b) frame problems using multiple mathematical and statistical representations of relevant structures and relationships and solve using standard techniques; c) create quantitative models to solve real world problems in appropriate contexts.

Reference / Text Book (s):

1. Statistical Analysis in Water Resources Engineering by Mamdouh Shahin, H. J. L. van Oorschot, S. J. de Lange. A.A. Balkema, 1993.

MCE2106: GIS and Remote Sensing for Land and Water Resources 4 Credits (3-1-0)

What is GIS. Geographic concepts for GIS. Spatial relationships, topology, spatial patterns, spatial interpolation. Data storage, data structure, non-spatial database models. Populating GIS, digitizing, data conversion. Spatial data models, Raster and Vector data structures and algorithms. Digital Elevation Models (DEM) and their application. Georeferencing and projection systems, GIS application areas, Spatial analysis, quantifying relationships, spatial statistics, spatial search.

Physics of remote sensing: Electromagnetic spectrum, atmospheric effects, energy interaction with earth surface features. Platforms and remote sensing sensors: Photographic camera, scanners, earth resources satellites, active and passive microwave sensors. Digital image processing: Image rectification, image enhancement, image classification and accuracy. Image interpretation. Geographical Information System (GIS): Map data representation, geographic database concepts and analysis. Application of remote sensing and GIS in land and water resources system and evaluation.

Course Outcomes: By the end of the course the student is expected to: a) learn about satellite remote sensing, GIS, DEM and GPS; b) learn about digital image processing for image rectification, enhancement and information extraction; c) apply Remote Sensing, GIS, DEM and GPS is various domains including rainfall-runoff modelling, Snow mechanics, Watershed management, Irrigation management, soil moisture estimation, Drought and Flood monitoring, Environment and ecology.

Reference / Text Book (s):

1. GIS and Remote Sensing Techniques in Land- and Water-management by A. van Dijk, M.G. Bos (2013), Springer.

MCE2107: Advanced Computational hydraulics **4 Credits (3-1-0)**

Ordinary and partial differential equations; finite difference schemes - implicit and explicit types; accuracy, convergence and stability; method of characteristics; finite element method - variational and weighted residual formulations; applications to steady and unsteady flows; pollutant dispersion; flood wave propagation; tidal model; applications with computer programming.

Course Outcomes: By the end of the course the student is expected to: a) acquire understanding of numerical approximations and solutions of physical systems, especially in open channel hydraulics, but with more general application in hydraulics and fluid mechanics, b) develop competence in understanding the fundamentals and applying application software for Computational Fluid Dynamics analysis, and obtain solutions of real-life problems.

Reference / Text Book (s):

1. Computational Hydraulics by Vreugdenhil, Cornelis B. (1989), Springer.

MCE2108: Hydraulic Structures **4 Credits (3-1-0)**

Storage, Diversion, Conveyance and Distribution structures: An Introduction.
Reservoirs behind water retaining structures: determination of capacities (influence of sedimentation). Dead and Live storages.

Design of storage structures: Gravity dam: Spillway and Non-overflow sections and their design. Concrete dam details: joints, water-seals, galleries and instrumentation: purpose and techniques; sluices. Foundation treatment for concrete dams (curtain and consolidation grouting). Other types of concrete dams (Arch, Buttress, Hollow, etc.). Typical sections of earth and rockfill dams (homogeneous / zoned). Analysis and design of embankment dams.

Types of spillways (adaptations for concrete and embankment dams). Flow characteristics of gated/ungated spillways / breast-walled gates. Types of energy dissipators (Hydraulic Jump / Ski-Jump / Roller bucket). Influence of tail water rating curve on choice of energy Dissipater.

Diversion structures: Barrages and weirs on permeable foundations. Barrage components: Glacis, Rigid apron, Flexible (concrete block) apron. Theories of seepage (Bligh's, Lane's and Khosla's theories, and concept of flow nets) and design of weirs and barrages. End-sill arrangements for energy dissipation for weir and under-sluice sections of a barrage. Pier, Divide wall, Sheet Piles.

Canal structures: Head regulator, Cross regulator and Falls. Canal section design (unlined and lined); in cutting and filling. Kennedy's and Lacey's theories, and design of canals in alluvial reach. Aqueducts; Super-passage; Syphon Aqueducts. Distribution structures for conveying water from canals to irrigation fields. Canal capacity determination from field water requirements.

Hydropower engineering structures. Basics of hydropower engineering: Non-conventional and Renewable sources of power generation, Capacity and energy generation, Base and Peak load, Techno-economic modelling. Arrangements for Run-of-the-River, Storage and Pumped Storage categories of hydropower projects. Types and components of Intakes and Trash racks, Water conductor system including desilting arrangements, open channel flow, Tunnels, Forebays and Surge-tanks/Surge-shafts, Penstocks, Anchor blocks, Power house. Role of PSHs and mixed PSHs in an electric grid. Types of Pumped Storage Hydropower (PSH) plants: On-stream, Off-stream open loop and Off-stream closed loop PSH Schemes, PSHs with daily, weekly and seasonal operating cycle,

River training and structural measures for river training works; design features of river training structures.

Cross drainage works: types and features.

Structures for prevention of riverbank and coastal erosion (considerations for toe scour; provision of filter to prevent subsidence).

Course Outcomes: By the end of the course the student is expected to: a) have in-depth knowledge of professional practices and design codes; b) formulate and solve multi-variable hydraulic design problems in an open-ended solution space; c) develop understanding of the basic principles and concepts of analysis and design of different types of conventional as well as innovative hydraulic structures.

Text Book:

Water Resources Engineering Vol. II Irrigation Engineering & Hydraulic Structures by S K Garg (2017), Khanna Publishers

(M. Des. Course Structure in Multimedia Communication and Design)
UPDATED VERSION AS PER NEP

SEMESTER - 2						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P/S**	**C**
01	MMD201	Design research (Theory)	1	1	0	2
02	MMD202	Approach to New media Technologies (Theory)	1	1	0	2
03	MMD271	Design research (Lab)	0	0	4	2
04	MMD272	Approach to New media Technologies (Lab)	0	0	4	2
05	MMD21*	***Elective-I*** (*Practical Based Course*) 1. 3D Sculpture & Visualization Techniques 2. Visual Communication and Advertising 3. Animation & Visual Effects 4. Animation Production Techniques	0	0	12	6
06	MMD291	Semester 2 Project *(Experimental / Developmental Animation / Digital media Project: Production)*	0	0	12	6
	Contact Hrs = 36	**Total**	2	2	16	20

COURSE CONTENTS

SEMESTER – 2

MMD201 / 271: Design Research **L-1, T-1, P/S-4, C-4**

The course is preparatory for the thesis and focuses on the appropriate use of theory and methods in writing a master's thesis. The course pays particular attention to developing their ability to read research literature and to conduct an advanced literature review. It is designed to help train students as both researchers in academia, as well as in other fields of professional life. The course content includes critical discussions of research in the field of global political studies as well as techniques of communicating social science research issues.

References:

1. Farr, Mihael; Design Management, Hoddar and Stoughton, London, 1966.
2. Goslet Dorothy, The Professional Practice of Design, Batszford, London 1971.
3. Pulos, Arthur J, Contract Selling Industrial DesignServices, Office of Design, Department of Industry, Trade and Commerce, Ottawa, 1975.
4. Abbott Howard, Safer by Design, Design Council, London, 1987.
5. Brustein David & Frank Stasiowski, Project Management for the Design, Professional, Whitney
6. Library of Design New York, 1982.
7. Staurt W Rose, Achieving Excellence in Your Design Practice, Whitney Library of Design, New York, 1987.
8. Oakley, Mark (ED.), Design Management a Handbook of Issues and Methods, Basil Blackwell Ltd. 1990.
9. Case studies by Design Management Institute, USA

MMD202 / 272: Approach to New media Technologies **L-1, T-1, P/S-4, C-4**

Nature and Characteristics of Communication: Communication: definition, nature and scope- Human needs of communication- Functions of communications - Types of communication: intrapersonal- interpersonal, group and mass communication- Indian concept of communication.

Process of Communication Elements and process of communication- Communication flows: one-step, two-step, and multi-steps- Barriers in communication- Verbal and non-verbal communication

Introduction to Media Characteristics of media- Print, electronic, new media and traditional media, Print & Digital Technologies, Media Management (Print & Radio), Film Production Analesis, Cinematography tolls & Techniques, Media research & evaluation, Video Production & Technologies, Wed Technology, Multimedia communication, Tools & Techniques of still photography, Graphics Design, Web Design & Social Media, Virtual Environments, Printing Technology, TV Satellite Communication.

Texts/References:

1) Mass Communication & Journalism in India -D S Mehta,
2) Mass Communication in India -Keval J. Kumar, Jaico Publishing House.
3) International Communication – N. Prabhakar & N. Basu, Commonwealth publishers, New Delhi.
4) Understanding Development Communication – Uma Joshi.Mcquail's Mass Communication Theory –
   Denis Mcquail, Sage Publication.Mass Communication Models-Uma Narula
5) T. Thyagarajan, K.P. Sendur Chelvi and T.R. Rangaswamy, "Engineering Basics" 3rd Edition, New Age International Publishers,2001
6) T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", Scitech Publications (Ind) Pvt. Ltd., Fourth Edition August 2006.
7) Paranjothi S.R.,"Electric Circuit Analysis" New Age International Ltd., Delhi, 2nd Edition, 2000.
8) Peter ward "Studio and outside broadcast Camera"
9) BernardWilkie "Creating special effects for TV & Video"
10) Roy Thomson "Grammar of the shot"
11) Der Lyur & Graham "Basics of Video Production"
12) Steven Katz "Film Directing: Cinematic Motion " Focal Press publishers
13) Antony Friedman "Writing for media"–Focal press
14) Dwight V Swain " Film Scriptwriting" Focal Press publishers
15) Steve Katz "Film Directing Shot" Focal Press publishers

Course Title: ELECTIVE – 1 **L-0, T-0, P/S-12, C-6**

Course Code: MMD21*

Elective subject – 1 (Code: MMD211): 3D Sculpture & Visualization Technique

Elective subject – 2 (Code: MMD212): Visual Communication and Advertising

Elective subject – 3 (Code: MMD213): Animation and Visual Effects

Elective subject – 2 (Code: MMD214): Animation Production Techniques.

As all these are project-based courses, hence the contents of these courses will be planned and informed by the concerned course instructors as and when the courses will be floated.

MMD291: Semester – 2 Project **L-0, T-0, P/S-12, C-6**

The semester project will be based on Experimental / Developmental Animation / Digital media Project Production.