National Institute of Technology Raipur

(An Institute of National Importance)

G.E. Road, Raipur – 492010 (C.G.)

Website: http://www. nitrr.ac.in **Phone:** +91-771-2254200

Department of Information Technology

MTech (IT) SEMESTER: II (New Scheme & Syllabus)

S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credits
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Information Technology	IT MC201	Internet of Things	4	0	-	20	15	15	100	-	150	4
2	Information Technology	IT MC202	Big Data analytics	4	0	-	20	15	15	100	-	150	4
3	Information Technology	IT ME23X	Elective-3	4	0	-	20	15	15	100	-	150	4
4	Information Technology	IT ME24X	Elective-4	4	0	-	20	15	15	100	-	150	4
5	Information Technology	IT ME25X	Elective-5	4	0	-	20	15	15	100	-	150	4
6	Information Technology	IT ML201	Lab 3 (IoT Lab)	-	-	3	75	-	-		50	125	2
7	Information Technology	IT ML202	Lab 4 (Optimization Lab)	-	-	3	75	-	-		50	125	2
				20	**0**	**6**	**250**	**75**	**75**	**500**	**100**	**1000**	**24**

S.No.	Elective-3	Elective-4	Elective-5
1	Next Generation Network	Foundations of Information Security	Advanced Optimization Technique
2	Computer Vision	High Performance Computing	Information Retrieval System
3	Cellular and Mobile Computing	Process Mining	Digital and Cyber Forensics
4	5G Networks	Robotics and Automation	Quantum Machine Learning
5	Wireless sensor networks	Agile Software Development	Text Mining
6	Social network analysis	Cloud and IoT Security	Pattern Recognition

Name of Program	M. Tech.	Semester – II	Year – I
Course – Name	**Internet of Things**		
Course – Code	**ITMC201**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Core**		

Prerequisites:

- Operating System
- Basic Computer Networking Concept

Course Outcomes:

Students will be able to –

CO-1	Explain the concept of IoT.
CO-2	Analyze various protocols for IoT.
CO-3	Design a PoC of an IoT system using Rasperry Pi/Arduino
CO-4	Apply data analytics and use cloud offerings related to IoT.
CO-5	Analyze applications of IoT in real time scenario.

Course Contents:

UNIT-1	**Enabling Technologies of IoT:**Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects
UNIT-2	**Fundamental Protocols for IoT network:** IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory

	Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT
UNIT-3	**IoT System Design and Development:** Design Methodology – Embedded computing logic – Microcontroller, System on Chips – IoT system building blocks – Arduino – Board details, IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.
UNIT-4	**IoT Data Analytics and Supporting Services:**Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine/Deep Learning in IoT Analytics, No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework: Django, AWS for IoT – System Management with NETCONF-YANG
UNIT-5	**Case Studies/Industrial Applications:**Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model – Smart and Connected Cities: Layered architecture,Smart Lighting, Smart Parking Architecture and Smart Traffic Control
Reference Books:	
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ***—IoT Fundamentals:Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017***
2.	Arshdeep Bahga, Vijay Madisetti, ***—Internet of Things – A hands-on approach, Universities Press, 2015***
3.	Olivier Hersent, David Boswarthick, Omar Elloumi , ***—The Internet of Things – Key applications andProtocols, Wiley, 2012***
4.	Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David
5.	Boyle, ***"From Machine-to-Machine to the Internet of Things – Introduction to a New Age ofIntelligence", Elsevier, 2014.***
6.	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ***—Architecting the Internet of Things,Springer, 2011.***
7.	Michael Margolis, Arduino Cookbook, ***Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.***

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Big Data Analytics**		
Course– Code	**IT ME251**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 5**		

Course Outcomes:	
Students will be able to –	
CO-1	Describe big data and use cases from selected business domains
CO-2	List the components of Hadoop and Hadoop Eco-System
CO-3	Access and Process Data on Distributed File System
CO-4	Manage Job Execution in the Hadoop Environment
CO-5	Develop Big Data Solutions using the Hadoop Eco System

Course Contents:	
UNIT-1	**Introduction to Big Data:** Definition and characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), Importance and applications of Big Data, Challenges in Big Data, Overview of the Hadoop ecosystem, Introduction to MapReduce, Hadoop Distributed File System (HDFS), Applications of Big Data.
UNIT-2	**Data Processing Frameworks**Apache Spark fundamentals, Spark vs. Hadoop, Spark SQL, Spark Streaming, Data collection methods, Data cleaning and preprocessing, ETL tools (e.g., Apache NiFi, Talend)
UNIT-3	**Big Data Analytics Methods:** Descriptive analytics, Data visualization tools and techniques, Exploratory Data Analysis (EDA), Predictive Analytics, Machine learning basics, Common algorithms (e.g., linear regression, decision trees, clustering, Deep learning overview, Neural networks, Use cases in Big Data, Stream processing concepts, Tools for real-time analytics (e.g., Apache Kafka, Apache Storm, Flink).
UNIT-4	**Big Data Security and Privacy:** Data security challenges in Big Data, Privacy-preserving techniques, Legal and ethical considerations.

Reference Books:	
1.	Nathan Marz and James Warren**,** “Big Data: Principles and Best Practices of Scalable Real-Time Data Systems"
2.	Tom White, “Hadoop: The Definitive Guide"
3.	Foster Provost and Tom Fawcett, “Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking"
4.	Martin Kleppmann,"Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems"
5.	Ian Goodfellow, Yoshua Bengio, and Aaron Courville,"Deep Learning".

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Next Generation Networks**		
Course– Code	**ITME231**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 3**		

Prerequisites:

- Computer Networks
- Internet of Things

Course Outcomes:

Students will be able to –

CO-1	To understand the concept of basic cellular system.
CO-2	To know the types of channel coding techniques, data transmission modes and services of GSM, CDMA.
CO-3	To have an insight into the various propagation models used in mobile communication.
CO-4	To study the recent trends adopted in cellular systems and wireless standards.
CO-5	To understand the concept of basic cellular system.

Course Contents:

UNIT-1	**Next Generation Network:** Principles and definition of an NGN, The NGN architecture, Outline of technology choices, Network and implementation issues with NGN, Numbering & Addressing.
UNIT-2	**The Cellular Network Concept:** System Design Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel , Soft handoff, hard handoff ,Handoff Strategies, Channel assignment strategies, Large scale path loss:-Free Space Propagation loss equation, Pathloss of NLOS and LOS systems, , Outdoor propagation model, Indoor propagation models.

UNIT-3	**UMTS Terrestrial Radio Access Network:** 2G, 2G Transition, IMT 2000, 3G transition, IMT Advance, 5G.
UNIT-4	**Transition from 3G to 4G:** Transition from 3G to 4G, Long Term Evolution, Architecture of LTE, System Architecture Evolution, Evolve Packet Core, E-UTRAN, Roaming Architecture, communication protocol
UNIT-5	**5G architecture:** 5G architecture, Propagation Channel models for 5G, Device to device communication, Software defined radio networks, 5G for Massive Machine Type Communication and Massive IoT- V2X Communication.
Reference Books:	
1.	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
2.	Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.
3.	Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
4.	Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
5.	Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
6.	R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Computer Vision**		
Course– Code	**ITME232**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 3**		

Prerequisites:

- Knowledge in Image Processing
- Coordinate Geometry
- Analysis of Algorithms
- Fundamentals of Matrix and Algebra
- Probability and Statistics is desired

Course Outcomes:

Students will be able to –

CO-1	Understand, use, design or specify basic image processing and computer vision algorithms in the context of a complete application
CO-2	Conduct independent study and analysis of image processing and computer vision problems and techniques
CO-3	Get broad exposure to understand of various applications of computer vision in industry, medicine, and defence
CO-4	Explore a range of practical techniques, by developing their own simple processing functionsby using library facilities and tools such as Matlab and Open CV
CO-5	Understand, use, design or specify basic image processing and computer vision algorithms in the context of a complete application

Course Contents:

UNIT-1	**Digital Image Formation and low-level processing:** Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing

UNIT-2	**Depth estimation and multi-camera views:** Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration, Two-view structure from motion, Object detection and tracking.
UNIT-3	**Image Descriptors and Features:** Object Recognition, Boundary and Regional Descriptors, Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters, Gray level cooccurrence matrix, local binary pattern and DWT.
UNIT-4	**Detection, Segmentation, Visualizing and understanding:** CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN, Visualizing CNN features DeepDream, Style Transfer, GAN overview, semantic image synthesis
UNIT-5	**Applications to computer vision:** Motion estimation and object tracking, medical image segmentation and classification, image fusion, visual surveillance, activity, and action recognition, person-reidentification, gesture recognition
Reference Books:	
1.	E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012.
2.	Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition, Springer 2012
3.	R.C. Gonzalez, R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education
4.	Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
5.	D. L. Baggio, Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.
6.	R C Gonzalez, Woods and Eddins, Digital Image Processing using Matlab, 2nd Edition, Tata McGraw Hill

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Cellular and Mobile Computing**		
Course– Code	**ITME233**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 3**		

Prerequisites:

- Computer Networks
- Internet of Things

Course Outcomes:

Students will be able to –

CO-1	To understand the concept of basic cellular system.
CO-2	To know the types of channel coding techniques, data transmission modes and services of GSM, CDMA.
CO-3	To have an insight into the various propagation models used in mobile communication.
CO-4	To study the recent trends adopted in cellular systems and wireless standards.
CO-5	To understand the concept of basic cellular system.

Course Contents:

UNIT-1	**Introduction to Wireless Network System:** Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Adhoc Networks, Sensor Networks, Third Generation (3G) Wireless Networks.
UNIT-2	**The Cellular Network Concept:** System Design Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel , Soft handoff, hard handoff ,Handoff Strategies, Channel assignment strategies, Large scale path loss:-Free Space Propagation loss equation, Pathloss of NLOS and LOS systems, , Outdoor propagation

	model, Indoor propagation models
UNIT-3	**Wireless LAN Introduction:** WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security, IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX
UNIT-4	**Mobile computing Data management:** Mobile computing Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations, Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.
UNIT-5	**3G And 4G Wireless Standards:** : GSM, GPRS, WCDMA, LTE, WiMax, Simulations of Wireless Networks (OPNET, NS2)
Reference Books:	
1.	Jochen Schiller, Mobile Communications, Addison Wesley.
2.	Asha Mehrotra, GSM System Engineering, Artech House Publishers.
3.	M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House Publishers.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**5G Networks**		
Course– Code	**ITME234**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 3**		

Prerequisites:

- Computer Networks
- Internet of Things

Course Outcomes:

Students will be able to –

CO-1	To understand the concept of basic cellular system and modern cellular communication.
CO-2	To understand the 5G architecture.
CO-3	To understand radio access networks, Device to Device communication.

Course Contents:

UNIT-1	**Introduction:** Introduction and fundamentals of wireless communications: evolution of cellular systemsrequirements, goals, and vision of the next generation wireless communication systems fading, digital modulations, performance metrics. 1G, 2G, 3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization -Challenges and Applications.
UNIT-2	**The 5G architecture:** Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, , Integration of LTE and new air interface to fulfil 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.
UNIT-3	**Device-to-device (D2D) communications** : D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource

	management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example, Multi-hop D2D communications for proximity and emergency, services, , Device discovery without and with network assistance.
UNIT-4	**The 5G radio-access technologies**: Multiple access technology, Orthogonal multiple-access systems, Spread spectrum multipleaccess systems, Capacity limits of multiple-access methods,), Radio access for dense deployments, OFDM numerology for small-cell deployments, Small-cell sub-frame structure, , Radio access for massive machine type communication, , Interference management in 5G, Interference management in UDN

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Wireless Sensor Networks**		
Course– Code	**IT ME235**		
Course – Periods / Week	**(L + T + P) ↔(3+ 1 + 0)**		
Course – Exam Scheme	**(TA + FE +SE+ ESE) ↔(20 + 15+ 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective - 3**		

Course Outcomes:	
Students will be able to –	
CO-1	Understand the basics of Wireless Sensor Networks, architecture, applications, issues pertaining to sensor networks and the challenges involved in managing a sensor network.
CO-2	Contribute appropriate algorithms to improve existing or to develop new wireless sensor network applications.
CO-3	Design a fault-tolerant and energy-efficient routing protocol.
CO-4	Explore and implement solutions to real world problems using sensor devices, enumerating its principles of working

Course Contents:	
UNIT-1	**Introduction to Sensor Networks :** Key definitions of sensor networks, unique constraints and challenges, advantages of sensor network, driving applications, issues in design of sensor network, sensor network architecture, data dissemination and gathering, Brief Historical Survey of Sensor Networks, and Background of Sensor Network Technology, Applications of Wireless Sensor Networks.
UNIT-2	**MAC Protocols**: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.
UNIT-3	**Routing Protocols:** Routing Protocols for Wireless Sensor Networks, Data Dissemination and Gathering, Routing Challenges and Design Issues, Network Scale and Time-Varying Characteristics, Resource Constraints, Sensor Applications Data

	Models, Routing Strategies: WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low-Energy Adaptive Clustering Hierarchy, Power-Efficient Gathering in Sensor Information Systems, Geographical Routing, Directed Diffusion.
UNIT-4	**QoS and Energy Management:** QoS and Energy Management: Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.
UNIT-5	**Localization and Introduction to Simulators:** Localization and positioning, Coverage and connectivity, Single-hop and multi-hop localization, self-configuring localization systems, sensor management. Introduction to Simulation environment-Cooja Simulator, Programming, Glomosim, Qualnet, Case study of Wireless Sensor Network applications.
Reference Books:	
1.	Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Network, John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9).
2.	Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, Wireless Sensor Network, Springer, 1st Ed. 2004 (ISBN: 978-4020-7883-5).
3.	Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.
4.	Kazem, Sohraby, Daniel Minoli, Taieb Zanti, Wireless Sensor Network: Technology, Protocols and Application, John Wiley and Sons, 1st Ed., 2007 (ISBN: 978-0-471-74300-2).

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**SOCIAL NETWORK ANALYSIS**		
Course– Code	**ITME236**		
Course – Periods / Week	**(L + T + P) ↔(3+ 1 + 0)**		
Course – Exam Scheme	**(TA + FE +SE+ ESE) ↔(20 + 15+ 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective - 3**		

Course Outcomes:	
Students will be able to –	
CO-1	Describe about the current web development and emergence of social web.
CO-2	Design modelling, aggregating and knowledge representation of semantic web.
CO-3	Summarize knowledge on extraction and analysing of social web.
CO-4	Describe Association rule mining algorithms.
CO-5	Recognize the evolution of social networks.

Course Contents:	
UNIT-1	**Introduction to Semantic Web:** Limitations of current Web, Development of Semantic Web, Emergence of the Social Web. Social Network analysis: Development of Social Network Analysis, Key concepts and measures in network analysis.
UNIT-2	**Modelling, Aggregating and Knowledge Representation**:Ontology and their role in the Semantic Web: Ontology-based knowledge Representation, Ontology

	languages for the Semantic Web, Resource Description Framework, Web Ontology Language, Modelling and aggregating social network data, State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Advanced representations.
UNIT-3	**Algorithms and Techniques:** Association Rule Mining, Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Markov models, K-Nearest Neighboring, Content-based Recommendation, Collaborative Filtering Recommendation, Social Network Analysis, Detecting Community Structure in Networks, the Evolution of Social Networks.
UNIT-4	**Extracting and Analyzing Web Social Networks:** Extracting Evolution of Web Community from a Series of Web Archive, Temporal Analysis on Semantic Graph using Three-Way Tensor, Decomposition, Analysis of Communities and Their Evolutions in Dynamic Networks.
UNIT-5	**Web Mining and Recommendation Systems:** User-based and Item-based Collaborative Filtering Recommender Systems, Hybrid User-based and Item-based Web Recommendation System, User Profiling for Web Recommendation Based on PLSA and LDA Model, Combing Long-Term Web Achieves and Logs for Web Query Recommendation.
Reference Books:	
1.	Peter Mika, "Social networks and the Semantic Web", Springer, 2007.
2.	Guandong Xu,Yanchun Zhang, and Lin Li, "Web Mining and Social Networking Techniques andApplications", First Edition Springer, 2011
3.	Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.
4.	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social InformationRetrieval and Access: Techniques for Improved User Modelling", IGI Global Snippet, 2009.
5.	Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Foundations of Information Security**		
Course– Code	**ITME241**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE +SE+ ESE) ↔(20 + 15+ 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective - 4**		

Course Outcomes:	
Students will be able to –	
CO-1	To understand the basic principles of Security.
CO-2	To understand the basic concepts of the technical components involved in implementing of the security & privacy.
CO-3	Classify and analyse different cryptographic techniques.
CO-4	Select appropriate network protocols for securing data in transit.

Course Contents:	
UNIT-1	**Introduction to Information Security and Privacy**: Review of the essential terminologies, basic concepts of security and privacy. Taxonomy of Security attacks. Introductory Topics: Historical Ciphers - Monoalphabetic and polyalphabetic ciphers. Substitution cipher, Transposition cipher.
UNIT-2	**Important Ciphers and their Working**: Stream and block ciphers, modern block cipher, block ciphers principles, shannon's theory of confusion and diffusion, fiestal structure, data encryption standard, strength of DES, block cipher modes of operations, triple DES. Overview of number theory concepts for cryptography, Modern Cryptography: Symmetric vs. asymmetric cryptography, Encryption algorithms: AES, RSA
UNIT-3	**Cryptographic Tools:** The Public-Key-Infrastructure (PKI), Digital Signatures, Digital Certificates, Hybrid Cryptographic Systems, Steganography. The Public Key

	Cryptography (PKC) limitations and looking beyond the PKC. Authentication protocols: Kerberos, OAuth Cryptographic hash functions
UNIT-4	**Protocols for Secure Communications**: HTTPS, SSL/ TLS for Secure Internet Communication, Secure Email, WEP and WPA for Secure Wireless Communications.
UNIT-5	Firewalls, Virtual Private Networks. Intrusion Detection and Prevention Systems. Access control models and mechanisms. Emerging Trends and Practical Applications: Homomorphic encryption, Secure multi-party computation, Blockchain and Cryptocurrency.
Reference Books:	
1.	Bernard Menezes, Network Security and Cryptography, Cengage Learning, fifth edition, 2010.
2.	Behrouz A. Frouzan, Cryptography and Network Security, TMH Publication, third edition,
3.	Whitman and Mattord, *Principles of Information Security*, Cengage Learning, 2006
4.	William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI, 4th ed, 2006.
5.	Atul Kahate, Cryptography and Network Security, TMH, third edition, 2008.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**High Performance Computing**		
Course– Code	**IT ME242**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective - 4**		

Course Contents:

UNIT-1	**Introduction to Parallel Programming** Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD and MIMD architectures, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling. Overview of the MPI standard. Point-to-point communication operations. Synchronous and asynchronous modes of data transmission. Case studies: matrix computations, solving partial differential equations using OpenMP and MPI.
UNIT-2	**Introduction to Parallel Algorithms**: Basic Parallel Algorithmic Techniques: Divide-and-Conquer, Partitioning, pipelining, Accelerated Cascading, Symmetry Breaking, Synchronization (Locked, Lock-free) Parallel Algorithms and Data organization for shared/distributed memory, Min/Max, Sum Searching, Merging, Sorting, Various Parallel Sorting and Sorting Networks, Multiprocessor architecture: taxonomy of parallel architectures. Centralized shared-memory architecture, Distributed shared-memory architecture, Non von Neumann architectures.
UNIT-3	**Introduction to High Performance Computing:** Fundamental limitations in HPC: bandwidth, latency and latency hiding techniques; Benchmarking HPC: scientific, engineering, commercial applications and workloads; Scalable storage systems: RAID, SSD cache, SAS, SAN; HPC based on cluster, cloud, and grid computing: economic model, infrastructure, platform, computation as service; Accelerated HPC: architecture, programming and typical accelerated system with GPU, FPGA, Xeon Phi,

	Cell BE; Power-aware HPC Design: computing and communication, processing, memory design, interconnect design, power management.
UNIT-4	**High Speed Networks & Message Passing:**Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster.
UNIT-5	**Introduction toCUDA Programming:** Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory, Hybrid parallel programming models (MPI + OpenMP, MPI + CUDA, etc.). Case studies of exascale computing applications.
Reference Books:	
1.	Jean Loup Baer, Microprocessor Architecture, Cambridge University Press (2009).
2.	P. S. Pacheco, An Introduction to Parallel Programming, Elsevier (2011).
3.	M. Quinn, Parallel Programming in C and OpenMP, McCraw Hill Education (India) (2003).
4.	A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to Parallel Computing, Pearson (2007).
5.	J. Joseph & C. Fellenstien, Grid Computing, Pearson Education (2004).
6.	John L. Hennessy and David A. Patterson. Computer Architecture: A Quantitative Approach . Elsevier India Pvt. Ltd. (2010).
7.	Georg Hager and Gerhard Wellein. Introduction to High Performance Computing for Scientists and Engineers, CRC Press (2011).
8.	G. Zaccone. Python Parallel Programming Cookbook, Packt Publ. (2015).
9.	Milos Prvulovic, HPCA Course, Georgia Tech. https://www.udacity.com/course/high-performance-computer-architecture--ud007
10.	D. A. Patterson and J. L. Hennessy, Computer Organization and Design 4th Ed, Elsevier Science (2009).
11.	Berhooz Parhami, Computer Architecture, Oxford University Press (2005).

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Agile Software Development**		
Course– Code	**ITME245**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective - 4**		

Course Outcomes:	
Students will be able to –	
CO-1	Interpret the concept of agile software engineering and its advantages in software development.
CO-2	Analyse the core practices behind several specific agile methodologies.
CO-3	Access implications of functional testing, unit testing, and continuous integration.
CO-4	Determine the role of design principles in agile software design.
CO-5	Make use of various tools available to agile teams to facilitate the project
Prerequisites:	Software Engineering fundamentals
Course Contents:	
UNIT-1	**Fundamentals of Agile:**Need of Agile software development, agile context– Manifesto, Principles, Methods, Values, Roles, Artifacts, Stakeholders, and Challenges. Business benefits of software agility.
UNIT-2	**Planning and Design:** Recognizing the structure of an agile team– Programmers, Managers, Customers. User stories– Definition, Characteristics and content. Estimation– Planning poker, Prioritizing, and selecting user stories with the customer, projecting team velocity for releases and iterations. **Project Design:** Fundamentals, Design principles–Single responsibility, Open-

	closed, Liskov substitution, Dependency-inversion, Interface-segregation.
UNIT-3	**Sensors, Actuators & Controls**: Sensor classifications, Characteristics of Sensors, Various Internal and External Sensors. Characteristics of Actuators, Pneumatic, Hydraulic and Electrical Actuators. Transfer Function, Sequence Control, Servo motor operation and control, PID Controller Design, Regulation of Robotic Manipulators, Intelligent Control.
UNIT-4	Design Methodologies: Need of scrum, Scrum practices –Working of scrum, Project velocity, Burn down chart, Sprint backlog, Sprint planning and retrospective, Daily scrum, Scrum roles– Product Owner, Scrum Master, Scrum Team. Extreme Programming- Core principles, values and practices. Kanban, Feature-driven development, Lean software development.
TextBooks:	
1.	Ken Schawber, Mike Beedle, "Agile Software Development with Scrum", International Edition, Pearson.
2.	Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", First International Edition, Prentice Hall.
3.	Lisa Crispin, Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", International edition, Addison Wesley.
4.	Alistair Cockburn, "Agile Software Development: The Cooperative Game", 2nd Edition, Addison-Wesley
5.	Anis Koubaa et. al., Robot Path Planning and Cooperation Foundations, Algorithms and Experimentations, Springer Cham, 2018.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Cloud and IoT Security**		
Course– Code	**IT ME246**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 4**		

Course Contents:

UNIT-1	**Fundamentals of Cloud Computing and Deployment Models:** Fundamentals of Cloud Computing: Introduction to cloud computing, Architectural characteristics of cloud computing, Cloud Deployment Models: Public Cloud, Private Cloud, Community Cloud, Hybrid Cloud, Scope of control in different models, Cloud Service Models: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Cloud Computing Roles and Risks : Roles in cloud computing, Security risks and mitigation
UNIT-2	**Cloud Security and IoT Security:** Cloud security models and frameworks, Secure cloud infrastructure design, Identity and access management in the cloud, Encryption and key management for cloud data, Monitoring and logging in cloud environments, Compliance and regulatory requirements for cloud services. IoT security architecture and design principles, Secure IoT device lifecycle management, Secure communication protocols for IoT, Embedded systems security for IoT devices, IoT network security and segmentation, IoT data security and privacy

UNIT-3	**Secure Software Development:** Secure coding principles and techniques, Application security testing and vulnerability assessment, Secure DevOps and DevSecOps practices, Threat modeling and risk assessment, Secure software design patterns, Secure coding for cloud and IoT platformsCyber risk assessment and management frameworks, Threat intelligence and risk modeling, Incident response and disaster recovery planning, Compliance and regulatory requirements, Cybersecurity insurance and risk transfer, Organizational cybersecurity governance
UNIT-4	**IoT Communication with Cloud and Security:** IoT to Cloud Communication Protocols: Overview of communication protocols used in IoT systems to connect with cloud services, Comparison of protocols such as MQTT, CoAP, and HTTP/HTTPS in terms of efficiency and security.Secure Data Transmission: Encryption techniques (e.g., AES, RSA) used to secure data transmitted between IoT devices and the cloud., Importance of end-to-end encryption and key management practices in ensuring data confidentiality. Authentication and Authorization: Methods for authenticating IoT devices to cloud platforms., Role-based access control (RBAC) and policy management to enforce authorized access to IoT data.Data Integrity and Validation: Techniques for ensuring the integrity of data transmitted over IoT networks, Validation mechanisms to detect and mitigate data tampering or corruption.,
UNIT-5	**Advanced IoT Security and Networking:** device/user authentication, IoT networking protocols, and real-time communication security.Introduction to authentication techniques for IoT devices, securing lower and higher layers of IoT communication, and ensuring data trustworthiness and bandwidth efficiency.Case Study: IoT Solutions with Rubber Pie and Arduino. Rubbery Pie, a fictional IoT device, integrates sensors and actuators to monitor and control industrial processes. Arduino-based IoT systems are widely used in various applications, from smart home automation to environmental monitoring.
Reference Books:	
1.	Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi**, Mastering Cloud Computing: Foundations and Applications Programming,Morgan Kaufmann, 2013**
2.	Tim Mather, Subra Kumaraswamy, and Shahed Latif, **Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance,** O'Reilly Media,2009
3.	John R. Vacca**, Cloud Computing Security: Foundations and Challenges,** CRC Press, **2016**
4.	B. Russell and D. Van Duren, Practical Internet of Things Security, Packt Publishing, 2016.
5.	FeiHU, Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and

	Implementations, CRC Press, 2016.
6.	Narayanan et al., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
7.	David B. Davenport, Hong Lin, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for Internet of Things" Publisher: Cisco Press 2017

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Advanced Optimization Technique**		
Course– Code	**ITMC202**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**3**		
Course – Type	**Core**		

Prerequisites:

- Undergraduate mathematics: Theory of sets
- Relations and functions
- Linear algebra
- Logic and proof techniques
- Basic knowledge of computer programming

Course Outcomes:

Students will be able to –

CO-1	To cultivate an ability to formulate mathematical model for various complex system occurring in real world applications.
CO-2	To develop knowledge of the mathematical structure of the most commonly used linear and non-linear programming models.
CO-3	To understand the classical optimizations and its applications.
CO-4	Understand the fundamental concepts of meta-heuristics and distinguish between various categories of meta-heuristic optimization techniques.
CO-5	Apply swarm-based, bio-inspired, and nature-inspired optimization techniques to real-world engineering and scientific challenges.
UNIT-1	**Basics of Optimization:** Mathematical formulation (linear and non-linear); Engineering applications of optimization; Classification of optimization problems. Classical optimization (single and multi variable): Optimal criterion for single and multi-variable method; Region elimination methods; Gradient based methods for single variable; Unidirectional search, Direct search methods, Gradient based methods for multi-variable.
UNIT-2	**Constraint Optimization:** problem preparation, Kuhn-Tucker Conditions, Lagrangian Duality Theory, Transformation Methods- Penalty Function Method, Method of Multipliers ; Sensitivity Analysis; Direct Search for Constrained

	Minimization; Linearization methods for constraint problems; Feasible Direction Method; Generalized Reduced Gradient Method and Gradient Projection Method.
UNIT-3	**Goal Programming:** Concept of goal programming, Modeling Multiple objective problems, Goal programming model formulation (Single goal with multiple sub goals, equally ranked multiple goals, Priority ranked goals, General goal programming models), Graphical method of goal programming, Post optimal analysis. 6L Stochastic Programming: Stochastic programming with one objective function. Stochastic linear programming. Two stage programming technique. Chance constrained programming technique. Geometric Programming: Posynomial; Unconstrained GPP using differential Calculus; Unconstrained GPP using Arithmetic – Geometric Inequality; Constrained GPP
UNIT-4	**Metaheuristics Optimization-I** - Introduction to Meta-Heuristics Optimization, Categories of Meta-Heuristic Algorithms, Evolutionary-based Optimization Techniques- Genetic Algorithm (GA), Evolutionary Strategies (ES), Differential Evolution (DE), Working mechanism and applications Case studies of evolutionary algorithms in real-world problems, Swarm-based Optimization Techniques- Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Artificial Bee Colony (ABC)
UNIT-5	**Metaheuristics Optimization-II** - Physics-Based Optimization Techniques-Simulated Annealing (SA), Gravitational Search Algorithm (GSA), Electromagnetism-like Algorithm (EM), Physics-inspired algorithms and real-world examples, Bio-Inspired Optimization Techniques-Grey Wolf Optimizer (GWO), Firefly Algorithm (FA), Cuckoo Search Algorithm (CSA), Nature-Inspired Optimization Techniques-Harmony Search (HS), Flower Pollination Algorithm (FPA), Bat Algorithm (BA), Comparative Analysis of Meta-Heuristic Techniques, ractical Aspects of Optimization

Reference Books:

1.	S. S. Rao, Engineering Optimization: Theory and Practice, New Age International.
2.	K. Deb, Optimization for Engineering Design, Prentice Hall of India.
3.	A. Ravindran, K. M. Ragsdell and G. V. Reklaitis, Engineering Optimization: Methods and Applications, Wiley.
4.	Metaheuristics - From Design to Implementation: 74 (Wiley Series on Parallel and Distributed Computing)
5.	Swarm Intelligence: From Natural to Artificial Systems Eric Bonabeau, Marco Dorigo, Guy Theraulaz

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Information Retrieval System**		
Course– Code	**IT ME252**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 5**		

Prerequisites:

- Probability and Statistics
- Programming

Course Outcomes:

Students will be able to –

CO-1	An in-depth understanding of how unstructured texts are processed, indexed, and queried to meet users' information needs.
CO-2	Understanding of different methods for clustering and classifying documents to enhance the efficiency of the retrieval system.
CO-3	Understand the basic concepts of the information retrieval.
CO-4	Understand data pre-processing, indexing, retrieval methods and concepts.
CO-5	Understand how to evaluate the effectiveness and efficiency of different information retrieval.

UNIT-1	**Introduction**:History of IR, Components of IR, Issues, Open source Search engine Frameworks. The impact of the web on IR, role ofartificial intelligence (AI) in IR, IR Versus Web Search, Components of a Search engine. Basic Text Processing: Tokenization, Stopwords, Stemming, Lemmatization, Zipf's and Heap's law, Spelling correction and Edit distances: Hamming distance, Longest common Subsequence, Levenstein edit distance, Boolean Retrieval Model
UNIT-2	**Information Retrieval-I:** Basic Ranking and Evaluation Measures- Vector Space Model, TF*IDF, IR Evaluation: Precision, Recall, F-measures, Mean Reciprocal Rank (MRR), Mean Average Precision (MAP), Normalized Discounted Cumulative Gain (NDCG), designing test collection, relevance judgments, Probabilistic Retrieval Model-Introduction: Generative Model, Probabilistic Ranking Principle, Binary Independence Model, Okapi 25, Bayesian Networks for IR, Statistical Language

	Model-Basics of Language Model, Query-likelihood Approach and different Smoothing Methods, Advance Query Type: Query expansion, Relevance feedback, Novelty & Diversity
UNIT-3	**Information Retrieval-II**: Topic Model- Introduction to topic model, Latent Semantic Indexing, Probabilistic Latent Semantic Indexing, Latent Dirichlet Allocation, Topic model for IR, Link Analysis-Introduction: World Wide Web as Graph, PageRank, HITS, Topic-specific and Personalized PageRank, Indexing and Searching- Different Compression Methods: Ziv-Lempel, Variable-Byte, Gamma, Golomb, Gap encoding, Query Processing: TAAT, DAAT, WAND, Fagin's algorithm, Near Duplicate Detection: Shingling, Min-wise independent permutations, locality sensitive hashing
UNIT-4	**Information Retrieval and Web Search Engine:** Retrieval using unsupervised techniques- Retrieval using word-embeddings and clustering, Retrieval using Supervised ML- Introduction to Learning to Rank for retrieval, Retrieval using classification. Introduction and Crawling,Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement, search engine optimization/spam, Web Search Architectures, crawling, meta-crawlers, Focused Crawling, web indexes, Near-duplicate detection, Index Compression, XMLretrieval.
UNIT-5	**Web Search and Specialized Search:**Similarity, Hadoop & Map Reduce - Evaluation, Personalized search, Collaborative filtering and content-based recommendation of documents and products, handling "invisible" Web Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval.
Reference Books:	
1.	Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze. Introduction to Information Retrieval, Cambridge University Press, 2008. ISBN-13: 978-0521865715 ebook
2.	Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack. Information Retrieval: Implementing and Evaluating Search Engines, MIT Press, ISBN-13: 978-0262026512.
3.	David A. Grossman and OphirFrieder "Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series", 2nd Edition, Springer, 2004.
4.	Jure Leskovec, Anand Rajaraman , Jeffrey D. Ullman. Mining of Massive Datasets, Cambridge University Press, 2011. ISBN: 978-1107077232.
5.	Larry Wasserman. All of Statistics, Springer, 2004. ISBN-13: 978-0387402727

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Digital and Cyber Forensics**		
Course– Code	**ITME253**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 5**		

Prerequisites:

- Operating System
- Data Structures

Course Outcomes:

Students will be able to –

CO-1	To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
CO-2	To understand how to examine digital evidences such as the data acquisition, identification analysis.
CO-3	To understand the basics of mobile phone forensics.
CO-4	To understand the network based cyber security intrusion detection.
CO-5	To know the various forensics tool

Course Contents:

UNIT-1	**Course Introduction:** Introduction to Cyber Forensics, Digital Forensics, Types of Digital Forensics, Forensics Investigation Process,Forensic Protocol for Evidence Acquisition, Digital Forensics Standards and Guidelines
UNIT-2	**Windows Forensic Analysis:** Window artifacts, Evidence volatility, System time, Logged on user(s), Open files, MRUs, Network information, Process information, Service information, Windows Registry, Startup tasks, Memory dumping; Document Forensics: PDF structure, PDF analysis, MSOffice Document structure and analysis, Macros, Windows thumbnails, Android Thumbnails

UNIT-3	**Network Forensics:** Introduction to Network Forensics, Capturing Network Traffic: DHCP Logs, tcpdump/WinDump,Wireshark, SPAN Ports or TAPS, Network-Based Forensics: IDS Overview,Snort Architecture, Snort Preprocessor Component, Snort Detection Engine Component, Network Forensics Evidence Generated with Snort. NetFlow, Using Flow Analytics to Identify Threats within NetFlow, Network Forensic Artifacts, ICMP Attacks, ICMP Sweep Attack, Traceroute Attack, Inverse Mapping Attack, ICMP Smurf Attack.
UNIT-4	**Mobile Network Forensic:** Introduction, Mobile Network Technology, Investigations, Collecting Evidence, Where to seek Digital Data for further Investigations, Interpretation of Digital Evidence on Mobile Network.**Mobile Forensics:** SIM Card, Android architecture, Android File System, Android application, Android SDK, Android Debug Bridge, Memory & SIM acquisition; Virtual Machines, Network Forensics; Cybercrime investigation: Pre investigation, SOP for Investigation; Case scenarios: social media crime, Online defacement crime, Email investigation; CDR Analysis
UNIT-5	**Cloud Forensics:** Introduction to Cloud Forensics, Server-Side Forensics, Client-Side Forensics, Challenges in Cloud Forensics, Artifacts in Cloud Forensics, Use of Cloud Forensics, Forensics as a Service (FaaS), Case Study: Google Drive Investigation, Case Study: Dropbox Investigation, WhatsApp Forensics,Case Study: WhatsApp Database Extraction
Reference Books:	
1.	Kävrestad, Joakim, Marcus Birath, and Nathan L. Clarke. "Fundamentals of Digital Forensics-A Guide to Theory, Research and Applications." *Texts in Computer Science* (2024): 3-267.
2.	Reddy, Niranjan. *Practical cyber forensics*. Apress, 2019.
3.	Lillard, Terrence V. *Digital forensics for network, Internet, and cloud computing: a forensic evidence guide for moving targets and data*. Syngress Publishing, 2010.
4.	Enfinger, Frank, Amelia Phillips, Bill Nelson, and Christopher Steuart. "Guide to computer forensics and investigations." *Boston: Thomson Course Technology* (2005).
5.	Brown, Christopher LT., *"Computer evidence: Collection and preservation",* Charles River Media, Inc., 2009.
6.	Vacca, John R. *Computer forensics: computer crime scene investigation*. Charles River Media, Inc., 2002.
7.	Bunting, Steve and William Wei. EnCase Computer Forensics: The Official EnCE: EnCaseCertifed Examiner Study Guide. Sybex,
8.	Prosise, Chris, Kevin Mandia, and Matt Pepe. *Incident response & computer forensics*. McGraw-Hill, Inc., 2003.
9.	Carrier, Brian. *File system forensic analysis*. Addison-Wesley Professional, 2005.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Quantum Machine Learning**		
Course– Code	**ITME254**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 5**		

Prerequisites:

- Quantum Computing and Algorithms
- Classical Machine Learning
- Quantum Programming Skills

Course Outcomes:

Students will be able to –

CO-1	Correlatelearned quantum computing principles with machine learning techniques.
CO-2	Analyze key quantum algorithms to solve machine learning problems effectively.
CO-3	Design quantum machine learning models, integrating classical machine learning techniques with quantum computing frameworks.
CO-4	Implement and evaluate the performance of quantum machine learning algorithms,with classical and other quantum algorithms, based onvarious performance factors.
CO-5	Investigate quantum algorithms as effective solutions to solve real-world problems in diversified domains of computational science and technology.

Course Contents:

UNIT-1	**Course Introduction:**Introduction and Overview, Basics of Quantum Computing, Basics of Machine Learning and Algorithms Revision, Quantum-Classical Models.
UNIT-2	**Quantum Structures for Machine Learning:**Foundation for Building Quantum Machine Learning Framework, Quantum Algorithmic Design Strategies Revisited, Basic Concepts of Designing Quantum-Based Machine Learning Algorithms.
UNIT-3	**QuantumMachine Learning Algorithms:**Quantum Regression, Classification, and Clustering Algorithms, Quantum Decision Trees (QDTs), Quantum Support Vector Machines (QSVM), Quantum K-Means, Quantum Principal Component Analysis (QPCA), Quantum Naïve Bayes (QNB), Quantum Pattern Recognition (QPR), Adiabatic Quantum Computing, Variational Quantum Eigen-solver (VQE).

UNIT-4	**Quantum Algorithmic Realization:** Quantum Programming using QuEST, Quirk and IBM Qiskit, Hands-on with **TensorFlow Quantum** (TFQ) Library, Quantum Circuit Development and Realization of Quantum Machine Learning Algorithms.
UNIT-5	**Recent Research Progress:** Significant Research and Development of Quantum Computing in Computer Science, Quantum-Based Machine Learning Applications in Cryptography and Security, Optimization Problems,Bio-Medical Informatics, Healthcare, Data Science and Analytics, Natural Language Processing and etc.
Reference Books:	
1.	Michael A. Nielsen & Isaac L. Chuang,***Quantum Computation and Quantum Information***, 10th Anniversary Edition – 2010, Cambridge University Press.
2.	Peter Wittek, ***Quantum Machine Learning – What Quantum Computing Means to Data Mining***, I Edition – 2014, Elsevier Publication.
3.	Xavier Vasques, ***Machine Learning Theory and Applications: Hands-on Use Cases with Python on Classical and Quantum Machines*****,** First Edition – 2024, Wiley & Sons Publications.
4.	Elias F. Combarro, ***A Practical Guide toQuantum Machine Learningand Quantum Optimization: Hands-on Approach to Modern QuantumAlgorithm*****,** First Edition – 2023, Packt Publishing Ltd.
5.	Dr. Frank Zickert, ***Hands-on Quantum Machine Learning with Python***, First Edition Volume 1 – 2021, PYQML Publication.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Text mining**		
Course– Code	**ITME255**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 5**		

Prerequisites:

- Data Mining
- Machine Learning

Course Outcomes:

Students will be able to –

CO-1	Understand the basic concepts of text mining.
CO-2	Understand various text categorization and clustering techniques.
CO-3	Understand various topic modeling techniques and its application.
CO-4	Understand concept of document summarization.

Course Contents:

UNIT-1	**Introduction:** Overview, Problem Types, Text vs. Data Mining, Fundamental concepts Natural language processing: Part-of-speech tagging, chunking, syntax parsing and named entity recognition, Document representation: Vector Space Model.
UNIT-2	**Text Categorization:** Basic supervised text categorization algorithms: Decision Tree, Rule-based classifiers Naive Bayes, kNearest Neighbor (kNN) and Logistic Regression,
UNIT-3	**Text Clustering:** connectivity-based clustering and centroid-based clustering algorithms.
UNIT-4	**Topic modelling:** General idea of topic modeling, two basic topic models: ProbabilisticLatent Semantic Indexing (pLSI) and Latent Dirichlet Allocation (LDA), and their variants fordifferent application scenarios, including classification, collaborative filtering, and hierarchicaltopical structure modeling.
UNIT-5	**Document summarization and Sentiment Analysis**

	Document summarization: Extractive and Abstractive summarization. Sentiment Analysis: Coarse-grained and Fine-grained analysis, Machine Learning for Sentiment Analysis. Opinion mining, Opinion lexicon expansion, Text mining applications and case studies.
Reference Books:	
1.	Mining Text Data. Charu C. Aggarwal and ChengXiangZhai, Springer, 2012.
2.	Speech & Language Processing. Dan Jurafsky and James H Martin, Pearson Education India,2000.
3.	Introduction to Information Retrieval. Christopher D. Manning, PrabhakarRaghavan, and HinrichSchuetze, Cambridge University Press, 2007.
4.	Sholom Weiss, Nitin Indurkhya, Tong Zhang, Fred Damerau "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Springer, paperback 2010.
5.	Ronen Feldman, James Sanger -"The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data"-Cambridge University press, 2006.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	**Pattern Recognition**		
Course– Code	**IT ME256**		
Course – Periods / Week	**(L + T + P) ↔(3 + 1 + 0)**		
Course – Exam Scheme	**(TA + FE + SE + ESE) ↔(20 + 15 + 15 + 100)**		
Course – Total Marks	**150**		
Course – Credits	**4**		
Course – Type	**Elective – 5**		

Prerequisites:

- Basics of Probability
- DBMS

Course Outcomes:

Students will be able to –

CO-1	Understand the basic of pattern recognition.
CO-2	Understand various dimensionality reduction techniques.
CO-3	Understand various Supervised Learning techniques.
CO-4	Understand various Unsupervised Learning techniques.

Course Contents:

UNIT-1	**Introduction:** Definitions, data sets for Pattern Recognition, Structure of a typical pattern recognition system. Learning paradigms, Supervised and unsupervised learning, Bayesian decision theory: Minimum error rate classifier; Parameter estimation: Maximum likelihood.
UNIT-2	**Dimensionality Reduction Techniques:** Feature vectors, Feature spaces, Feature selection: class separability measures, Feature Selection Algorithms: Branch and bound algorithm, sequential forward / backward selection algorithms, Features extraction: Principal Component Analysis. Fisher linear discriminate.
UNIT-3	**Pattern Classification:** Naive Bayes classifier, Non-parametric techniques for density

	estimation, Parzen windows, K-nearest neighbours, Hidden Markov models. Perceptron, Support vector machines; Generalization ability of learning methods: Bias and variance, Regularization.
UNIT-4	**Pattern Clustering:** Similarity/dissimilarity measures; clustering criteria, K-means clustering, DBSCAN.
UNIT-5	**Ensemble Techniques:** Bootstrapping, Boosting, Bagging.
Reference Books:	
1.	C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
2.	R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
3.	S. Theodoridis and K. Koutroumbas, Pattern Recognition, Academic Press, 2009
4.	E. Alpaydin, Introduction to Machine Learning, Prentice-Hall of India, 2010.
5.	G. James, D. Witten, T. Hastie and R. Tibshirani, Introduction to Statistical Learning, Springer, 2013.