



National Institute of Technology Raipur

(An Institute of National Importance)

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Department of Information Technology

MTech (IT) SEMESTER: II

S.No.	Sub. Code	Subject Name	Periods/week			Examination Scheme			Total Marks	Credits
			L	T	P	TA	MSE	ESE		
1	IT312101IT	Internet of Things	3	0	0	20	30	100	150	3
2	IT312102IT	Big Data analytics	3	0	0	20	30	100	150	3
3	IT312103IT	Foundations of Information Security	3	0	0	20	30	100	150	3
4	IT3122XXIT	Elective-3	3	0	0	20	30	100	150	3
5	IT3122XXIT	Elective-4	3	0	0	20	30	100	150	3
6	IT312401IT	Lab 3 (IoT Lab)	0	0	4	25	25	50	100	2
7	IT312401IT	Lab 4 (Big Data Analytics Lab)	0	0	4	25	25	50	100	2
8	IT312601IT	Seminar	0	0	3	-	-	50	50	1
			15	0	11	150	200	650	1000	20

S.No.	Elective-3	S.No.	Elective-4
01	Next Generation Network	07	Advanced Optimization Technique
02	Computer Vision	08	Information Retrieval System
03	Cellular and Mobile Computing	09	Computing with Spatial Trajectories
04	5G Networks	10	Quantum Machine Learning
05	Wireless sensor networks	11	Text Mining
06	Social network analysis	12	Pattern Recognition

Name of Program	M. Tech.	Semester – II	Year – I
Course – Name	Internet of Things		
Course – Code	IT312101IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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 Raspberry 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, — <i>IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things</i> , Cisco Press, 2017
2.	Arshdeep Bahga, Vijay Madisetti, <i>Internet of Things – A hands-on approach</i> , Universities Press, 2015
3.	Olivier Hersent, David Boswarthick, Omar Elloumi, <i>The Internet of Things – Key applications and Protocols</i> , Wiley, 2012
4.	Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David
5.	Boyle, “ <i>From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence</i> ”, Elsevier, 2014.
6.	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), — <i>Architecting the Internet of Things</i> , Springer, 2011.
7.	Michael Margolis, Arduino Cookbook, <i>Recipes to Begin, Expand, and Enhance Your Projects</i> , 2 nd Edition, O'Reilly Media, 2011.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	Big Data Analytics		
Course– Code	IT312102IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Core		
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 FrameworksApache 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		Foundations of Information Security		
Course– Code		IT312103IT		
Course – Periods / Week		(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme		(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks		150		
Course – Credits		3		
Course – Type		Core		
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, <i>Principles of Information Security</i> , 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	Next Generation Networks		
Course– Code	IT312201IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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	IT312202IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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 functions by 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	IT312203IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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	IT312204IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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 systems requirements, 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 multiple-access 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.
Reference Books:	
1.	Afif Osseiran, Jose F Monserrat, Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.
2.	Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, CRC Press, Taylor & Francis Group, First Edition, 2018.
3.	Harri Holma, Antti Toskala, Takehiro Nakamura, “5G Technology 3GPP NEW RADIO”, John Wiley & Sons First Edition, 2020.
4.	Gordon L. Stuber, “Principles of Mobile Communication”, KLUWER ACADEMIC PUBLISHERS, 2nd Edition, 2002.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	Wireless Sensor Networks		
Course– Code	IT312205IT		
Course – Periods / Week	(L + T + P) ↔(3+ 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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	IT312206IT		
Course – Periods / Week	(L + T + P) ↔(3+ 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
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, Combining 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 and Applications”, 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 Information Retrieval 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	Advanced Optimization Technique		
Course– Code	IT312207IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Elective - 4		
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	IT312208IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Elective – 4		
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 of artificial intelligence (AI) in IR, IR Versus Web Search, Components of a Search engine. Basic Text Processing: Tokenization, stop words, 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 Ophir Frieder "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	Computing with Spatial Trajectories		
Course– Code	IT312209IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Elective – 4		
Prerequisites:			
• Data Structures and Algorithms, • Database Systems, • Machine Learning (Intro or Applied ML), • Data Mining.			
Course Outcomes:			
Students will be able to –			
CO-1	Understand foundational concepts of spatial trajectories, their characteristics, and data acquisition models.		
CO-2	Apply preprocessing and cleaning techniques to real trajectory datasets.		
CO-3	Analyze and compute similarity/distance measures between trajectories and segments.		
CO-4	Implement trajectory mining algorithms including clustering, classification, and pattern discovery.		
CO-5	Design applications using trajectory-based knowledge in domains like mobility prediction, traffic management, and social computing.		
CO-6	Evaluate advanced techniques including semantic trajectories, trajectory embedding, and privacy-aware models.		
Course Contents:			
UNIT-1	Introduction to Spatial Trajectories: Trajectory Data: Definition, Components, Spatio-temporal Points; Types of Trajectories: Raw, Semantic, Network-based; Data Acquisition: GPS, sensors, mobile devices, check-ins, logs; Trajectory Data Management: Storage models, indexing, query types; Challenges: Uncertainty, noise, sampling issues, sparsity;		

	Real-world applications: Transportation systems, urban computing, human mobility modelling.
UNIT-2	Trajectory Preprocessing and Understanding: Data Cleaning & Preprocessing: Noise removal, calibration, synchronization, Stay point detection, Map matching; Trajectory Compression Techniques: Line simplification, partition-and-group framework; Segmentation of Trajectories: Semantic segmentation, Time-based vs. behavior-based segmentation; Feature Extraction from Spatial Trajectories.
UNIT-3	Similarity Computation & Distance Measures: Similarity Measures: Euclidean, DTW (Dynamic Time Warping), LCSS (Longest Common Subsequence), Fréchet distance, Trajectory Pattern Discovery Basics, Sampling, Alignment, and Matching Strategies, Trajectory Outlier Detection, Index Structures for Efficient Similarity Search.
UNIT-4	Trajectory Pattern Mining & Knowledge Discovery: Clustering Trajectories: Partition-and-Group Framework, Density-based & hierarchical models; Frequent Pattern Mining: Sequential patterns, Periodicity detection; Classification of Semantic Trajectories; Predictive Modelling: Next-location prediction, Mobility pattern discovery; Social and Urban Mobility Analysis.
UNIT-5	Advanced Topics & Applications in Spatial Trajectory Computing: Semantic Trajectories & Annotations; Trajectory Embedding and Representation Learning; Deep Learning for Trajectory Mining: RNN, LSTM, GRU approaches, Transformers for trajectory prediction Privacy-preserving trajectory data publishing; Big Trajectory Data Analytics & Urban Computing Systems; Case Studies: Intelligent transportation, Ride-sharing services analytics, Smart city planning & crowd flow prediction.
Reference Books:	
1.	Computing with Spatial Trajectories — Yu Zheng & Xiaofang Zhou (Eds.)
2.	Big Trajectory Data Mining: A Survey of Methods, Applications and Services — D. Wang
3.	Trajectory data mining: A review of methods and applications — J.D. Mazimpaka et al., 2016
4.	Classifying spatial trajectories using representation learning — Y. Endo et al., 2016

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	Quantum Machine Learning		
Course– Code	IT312210IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Elective – 4		
Prerequisites:			
• Quantum Computing and Algorithms • Classical Machine Learning • Quantum Programming Skills			
Course Outcomes:			
Students will be able to –			
CO-1	Correlate learned 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 on various 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	Quantum Machine 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, <i>Quantum Computation and Quantum Information</i> , 10 th Anniversary Edition – 2010, Cambridge University Press.
2.	Peter Wittek, <i>Quantum Machine Learning – What Quantum Computing Means to Data Mining</i> , I Edition – 2014, Elsevier Publication.
3.	Xavier Vasques, <i>Machine Learning Theory and Applications: Hands-on Use Cases with Python on Classical and Quantum Machines</i> , First Edition – 2024, Wiley & Sons Publications.
4.	Elias F. Combarro, <i>A Practical Guide to Quantum Machine Learning and Quantum Optimization: Hands-on Approach to Modern Quantum Algorithm</i> , First Edition – 2023, Packt Publishing Ltd.
5.	Dr. Frank Zickert, <i>Hands-on Quantum Machine Learning with Python</i> , First Edition Volume 1 – 2021, PYQML Publication.

Name of Program	M. Tech.	Semester – II	Year – I
Course– Name	Text Mining		
Course– Code	IT312211IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Elective – 4		
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: Probabilistic Latent Semantic Indexing (pLSI) and Latent Dirichlet Allocation (LDA), and their variants for different application scenarios, including classification, collaborative filtering, and hierarchical topical 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 Indurkha, 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	IT312212IT		
Course – Periods / Week	(L + T + P) ↔(3 + 0 + 0)		
Course – Exam Scheme	(TA + MSE + ESE) ↔(20 + 30 + 100)		
Course – Total Marks	150		
Course – Credits	3		
Course – Type	Elective – 4		
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.