

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in CSE (INTERNET OF THINGS)
III & IV YEAR COURSE STRUCTURE & TENTATIVE SYLLABUS (R18)

Applicable From 2020-21 Admitted Batch

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Finite Automata and Compiler Design	3	0	0	3
2		Microprocessors & Microcontrollers	3	0	0	3
3		Computer Networks	3	0	0	3
4		Database Management Systems	3	0	0	3
5		Professional Elective - I	3	0	0	3
6		Professional Elective - II	3	0	0	3
7		Database Management Systems Lab	0	0	3	1.5
8		Microprocessors & Microcontrollers Lab	0	0	3	1.5
9		Advanced Communication Skills Lab	0	0	2	1
10		Intellectual Property Rights	3	0	0	0
		Total Credits	21	0	8	22

III YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		IoT Communication Protocols	3	1	0	4
2		Computer Vision and Robotics	3	1	0	4
3		Programming Languages for IoT	3	1	0	4
4		Professional Elective – III	3	0	0	3
5		Open Elective - I	3	0	0	3
6		IoT lab	0	0	3	1.5
7		Professional Elective - III Lab	0	0	3	1.5
8		Computer Vision Lab	0	0	2	1
9		Environmental Science	3	0	0	0
		Total Credits	18	3	8	22

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		IoT Cloud Processing and Analytics	3	0	0	3
2		IoT Security	2	0	0	2
3		Professional Elective - IV	3	0	0	3
4		Professional Elective - V	3	0	0	3
5		Open Elective - II	3	0	0	3
6		IoT Security & Cloud Computing Lab	0	0	2	1
7		Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
8		Seminar	0	0	2	1
9		Project Stage – I	0	0	6	3
		Total Credits	14	0	10	21

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Organizational Behaviour	3	0	0	3
2		Professional Elective – VI	3	0	0	3
3		Open Elective – III	3	0	0	3
4		Project Stage – II	0	0	14	7
		Total Credits	9	0	14	16

***Note:** Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

MC – Environmental Science – Should be Registered by Lateral Entry Students Only.

MC – Satisfactory/Unsatisfactory.

Professional Elective – I

	Architecting Smart IoT Devices
	Data Analytics for IoT
	IoT System Architectures
	Operating Systems for IoT
	Design and Analysis of Algorithms

Professional Elective – II

	Machine Learning
	Real Time Systems
	Embedded Hardware Design
	Energy Sources and Power Management
	Software Engineering

Professional Elective – III

	Mobile Application Development for IoT
	Software Testing Methodologies
	Cloud Computing and Virtualization
	Artificial Intelligence
	Lightweight Cryptography

Courses in PE – III and PE – III Lab must be in 1-1 correspondence.

Professional Elective – IV

	Quantum Computing
	Wireless Networks
	Augmented Reality & Virtual Reality
	IoT Automation
	Ad-hoc & Sensor Networks

Professional Elective - V

	Embedded Software Design
	5G & IoT Technologies
	Cognitive Computing
	Distributed Systems
	Edge Computing

Professional Elective – VI

	Industrial IoT
	Fog Computing
	Smart Sensor Technologies
	Digital Forensics
	Blockchain Technology

ORGANIZATIONAL BEHAVIOUR**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Course Objectives: The objective of the course is to provide the students with the conceptual framework and the theories underlying Organizational Behavior.

Course Outcomes:

1. Demonstrate the applicability of analyzing the complexities associated with management of individual behavior in the organization.
2. Analyze the complexities associated with management of the group behavior in the organization.
3. Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization.

UNIT - I:

Introduction to OB - Definition, Nature and Scope – Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organizational Behaviour. Cognitive Processes-I: Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization – Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.

UNIT- II:

Cognitive Processes-II: Personality and Attitudes – Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organizational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy.

UNIT - III:

Dynamics of OB-I: Communication – types – interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision-making techniques – creativity and group decision making. Dynamics of OB –II Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intra-individual conflict - strategies to cope with stress and conflict.

UNIT - IV:

Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups – dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.

UNIT - V:

Leading High performance: Job design and Goal setting for High performance- Quality of Work Life- Socio technical Design and High-performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.

REFERENCE BOOKS:

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009
2. McShane: Organizational Behaviour, 3e, TMH, 2008
3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.

4. Newstrom W. John & Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.
6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.
7. Pareek Udai: Behavioural Process at Work: Oxford & IBH, New Delhi, 2009.
8. Schermerhorn: Organizational Behaviour 9/e, Wiley, 2008.
9. Hitt: Organizational Behaviour, Wiley, 2008
10. Aswathappa: Organisational Behaviour, 7/e, Himalaya, 2009
11. Mullins: Management and Organisational Behaviour, Pearson, 2008.
12. McShane, Glinow: Organisational Behaviour--Essentials, TMH, 2009.
13. Ivancevich: Organisational Behaviour and Management, 7/e, TMH, 2008.

INDUSTRIAL IOT (Professional Elective – VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Course Objectives: To provide students with a good depth of knowledge of Designing Industrial IOT Systems for various applications.

Course Outcomes: Upon completion of this course, the students will be able to:

1. Identify the Key opportunities and benefits in Industrial IoT.
2. Apply virtual network to demonstrate the use of Cloud in Industrial IoT.
3. Analyze industrial IoT Three tier topology and data management system.
4. Summarize Legacy Industrial and Modern Communication Protocols.
5. Describe Middleware Architecture, LoRaWAN- and Augmented reality.

UNIT - I:

Introduction to Industrial Internet and Use-Cases: Industrial Internet- Key IIoT Technologies- Innovation and the IIoT -Key Opportunities and Benefits -The Digital and Human Workforce - Logistics and the Industrial Internet- IOT Innovations in Retail.

UNIT – II:

The Technical and Business Innovators of The Industrial Internet: Cyber Physical Systems (CPS) – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog – Role of Big Data in IIOT - Role of Machine learning and AI in IIOT.

UNIT - III:

IIOT Reference Architecture: Industrial Internet Architecture Framework (IIAF) -Industrial Internet Viewpoints -. Architectural Topology: The Three-Tier Topology- Key System Characteristics- Data Management- Advanced data analytics.

UNIT - IV:

Protocols for Industrial Internet Systems: Legacy Industrial Protocols - Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies- Gateways: industrial gateways - CoAP (Constrained Application Protocol) - NFC.

UNIT - V:

Middleware Software Patterns and IIOT Platforms: Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFox- LoRaWAN Augmented reality- Real-World Smart Factories

Application of IIOT: Case study: Health monitoring, lot smart city, Smart irrigation, Robot surveillance.

TEXT BOOKS:

1. Gilchrist, Alasdair, “Industry 4.0 The Industrial Internet of Things”, Apress, 2017.
2. Zaigham Mahmood, “The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer), 2019.

REFERENCE BOOKS

1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat “Industrial Internet of Things: Cyber manufacturing Systems” (Springer), 2017.
2. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)
3. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014
4. Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
5. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 20132 Cuno Pfister, Getting Started with the Internet of Things, O” Reilly Media, 2011, ISBN: 978-1-4493-9357-1

E-BOOK:

1. <https://www.apress.com/gp/book/9781484220467>

FOG COMPUTING (Professional Elective – VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Course Objectives: This course gives an overview of Fog Computing and its architecture, challenges and applications in different contexts.

Course Outcomes:

1. Become familiar with the concepts of Fog.
2. Understand the architecture and its components and working of components and its performance.
3. Explore Fog on security, multimedia and smart data.
4. Model the fog computing scenario.

UNIT - I

Introduction to Fog Computing: Fog Computing, Characteristics, Application Scenarios, Issues and challenges. Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Fog Computing Communication Technologies: Introduction, IEEE 802.11, 4G, 5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.

UNIT - II

Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds, IoT Integration, Security Management for Edge Cloud Architectures.

Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation.

UNIT - III

Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog-IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security and privacy issues. Integrating IoT, Fog, Cloud Infrastructures: Methodology, Integrated C2F2T Literature by Modeling Technique by Use-Case Scenarios, Integrated C2F2T Literature by Metrics.

UNIT - IV

Exploiting Fog Computing in Health Monitoring: An Architecture of a Health Monitoring IoT Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, Discussion of Connected Components. Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Fog Computing for Smart Transportation Applications Case Study: Intelligent Traffic Lights Management (ITLM) System.

UNIT - V

Software Defined Networking and application in Fog Computing: Open Flow Protocol, Open Flow Switch, SDN in Fog Computing, Home Network using SDN. Security and Privacy issues: Trust and privacy issues in IoT Network, web Semantics and trust Management for Fog Computing, Machine Learning based security in Fog Computing, Cyber- Physical Energy Systems over Fog Computing.

TEXT BOOKS:

1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya.
2. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama.
3. Amir Vahid Dastjerdi and Rajkumar Buyya, —Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne.

REFERENCE BOOKS:

1. Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, —Fog Computing and Its Role in the Internet of Things, MCC' 12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978-1-4503-1519-7/12/08... \$15.00.
2. Shanhe Yi, Cheng Li, Qun Li, —A Survey of Fog Computing: Concepts, Applications and Issues, Mobidata' 15, ACM 978-1-4503-3524-9/15/06, DOI: 10.1145/2757384.2757397, June 21, 2015, Hangzhou, China.
3. Amir M. Rahmani, Pasi Liljeberg, Preden, Axel Jantsch, —Fog Computing in the Internet of Things - Intelligence at the Edgell, Springer International Publishing, 2018.
4. Ivan Stojmenovic, Sheng Wen, "The Fog Computing Paradigm: Scenarios and Security Issues", Proceedings, Federated Conference on Computer Science and Information Systems, pp. 1–8, 2014.

SMART SENSOR TECHNOLOGIES (Professional Elective – VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Course Objectives: Obtain knowledge on sensors, sensors with microcontrollers and their applications.

Course Outcomes:

1. Analyze the sensors available in IoT based on application requirements and the Sensing methods.
2. Create a Real-time application by choosing appropriate sensors for temperature monitoring.
3. Interfacing different types of Sensors with MCU.
4. Infer Wireless Sensing, RF Sensing and RF MEMS.
5. Design a real-time application for landslide monitoring and hazard mitigation.

UNIT - I:

Basics of Sensors: Introduction- Sensor Vs Transducer, Nature of Sensors, Sensor Output Characteristics, Sensing Technologies, Digital Output Sensors.

UNIT - II:

Application Specific Sensors: Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors- optical presence sensor, Light Detectors: Photo diodes – phototransistor – photoresistor- CCD and CMOS image sensors, Temperature Sensors: thermos-resistive sensors – thermoelectric contact sensor.

UNIT - III:

Sensor with Microcontroller: Introduction, Amplification and Signal Conditioning, Integrated Signal Conditioning, Digital Conversion, MCU Control, MCUs for Sensor Interface, Techniques and Systems Considerations, Sensor Integration.

UNIT - IV:

Wireless Sensing: Wireless Data and Communications, Wireless Sensing Networks, Industrial Wireless Sensing Networks, RF Sensing, Telemetry, RF MEMS, Complete System Consideration.

UNIT - V:

Smart Applications and System Requirements: Automotive Applications, Industrial (Robotic) Applications, Consumer Applications, Future Sensor Plus Semiconductor Capabilities, Future System Requirements.

TEXT BOOKS:

1. Frank, Randy, "Understanding smart sensors", Artech House integrated microsystems series, 3rd Edition, 2013.
2. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", 5th Edition, Springer, 2016.

REFERENCE BOOKS:

1. Vlasios Tsiatsis, Stamatis Karnouskos, Jan Holler, David Boyle, Catherine Mulligan, "Internet of Things: Technologies and Applications for a New Age of Intelligence", Academic Press, 16-Nov- 2018.
2. Henry Leung, Subhas Chandra Mukhopadhyay, "Intelligent Environmental Sensing", Springer, 22-Jan-2015.

E-BOOKS

1. <https://www.sciencedirect.com/topics/engineering/smart-sensors>
2. <https://www.azosensors.com/article.aspx?ArticleID=1289>

DIGITAL FORENSICS (Professional Elective – VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: Cybercrime and Information Warfare, Computer Networks.**Course Objectives:**

1. provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
4. E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics.

Course Outcomes: On completion of the course the student should be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

UNIT - I**Digital Forensics Science:** Forensics science, computer forensics, and digital forensics.**Computer Crime:** Criminalistics as it relates to the investigative process, analysis of cyber criminalistics area, holistic approach to cyber-forensics**UNIT - II****Cyber Crime Scene Analysis:** Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.**UNIT - III****Evidence Management & Presentation:** Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.**UNIT - IV****Computer Forensics:** Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case.**Network Forensics:** open-source security tools for network forensic analysis, requirements for preservation of network data.**UNIT - V****Mobile Forensics:** mobile forensics techniques, mobile forensics tools.**Legal Aspects of Digital Forensics:** IT Act 2000, amendment of IT Act 2008. Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.**TEXT BOOK:**

1. John Sammons, The Basics of Digital Forensics, Elsevier John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications.

REFERENCE BOOKS:

1. William Oettinger, Learn Computer Forensics: A beginner's guide to searching, analyzing, and securing digital evidence, Packt Publishing; 1st edition (30 April 2020), ISBN: 1838648178.
2. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge.

BLOCKCHAIN TECHNOLOGY (Professional Elective – VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Prerequisites:

1. Knowledge in security and applied cryptography.
2. Knowledge in distributed databases.

Course Objectives: To Introduce block chain technology and Cryptocurrency.**Course Outcomes:**

1. Learn about research advances related to one of the most popular technological areas today.
2. Understand Extensibility of Blockchain concepts.
3. Understand and Analyze Blockchain Science.
4. Understand Technical challenges, Business model challenges.

UNIT - I

Introduction: Block chain or distributed trust, Protocol, Currency, Cryptocurrency, How a Cryptocurrency works, Crowdfunding.

UNIT - II

Extensibility of Blockchain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Blockchain Environment.

UNIT - III

Blockchain Science: Gridcoin, Folding coin, Blockchain Genomics, Bitcoin MOOCs.

UNIT - IV

Currency, Token, Tokenizing, Campuscoin, Coindrop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency.

UNIT - V

Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations.

TEXT BOOK:

1. Melanie Swan, Blockchain Blueprint for Economy, O'reilly.

REFERENCE BOOKS:

1. Building Blockchain Apps, Michael Juntao Yuan, Pearson Education
2. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition
3. Bradley Lakeman, Blockchain Revolution: Understanding the Crypto Economy of the Future. A Non-Technical Guide to the Basics of Cryptocurrency Trading and Investing, ISBN: 1393889158.