

JNTUA COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU**Department of Electronics & Communication Engineering****M. Tech(Regular)– Internet of Things (IoT)****in collaboration with****M/s Efftronics Systems Pvt. Ltd., Vijayawada****(w. e. f2018-19AdmittedBatch)****COURSE STRUCTURE****M.Tech I SEMESTER**

S. No	Sub. Code	Subject	Period	Credits
1.		Internship at M/s Efftronics Systems Pvt. Ltd., Vijayawada (Monthly Evaluation followed by Report)	6 months	12

M.Tech II SEMSTER

S.No	Sub. Code	Subject	Theory	Lab	Credits
1.	15D45201	Internet of Things (IoT) – Reference Architecture	3	2	4
2.	15D45202	Algorithms	3	2	4
3.	15D45203	Measurements and Sensing Systems	3	2	4
4.	15D45204	Business Intelligence & Analytics	3	2	4
5.	15D45205	Elective-I a) Communication Technologies b) Kernel Programming & Device Drivers c) Real Time Operating System	3	-	3
6.	15D54201	Research Methodology	2	-	2
7.	15D45206	Audit Course	2	-	-
Contact periods/week			19	08	21
			Total/Week	27	

M. Tech III SEMSTER

S. No	Sub. Code	Subject	Theory	Lab	Credits
1.	15D45301	Service Oriented Architecture – SOA (Event-Driven Model)	3	2	4
2.	15D45302	Machine Learning (ML) & Artificial Intelligence (AI)	3	2	4
3.	15D45303	Simulation & Modelling	3	2	4
4.	15D45304	Digital Twin – Design, Build, Operate	3	2	4
5.	15D45305	Elective-II a) Business Systems b) JTAG & Boundary scan c) Fog Computing	3	-	3
6.	15D45306	Audit Course	2	-	-
Contact periods/week			17	08	19
			Total/Week	25	

M.Tech IV SEMSTER

S. No	Sub. Code	Subject	Period	Credits
1.		Industrial Project at M/s Efftronics Systems Pvt. Ltd., Vijayawada (Monthly Evaluation followed by Report)	6 months	16

Internet of Things (IoT) – Reference Architecture

Objective	To make student to understand IoT architecture and build IoT devices using sensing, actuation, processing, and communication
Outcomes	Understand IoT architecture and build prototypes
Pre-Requisites	Basics of microprocessors, controllers, programming
Unit-1	IoT Overview: Introduction to Internet of Things (IoT) - <i>Sense, Communicate, Analyze and ACT</i> , IOT Reference architecture - Sensors, Devices, Controllers, Connectivity, Data processing, Identity and Access, Data management and Analytics, Applications, Data privacy and security, standardization and regulatory limitations. Technology and business drivers, Trends and implications
Unit-2	Sense Fundamentals of Data Acquisition and digitilization, Analog and digital data acquisition, Sampling, Time avergaing, Static and dynamic characteristics, placement of sensors, Calibration and types of calibrations Communication Fundamentals of communication, Signal Types and its characteristics, Data Transmission Types, Communication Techniques, Data Transmission Modes, Network Topologies and its applications, Communication packets - Header, Footer, Record Length, Integrity check (Checksum, CRC)
Unit-3	IoT communication technologies and Protocols: Internet and Web layering, Introduction to wired and wireless communicaton technologies for IoT, Edge connectivity and IoT protocols - MQTT, MQTT-SN, Constrained Application Protocol (CoAP), STOMP, AMQP, Comparison of protocols, Wireless sensor networks
Unit-4	IoT Reliability, Security, Privacy and Governance Robustness and Reliability: Characteristics and reliability issues, addressing reliability Security and Privacy: Concepts, security overview, frameworks and privacy in IoT networks IoT Governance Models and Issues
Unit-5	IoT Platform and Applications Thingworx IoT Platform - Architecture overview, Connecting various sources, Modeling the System, Building Analytical Logics, Notifications and Interactions Case Studies: Air Quality MOnitoring, Smart Farming, Smart Parking and Smart Home
Text Books	1. Internet of Things: Principles and Paradigms – Rajkumar Buyya, Amir Vahid Dastjerdi 2. Internet of Things for Architects: Architecting IoT solutions – Perry Lea
Reference Books	1. Internet of Thing and Data Analytics Handbook – Hwaiyu Geng 2. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies - Dimitrios Serpanos, Marilyn Wolf 3. Internet of Things Reference Architecture – White paper – Cisco. 4. PTC University - https://www.ptcu.com/

Algorithms

Objective	Acquire knowledge on: Searching, sorting and various computational algorithms
Outcomes	1. Building Algorithms 2. Perform multithreaded computations
Perquisites	Basics computer, number systems, C programming language
Unit-1	Role of Algorithms in Computing: Algorithms, Algorithms as a technology Deriving Functions: Defining relationship between variables , formulating relationships Digital Building Blocks: Combinational and Sequential Logics, Synthesis Data Structures: Unions, structures, Stacks, queues, linked lists, pointers and objects, Array Manipulations, Format translations , Lookuptables
Unit-2	Searching Techniques: Linear Search, Binary Search & applications Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap sort, Sorting in Linear time
Unit-3	Dynamic Programming: Rod cutting, matrix-chain multiplication, elements of dynamic programming, longest common subsequence, optimal binary search trees Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Matroids and greedy methods
Unit-4	Elementary Graph Algorithms: Representations of graphs, Breadth-first search, Depth-first search, Topological sort Minimum spanning trees: Growing a minimum spanning tree, The algorithms of Kruskal and Prim Single-Source Shortest Paths: The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm
Unit-5	Multithreaded algorithms: Basics, matrix multiplication, merge sort Approximation Algorithms: The vertex-cover problem, The traveling-salesman problem, The set-covering problem, Randomization and linear programming
Textbooks	1. Introduction to algorithms – Cormen, Leiserson, Rivest, Stein 2. Graphs, Networks and Algorithms - Dieter Jungnickel
References	1. Programming in C- Balguruswamy 2. Let us C-Yashwant Kanetkar.

Measurements and Sensing Systems

Objective	To make student to acquire the knowledge on types of sensors/transducers, working principles, selection procedure, applications of sensing systems
Outcomes	1. Select a sensor/sensing systems for a requirement 2. Able to test, install and collect the data from a group of sensors. 3. Able to derive sensor based solution for different applications.
Pre-Requisites	Basic Knowledge on units and dimensions, Mechanics: motion, work and energy. Thermodynamics: Heat Transfer mechanisms, specific heat, latent heat. Optics: Properties of light, Principles of Measurements, Dynamic and static characteristics, basic knowledge on calibration

Unit-1	<p>Introduction to Measurement: Measurement units, applications, elements, choosing appropriate measuring instruments.</p> <p>Instrument Types and Performance Characteristics: Review of instrument types, Static characteristics, dynamic characteristics, necessity for calibration.</p>
Unit-2	<p>Errors During the Measurement process: Sources of systematic error, reduction and quantification of systematic errors, random errors, aggregation of measurement system errors.</p> <p>Calibration: Principles of calibration, control of calibration environment, calibration chain, traceability and records.</p>
Unit-3	<p>Temperature Sensors: Thermoresistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric</p> <p>Humidity and Moisture Sensors: Capacitive, Electrical Conductivity, Thermal Conductivity, Optical Hygrometer, Time Domain Reflectometer.</p> <p>Pressure and Force Sensors: Mercury Pressure, Bellows, Membranes, and Thin Plates, Piezoresistive, Capacitive, Optoelectronic, Vacuum, Strain Gauges, Tactile, Piezoelectric Force</p> <p>Force, Strain, and Tactile Sensors : Strain Gauges , Tactile Sensors , Piezoelectric Force Sensors</p> <p>Applications: Case studies in processing industries, indoor environment monitoring in offices, cold storages</p>
Unit-4	<p>Occupancy and Motion Detectors: Ultrasonic, Microwave Motion, Capacitive Occupancy, Visible and Near-Infrared Light, Far-Infrared Motion, PIR Motion, Position, Displacement, and Level Sensors: Potentiometric, Gravitational , Capacitive , Inductive and Magnetic, Optical, Ultrasonic, Radar</p> <p>Position, Displacement, and Level Sensors: Potentiometric, Gravitational , Capacitive , Inductive and Magnetic, Optical, Ultrasonic, Radar.</p> <p>Velocity and Acceleration Sensors: Capacitive Accelerometers, Piezoresistive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers, Heated-Plate Accelerometer, Heated-Gas Accelerometer, Gyroscopes , Piezoelectric Cables</p> <p>Gas Sensors: Carbon Dioxide, Carbon Monoxide, NOX, SOX, PM2.5, PM10, Volatile Organic Compounds Applications: Case studies in manufacturing industries, robotics</p>
Unit-5	<p>Flow Sensors: Pressure Gradient Technique, Thermal Transport, Ultrasonic, Electromagnetic, and Micro flow, Coriolis Mass Flow</p> <p>Acoustic Sensors: Resistive Microphones, Fiber-Optic, Piezoelectric, Solid-State microphone</p> <p>Light & Radiation Sensors: Photodiodes, Phototransistor, Photo resistors, Thermal detectors</p> <p>Chemical Sensors: Metal-Oxide Chemical , ChemFET, Electrochemical , Potentiometric , Conduct metric , Amperometric , Optical Chemical , Mass Detector</p> <p>Applications: Case studies in processing industries, oil and gas industries, water SCADA, pharmaceutical industries</p>
Text Books	<ol style="list-style-type: none"> 1. Measurement and Instrumentation Principles - Morris, Alan S 2. Sensor Technology Handbook, John S. Wilson
Reference Books	<ol style="list-style-type: none"> 1. Measurement of systems - Application and design - Earnest O. Doebelin 2. An Introduction to Error Analysis by John R. Taylor

Business Intelligence & Analytics

Objective	To make students to extract insights from large volumes of data in various forms, either structured or unstructured by employing statistical mathematics techniques for drawing conclusions about that information.
Outcomes	Analyse the data and conclude on: 1. What happened (Descriptive Analytics) 2. Why did it happen(Diagnostics Analytics)
Pre-Requisites	Basic mathematics, units and conversions, Algebra, Trigonometry, Geometry
Unit-1	<p>Essentials of Data analysis - Data Collection, Data Cleansing, Data Exploration, Statistical Analysis, Reporting, Decision</p> <p>Statistical Methods: Arithmetic mean: The Arithmetic mean of grouped Data, The Median: The mode; The variance and standard deviation: Interpretation of SD, Chebyshev's Lemma or Rule (for sample), Skewness and Kurtosis, Skewness and its measurement, Kurtosis and its measurements.</p> <p>Introduction to R/Python: Introduction, mathematical and statistical functions and use cases of R/Python</p> <p>Applications: Estimating errors in from Calibration Data, Estimating average weather condition of a place, Estimating average population/GDP of a country (practice using MS-Excel & R/Python-software)</p>
Unit-2	<p>Visualization: Line graphs, Geometric Forms, Pictorial Diagrams, Control Charts, Radar charts, Parteto Diagrams, Histograms, Pie Charts, Histogram, Scatter diagram, Flow charts,</p> <p>Applications: Graphical representation of data from Battery health monitoring, Indoor Air Quality , CO2 emissions by country/region (Practice using MS-Excel & R/Python-software)</p>
Unit-3	<p>Time series Analysis: Characteristics Movements in a time series; Time series models; Measurement of Trend; Secular Trend; Seasonal Movements; Cyclical Movements; Irregular Movements; Long Cycles, Applications: Analyze the trends of population growth, global temperatures, solar radiation, wind patterns. (Practice using MS-Excel & R/Python-software)</p>
Unit-4	<p>Self-Service Business Intelligence and Analytics:</p> <p>What is self-service Business Intelligence and Analytics? The need for self-service, How to determine requirements for Self Service, Benefits and Issues with Self-Service, Designing sustainable Self Service solutions, Using the self-service tools, Sourcing data from persona data sources, across the web and Corporate IT Systems, Preparation of data, creation of models and loading of data to models, Creation of effective data visualizations</p>
Unit-5	<p>BI Tools</p> <p>Getting Started with BI Tools and Analytics. Create real-time dashboards, Create custom visualizations which can be re-usable in reports and dashboards, Exploring live connections to data with BI, Connecting directly to data bases - SQL Server etc., Introduction to BI Development API, Leveraging custom visuals in BI</p>
Reference Books	<p>Statistics Concepts and applications, Nabendu pal & Sahadeb sarkar</p> <p>Linear algebra and its applications, Strang G Caluclus, Anton, Bivens, Davis</p> <p>Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media, 2008.</p> <p>Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, 4 LLC, 2014.</p> <p>Applied Microsoft Power BI: Bring your data to life!, Teo Lachev, 2015</p> <p>Introducing Microsoft Power BI, Alberto Ferrari and Marco Russo, 2016</p>

Communication Technologies (Elective – I)

Objective	To make student to acquire knowledge about transferring data using various Wired/Wireless communication technologies.
Outcomes	<ol style="list-style-type: none"> 1) Able to design communication architecture 2) Able to work with various communication technologies (Wired/Wireless) 3) Able to work with various protocols 4) Configure and test communication technologies
Pre-Requisites	Basic knowledge on Digital numbering system; Micro Controller Peripheral Programming, Communication interfaces and protocols
Unit-1	Introduction to Communication and Networking : Communications, Signal Types and its characteristics (Analog/Digital), Data Transmission Types (Serial/Parallel), Communication Techniques (Asynchronous, Synchronous), Data Transmission Modes (Simplex, Half/Full Duplex), Network Topologies (Star, Ring, Mesh, Point to Point, Tree, Bus, Daisy chain, Multi drop) and its applications, Modulation need and types.
Unit-2	OSI Layers: Communication Layers and its applications, Communication media (Twisted Pair, Coaxial, Fiber Optics), Introduction to Errors (Error types, Detection, Correction) and Flow Control and its applications.
Unit-3	Wired Communication Protocols and standards: Ethernet (Types, Socket, MAC, IP, ARP, ICMP, TCP, UDP, DHCP), CAN, Modbus(RTU, ASCII), UART (RS485, RS232), OFC and Advantages, Disadvantages and its applications, Introduction to Dial up Modems, Leased line modems.
Unit-4	Wireless Communication Protocols and Standards: Zigbee, Bluetooth, Wi-Fi, GPRS, GSM, NFC, IR, LoRa, NB-IoT, Satellite Communication. Advantages, Disadvantages and its applications. IoT Protocols & procedures: MQTT, COAP, STOMP, AMQP, Addressing, configuration & re-configuration, fault detection, Recovery
Unit-5	Network Types: Introduction to LAN, WAN, PAN, Internet and Intranet, sensor networks (wired/wireless) and its applications, Introduction to NAT, PAT, DNS, Network Routing algorithms, Introduction to Switch, Hub, Bridges and its working, Network Security and Introduction to Firewall and its applications.
Reference Books	<ol style="list-style-type: none"> 1. Introduction to data communication and networking by Wayne Tomasi 2. Introduction to data communication and networking by Behrouz Forouzan 3. Basics of data communications by William Stallings 4. Basics of computer networking by Thomas Robertazzi 5. Wireless Networking Absolute Beginner's Guide by Michael Miller: 6. Designing and Deploying 802.11n Wireless Networks by Jim Geier 7. CAN System Engineering from Theory to Practical Applications 8. Communication (NFC) From Theory to Practice by Vedat Coskun, Kerem Ok .