RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

CSE-IOT/IOT, VI-Semester

IO 601 - Data Analytics in IOT

Course Objectives: The objective of this course is to introduce big data technology platforms and how these can be applied to IoT data.

UNIT I Introducing IoT Analytics: Types of Data Sources, Understanding Big Data, Applications of Big Data Analytics, IoT Data and Big Data, Defining IoT Analytics, Challenges of IoT Analytics, IoT Analytics Lifecycle and Techniques

UNIT II IoT, Cloud and Big Data Integration for IoT Analytics: Cloud-based IoT Platform, Requirements of IoT Big Data Analytics Platform, Functional Architecture, Data Analytics for the IoT, Characteristics of IoT Generated Data, Data Analytic Techniques and Technologies, Data Collection Using Low-power, Long-range Radios, IoT Analytics for the cloud

UNIT III Searching the Internet of Things: A Search Architecture for Social and Physical Sensors, Local Event Retrieval, Using Sensor Metadata Streams to Identify Topics of Local Events in the City, Venue Recommendation, Development Tools for IoT Analytics Applications; IoT Analytics as a Service: Architecture for IoT Analyticsas-a-Service, Sensing-as-a-Service, Scheduling, Metering and Service Delivery, Sensing-as-a-Service Example, From Sensing-as-a-Service to IoT-Analytics- as-a-Service

UNIT IV Data Science for IoT Analytics: Machine Learning, Feature Engineering with IoT Data, Validation Methods, Bias, Variance, Comparing different Models to find the Best fit, Anomaly Detection, Forecasting, Deep Learning with IoT data; Strategies to organize data for Analytics; The Economics of IoT Analytics: Cost Considerations for IoT Analytics

UNIT V IoT Analytics Applications and Case Studies: Data Analytics in Smart Buildings, Internet-of-Things Analytics for Smart Cities, Ethical IoT

Reference Books:

1. John Soldatos, “Building Blocks for IoT Analytics”, River Publishers, 2017
2. Andrew Minteer, “Analytics for the Internet of Things”, Packt Publishing, 2017

Course Outcomes: On successful completion of this course the students will be able to

1. Understand IoT Analytics Lifecycle and Techniques
2. Know the characteristics of IoT Generated Data
3. Use development tools for IoT Analytics Applications
4. Learn Machine Learning for IoT data
5. Understand IoT Data Analytics applications

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CSE-IOT/IOT, VI-Semester

IO 602 -Wireless Ad-hoc networks

Unit I: Introduction :Introduction-Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, GSM, GPRS, PCS, WLAN and UMTS, Components of Packet Radios, Routing in PRNETs, Route calculation, Pacing techniques, Ad Hoc Wireless Networks, Heterogeneity in Mobile Devices, Wireless Sensor Networks, Traffic Profiles, Types of Ad Hoc Mobile Communications, Types of Mobile Host Movements, Challenges Facing Ad Hoc Mobile Networks.

Unit II: Ad Hoc wireless MAC protocols- Introduction, Synchronous and asynchronous MAC protocols, Problem in Ad Hoc channel access, Receiver-initiated and sender-initiated MAC protocols, Existing Ad Hoc MAC protocols, Ad Hoc Routing Protocols- Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols: Table-Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Cluster Switch Gateway Routing (CSGR), Source-Initiated On-Demand Approaches - Ad Hoc On-Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Signal Stability Routing (SSR) Location- Aided Routing (LAR), PowerAware Routing (PAR), Zone Routing Protocol (ZRP).

Unit III: Multicast routing In Ad Hoc Networks : Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols, Mesh-Based Multicast Routing Protocols, Summary of Tree-and Mesh-Based Protocols - Energy-Efficient Multicasting, Multicasting with Quality of Service Guarantees, Application Dependent Multicast Routing, Comparisons of Multicast Routing Protocols.

Unit IV: Transport Layer, Security Protocols : Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocols for Ad Hoc Wireless Networks, Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks.

Unit V: QoS and Energy Management : Introduction, Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks, Classifications of QoS Solutions, MAC Layer Solutions, Network Layer Solutions, QoS Frameworks for Ad Hoc Wireless Networks, Energy Management in Ad Hoc Wireless Networks – Introduction, Need for Energy Management in Ad Hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Power Management Schemes, System Power Management Schemes.

References Books:-

1 C. Siva Ram Murthy and B.S. Manoj “Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson Education.

2 C.K. Toh, “Ad Hoc Mobile Wireless Networks: Protocols and Systems”, Pearson Education.

3 George Aggelou, “Mobile Wireless Networks”, Tata McGraw- Hill. 4 Charles E. Perkins, Ad Hoc Networking, Pearson Education.

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CSE-IOT/IOT, VI-Semester

Departmental Elective IO 603 (A) - Sensors and Actuator Devices for IoT

UNIT – I SENSORS Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

UNIT- II INDUCTIVE & CAPACITIVE TRANSDUCER Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications:- capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT III ACTUATORS Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

UNIT IV MICRO SENSORS AND MICRO ACTUATORS Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

UNIT V SENSOR MATERIALS AND PROCESSING TECHNIQUES Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

TEXT BOOKS

1. Patranabis.D, “Sensors and Transducers”, Wheeler publisher, 1994.
2. Sergej Fatikow and Ulrich Rembold, “ Microsystem Technology and Microbotics”, First edition, Springer – Verlag NEwyork, Inc, 1997.
3. Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” Fourth edition, Springer, 2010.

REFERENCE BOOKS

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.,
3. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1997. 4. Manfred Kohl, "Shape Memory Actuators", first edition, Springer

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CSE-IOT/IOT, VI-Semester

Departmental Elective IO 603 (B) - IoT and Multimedia Technology

Course Objectives: The objective of this course is to enable the students to learn and apply the programming skills in developing IoT applications pertaining to Industrial, medical, agricultural field etc.

Unit I Markup Language: Introduction to Markup language, HTML document structure, HTML forms, Style (CSS), Multiple CSS stylesheets, DHTML, Tools for image creation and manipulation, User experience design, IoT development using charts

Unit II Scripting Language: Introduction to JavaScript, Functions, DOM, Forms, and Event Handlers, Object Handlers, Input validation, J2ME, application design using J2ME , IoT development using Real time rules, platforms, alerts

Unit III Android Programming Framework: Mobile app development: Android Development environment, Simple UI Layouts and layout properties, GUI objects, Event Driven Programming, opening and closing a Database

Unit IV Industrial IoT: IIoT Fundamentals and Components, Industrial Manufacturing, Monitoring, Control, Optimization and Autonomy, Introduction to Hadoop and big data analytics

Unit V Applications: Smart Farming: Weather monitoring, Precision farming, Smart Greenhouse, Drones for pesticides, Energy Consumption Monitoring, Smart Energy Meters, Home automation, Smart Grid and Solar Energy Harvesting, Intelligent Parking, Data lake services scenarios, Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture. Use Cases : Wearable devices for Remote monitoring of Physiological parameter, ECG, EEG, Diabetes and Blood Pressure.

References:

1. John Dean, Web Programming with HTML5, CSS and JavaScript, 2018, Jones and Bartlett Publishers Inc., ISBN-10: 9781284091793
2. DiMarzio J. F., Beginning Android Programming with Android Studio, 2016, 4th ed., Wiley, ISBN-10: 9788126565580
3. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849
4. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.
5. Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Springer, ISBN-10: 3642276377

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

1. Design dynamic web forms to acquire and process user & sensor data

2. Interactive forms using Java Script with a focus on internet of things
3. Implement mobile application using android SDK
4. Understand the IoT architecture and building blocks for various domains
5. Devise multidisciplinary case to case modelling and execute wide range of application

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CSE-IOT/IOT, VI-Semester

Departmental Elective IO 603 (C) - Introduction to Industry 4.0

UNIT I : Introduction to Industry 4.0 definition of Industry 4.0 What is it all about and why do we have to change industrial production Videos from Bosch, Siemens, ABB, Automotive Industry (VW, Audi, Mercedes),Developments in USA, Europe, China and other countries ,Comparison of Industry 4.0 Factory and today's Factory The 10 most important things that will change with Industry 4.0 ,Difference between conventional automation and Industry 4.0

UNIT II Basic principles and technologies of a Smart Factory ,Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services ,Big Data ,Cyber-Physical Systems , Value chains in manufacturing companies, Customization of products , Digital Twins , Cloud Computing / Cloud Manufacturing ,Security issues within Industry 4.0 networks

UNIT III The smart work piece, The intelligent work piece as basic functionality in implementing Industry 4.0, What is an intelligent workpiece?, How to make a work piece intelligent? , Work piece tagging, QR codes and RFID,Communication between work piece and environment,Multi-agent systems in production,Applications for smart work pieces (examples of existing or future applications in the field of manufacturing)

UNIT IV Digital Twins in Production, Example: Real time use of Digital Twin (Video),Basic concepts of Digital Twins, Benefits, impact and challenges, Features and Implementation of Digital Twins, Types of Digital Twins, Digital Twin use cases, Applications for digital twins in production (examples of existing or future applications in the field of manufacturing)

UNIT V: Assistance systems for production, The connected worker within the Industry 4.0 scenario ,Diversity-driven workplaces (barrier free workplaces, accessibility in production),Human-and task-centered assistance systems (e.g. motion capture system for training employees, etc.) ,Technical tools (“Ambient Assisted Working” (AAW)) , Mobile information technologies ,Shop floor information systems Production line support systems (pick by light, assembly display systems, assembly control by vision, ...) , Manipulator systems and intelligent chairs, Human work support by using exoskeletons, Applications assistance systems in production (examples of existing or future applications in the field of manufacturing)

Books and references

1. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress)
2. “Industrial Internet of Things: Cybermanufacturing Systems”by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)

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CSE-IOT/IOT, VI-Semester

Open Elective IO 604 (A) - Embedded System Design

Course Objectives:

1. To introduce students with knowledge about the basic functions and applications of embedded systems
2. To introduce the architecture of embedded systems
3. To introduce the various communication protocols
4. To enable students to have knowledge of the memory types and supporting technologies of embedded systems.
5. To enable students to have knowledge about the development of embedded software

UNIT-I Introduction to Embedded Systems: Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, classification, major application areas, purpose of embedded systems, characteristics and quality attributes of embedded systems, common design metrics, and processor technology: general purpose processor, application specific processor, single purpose processor.

UNIT-II Embedded System Architecture: Von Neumann v/s Harvard architecture, instruction set architecture, CISC and RISC instructions set architecture, basic embedded processor, microcontroller architecture, CISC & RISC examples: 8051, ARM, DSP processors.

UNIT-III Input Output and Peripheral Devices Timers and counters, watchdog timers, interrupt controllers, PWM, keyboard controller, analog to digital converters, real time clock. Introduction to communication protocols: basic terminologies, concepts, serial protocol: I2C, CAN, firewire, USB. Parallel protocols: PCI bus, IrDA, bluetooth, IEEE 802.11, wireless protocols.

UNIT-IV Memory System Architecture Caches, virtual memory, MMU, address translation, memory and interfacing, memory write ability and storage performance. Memory types, composing memory – advance RAM interfacing, microprocessor interfacing I/O addressing, interrupts, direct memory access, arbitration multilevel bus architecture.

UNIT-V Embedded System Supporting Technologies Difference between normal OS and RTOS, scheduling algorithms. Case study: Tiny OS, VxWorks, QNX. Overview of VLSI technology, introduction to device drivers. Case studies: washing machine, air-conditioning, auto focus camera.

References:

1. F Vahid, T Giogarvis, Embedded systems: A unified hardware/software approach, Wiley, 1999.
2. Raj Kamal, Embedded Systems Introduction, 2nd Ed., TMH publication, 2015.
3. David E Simons, An Embedded Software Primer, Pearson, 1999. Course Outcomes: Upon completion of this course, students will be able to

1. Explain the embedded system concepts and architecture of embedded systems
2. Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller
3. Select elements for an embedded systems tool.
4. Understand the memory types used in embedded systems
5. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

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CSE-IOT/IOT, VI-Semester

Open Elective IO 604 (B) - Theory of Computation

COURSE OBJECTIVE

- To understand computability, decidability, and complexity through problem solving.
- To analyse and design abstract model of computation & formal languages
- To understand and conduct mathematical proofs for computation and algorithms.

Unit-I

Introduction of Automata Theory: Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and mealy machines, composite machine, Conversion from Mealy to Moore and vice versa.

Unit-II

Types of Finite Automata: Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Meaning of union,intersection, concatenation and closure, 2 way DFA.

Unit-III

Grammars: Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, ambiguity in grammar, simplification of context free grammar, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar, killing null and unit productions. Chomsky normal form and Greibach normal form.

Unit-IV

Push down Automata: example of PDA, deterministic and non-deterministic PDA,conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petrinet model.

Unit-V

Turing Machine: Techniques for construction. Universal Turing machine Multitape, multihead and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem.

RECOMMENDED BOOKS

- Introduction to Automata Theory Language & Computation, Hopcroft& Ullman, Narosa Publication.
- Element of the Theory Computation, Lewis &Christors, Pearson.
- Theory of Computation, Chandrasekhar & Mishra, PHI.
- Theory of Computation, Wood, Harper & Row.
- Introduction to Computing Theory, Daniel I-A Cohen, Wiley.

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1.explain the basic concepts of switching and finite automata theory & languages.

CO2.relate practical problems to languages, automata, computability and complexity.

CO3.construct abstract models of computing and check their power to recognize the languages.
CO4.analyse the grammar, its types, simplification and normal form.
CO5.interpret rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO6.develop an overview of how automata theory, languages and computation are applicable in engineering application.

LIST OF EXPERIMENTS

1. Design a Program for creating machine that accepts three consecutive one.
2. Design a Program for creating machine that accepts the string always ending with 101.
3. Design a Program for Mode 3 Machine
4. Design a program for accepting decimal number divisible by 2.
5. Design a program for creating a machine which accepts string having equal no. of 1's and 0's.
6. Design a program for creating a machine which count number of 1's and 0's in a given string.
7. Design a Program to find 2's complement of a given binary number.
8. Design a Program which will increment the given binary number by 1.
9. Design a Program to convert NDFA to DFA.
10. Design a Program to create PDA machine that accept the well-formed parenthesis.
11. Design a PDA to accept WCW_R where w is any string and W_R is reverse of that string and C is a Special symbol.
12. Design a Turing machine that's accepts the following language $a_n b_n c_n$ where n>0.

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CSE-IOT/IOT, VI-Semester

Open Elective IO 604 (C) - Open Source Programming for IoT

Course Objectives:

1. This program aims to train students to be equipped with a solid theoretical foundation, systematic professional knowledge and strong practical skills in the Raspberry Pi.
2. The course focuses on higher-level operating systems, advanced networking, user interfaces, multimedia and uses more computing intensive IoT applications as examples using Raspberry Pi running Linux as the platform of choice. **Course Outcomes:**

1. Appreciate the development technology for IoT.
2. Familiar with Basic Concepts of Linux.
3. Design real time IoT Devices and Familiar with basic foundations of Python Programming and libraries.
4. Comprehend the basic concepts of Mobile Cloud Computing.

UNIT - I Getting Started with Raspberry Pi: Basic functionality of Raspberry Pi B+ board, setting up the board, configuration and use, booting Raspberry Pi 3, Downloading an Operating System, format an SD card and booting the OS, Interfacing Hardware with the Raspberry Pi, Raspberry Pi Remote Access, operates the Raspberry Pi in "headless mode", Bash Command line, operating Raspberry Pi without needing a GUI interface. Basics of Python programming language: Programming on the Raspberry Pi. Python on Raspberry Pi, Python Programming Environment, Python Expressions, Strings, Functions and Function arguments, Lists, List Methods, Control Flow.

UNIT - II Introducing Micro Python: MicroPython Features, MicroPython Limitations, Experimenting with Python on PC, Installing Python 3 on Windows 10, Running the Python Console, Running Python Programs with the Interpreter, The Run, Evaluate, Print Loop (REPL Console), Off and Running with MicroPython, Additional Hardware, Basic Electronics Kit, Breadboard and Jumper Wires and 3 Examples.

UNIT - III IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs. Web Server – Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful web API. Connecting to APIs.

UNIT - IV Baking Pi: Powering Raspberry Pi, Formatting SD cards, Installing and connecting Raspberry pi, How to tell Raspberry pi is working, Installing Raspbian with NOOBS, Networking Raspberry Pi, Connecting with Ethernet, Connecting Via Local Computer Network, Connecting Via Wireless Network, Updating and Upgrading, Setting up a Host Name, Connecting Raspberry pi with SSH, Creating Simple Rasspberry pi application.

UNIT - V FIRST Project on Java: Bill of Materials, Getting Started with NetBeans, Downloading and Configuring NetBeans, Revisiting HelloRaspberryPi, Brewing Java, Communicating with a USB Scale, Coffee Calculator, Asynchronous Communication, Coffee Brewing Recipe, Commercial Licensing.

TEXT BOOKS:

1. Simon Monk, “Programming the Raspberry Pi: Getting Started with Python”, January 2012, McGraw Hill Professional. 2. MicroPython for the Internet of Things, A Beginner’s Guide to Programming with Python on Microcontrollers, Charles Bell, Apress.

3. Raspberry Pi with Java: Programming the Internet of Things (IoT) (Oracle Press) 1st Edition.

REFERENCE BOOKS:

1. Eben Upton and Gareth Halfacree, “Raspberry Pi User Guide”, August 2016, 4th edition, John Wiley & Sons
2. Alex Bradbury and Ben Everard, “Learning Python with Raspberry Pi”, Feb 2014, JohnWiley & Sons
3. Michael Margolis, “Arduino Cookbook”, First Edition, March 2011, O'Reilly Media, Inc 4. The official raspberry Pi Projects Book, https://www.raspberrypi.org/magpiissues/Projects_Book_v1.pdf