IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Department of Computer Science & Engineering

Bachelor of Technology (B.Tech.)

Minor Certification in Internet of Things (IoT)

(To be offered to students of other departments excluding CSE Stream)

S.No.	Subject Code	Semester	Subject Name	Contact Hours per week			Total Credits
				L	T	P	
1.	MICS-IOT501	V	Embedded C	2	1	2	4
2.	MICS -IOT601	VI	Dynamic Paradigm in IoT	2	1	2	4
3.	MICS -IOT701	VII	Sensor and Actuator	3	1	-	4
4.	MICS -IOT801	VIII	*Wireless Sensor Network & IoT Standards	2	-	2	3
			Total	9	3	6	15

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

Note: *VIII semester subject (Wireless Sensor Network & IoT Standards or any other course equivalent to Wireless Sensor Network & IoT Standards) can also be done from MOOC courses (NPTEL etc.) with minimum credit 3.

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MICS-IOT501	Embedded C	2L: 1T: 2P (5 hrs.)	Credits:04

Course Objective:

1. To understand fundamentals of C language.
2. To develop algorithm/flowcharts for problem solving and writing programs.
3. To learn to use C programs for embedded system
4. To study optimization of programs for embedded applications

Course Contents:(40hrs)

Module 1: **(08 hrs.)**

C for embedded systems

What is an embedded system, Benefits of C in embedded systems, problem specifications - product requirements, hardware engineering, software planning, software architecture, flow charts, state diagrams, pseudo code, resource management, overview of embedded system resources – CPU, memory, timers, interrupts, IO ports, data converters, First embedded program, In-line assembly language, device knowledge #pragma, libraries.

Module 2: **(08 hrs.)**

Data types and variables

Identifiers, data types, function data, character data, integer data, bit data, real numbers, complex data types – pointers, array, enumerated types, structures, unions, data type modifiers- constant, volatile, signed, unsigned, short, long, near and far. Storage class modifiers – extern, static, register, auto etc.

Module 3: **(08 hrs.)**

C Functions, control structures, Decision and looping structures

Combining statements in a block, functions, control structures, main, initialization functions, control statements, decision structures, looping structures, control expression, break and continue, operations and expressions

Module 4: **(08 hrs.)**

Optimizing and testing Embedded C programs

Editing, compiling, linking, locating, building, debugging and downloading C programs, Creating and writing libraries, optimization based on instruction set, hand optimization, debugging embedded C, mixed C and assembly, working with emulators and simulators, packaging embedded software, Obtain software specifications for Case studies for applications based on 8bit embedded systems.

Module 5: **(08 hrs.)**

Embedded Applications using Data structures

Linear data structures– Stacks and Queues Implementation of stacks and Queues- Linked List - Implementation of linked list, Sorting, Searching, Insertion and Deletion,
Nonlinear structures – Trees and Graphs

Course Outcome:

1. The students able to understand basics of embedded systems and hardware & software architecture
2. The students able to understand data types and variables for embedded c
3. The students will learn C functions and looping structures
4. The students able to about how to test Embedded C programs
5. The students able to learn Data Structure for embedded C

List of Text Books / Reference Books:

1. C programming for embedded systems, Kirk Zurell, R&D books, CMP media Inc. (2000)
2. Programming Embedded Systems in C and C++, Michel Barr, O'Reilly (2001)

List of Experiments:

1. Write a program in embedded c to blink LED on PORT1 of 8051.
2. Write a program in embedded c to transfer one byte of data on serial port of 8051.
3. Write a program in embedded c for 8051 to control motor speed using PWM.
4. Write a program in embedded c to blink LED on PORTA of pic16f877a.
5. Write a program in embedded c to transfer one byte of data on serial port of pic16f877a.
6. Write a program in embedded c for pic16f877a to control motor speed using PWM.
7. Write a program in embedded c to blink LED using AVR controller.
8. Write a program in embedded c to transfer one byte of data on serial port of AVR controller.
9. Write a program in embedded c for pic16f877a to control motor speed using AVR controller.
10. Write a program in embedded c to blink LED using ARM controller.

MICS -IOT601	Dynamic Paradigm in IOT	2L: 1T: 2P (3 Hrs.)	Credits:04

Course Objective:

1. To understand the concepts of Internet of Things.
2. To build IoT applications.
3. To learn the mechanism of Machine to Machine (M2M) communication.
4. To understand IoT ecosystem, industrial internet, and IoT on cloud.

CourseContents:(40hrs)

Module1 **(08hrs.)**

Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural View, Physical design of IOT, Logical design of IOT, Application of IOT.

Module2: **(08hrs.)**

Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function Virtualization) for IOT, data storage in IOT, IOT Cloud Based Services.

Module3: (08hrs.)

Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

Module4: **(08hrs.)**

Sensor Technology , Participatory Sensing, Industrial IOT and Automotive IOT , Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology.

Module5: **(08hrs.)**

IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi &arduino devices. IOT Case Studies: smart city streetlights control & monitoring.

Course Outcome:

1. Understand the key components that make up an IoT system.
2. Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.
3. Understand where the IoT concept fits within the broader ICT industry and possible future Trends.
4. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
5. Apply the knowledge and skills acquired during the course to build and test a complete, Working IoT system involving prototyping, programming and data analysis

List of Text/Reference Books:

1. Rajkamal,"Internet of Things", Tata McGraw Hill publication
2. Vijay Madisetti and ArshdeepBahga, "Internet of things (A-Hand-on-Approach)" 1st Edition, Universal Press.
3. HakimaChaouchi "The Internet of Things: Connecting Objects", Wiley publication.
4. Charless Bell "MySQL for the Internet of things", Apress publications.
5. Francis dacosta "Rethinking the Internet of things: A scalable Approach to connecting everything", 1st edition, A press publications 2013.
6. Donald Norris "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", McGraw Hill publication.

List of Experiments:

1. Case study of various components of IoT.
2. To interface LED with Arduino and write a program to turn ON and OFF LED.
3. To interface Buzzer with Arduino and write a program to turn ON and OFF Buzzer.
4. To interface Multi Color LED with Arduino and write a program for RGB LED Color Mixing.
5. To interface Push button with Arduino and write a program to turn ON LED when push button is pressed (Digital Input with a Pushbutton).
6. To interface Temperature sensor with Arduino and write a program to print temperature readings on LCS.
7. To interface LED with Arduino and write a program to control it using Arduino Serial Port.
8. Write a program of Fading LED with Arduino Analog Output.
9. To interface PIR (Passive Infrared) Motion Sensor with Arduino and write a program to check motion.
10. Case study of Raspberry Pi.

MICS-IOT701	Sensor and Actuator	2L: 1T: 2P (5 hrs.)	Credits: 04

Course Objective:

The main goal of this course is to educate students in microtechnology and its use to fabricate sensors and systems.

CourseContents:(40hrs)

Module 1: **(08 hrs.)**

Basics of Energy Transformation: Sensors, Actuators and Transducers, , Understanding of thin film physics: Application in MOSFET and its variants,

Module 2: **(08 hrs.)**

Thin Film Deposition Techniques: Physical Vapor Deposition (Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition), Chemical Vapor Deposition (APCVD, LPCVD, UHVCVD, PECVD, ALCVD, HPCVD, MOCVD)

Module 3: **(08 hrs.)**

Basic understanding of Photolithography for pattering layer. Detailed overview of Etching methods. Understanding various gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas, sensor, Nano-structured based gas sensors

Module 4: **(08 hrs.)**

Design and fabrication process of Microsensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications, Working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications

Module 5: **(08 hrs.)**

Understanding of Sensor Interfacing with Microprocessor to build electronic system, Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor based electronics systems

Course Outcome:

1. The students able to understand basics of sensors and actuators.
2. The students able to understand Physical and chemical properties if sensors.
3. The students will learn about pattering and gas sensors
4. The students able to understand how to fabricate some sensors and actuators
5. The students able to learn modern day microsensors and micro actuators

List of Text Books/ Reference Books:

1. Sensors and Signal Conditioning Wiley-Blackwell, 2008 Jacob Fraden, Handbook of modern sensors, Springer, Stefan Johann Rupitsch.
2. Piezoelectric Sensors and Actuators: Fundamentals and Applications, Springer, 2018 Senturia S. D.
3. Microsystem Design, Kluwer Academic Publisher, 2001 J.D. Plummer, M.D. Deal, P.G. Griffin
4. Silicon VLSI Technology, Pearson Education, 2001 S.M. Sze (Ed)
5. VLSI Technology, 2 Edition, McGraw Hill, 1988 Madou 7. M Fundamentals of Microfabrication, CRC Press, 1997.
6. **NPTEL Course Link: https://nptel.ac.in/courses/108/108/108108147/**

List of Experiments:

1. Based on Specific Modules.

MICS-IOT801	Wireless Sensor Network & IOT Standard	2L: 1T: 0P (3 hrs.)	Credits:03

Course Objective:

- To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.
- To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.

Module 1: **(08 hrs.)**

Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Module 2: **(08 hrs.)**

Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

Module 3: **(08 hrs.)**

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.

Module 4: **(08 hrs.)**

Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

Module 5: **(08 hrs.)**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Course Outcome:

1. The students able to understand fundamental of wireless communication and wireless internet.
2. The students able to understand ad-hoc sensor networks.
3. The students will learn MAC Protocol and IEEE802 Standard.
4. The students able to understand how to implement routing protocols.
5. The students able to learn IoT Standards and its Protocol Standardization

List of Text Books/ Reference Books:

1. Kazem Sohraby, Daniel Minoli and TaiebZnati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.
3. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
4. Philip Levis, " TinyOS Programming"
5. Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,