IPS Academy, Institute of Engineering & Science
(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)
Scheme & Syllabus Based on AICTE Flexible Curricula **(B. Tech)**
Electronics & Communication Engineering Department

Honors Degree Certification Course in Communication and IoT
(To be offered to students of ECE departments)

S. No.	Subject Code	Category	Semester	Subject Name	Contact Hours per week			Total Credits
					L	T	P	
1			V	Communication Technology	2	1	2	4
2			VI	Advanced Embedded Systems	2	1	2	4
3			VII	IOT Sensors	3	-	2	4
4			VIII	Python & IoT Application	2	-	2	3
				Total	9	2	8	15

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

Note: *VII semester subject (Advanced Embedded Systems or any other course equivalent to Advanced Embedded Systems) can also be done from MOOC courses (NPTEL, SWAYAM, EDx etc.).

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	Communication Technology	**3L: 0T: 1P (05 hrs.)**	**Credits: 03**

Recommended Prerequisite: Analog & Digital Communication

Course Objective: The course is designed to cover principles, concepts, and technology of Elements of communication and networking, Communication Principles, Communication Interface, Communication and Relay Channels & Networking Cognitive Multiple Access via Communication

MODULE I **(8 Hrs.)**
Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing

MODULE II **(8 Hrs.)**
Communication Principles: RFID – Zigbee – Bluetooth – Internet Communication- IP Addresses - Mac Addresses - TCP And UPP – IEEE 802 Family Of Protocols – Cellular-Introduction To Ethernet.

MODULE III **(8 Hrs.)**
Communication Interface, IEEE 802.11 Wireless Networks Attacks: Basic Types, Wep Key Recovery Attacks, Keystream Recovery Attacks Against Web – RFID Security – Security Issues In Zigbee: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats to Bluetooth Devices and Networks

MODULE IV **(8 Hrs.)**
History Of Communication And Relay Channels- Characteristics Of Wireless Channels -Techniques To Exploit Spatial Diversity-Capacity Of Wireless -Diversity-And-Multiplexing Tradeoff- Decode-And-Forward Relaying Schemes, Modes Of Communications: Communication Protocols Communications With Single Relay- Multi-Node Communications- Relay Selection.

MODULE V **(8 Hrs.)**
Networking Cognitive Multiple Access Via Communication - Content-Aware Communication Multiple Access Distributed Communication E Routing- Broadband Cooperative Communications Communication Relaying Resource Allocation in Pair-Wise Communication OFDM - Communication OFDM Systems with Multiple Relays- Communication with Slotted Aloha-Communication with CSMA/CA throughput Optimal Scheduling Protocols For Communication Networks

Assessment: Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam

Course outcomes:

Students earning credits will develop ability to:

1. Illustrate elements of communication and networking – architectures, standards.
2. Understand the communication principles: RFID – Zigbee – Bluetooth.
3. Understand the communication and relay channels- characteristics of wireless channels convert analog signals to digital signals.
4. Understand the different digital modulation techniques.
5. Understand the networking cognitive multiple access via communication

Text/Reference Books:

1. Y.W. Peter Hong, Wan-Jen Huang C.-C. Jay Kuo, "Cooperative Communications and Networking", Springer edition,2013
2. K. J. Ray Liu, Ahmed K. Sadek, Weifeng Su and Andres Kwasinski, "Cooperative Communications and Networking", Cambridge University Press New York, USA
3. Murat Uysal, "Cooperative Communications for Improved Wireless Network Transmission: Framework for Virtual Antenna Array Applications", Information Science Reference, Hershey- New York, 2012
4. 4. Yan Zhang, Hsiao-Hwa Chen, Mohsen Guizani, "Cooperative Wireless Communications", CRC Press, 2014
5. W. Tomasi "Electronic Communications Systems", Pearson Education Pvt. Ltd.
6. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014.Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004.
7. B. P. Lathi, "Modern Analog and Digital Communication Systems",

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	Advanced Embedded System	**3L: 0T: 0P (03 hrs.)**	**Credits: 03**

Recommended Prerequisites : Fundamentals of embedded system, Processors

Course Objectives: The course is designed to cover advanced embedded System, Processor Technology, Architectural Issues, Interfacing of Microcontroller & architecture of arm cortex.

MODULE I **(8 hrs.)**

Embedded System Overview: Embedded System definition. Processor Technology: General purpose, Single Purpose, Application Specific, Super scalar, Pipelined, Very Long Instruction Word (VLIW) Processor, Microprocessors, Micro controllers and DSP Processors. Embedded Processors in VLSI circuit.

MODULE II **(8 hrs.)**

Architectural Issues: CISC, RISC, DSP and Harvard/Princeton Architectures. Memory: ROM, EPROM, EEPROM, FLASH, RAM, SRAM, DRAM, SDRAM, NVRAM, EDORAM, DDRRAM, Memory Hierarchy and Cache. Interfacing: Interfacing using Glue Logic, Interrupt, DMA, I/O Bus structure, I/O devices, Serial Communication Protocols, Parallel Communication Protocols, Wireless Protocols.

MODULE III **(8 hrs.)**

Interfacing of Microcontroller such as SPI, PWM, WDT, Input Capture , Output Compare Modes, Interfacing LED, Switches, ADC, DAC, LCD , RTC. Idea about the C programming of Microcontroller. I2C, CAN bus architecture

MODULE IV **(8 hrs.)**

Introduction to 16/32-bit microcontrollers. Introduction to ARM Architecture and Organization, Difference between ARM7, ARM9 & ARM11 TDMI, ARM programming model, ARM Instruction set.

MODULE V **(8 hrs.)**

ARCHITECTURE OF ARM CORTEX – M4 (9) ARM Cortex-M4 Processor Core overview - Programmers Model - Memory Model - Exception and Fault Handling - Power Management - Instruction Set Summary - CMSIS Functions - Hardware-Software Synchronization - Interrupt Synchronization - Multithreading - Register Map - System Timer - Nested Vectored Interrupt Controller - Floating Point Unit (FPU)-Optional Memory Protection Unit

Course Outcomes:

Students earning credits will develop ability to:

1. To understand overview of embedded system and processor.
2. To design & understand CIRC, RISC and various architectures issues.
3. To understand different types of Interfacing of Microcontroller
4. To understand the ARM Architecture and Organization
5. To design and understand architecture of arm cortex

List of Experiments:

1. To study development tools/environment for ATMEL/PIC microcontroller program and Architecture.
2. To write an assembly language program to add, subtract, multiply, divide 16 bit data by Atmel microcontroller.
3. To write an assembly language program to generate 10 KHz frequency using interrupts on P1.2.
4. To study and analyze the interfacing of 16 x 2 LCD.
5. To implement, analyze the interfacing of seven segment display.
6. To study and Program Transmission and Reception of data through serial port.
7. Interfacing of Stepper motor
8. 7 Interfacing of Temperature sensor and Relay control.
9. Implement the lighting and winking LEDs of the ARM I/O port via programming.
10. ISR (Interrupt Service Routine) programming in ARM based systems with I/O port.

Text/References Books:

1. Dr. RajKamal, Embedded Systems, TMH, 2nd edition 2008.
2. K. J. Ayala , 8051 Microcontrollers, Penram International, 3nd Edition 2007M. A. Mazidi & J. G. Mazidi, 8051 Microcontroller and Embedded System, Pearson Education Asia 2nd edition 2006.
3. J. W. Valvano, Embedded Microcomputer Systems - Real Time Interfacing, Thomson Asia Pte. Ltd. 2nd edition 2012.
4. R. H. Barnett, 8051 family of Microcontrollers, PHI, 2nd edition 2012.
5. Peter Spasov, Microcontroller Technology: The 68HC11, PHI, 4th Edition 2001.
6. Dr. Rajkamal, Microcontrollers (Architecture, Programming, Interfacing and System Design), Pearson Education. 3nd Edition 2009
7. John H. Davies, ―MSP430 Microcontroller Basics‖, First Edition, Newnes Publication, ISBN: 978- 93-80501-85-7, 2010.
8. C.P.Ravikumar. ―MSP430 Microcontroller in Embedded System Project‖, First Edition, Elite Publishing House Private Ltd, Dec , ISBN:978-81-88901-46-3, 2011

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	IOT Sensors	**3L: 1T: 0P (04 hrs.)**	**Credits:04**

Recommended Prerequisite: Fundamental of mathematics, DSP.

Course Objective: The purpose of this course is understand the different types of sensors & their applications with IoT.

MODULE I **(8 hrs.)**
Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structureof IoT– IoT Map Device

MODULE II **(8 hrs.)**
IOT SENSORS: Industrial sensors – Description & Characteristics–First Generation – Description &Characteristics– Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Polytronics Systems – Description &Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics –Description & Characteristics–IoT Generation Roadmap.

MODULE III **(8 hrs.)**
Technological Analysis (Wireless Sensor Structure–Energy Storage Module–Power Management Module–Rf Module–Sensing Modul

MODULE IV **(8 hrs.)**
IoT Development Examples: Acoem Eagle – Enocean Push Button – Nest Sensor – Ninja Blocks - Focus On wearable Electronics.

MODULE V **(8 hrs.)**
IOT PROJECTS Creating the sensor project - Preparing Raspberry Pi/ ARM Cortex - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values – Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware -Creating a controller - Representing sensor values - Parsing sensor data – Calculating control states - Creating a camera - Hardware -Accessing the serial port on Raspberry Pi/ ARM Cortex - Interfacing the hardware - Creating persistent default settings – Adding configurable properties - Persisting the settings - Working with the current settings -Initializing the camera.

Course Outcomes:

1. Students earned credits will develop ability to understand Scope–Sensors for IoT Applications
2. Students will be able to understand the different type of IoT sensors.
3. Students will able understand the technological analysis of sensors.
4. Students will able understand the IoT Development Examples

5. Students will be able to make IoT projects.

List of Experiments:

Text/Reference Books:

1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Editors OvidiuVermesan Peter Friess,'Internet of Things – From Research andInnovation to Market
4. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014

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	Python & IoT Applications	**3L: 0T: 0P (03 hrs.)**	**Credits: 03**

Prerequisite:-Embedded C, Microcontroller Programming.

Course Objective: The purpose of this subject is to understand principles and of IOT in electronics and communication & the programming of python.

MODULE I **(8 hrs.)**

Python Concepts, Data Structures, Classes(9L) Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing, Data Wrangling(9L) Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, RegularExpression

MODULE II **(8 hrs.)**

Data Aggregation, Group Operations, Time series & Web Scrapping (9L) GoupBy Mechanics – Data Aggregation – GroupWise Operations and Transformations – Pivot Tables and CrossTabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting. Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pagesthrough form submission – CSS Selectors Implementation using Raspberry Pi (9L) Working with Raspberry Pi 3 Model - Installing OS and Designing Systems using Raspberry pi

MODULE III **(8 hrs.)**

Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function virtualization) for IOT, data storage in IOT, IOT Cloud Based Services, Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, MQTT, CoAP, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

MODULE IV **(8 hrs.)**

Sensor Technology, Industrial IOT and Automotive IOT, Actuator, Sensor data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Network Technology.IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi &arduinodevices.IOT Case studies: smart city streetlights control & monitoring.

MODULE V **(8 hrs.)**

Introduction to R, LORAWAN and IOT WIFI Modules like ESP8266 series, AT Commands, Interfacing with microcontroller, server, data transfer in IOT, Design of IOT systems like temperature logger, actuator etc.

Assessment: Internal viva, Continuous evolution of experiments, Quiz and End semester exam.

Course outcome:
Students earning credits will develop ability to:

1. Understand the basics of python programming.
2. Understand the Data Aggregation, Group Operations & other terminology for python programming.
3. Understand the Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function virtualization) for IOT.
4. Understand the Sensor Technology, Industrial IOT and Automotive IOT
5. Understand the R, LORAWAN and IOT WIFI Modules.

List of Experiments:

1. Write a python program to add two numbers.
2. Write a python program to find largest numberamong three numbers.
3. Write a program for filter() to filter only evennumbers from a given list
4. Write a python program to check whether thegiven string is palindrome or not.
5. Write a python program to find factorial of a givennumber using functions.
6. Write a python program to that accepts length of three sides of a triangle asinputs. The program should indicate whether or not the triangle is a right-angled triangle (use Pythagorean theorem)
7. Write a Python class to convert an integer to a roman numeral.

Text/Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of things(A-Hand-on Approach)”1st Edition, Universal Press 2014.
2. Francis dacosta “Rethinking the Internet of things: A scalable Approach to connecting everything”, 1st edition, Apress publications 2013.
3. Hakima Chaouchi “The Internet of Things: Connecting Objects”, 1st edition, Wiley publication 2010.
4. Donald Norris “The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black”, 1st edition, McGraw Hill publication 2015.
5. Mark Lutz, “Learning Python”, O'Reilly Media, 5th Edition, 2016.
6. White, “Hadoop: The Definitive Guide”, Third Edition - O’Reilly, 2012.
7. Brandon Rhodes and John Goerzen, “Foundations of Python Network Programming: The ComprehensiveGuide to Building Network Applications with Python”, Apress, Second Edition, 2016.

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