ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

MINOR

Subject: Internet of Things

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Digital Electronics	3	3
			Digital Electronics Practical Course	2	1
II	III	2	Introduction to ARM Microcontroller	3	3
			Introduction to ARM Microcontroller Practical Course	2	1
	IV	3	Communication Systems	3	3
			Communication Systems Practical Course	2	1
		4	Embedded Systems Design with STM-32	3	3
			Embedded Systems Design with STM-32 Practical Course	2	1
III	V	5	Robotics and its Applications	3	3
			Robotics and its Applications Practical Course	2	1
		6	Fundamentals of IOT and Applications	3	3
			Fundamentals of IOT and Applications Practical Course	2	1

SEMESTER-II

COURSE 1: DIGITAL ELECTRONICS

Theory Credits: 4 5 hrs/week

OBJECTIVES

More broadly, they will be ready to handle substantial and challenging design problems. In particular, students will be able to:

- Explain the elements of digital system abstractions such as digital representations of information, digital logic, Boolean algebra, state elements and finite state machine (FSMs).
- Design simple digital systems based on these digital abstractions, using the "digital paradigm" including discrete sampled information.
- Use the "tools of the trade": basic instruments, devices and design tools.
- Work in a design team that can propose, design, successfully implement and report on a digital systems project.
- Communicate the purpose and results of a design project in written and oral presentations.

COURSE OUTCOMES

Student will be able to

- Describe how analog signals are used to represent digital values in different logic families, including characterization of the noise margins.
- Create the appropriate truth table from a description of a combinational logic function.
- Create a gate-level implementation of a combinational logic function described by a truth table using and/or/inverter gates, MUX‘S or ROMs, and analyse its timing behaviour.
- Create a state transition diagram from a description of a sequential logic function and then convert the diagram into an implementation of a finite-state machine with the appropriate combinational and sequential components.
- Describe the operation and timing constraints for latches and registers.
- Draw a circuit diagram for a sequential logic circuit and analyse its timing properties (input setup and hold times, minimum clock period, output propagation delays).
- Evaluate combinational and sequential logic designs using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power
- Properly incorporate synchronous and asynchronous memories into a circuit design.

NUMBER SYSTEM AND CODES:

UNIT-I

Decimal, Binary, Hexadecimal, Octal BCD, Conversions, Complements (1‘s,2‘s, 9‘s and 10‘s), Addition, Subtraction, Grey, Excess-3, inter Code conversion between number system.

UNIT-II

BOOLEAN ALGEBRA AND THEOREMS:

Boolean Theorems, De Morgan‘s laws. Digital logic gates, Multilevel NAND & NOR gates. Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh Map Method: 4 variables), don‘t care condition.

Unit-III
IC LOGIC FAMILIES:

Digital Logic Families: Characteristics of logic families – fan in, fan out, power dissipation, propagation delay, noise margin., DTL, ECL, RTL, TTL and CMOS logic circuits- Inverter, NAND , NOR. Bi- CMOS Inverter and its characteristics.

UNIT-IV
COMBINATIONAL DIGITAL CIRCUITS:

Adders: Half & full adder, Subtractor – Half and Full Subtractor, Parallel binary adder, Magnitude Comparator, Multiplexers (2:1, 4:1)) and De-multiplexers (1:2, 4:1) , Encoder (8- line-to-3-line) and Decoder (3-line-to-8-line).

UNIT-V
SEQUENTIAL DIGITAL CIRCUITS:

Flip -Flops: S-RFF,J-KFF,T and D type FFs , Master –Slave FFs ,Excitation tables , Registers: shift left register, shift rightregister,Counters-Asynchronous-Mod16, Mod-10, Mod-8, Downcounter,,Synchronous-4-bit&Ring counter.

TEXTBOOKS:

1. M.MorrisMano, –Digital Design– 3rd Edition, PHI, New Delhi.
2. RonaldJ.Tocci.―Digital Systems-Principles and Applications‖6/e.PHI.New Delhi. 1999.(UNITSI to IV)
3. G.K.Kharate-Digital electronics-oxford university press
4. S.Salivahana & S.Arivazhagan- Digital circuits and design
5. Fundamentals of Digital Circuits by Anand Kumar

ReferenceBooks:

1 Herbert Tau band Donald Schilling. –Digital Integrated Electronics‖ .McGraw-Hill. 1985.

2 S.K.Bose.―DigitalSystems‖.2/e. New Age International.1992.

3 D.K. Anvek arand B.S. Sonade. "Electronic Data Converters: Fundamentals& Applications".TMH.1994.

Malvino and Leach."Digital Principles and Applications". T MG Hill Edition.

SEMESTER-III

COURSE 2: INTRODUCTION TO ARM MICROCONTROLLER

Theory Credits: 4 5 hrs/week

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.

Course Outcomes:

1. Expected to understand the selection procedure of Processors in the embedded domain.
2. Design Procedure for Embedded Firmware.
3. Expected to visualize the role of Real time Operating Systems in Embedded Systems
4. Expected to evaluate the Correlation between task synchronization and latency issues

Unit – I: ARM7 Microcontroller Architecture

Introduction to the ARM Microcontrollers –LPC2148 ARM 7 Microcontroller – Features of LPC2148 – Block Diagram of LPC2148 – Pin Diagram of LPC2148 – Architectural Overview – On-Chip Flash Program Memory – On-Chip Static RAM.

Unit – II: System Control- Memory Map- Pin Connect Block- GPIO

External Interrupt Input – Memory Mapping Control – Power Control- VPB – Memory Map – Pin Connect Block – General Purpose I/O Features.

Unit – III: Timer- Interrupt and Serial Communication

General Purpose Timer – External Event Counters: Features – Interfacing Timer and Counter Operation – Interrupts on the ARM 7 – Interrupt Sources – External Interrupt – UART s Features – Serial Communication – RS 232 – RS 485.

Unit – IV: I^2C- SPI- PWM- Watchdog Timer and Memory Card Interfacing

I^2C Bus Serial I/O Controller – Interfacing With AT24C1024 – SPI Port Operation – Interfacing with 25LC040– Real Time Clock – SD Memory Card Basics – SPI Memory Card Operation in SPI Mode - LPC 2148 Interfacing with SD Memory Card.

Unit – V: Interfacing Digital Input and Output

Interfacing LEDs and Switches – Interfacing Keypads – Interfacing Seven Segment Display – Interfacing LCD –Interfacing Temperature Sensor LM35 – 10bit DAC Features - Interfacing DAC – PWM Audio.

Text and Reference Books:

1. Steve Furber- ARM System-on-Chip Architecture- Second Edition- Pearson-2012.
2. Wayne Wolf- Computer as Components: Priciples of Embedded Computing System Design- Third Edition-Morgan Kaufmann Publication.
3. J.R.Gibson- ARM Assembly Language- Second Edition- Cengage Learning
4. Trevor Martin- Hitex- ARM7-Based Microcontrollers-The Insider‘s Guide To The Philips.
5. Warwick A.Smith- ARM Microcontroller Interfacing Hardware and Software- Elektor (www.elecktor.com)

SEMESTER-IV

COURSE 3: COMMUNICATION SYSTEMS

Theory Credits: 4 5 hrs/week

COURSE OBJECTIVES:

The purpose of this course is to provide a thorough introduction to analog and digital communications with an in depth study of various modulation techniques, Random processes are discussed, and information theory is introduced.

OUTCOMES:

1) Student understand the basic signals and systems

2) Knowledge in various methods of analog and digital communications, including amplitude (AM), frequency modulation (FM), and phase modulation (PM).

3) Student understand the basic knowledge necessary for transmitting and receiving information

4) Student understand different types of modulation and demodulation

5) Student can solve analog and digital modulation problems

Assignments that demonstrate accomplishment of this outcome: Simulate the modulation and demodulation of signals.

UNIT- I: INTRODUCTION TO COMMUNICATIONS:

Introduction Communication Process, Source of Information, Communication channels, base-band and pass-band signals, different types of PDF, need of modulation process, primary communication resources, analog versus digital communications.

UNIT-2: AMPLITUDE MODULATION:

Modulation-types of modulations- Block Diagram and Explanation of Radio transmitter and radio Receiver, Analysis of AM wave ,Side Bands, Power and Current Relations, Simple AM Circuit and it‘s working, detection of AM – Diode Detector.

UNIT-3: ANGLE MODULATION:

Angle Modulation Narrow and wide band FM, Direct & Indirect FM generations, Advantages of FM, frequency spectrum Analysis, phase modulation- Analysis of PM wave - Demodulation of FM signals-ratio detection-Differences between AM,FM,PM.

UNIT-4: PULSE MODUATION:

Pulse Modulation -Pulse amplitude, width & position modulation, generation & detection of PAM, PWM & PPM, Types of multiplexing-FDM, TDM-Comparison of frequency division and time division multiplexed systems.

UNIT-5: DIGITAL COMMUNICATIONS

Basics of digital communications-Amplitude shift keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Differential Shift Keying (DPSK) -Noise Different types of noise, noise calculations, equivalent noise band width, noise figures, effective noise temperature, noise figure.

Text & References:

Text:

1. B. P. Lathi: ―Modern analog & digital communication‖, OXFORD Publications
2. Wayne Tomasi: ‖Electronic Communication systems‖, Pearson Education, 5th edition

References:

1. Simon Haykin, ―Communication Systems‖, John Wiley & Sons, 1999, Third Edition.
2. Taub and schilling, –Principles of Communication Systems‖ TMH

SEMESTER-IV

COURSE 4: EMBEDDED SYSTEMS DESIGN with STM-32

Theory Credits: 4 5 hrs/week

COURSE OBJECTIVES:

For embedded systems, the course will enable the students to:

1. Understand the basics of an embedded system.
2. Understand the typical components of an embedded system.
3. To understand different communication interfaces.
4. To learn the design process of embedded system applications.
5. To understands the RTOS and inter-process communication.

COURSE OUTCOMES:

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

1. Understand the design process of an embedded system.
2. Understand typical embedded System & its components .
3. Understand embedded firmware design approaches .
4. Learn the basics of OS and RTOS.

UNIT-I

INTRODUCTION TO EMBEDDED SYSTEMS

History of embedded systems, Classification of embedded systems based on generation and complexity, Purpose of embedded systems, The embedded system design process-requirements, specification, architecture design, designing hardware and software, components, system integration, Applications of embedded systems, and characteristics of embedded systems.

UNIT-II TYPICAL EMBEDDED SYSTEM

Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, Sensors, actuators, I/O components: seven segment LED, relay, piezo buzzer, push button switch, other sub-systems: reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

UNIT-III EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT

Embedded firmware design approaches-super loop based approach, operating system based approach; embedded firmware development languages-assembly language based development, high level language based development.

UNIT-IV RTOS BASED EMBEDDED SYSTEM DESIGN

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-pre-emptive and pre-emptive scheduling; task communication-RTOS-Device Drivers.

UNIT -V:STM32F4 PERIPHERALS & PROGRAMING

STM32F4 PERIPHERALS & PROGRAMING GPIO, General Purpose Timers, GPIO: Introduction, Main Features, Function Description, Registers, Basic timers (TIM6&TIM7): introduction, main features, functional description, registers Embedded C Programming for GPIO and Timers- STM32 TIMERS, ADC, & DAC -Timers Basics, General Purpose Timer, Sys-Tick Timer, ADC & DAC Basics, Initialization, DAC Peripherals & Modules

TEXT BOOKS:

1. Introduction to Embedded Systems - shibu k v, Mc Graw Hill Education.
2. Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).
3.Shibu K V, ―Introduction to Embedded Systems‖, Tata McGraw Hill Education Private Limited, 2nd Edition
4.Noviello, Carmine. "Mastering STM32." Obtenido de http://www2. keil. com/mdk5/uvision,2017.

REFERENCE BOOKS:

1. Embedded System Design -frank vahid, tony grivargis, john Wiley.
2. Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.
3. Embedded Systems – Raj Kamal, TMH
4.1.STM32F10xx User Manual

SEMESTER-V

COURSE 5: ROBOTICS AND ITS APPLICATIONS

Theory Credits: 4 5 hrs/week

Course Objectives:

1. To introduce basic concepts, parts of robots and types of robots.

2. To make the students familiar with various drive systems of robots, sensors and their applications in programming of robots .

3. To discuss the applications of robots, and implementations of robots.

Course Outcome:

1. Explain the basic concepts of working of robot

2. analyse the function of sensor in robot and design the robotic arm with various tools

3. Program the robot for a typical application and path planning using robotic vision

4. Understand the various robot programming languages

5. Conduct and design the experiments for various robot operations

6. Use the advanced techniques for robot processing

UNIT1:

Introduction, brief history, types, classification and usage, science and technology of robots, Artificial Intelligence in Robotics.

UNIT2:

Elements of Robots-Joints, Links, Actuators, and Sensors Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kind of actuators, stepper-DC-servo-and brushless motors- model of a DC servo motor-types of transmissions-purpose of sensor-internal and external sensor-common sensors-encoders-tachometers-strain gauge-based force torque sensor-proximity and distance measuring sensors-and vision

UNIT3

End Effectors Classification of end effectors-tools as end effectors-drive system for grippers-mechanical adhesive- vacuum magnetic-grippers-hooks and scoops-gripper force analysis-and gripper design active and passive grippers

UNIT4

Planning and Navigation Introduction, path planning-overview-road map path planning-cell decomposition path planning potential field path planning-obstacle avoidance-case studies

Vision system Robotic vision systems-image representation-object recognition-and

categorization-depth measurement- image data compression-visual inspection-software considerations

UNIT5

Robot Programming Introduction to robot languages-VAL-RAPID-language-basic commands-motion instructions pick and place operation using industrial robot manual mode-automatic mode-subroutine command-based programming-move master command language-introduction-syntax-simple problems

Field and service robots / Industrial Robots Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian and military applications ect,.

Reference books,

- INTRODUCTION TO ROBOTICS: S Saha
- 123 Robotics Experiments for the Evil Genius
- Introduction to Autonomous Mobile Robots 2e (Intelligent Robotics & Autonomous Agents Series)
- Robotics Appuu K.K. Kuttan
- Introduction To Robotics : Analysis, Control, Applications (English) 2nd Edition

SEMESTER-V

COURSE 6: FUNDAMENTALS OF IOT AND APPLICATIONS

Theory Credits: 4 5 hrs/week

Course Objectives

1. To study fundamental concepts of IoT
2. To understand roles of sensors in IoT
3. To Learn different protocols used for IoT design
4. To be familiar with data handling and analytics tools in IoT
5. Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.
6. Understand the role of IoT in various domains of Industry.

Course Outcomes:

On completion of the course, student will be able to

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems
4. Use various techniques of data storage and analytics in IoT
5. Understand various applications of IoT
6. Understand APIs to connect IoT related technologies

UNIT-I

Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

UNIT-II

Sensors Networks: Definition, Types of Sensors, Types of Actuators, Examples and Working

IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components,

Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

UNIT-III

Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.

IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.

Edge connectivity and protocols

UNIT-IV

Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications

UNIT-V

Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.

Text Books:

1. Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
3. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on- Approach)", 1st Edition, VPT, 2014.
4. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
5. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.

References

1. Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
3. https://onlinecourses.nptel.ac.in/noc17_cs22/course
4. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

RECOMMENDED CO-CURRICULAR ACTIVITIES:

(Co-curricular activities shall not promote copying from textbook or from others work and shall encourage self/independent and group learning)

A. Measurable

1. Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
2. Student seminars (on topics of the syllabus and related aspects (individual activity))
3. Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams))
4. Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity))

B. General

1. Group Discussion
2. Try to solve MCQ's available online.
3. Others

RECOMMENDED CONTINUOUS ASSESSMENT METHODS:

Some of the following suggested assessment methodologies could be adopted;

1. The oral and written examinations (Scheduled and surprise tests),
2. Closed-book and open-book tests,
3. Problem-solving exercises,
4. Practical assignments and laboratory reports,
5. Observation of practical skills,
6. Individual and group project reports like "Developing IoT real time application using Arduino".
7. Efficient delivery using seminar presentations,
8. Viva voce interviews.
9. Computerized adaptive testing, literature surveys and evaluations, Peers and self-assessment, outputs form individual and collaborative work