B. Tech with

HONORS

in

EMBEDDED SYSTEMS AND IOT

Academic Regulations, Course Structure and Syllabus

Effective from 2023-24 admitted batches

Offered by

Department of Electronics and Communication Engineering

KSRM College of Engineering (A) – Kadapa

(Approved by AICTE, Accredited by NAAC with A+ Grade and NBA and Affiliated to JNTUA, Anantapuramu)

ELIGIBILITY / REGISTRATION / AWARD OF HONORS

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The program is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) Those students with **at least 7.0 CGPA without any course backlogs up to III Semester in the major degree are only eligible to register for Honor degree**.

iii) A student shall earn **additional 18 credits for award of Honors** from same branch / department / discipline registered for major degree. This is in addition to 163 credits by a regular student and 123 Credits by a Lateral Entry student for the award of Major degree.

iv) A student is permitted to register for Honors in IV Semester after the results of III Semester are declared. Students shall register and pass in all the courses prescribed and being offered from V semester under the respective Honor degree.

v) Students have to attend classwork for courses under Honor degree beyond regular academic hours meant for major degree. Students can also undergo the courses under Honor through any proctored online platforms with the prior approval of the BoS Chairman and the HoD of the respective department offering Honor degree.

vi) The attendance for the registered courses under Honors and regular courses offered for Major degree in a Semester will be considered separately.

vii) A student shall have an aggregate of 75% attendance in all courses registered under Honors in that particular semester to become eligible for attending Semester-End examinations.

viii) The registration for the Honor will be cancelled, if the student is detained due to lack of attendance in Major,

ix) The registration for the Honor will be cancelled, if the student fails in any course of either Honor / Major in any semester from V to VIII Semester.

x) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) will be awarded for Honors degree program.

xi) A separate grade sheet will be issued for the Honor degree courses semester-wise.

xii) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra.

xiii) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical

Engineering.

xiv) There shall be a minimum enrolment of 20% OR 20 enrollments from the list of eligible students to offer Honors program.

xv) There is no fee for registration of courses for Honors program offered.

xvi) A student can register for either Minor / Honor but not both.

xvii) Student shall submit an application for either Minor / Honor at least one week before the commencement of the V Semester.

HONORS PROGRAMS OFFERED

Offering Department	Title	Who can Register
Civil Engineering	Civil Engineering	B.Tech. CE
	Tunnel Engineering	
	Interior Design	
Mechanical Engineering	Mechanical Engineering	B.Tech. ME
Electrical and Electronics Engineering	Electric Vehicles	B.Tech. EEE
Electronics and Communication Engineering	VLSI	B.Tech. ECE
	Embedded Systems and IoT	
Computer Science and Engineering	Computer Science and Engineering	B.Tech. CSE, B.Tech. AIML, B.Tech. CSE(DS), B.Tech. CSE(AIML)
	Artificial Intelligence and Machine Learning	
	Data Science	
	CSE-Artificial Intelligence and Machine Learning	

COURSE STRUCTURE

for

HONORS

in

EMBEDDED SYSTEMS AND IOT

S. No	COURSE CODE	COURSE TITLE	Semester Offered	L	T	P	IM	EM	CR
1	2304581H	IOT Architecture and Applications	V	3	0	0	30	70	3
2	2304582H	Real Time Embedded systems design and Analysis	V	3	0	0	30	70	3
3	2304681H	ARM based Embedded System Design	VI	3	0	0	30	70	3
4	2304682H	System Design with Embedded Linux	VI	3	0	0	30	70	3
5	2304781H	Industrial IOT 4.0	VII	3	0	0	30	70	3
6	2304782H	Applied Project Work	VII	0	0	6	60	140	3
			Total	**15**	**0**	**6**	**210**	**490**	**18**

2304581H	HONORS IN EMBEDDED SYSTEMS AND IOT IOT ARCHITECTURE AND APPLICATIONS (ECE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Nil

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Comprehend the essentials of IoT and its applications.
CO2. Understand the concepts of IoT Architecture
CO3. Analyse various IoT Application Layer Protocols.
CO4. Apply IP based protocols and Authentication Protocols for IoT.
CO5. Design IoT-based systems for real-world problems.

SYLLABUS

UNIT - I: INTRODUCTION TO IoT (11 Periods)

Introduction to IoT, Applications of IoT, Use cases of IoT

UNIT - II: IoT Reference Model for Logistics and Health (10 Periods)

The IoT architectural reference model as enabler, IoT in practice. Examples: IoT in logistics and health IoT reference model: domain, information, functional and communication models.

UNIT - III: IoT REFERENCE ARCHITECTURE (10 Periods)

Architecture, Functional, information, deployment and operation views, SOA based Architecture, API-based Architecture, OPENIoT Architecture for IoT/Cloud Convergence.

UNIT-IV: APPLICATION PROTOCOLS forIoT (07 Periods)

UPnP, CoAP, MQTT, XMPP. SCADA, Web Socket, IP-based Protocols: 6LoWPAN, RPL; Authentication Protocols; IEEE 802.15.4.

UNIT-V: CASE STUDY (07 Periods)

Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.

Total Periods: 45

TEXT BOOKS:

T1. Enabling things to talk, Bassi, Alessandro, et al, Springer-Verlag Berlin An, 2016.

T2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of
Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,
CISCO Press, 2017.

T3. Internet of Things (A Hands-on- Approach), Vijay Madisetti and ArshdeepBagha, VPT, 2014,
First Edition

REFERENCE BOOKS:

R1. The internet of things: Key applications and protocols, Hersent, Olivier, David Boswarthick,
and Omar Elloumi.John Wiley & Sons, 2011.

R2. Internet of Things:Principles and Paradigms Bunya, Rajkumar, and Amir VahidDastjerdi, eds
Elsevier, 2016.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. https://nptel.ac.in/courses/108104139
3. https://nptel.ac.in/courses/108106172
4. https://nptel.ac.in/courses/117106108

2304582H	HONORS IN EMBEDDED SYSTEMS AND IOT REAL TIME EMBEDDED SYSTEMS DESIGN AND ANALYSIS (ECE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Nil

Course Outcomes:

After successful completion of the course, the student will be able to

CO1. Explain the architecture of RTOS, task scheduling, and synchronization mechanisms such as semaphores, mutexes, and message queues.
CO2. Demonstrate proficiency in real-time embedded software development using Linux, RT Linux, and various RTOS platforms.
CO3. Apply real-time scheduling algorithms to optimize task execution and system performance.
CO4. Analyze real-time embedded hardware architectures and software stacks for efficient system integration.
CO5. Implement real-time communication protocols and perform validation and verification of embedded systems using case studies.

SYLLABUS:

UNIT - I: INTRODUCTION TO RTOS (09 Periods)

Overview Of RTOS, Architecture of Kernel, Task & Task Scheduler, ISR, Semaphore, Mutex, mailbox, Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority Inversion Problem.

UNIT - II: REAL TIME EMBEDDED SOFTWARE (09 Periods)

Linux, RT Linux, multiprocessor software developments, data flow graph, Study and programming of RTOS like RTX51, Free RTOS etc. timing diagram analysis for fixed and dynamic priority software services.

UNIT - III: REAL TIME SCHEDULING (09 Periods)

Scheduling Real-Time Tasks: Types of Schedulers Table-driven Scheduling Cyclic schedulers EDF RMA, Priority Pre-emptive Scheduler State Machine for Linux and VxWorks, Comparison of Cyclic Executive, Introduction to Worst Case Analysis, Example of scheduling, Real-Time Scheduling and Rate Monotonic Least Upper Bound.

UNIT - IV: OVERVIEW OF REAL-TIME HARDWARE ARCHITECTURES AND SOFTWARE STACKS (08 Periods)

Embedded Linux on the Raspberry Pi ARM A-Series System-on-Chip processors, Tracing Linux kernel and network stack events. Best Practices for RTES Programming, System Integration Testing (Hardware, Firmware, and Software),

UNIT - V: REAL TIME COMMUNICATION (10 Periods)

RT Services Communication and Synchronization, Performance of two Real-Time Communication Protocols, Real time communication over network, Real Time database.

Verification and Validation of RTES project: Using Point-to-point Serial and TCP/IP for Embedded Systems, Case Study of Coding for Sending Application Layer Byte Streams on A TCP/IP Network Using RTOS. Building a simple Linux multi-service system using POSIX real-time extensions on Raspberry Pi 3b using sequencing and methods to log and verify agreement between theory and practice.

Total Periods: 45

TEXT BOOKS:

T1. Embedded Real Time systems, Prasad, Dreamtech Wiley Publication,2003.
T2. Real-Time Systems: Theory and Practice, Rajib Mall Pearson,2008.

REFERENCE BOOKS:

R1. Real-Time Systems Design and Analysis, Philip Laplante, Prentice Hall, 2013, Second Edition.

WEB RESOURCES:

1. https://www.youtube.com/watch?reload=9&v=hek-CUcLlTw
2. https://learning.windriver.com/vxworks-essentials-the-basics

2304681H	HONORS IN EMBEDDED SYSTEMS AND IOT ARM BASED EMBEDDED SYSTEM DESIGN (ECE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Nil

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Understand the ARM Processor, Architecture, and Instructions, Addressing modes and conditional instructions.
CO2. Analyse the applications in various processors and domains of embedded systems.
CO3. Demonstrate advanced controllers using thumb instruction for embedded system design.
CO4. Develop embedded hardware and software development cycles and tools.
CO5. Understand the concept of Memory management unit and integration methods.

SYLLABUS:

UNIT - I: ARM ARCHITECTURE (09 Periods)

ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

UNIT - II: ARM PROGRAMMING MODEL – I (09 Periods)

Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT - III: ARM PROGRAMMING MODEL – II (09 Periods)

Thumb Instruction Set, Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions.

UNIT - IV: ARM PROGRAMMING (09 Periods)

Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating-Point arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

UNIT - V: MEMORY MANAGEMENT (09 Periods)

Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access

Permissions, Context Switch.

Total Periods: 45

TEXT BOOKS:

T1. ARM Systems Developer's Guides- Designing & Optimizing System Software – Andrew N.Sloss, Dominic Symes, Chris Wright, Elsevier,2008.
T2. Professional Embedded ARM Development-James A Langbridge, Wiley/Wrox.

REFERENCE BOOKS:

R1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes/ Cole, Thomas Learning, 1999.
R2. ARM System on Chip Architecture, Steve Furber, Pearson, Second Edition.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. https://nptel.ac.in/courses/108104139
3. https://nptel.ac.in/courses/108106172
4. https://nptel.ac.in/courses/117106108

2304682H	HONORS IN EMBEDDED SYSTEMS AND IOT SYSTEM DESIGN WITH EMBEDDED LINUX (ECE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Nil

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Differentiate between Embedded Linux and Desktop Linux in terms of architecture and application.
CO2. Demonstrate knowledge of the Embedded Linux development environment, toolchains, and kernel configuration.
CO3. Develop and debug device drivers and user-space applications in Embedded Linux.
CO4. Build and customize Embedded Linux BSPs for target hardware platforms.
CO5. Apply real-time Linux concepts for porting and executing real-time applications.

SYLLABUS:

UNIT - I: INTRODUCTION TO REAL TIME OPERATING SYSTEMS

(10 Periods)

Characteristics of RTOS, Task specifications and types, Real-Time Scheduling Algorithms, Concurrency, Inter-process Communication and Synchronization mechanisms, Priority Inversion, Inheritance and Ceiling. Embedded Linux Vs Desktop Linux, Embedded Linux Distributions, System calls, Static and Dynamic Libraries, Cross Tool Chains.

UNIT - II: EMBEDDED LINUX ARCHITECTURE (08 Periods)

Kernel Architecture – HAL, Memory Manager, Scheduler, File System, I/O and Networking Subsystem, IPC, User Space, Start-up Sequence.

UNIT - III: BOARD SUPPORT PACKAGE AND DEVICE DRIVERS

(12 Periods)

Embedded Storage: MTD, Architecture, Drivers, Embedded File System **Embedded Device Drivers:** Communication between user space and kernel space drivers, Character and Block Device Drivers, Interrupt Handling, Kernel Modules **Embedded Drivers:** Serial, Ethernet, I2C, USB, Timer, Kernel Modules.

UNIT - IV:PORTING APPLICATIONS AND REAL-TIME LINUX (08 Periods)

Linux and Real-Time Programming, Hard Real-Time Linux

UNIT - V: BUILDING AND DEBUGGING (07 Periods)

Bootloaders, Kernel, Root File System, Device Tree

Total Periods: 45

TEXT BOOKS:

T1. Mastering Embedded Linux Programming, Chris Simmonds, PACKT Publications Limited, Second Edition.
T2. Building Embedded Linux Systems, Karim Yaghmour, O'Reilly & Associates, First Edition.
T3. Embedded Linux System Design and Development, P. Raghavan, Amol Lad, SriramNeelakandan, Auerbach Publications, First Edition.

REFERENCE BOOKS:

R1. Embedded Linux Primer: A Practical Real-World Approach, Christopher Hallinan, Prentice Hall, 2010, Second Edition.
R2. Exploring Beagle Bone: Tools and Techniques for Building with Embedded Linux, Derek Molloy, Wiley, 2014, First Edition.

WEB RESOURCES:

1. https://elearn.nptel.ac.in/shop/nptel/embedded-linux-batch-2/?v=c86ee0d9d7ed
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-linux/?v=c86ee0d9d7ed
3. NPTEL : Linux Programming and Scripting (Electronics and Communication Engineering)
4. Embedded Systems Design Week 6 | NPTEL ANSWERS 2025 | #nptel2025 #myswayam #nptel

2304781H	HONORS IN EMBEDDED SYSTEMS AND IOT INDUSTRIAL IOT 4.0 (ECE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Nil

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explain the concept of Industry 4.0, its evolution, architecture, features, and applications.
CO2. Distinguish between IoT and IIoT, and describe IIoT architecture and components.
CO3. Apply smart sensing technologies and analytics in industrial processes.
CO4. Analyse safety and security requirements of industrial environments and implement IIoT-based solutions.
CO5. Evaluate IIoT applications in industrial healthcare, inventory management, and quality control.

SYLLABUS:

UNIT - I: INTRODUCTION TO INDUSTRY 4.0 AND IoT (09 Periods)

Industrial Revolution and Historical Context, Characteristics and Features of Industry 4.0, Design Requirements of Industry 4.0, Drivers of Industry 4.0 (Mega Trends, Tipping Point), Smart Business Perspective (Monitor, Control, Optimize, Automate), Characteristics of Smart Business Model, Impacts of Industry 4.0 (Economy Perspective, Business Perspective, Global Perspective), Applications of Industry 4.0 (Smart Factory and Manufacturing System, Smart City, Logistics, Agriculture, Public Transport, Construction, Food Production).

UNIT - II: INDUSTRIAL INTERNET OF THINGS (IIoT) (09 Periods)

Introduction to Industrial Internet of Things (IIoT), Comparison between IoT and IIoT, Prerequisites of IIoT, Architecture of IIoT, Industrial Sensing (Traditional Sensing, Contemporary Sensing), Smart Sensors, Applications of Smart Sensors in Industries (Agriculture, Health Care, Retail, Supply Chain, Manufacturing), Features of IIoT for Industrial Processes, Future Architecture of Industries.

UNIT - III: IIoT ANALYTICS AND APPLICATIONS (09 Periods)

Introduction to IIoT Analytics, Positive Impacts of Data Analytics on Industries, Categorization of Analytics (Descriptive, Predictive, Prescriptive, Streaming, Spatial, Time-Series), Artificial Intelligence (Machine Learning (ML), Deep Learning (DL)), Usefulness of IIoT Analytics, Challenges of Analytics in Industries, Mapping of Analytics with Industrial Internet Reference Architecture (IIRA), Applications of Analytics Across Value Chain.

UNIT - IV: PLANT SAFETY, SECURITY AND INDUSTRIAL HEALTHCARE

(09 Periods)

Introduction to Plant Safety, IIoT Applications for Safety Measures in Plant, Plant Security (Culture, Compliance, Capital), Network Security (Access Control, Antivirus and Anti-Malware Software, Application Security, Behavioral Analytics, Email Security, Firewalls, Intrusion Prevention Systems (IPS), Mobile Device Security, VPN, Web Security), Mobile Device Security (Endpoint Security, VPN, Secure Web Gateway (SWG), Email Security), Introduction to Health Care Applications in Industries, Major Challenges in Healthcare, IIoT-Based Health Care Systems, Smart Devices (Smart ECG Monitor, Smart Blood Pressure Monitor, Smart Body Temperature Monitor, Smart Oxygen Saturation Monitor, Smart Health Monitoring Chair).

UNIT - V: INVENTORY MANAGEMENT AND QUALITY CONTROL USING IoT **(09 Periods)**

Types of Inventory (Finished Goods, Work-in-Process, Raw Materials, Maintenance, Repair and Operating Supplies (MRO) Goods), Types of Inventory Management (Just-In-Time (JIT), Materials Requirement Planning (MRP), Economic Order Quantity (EOQ), Days Sales Inventory (DSI)), Integration of IIoT in Inventory Management, Benefits of IIoT in Inventory Systems, IIoT for Industrial Quality Control.

Total Periods: 45

TEXT BOOKS:

T1. Introduction to Industrial Internet of Things and Industry 4.0 by Sudip Mishra, Chandana Roy, and Anandrup Mukherjee, CRC Press, 2020.
T2. Introduction to IoT by Sudip Mishra, Anandarup Mukherjee, and Arjit Roy, Cambridge University Press, 2022.

REFERENCE BOOKS:

R1. Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance by R. Anandan, SuseendranGopalakrishnan, S. Pal, and N. Zaman, Wiley-Scrivener, 2022.
R2. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, Apress, 2017.

WEB RESOURCES:

1. https://www.epicor.com/en-us/blog/technology-and-data/what-is-industry-4 0/?utm_source=chatgpt.com
2. https://link.springer.com/article/10.1007/s42488-025-00146- 3?utm_source=chatgpt.com

2302772H	HONORS IN EMBEDDED SYSTEMS AND IOT APPLIED PROJECT WORK (ECE)	L	T	P	C
		0	0	6	3

Pre-Requisites: System Design with Embedded Linux, Industrial IOT 4.0

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Design IoT-based systems for real-world problems
CO2. Analyze real-time embedded hardware architectures and software stacks for efficient system integration.
CO3. Evaluate IIoT applications in industrial healthcare, inventory management, and quality control.
CO4. Apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.
CO5. work as a team and communicate results in an effective way.
CO6. Make decisions as an individual or as a team member to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.