

S13BLH13	ELECTRONIC DEVICES	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices.
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits with alternate electronic devices.
- To study Nano devices.

UNIT 1 BASIC SEMICONDUCTOR DEVICES 12 Hrs.

PN junction diode- construction and operation, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Breakdown in PN Junction Diodes. Applications- Rectifiers, Limiting and Clamping Circuits, Zener diode-construction and VI characteristics. Design and Experimental Verification of Diode Characteristics (PN and Zener) and applications (Rectifiers and Voltage Regulators).

UNIT 2 BIPOLAR JUNCTION TRANSISTORS 12 Hrs.

Bipolar junction transistors, NPN -PNP, construction, forward and reverse bias characteristics -Early effect, current equations-Input and Output characteristics of CE,CB,CC-Ebers Moll Model-Multi Emitter Transistor, Gummel Poon-model- Verification of Transistor Characteristics (CE,CB,CC).

UNIT 3 FIELD EFFECT TRANSISTORS 12 Hrs.

JFETs–Drain and Transfer characteristics,-Current Equations-Pinch off voltage and its significance- MOSFET-Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET,DUALGATEMOSFET- Non – Theoretical Comparison of JFET and MOSFET Characteristics.

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES 12 Hrs.

Schottky barrier diode-SCR, DIAC, TRIAC, Varactor diode, Tunnel diode, UJT, LDR, Phototransistor, Gallium Arsenide device- Heuristics approach to Special semiconductor devices, VI characteristics of special semiconductor devices.

UNIT 5 COMSOL MULTIPHYSICS 12 Hrs.

Introduction to COMSOL environment: Model Builder, Graphics window, Settings window, Results, Understanding the COMSOL workflow: Geometry creation - Building 2D and 3D geometries, Physics selection, Meshing, Physics Interfaces and Boundary Conditions: physics interfaces - Heat Transfer, Structural Mechanics, Fluid Flow, Electromagnetics, Applying boundary and initial conditions, Using material libraries and custom material definitions, Study types: Stationary, Time-dependent, Eigenfrequency, Parametric sweep.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** Apply the knowledge of basic semiconductor materials by understanding fabrication processes.
- CO2** Analyze the characteristics of various electronic devices
- CO3** Analyze the various circuit configurations and its classifications of BJT and MOSFETs.
- CO4** Analyze the characteristics of special semiconductor devices.

- CO5** Analyze the performance characteristics of various sensors.
CO6 Design of semiconductor devices using COMSOL Multiphysics.

TEXT / REFERENCE BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices", 4th Edition, Tata McGraw Hill Inc. 2012.
2. Wolfgang Fritzsche (Editor), Jürgen Popp (Editor) "Optical Nano- and Microsystems for Bio- analytics (Springer Series on Chemical Sensors and Biosensors Book 10)" 2012th Edition
3. Jun J. Liou (Editor), Shien-Kuei Liaw (Editor), Yung-Hui Chung (Editor), "Nano Devices and Sensors Hardcover – Import, 25 April 2016"
4. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A** MCQ Questions**20 Marks****PART B** Laboratory Practical**80 Marks**

SECB3040	EMBEDDED C PROGRAMMING	L	T	P	EL	Credits	Total Marks
		3	0	0	0		

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVE

- To study the basic concepts of Embedded C
- To expose the students to the fundamentals of Embedded C Programming
- To Introduce the GNU C Programming in Linux.
- To introduce basic features of real time operating systems

UNIT 1 Embedded Systems**9 Hrs.**

Introduction to Embedded Systems – Embedded system design process. Choice of Embedded processors
Embedded software development tools – Emulators and debuggers.

UNIT 2 C Language Essentials**9 Hrs.**

Data Types and Operators –Bitwise operations- Program Control statements- Looping Statements – Functions in C – Arrays – Pointers.

UNIT 3 EMBEDDED C PROGRAMMING**9 Hrs.**

Structure of Embedded C Program - Header files – C Preprocessors – Creating hardware time delay- GPIO Programming – LCD Interfacing – Interrupt Programming – Serial Communication using USART

UNIT 4 RTOS PRINCIPLE**9 Hrs.**

Real time operating systems (RTOS) - Features - Commercial and opensource RTOS – RTOS Kernel Architecture - Scheduler Algorithms- RMA and DMA – Priority Inversion – Features of freeRTOS - Multitasking and Inter process communication programming using freeRTOS.

UNIT 5 CASE STUDIES**9 Hrs.**

Case studies – Weather Monitoring System – Smart Agriculture System – Home Automation System Industrial Process Control System

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1 Apply the knowledge of C programming in design of Embedded Systems.

CO2 Develop C programs compatible to different embedded processors.

CO3 Demonstrate programming of hardware peripherals in Embedded Processors.

CO4 Develop embedded systems using RTOS

CO5 Trouble shoot functionalities of Embedded Systems using Debuggers and Emulators

CO6 Develop embedded systems for real world problems.

TEXT / REFERENCE BOOKS

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Steve Heath, "Embedded System Design", Elsevier, 2005.
3. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.
4. Steve Heath, "Embedded system design", Elsevier, 2003.
5. David E. Simon, "An Embedded Software Primer", Pearson Education, 2003.
6. E. Balaguruswamy, "Object oriented programming with C++", Tata McGraw Hill, 2011.

S35BLH12	SOFTWARE FOR EMBEDDED SYSTEMS	L	T	P	EL	CREDITS	TOTAL MARKS
		2	0	0	2	3	100

COURSE OBJECTIVES

- Introduce the students to the issues and challenges in developing software for embedded systems.
- Educate the students in formal modeling, design and development methodologies.
- Expose the students to software tools and techniques used in the development process.

UNIT 1 EMBEDDED PROGRAMMING

9 Hrs.

C and Assembly - Programming Style - Declarations and Expressions – Arrays- Decision and Control Statements – Functions - Preprocessors - Simple Pointers – Experiment Debugging and Optimization of C Programs.

UNIT 2 C PROGRAMMING TOOLCHAIN IN LINUX

9 Hrs.

Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Introduction to GNU C Library – Develop Embedded C programs in Linux platforms.

UNIT 3 EMBEDDED C AND EMBEDDED OS

9 Hrs.

Creating hardware delays - Need for timeout mechanism - Creating loop timeouts – Basics of Embedded Operating System – freeRTOS and Embedded Linux comparison – Applications development using Embedded Linux

UNIT 4 MODEL BASED DESIGN OF EMBEDDED SYSTEMS

9 Hrs.

System-level design methodologies - UML basics, Object state behaviour - UML state charts - Timing diagrams - Sequence diagrams - Develop UML model for Real World Problems using Matlab-Mapping UML Models to MATLAB/Simulink Blocks

UNIT 5 REALWORLD APPLICATIONS - CASE STUDY

9 Hrs.

DC Motor speed control system, Automotive cruise control system - Path Planning for Autonomous Vehicles- Home security systems-Autonomous Drone Flight Control

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Develop C programs for various microcontroller based applications.

CO2 - Analyze embedded C programs and debug the software faults.

CO3 - Apply embedded C programming tool chain available in Linux platforms.

CO4 - Develop applications with embedded operating system.

CO5 - Create UML models for given applications.

CO6 - Apply model based approach in design of Embedded Systems.

TEXT / REFERENCE BOOKS

1. Steve Oualline, "Practical C Programming", 3rd Edition, O'Reilly Media, Inc, 2016.
2. Hassan Gomma, "Designing concurrent, distributed, and real time applications with UML", 2nd Edition, Pearson Education, 2012.
3. Michael J Pont, "Embedded C", 2nd Edition, Pearson Education, 2017.
4. Alan Holt , Chi-Yu Huang, " Embedded Operating Systems - A Practical Approach", Springer, 3rd Edition, 2018.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A:	20 Questions MCQs	20 Marks
PART B:	Practical Laboratory	80 Marks

SECB3041	IC FABRICATION TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: NIL

Co Requisite: NIL

COURSE OBJECTIVES

- Introduce the various process involved in semiconductor manufacturing and integrated circuit fabrication
- Model the oxidation growth rate & to understand oxidation and diffusion mechanisms, along with the fundamentals of the ion implantation process
- Explain the principles thin film deposition and compare MOS and Bipolar process integration techniques

UNIT 1 CRYSTAL GROWTH AND WAFER PREPARATION 9 Hrs.

Introduction to Semiconductor Manufacturing and Fabrication – Clean Room Types and Standards – Physics of Crystal Growth – Czochralski and Float Zone Methods – Wafer Preparation and Polishing – Basic Properties of Silicon Wafers.

UNIT 2 LITHOGRAPHY AND OXIDATION 9 Hrs.

Photolithographic Process – Photomask Fabrication – Positive and Negative Photoresists – Exposure Systems and Their Characteristics – E-beam and X-ray Lithography – Thermal Oxidation of Silicon – Oxidation Modeling – Masking Properties of Silicon Dioxide – Si-SiO₂ Interface and Oxidation Technology.

UNIT 3 DIFFUSION AND ION IMPLANTATION 9 Hrs.

Diffusion Process – Fick's Laws – Diffusion Coefficient and Successive Diffusions – Diffusion Systems – Ion Implantation Technology – Mathematical Model for Ion Implantation – Selective Implantation – Channeling, Lattice Damage and Annealing – Shallow Implantations.

UNIT 4 THIN FILM DEPOSITION AND METALLIZATION 9 Hrs.

Chemical Vapor Deposition (CVD) – Physical Vapor Deposition (PVD) – Epitaxy – Metal Interconnections and Contact Technology – Silicide and Multilayer-Contact Technology – Copper Interconnects and Damascene Processes – Yield Considerations.

UNIT 5 PROCESS INTEGRATION AND PACKAGING 9 Hrs.

MOS Process Integration – MOS Transistor Layout and Design Rules – CMOS Technology – Bipolar Process Integration – Isolation Techniques in BJT Fabrication – Advanced Bipolar Structures – Low-Voltage/Low-Power CMOS/BiCMOS Processes – Wafer Thinning, Die Separation, Die Attachment, Wire Bonding and Packaging – Future Trends in CMOS/BiCMOS Processes.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** Explain the principles of semiconductor crystal growth, wafer preparation, and cleanroom standards.
- CO2** Describe the processes of lithography and thermal oxidation used in integrated circuit fabrication.
- CO3** Analyze diffusion and ion implantation mechanisms and their impact on device characteristics.
- CO4** Illustrate various thin-film deposition, metallization, and interconnection techniques in IC fabrication.

- CO5** Compare MOS and Bipolar process integration techniques used in modern CMOS/BiCMOS technologies.
- CO6** Evaluate advanced packaging, yield considerations, and emerging trends in semiconductor process technology.

TEXT / REFERENCE BOOKS

1. S.M. Sze and Kwok K. Ng, "Physics of Semiconductor Devices", Wiley, 2007.
2. S.K. Gandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide", John Wiley & Sons, 1994.
3. Peter Van Zant, "Microchip Fabrication: A Practical Guide to Semiconductor Processing", McGraw Hill, 2014.
4. R.C. Jaeger, "Introduction to Microelectronic Fabrication", Pearson Education, 2001.
5. S. Wolf and R.N. Tauber, "Silicon Processing for the VLSI Era, Volume 1: Process Technology", Lattice Press, 2000.
6. S.A. Campbell, "Fabrication Engineering at the Micro- and Nanoscale", Oxford University Press, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

Exam Duration: 3 Hrs.

PART A 10 Questions of 2 marks each-No choice

20 Marks

PART B 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SECB3042	Prompt Engineering	L	T	P	EL	CREDITS	TOTAL MARKS
		2	0	0	2	3	100

COURSE OBJECTIVES

- Understand the principles and techniques of prompt engineering, including the designs of effective prompts
- Explore the capabilities of large language models for text and image generations and to leverage the creation of engaging content
- Gain practical experience in crafting prompts and generating text and images using AI tools and platforms

UNIT 1 INTRODUCTION TO LLM AND PROMPTING

9 Hrs.

Brief History of Language Models, LLMs in the Market - Five Principles of Prompting, LLM Prompts, LLM Prompts Working, Types of Prompts, Components of an Prompt, Challenges and Limitations of Using Prompts.

UNIT 2 TEXT GENERATION WITH AI

9 Hrs.

Generating Lists - Universal Translation through LLMs -Text Style Unbundling - Generating New Content with Extracted Features, Using AI for Copywriting, Creating Social Media Posts- Using AI for Personalized Messaging- Creating Engaging and Tailored Content with AI.

UNIT 3 IMAGE GENERATION WITH AI

9 Hrs.

Role of AI in Visual Content Creation-Ethical considerations and Deepfake Awareness-Generative Model Architectures - Variational Autoencoders (VAEs)- Generative Adversarial Networks (GANs) - Diffusion Models - Training and Dataset Preparation - Tools and Frameworks for Image Generation

UNIT 4 PROMPT ENGINEERING STRATEGIES

9 Hrs.

Retrieval-Augmented Thoughts (RAT) Approach - Benefits of RAT strategy- Initial Thought Generation - Iterative Revision with Retrieval- Context-Aware Refinement – Statistical Language Model (SLM) – Role of SLM in Prompt Engineering.

UNIT 5 CASE STUDIES

9 Hrs.

AI Chatbot for Customer Support - AI Blog Writing - Data Analysis Assistant- Multilingual Translator- Voice Command Interface for Embedded Systems

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: Design clear, concise, and relevant prompts following the standard principles of prompt engineering

CO2: Utilize LLMs to generate text

CO3: Analyze existing prompts and make strategic combinations for enhanced prompts

CO4: Acquire the ability to fine-tune LLMs to produce structured outputs and enhance knowledge retrieval

CO5: Apply prompt engineering concepts for image based content creation

CO5: Identify and address common issues in LLMs

CO6: Develop AI powered applications using advanced prompt strategies.

TEXT / REFERENCE BOOKS

1. James Phoenix, Mike Taylor, "Prompt Engineering for Generative AI", O'Reilly, 2024.
2. Gilbert Mizrahi, "Unlocking the Secrets of Prompt Engineering: Master the Art of Creative Language Generation to Accelerate Your Journey from Novice to Pro", Packt Publishing, 2024.
3. Michael Ferguson, "Prompt Engineering: The Future of Language Generation", January 2023
4. El Amri, Aymen. LLM Prompt Engineering for Developers. Packt Publishing, 2024

SECB4008	Biomedical Signal Processing using AI	L	T	P	EL	Credits	Total Marks
		2	1	0	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To understand biomedical signal types (ECG, EEG, EMG, EOG, ERG, PCG) and their origins, characteristics, and noise sources.
- To master signal processing basics, including time/frequency domains, sampling, quantization, artifact removal, and ethical data handling.
- To apply machine learning and deep learning to biomedical signals with focus on feature extraction, model evaluation, and clinical interpretability.

UNIT 1 Fundamentals of Biomedical Signals 9 Hrs.

Introduction to Biomedical signals, Types of biomedical signals – ECG, EEG, EMG, EOG, ERG, PCG – characteristics, origin, and noise sources. Signal acquisition, sampling, and quantization. Artifact removal and signal conditioning. Ethical issues in biomedical data handling.

UNIT 2 Mathematical Foundations of Biomedical Signals 9 Hrs.

Time-domain and frequency-domain representations. Fourier Transform, correlation, convolution, and spectral estimation, PCA, ICA, and wavelet transforms for biomedical data.

UNIT 3 Machine Learning Techniques for Biomedical Signal Analysis 9 Hrs.

Feature extraction and selection. Supervised and unsupervised learning: SVM, k-NN, Random Forest, Decision Trees, k-Means clustering. Signal denoising and classification. Evaluation metrics (Accuracy, Sensitivity, Specificity, ROC).

UNIT 4 Deep Learning Techniques for Biomedical Signal Analysis 9 Hrs.

Neural network fundamentals, CNN, RNN, LSTM architectures for biomedical time-series. Autoencoders and transfer learning. Explainable AI (XAI) for medical interpretation. Frameworks: TensorFlow, PyTorch.

UNIT 5 Case Studies and Research-Based Applications 9 Hrs.

ECG signals for arrhythmia detection and heart rate variability (HRV) assessment, EEG signal analysis for the diagnosis of epilepsy, Alzheimer's disease, EMG-based pattern recognition for prosthetic limb control.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** understand the fundamental concepts, sources, and characteristics of various biomedical signals and the methods for their acquisition and preprocessing.
- CO2** Develop mathematical and analytical skills for representing, transforming, and filtering biomedical signals using time- and frequency-domain techniques.
- CO3** Apply classical machine learning algorithms for biomedical signal classification, prediction, and noise reduction.
- CO4** Design and implement deep learning architectures such as CNNs and RNNs for analyzing complex biomedical signal patterns
- CO5** Examine real-world biomedical signal processing applications through case studies involving neurological and cardiac disorders.
- CO6** Critically analyze and interpret biomedical data for disease diagnosis and decision-making using ML/DL-based approaches supported by research literature.

Textbook / References

1. 'Biomedical signal analysis', Rangaraj M. Rangayyan, Sridhar Krishnan, Third edition, IEEE Press.
2. 'Advanced Bio-signal processing', Amine Nait-Ali, Springer-Verlag.
3. Practical guide for Biomedical signalsanalysis using Mahine Learning techniques, A MATLAB based approach. Abdulhamit Subasi.
4. 'Biomedical Signal Processing – A modern approach', Ganesh R. Naik, Wellington Pinheiro dos Santos, CRC Press.
5. [Biomedical Signal Processing and Artificial Intelligence in Healthcare - Google Books](#)
6. [Biomedical Signal Analysis - Google Books](#)
7. Reddy, D.C., 2005. Biomedical signal processing: principles and techniques. McGraw-Hill.

SECB4009	QUANTUM INFORMATION THEORY	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES -

- To introduce the fundamental principles and representations underlying quantum mechanics and quantum computation.
- To develop an understanding of quantum logic gates, algorithms, and communication techniques used in quantum computing.
- To familiarize with post-quantum cryptographic methods and emerging quantum technologies for secure and efficient computation

Elements of Quantum Mechanics

9 Hrs.

UNIT 1

Introduction to quantum theory – superposition and measurement postulates. Quantum bits (qubits): representation, Bloch sphere visualization. Quantum states, Pauli matrices, unitary transformations, and tensor products. Concept of entanglement – Bell states.

UNIT 2 Quantum Computation and Algorithms

9 Hrs.

Principles of quantum computation – quantum parallelism and evolution. Quantum logic gates (Hadamard, CNOT). Basic algorithms – Deutsch–Jozsa, Grover’s search algorithm. Applications of entanglement: teleportation and superdense coding.

UNIT 3 Quantum Cryptography and Key Distribution

9 Hrs.

Motivation and principles of quantum cryptography. Quantum Key Distribution (QKD): BB84 and E91 protocols. Security from the no-cloning theorem. Overview of quantum hacking and countermeasures.

UNIT 4 Post-Quantum Cryptography

9 Hrs.

Limitations of classical cryptography in the quantum era. Introduction to Post-Quantum Cryptography (PQC): lattice-based, hash-based, and code-based schemes. NIST PQC standardization (Kyber, Dilithium). Hybrid frameworks integrating QKD and PQC.

UNIT 5 Quantum Emerging Applications

9 Hrs.

Quantum computing architectures: superconducting, photonic systems. Quantum communication networks and satellite-based QKD. Quantum sensors and emerging quantum technologies. Applications in secure communications, healthcare, and finance.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Explain the fundamental concepts of quantum mechanics and the representation of qubits and quantum states
- CO2** - Describe the operation of quantum logic gates and basic algorithms used in quantum computation
- CO3** - Apply the principles of quantum cryptography and quantum key distribution for secure communication

- CO4** - Compare various post-quantum cryptographic approaches and evaluate their integration with quantum systems.
- CO5** - Analyze emerging quantum technologies and assess their applications in modern secure communication frameworks

Textbook(s)

1. Wilde, M. (2017). Quantum Information Theory (2nd ed.). Cambridge: Cambridge University Press. doi:10.1017/9781316809976.
2. Nielsen, Michael A.; Chuang, Isaac L. (2010). Quantum Computation and Quantum Information (10th ed.). Cambridge University Press.

Reference(s)

1. Watrous, J. (2018), The Theory of Quantum Information. Cambridge: Cambridge University Press. doi:10.1017/9781316848142
2. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015).

S13BLH62	Advanced Embedded Systems	L	T	P	EL	Credits	Total Marks
		3		1		3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- Understand the architecture and core concepts of the QNX RTOS.
- Learn to develop and debug applications using the QNX Momentics IDE.
- Gain knowledge of process and thread management, including synchronization techniques.
- Explore inter-process communication (IPC) methods and their applications in QNX.
- Understand hardware programming concepts, including interrupt handling and memory access.
- Learn to build and configure QNX boot/OS images for embedded systems.

UNIT 1 INTRODUCTION TO QNX OS ARCHITECTURE 9 Hrs.

Overview of QNX OS architecture: microkernel, process manager, and standards. Protected address spaces, process/thread model, and scheduling. Introduction to inter-process communication (IPC) and synchronization. Resource managers and shared objects.

UNIT 2 PROCESSES, THREADS, AND SYNCHRONIZATION 9 Hrs.

Process management: creation, termination, and memory protection. Thread management: creation, termination, and synchronization. Synchronization techniques: mutexes, semaphores, and condition variables. Hands-on exercises: process/thread creation and synchronization.

UNIT 3 INTER-PROCESS COMMUNICATION (IPC) 9 Hrs.

Overview of IPC methods in QNX: message passing, pulses, and shared memory. Comparing IPC methods: advantages and disadvantages. Practical implementation of IPC in QNX. Hands-on exercises: message passing and shared memory.

UNIT 4 HARDWARE PROGRAMMING AND TIMING 9 Hrs.

Hardware access methods: IO-mapped and memory-mapped IO. Interrupt handling and DMA-safe memory allocation. Timing architecture: periodic timing, one-shot timing, and timeouts. Hands-on exercises: interrupt handling and timing mechanisms.

UNIT 5 BUILDING AND CONFIGURING QNX BOOT/OS IMAGES 9 Hrs.

Overview of QNX boot/OS image structure. Components of a boot image: startup code, kernel, drivers, and scripts. Building and loading boot images onto target hardware. Introduction to resource managers and their implementation.

LAB EXPERIMENTS 15 Hrs

1. QNX configuration and application development using QNX Momentics IDE.
2. Process and thread creation, management, and synchronization.
3. Implementation of IPC methods: passing message and shared memory.
4. Interrupt handling and hardware access programming.
5. Building and deploying QNX boot/OS images.
6. Mini capstone project: Design and implement a QNX-based embedded system.

Max. 60 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- C01** Describe the QNX OS architecture and its microkernel-based design.
- C02** Develop and debug QNX-based applications using appropriate tools.
- C03** Apply process/thread management and synchronization techniques in QNX.
- C04** Implement inter-process communication methods for real-time systems.
- C05** Configure and build QNX boot/OS images for specific hardware platforms.
- C06** Develop strong knowledge on the POSIX standards that help in System Application Development

TEXT / REFERENCE BOOKS

1. QNX Neutrino RTOS User's Guide, QNX Software Systems.
2. Programming for Embedded Systems, Michael Barr, O'Reilly Media.
3. Hands-on RTOS with Microcontrollers, Brian Amos, Packt Publishing, 2020.
4. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2018.
5. Online Resource
 - QNX online training
 - QNX training material
 - QNX Documentation for SDP 8.0
 - QNX Everywhere page - <https://blackberry.qnx.com/en/products/qnx-everywhere>
 - QNX Gitlab page - <https://gitlab.com/qnx>
 - **QNX Developer Community:** Access to forums and communities where they can ask questions and interact with other QNX developers.
 - QNX on Reddit: <https://www.reddit.com/r/QNX/>
 - QNX on StackOverflow: <https://stackoverflow.com/questions/tagged/qnx>
 - QNX on YouTube: <https://www.youtube.com/qnxcam>.
 - Collection of open-source projects (incl Links) for QNX: <https://gitlab.com/qnx/projects>
 - Ported libraries that work on QNX: <https://github.com/qnx-ports>