Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Master of Technology (Embedded System)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTES201	EC	Advanced Microcontroller	60	20	20	30	20	2	1	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;

***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. To teach students how a microcontroller can be used as a computer within a single integrated circuit.
2. To teach programming for TM4C123 using assembly and C language.
3. To present the microcontrollers input/output interface capabilities for developing embedded systems with advanced microcontrollers.
4. To illustrate how a microcontroller is a component within embedded systems controlling the interaction of the environment with system hardware and software.

Course Outcomes:

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

1. To understand the architecture of advanced microcontroller TM4C123 and its programming.
2. To interface TM4C123 with analog peripherals and communication systems.
3. To design an embedded system using TM4C123 for specific application

Syllabus

UNIT I **10 Hrs.**

Introduction to Cortex-M Microcontroller: Architecture of Cortex-M4F (TM4C123) Microcontroller, ARM Instruction Set Architecture:Register Set, Processor Operating Modes, Interrupts and Processor Reset Sequence, Pipelined Architecture and Data Path, Memory Address Map;Nested Interrupt Vector Controller;Bus System and Bus Matrix; Memory and Peripherals:Memory Endian ness, Bit Banding, System Stack Architecture; Debug System.

UNIT II **8 Hrs.**

Introduction to ARM Instruction Sets: Cortex-M Assembly Programming Basics, Assembler Directives, Addressing modes, Instruction Encoding, Instruction Set, Data Processing Instructions;Shift, Rotate, and Logical Instructions, Arithmetic Instructions, Data Movement, Bitfield Instructions, Test and Compare Instructions, Saturating Instructions, Memory Access Instructions, Branch and Control Instructions.

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UNIT III **8 Hrs.**

Interfacing: TM4C123 Microcontroller Peripherals, Configuring Microcontroller Pins as GPIOs, Interfacing for LED and Switch, Seven-Segment Interfacing, Interfacing of Keypad &LCD Module, analog interfacing.

UNIT IV **9 Hrs.**

I/O Synchronization and Interrupt Programming: Introduction to I/O Synchronization, Methods for I/O Synchronization, Types of Exceptions or Interrupts, Configuring Interrupts for Cortex-M Devices, Interrupt-Based Switch Interfacing.

Timing Interfaces: Basics of Timing Interfaces, Clocking, TM4C123 Clock and Frequency Configuration, Timer, TM4C123 Timing Interfaces and Systick Timer, General Purpose Timer Modules in TM4C123

UNIT V **10 Hrs.**

Serial Communication Interfaceson TM4C123 Microcontroller: Fundamentals of Serial Communication, UART Interface, I2C Interface, Serial Peripheral Interface (SPI), Controller Area Network (CAN), Comparison between MSP432 & TM4C123

Text books:

1. "ARM Microprocessor System" , Muhammad Tahit and KashifJaved, CRC press, 2017
2. "Embedded Systems: Real Time Operating System for ARM Cortex-M Microcontroller", Jonathan W. Valvano, Fourth Edition; 2017
3. "Embedded Systems Architecture" , Tammy Noergaard, Elsevier Publisher; 2005

References:

1. "Embedded System Design" ,Steve Heath, Elsevier Publisher; 2006
2. "Embedded Systems" , Raj Kamal, TMH; Fourth edition; 2020

List of Experiments:

1. Blinking LED and switch handling.
2. Interrupt programming by GPIO's.
3. Handling Hibernation & Wakeup.
4. Interfacing of seven segment & LCD module.
5. Interfacing of potentiometer.
6. Waveform generation using PWM.
7. Velocity control of motor.
8. UART communication.
9. I2C Communication Interface.
10. SPI Communication.
11. Case Study: Weather monitoring / Traffic light controller.

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Master of Technology (Digital Communication/ VLSI Design/ Embedded System)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTDC202	EC	Advanced Digital Signal Processing	60	20	20	30	20	2	0	2	3

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. Students are expected to demonstrate the ability to design FIR and IIR filters by hand to meet specific magnitude and phase requirements.
2. Perform Z and inverse Z transforms using the definitions, Tables of Standard Transforms and Properties, and Partial Fraction Expansion.
3. Determine if a DT system is linear, time-invariant, causal, and memoryless, determine asymptotic, marginal and BIBO stability of systems given in frequency domain.

Course Outcomes:

1. Students will be able to design and implement digital filters by hand and by using MATLAB.
2. Use computers and MATLAB to create, analyze and process signals, and to simulate and analyze systems sound and image synthesis and analysis.
3. To plot and interpret magnitude and phase of LTI system frequency responses.

Syllabus:

UNIT I

Introduction of DSP and Discrete Fourier transforms: Properties of the DFT Decimation in time and decimation in frequency FFT algorithms, discrete cosine transform. Linear filtering methods based on the DFT.

UNIT II

Design of digital filters: IIR Filter design: Butterworth design, Bilinear Transformation. Low Pass, High Pass, Band Pass and Band Stop digital filters. Spectral transformation of IIR filters. FIR filter design: Symmetric and Antisymmetric linear phase. FIR filter by rectangular, triangular and Hamming window functions.

UNIT III

Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors.
Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, Interpolators, Polyphase decompositions. Applications of Multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank.

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Master of Technology (Embedded System)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES202		Real Time Operating Systems	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:-

The subject aims to provide the student with:

1. To understand the concepts of Operating System.
2. To obtain hands-on experience in programming Real time OS.

Course Outcomes:-

After completion of the course student will be able

1. Explain the operating system concepts and types of operating system.
2. Demonstrate deadlock and memory management techniques.
3. Demonstrate concepts of real time operating system implementation

Syllabus

UNIT I **9 Hrs.**

Introduction to Operating System, Goals of an OS, Operation of an OS, Computer Architecture, Classes of Operating Systems, Structure of an Operating System, Memory Management: Single User Contiguous Scheme, Dynamic Partitions, Best-Fit Versus First-Fit Allocation, Deallocation, Paged Memory Allocation, Demand Paging, Page Replacement Policies, Segmented Memory Allocation.

UNIT II **8 Hrs.**

Process Management: Processes and programs, Implementing processes, Threads, Process Synchronization, Semaphores, Monitors, Scheduling terminology and its concepts, Deadlock: Detection, Prevention and Avoidance.

UNIT III **9 Hrs.**

Introduction to RTOS, Cortex-M Processor Architecture, ARM Cortex-M Assembly Language, Pointers in C, Memory Management,MSP432 I/O programming, Interrupts, First in First Out (FIFO) Queues, Edge-triggered Interrupts, UART Interface, Basic principles of Input Capture, Pulse Width modulation on MSP432, OS Considerations for I/O Devices, Debugging.

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UNIT IV **8 Hrs.**

Thread Management: Parallel, distributed and concurrent programming, Introduction to threads, States of a main thread, Two types of threads, Thread Control Block, Creation of threads, Switching threads, Profiling the OS, Semaphores, Thread Synchronization, Process Management, Dynamic loading and linking

UNIT V **9 Hrs.**

Time Management: Cooperation, Blocking semaphores, First in First out Queue, Thread Sleeping, Deadlocks, Monitors, Fixed Scheduling.

Real-time Systems: Data Acquisition Systems, Priority scheduler, Debouncing a switch, Texas Instruments RTOS, FreeRTOS

Text Books:

1. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", McGraw Hill Education; Third Edition,2017
2. Ann Mciver Mchoes ,Ida M. Flynn , "Understanding Operating Systems"., Cengage Learning Sixth Edition
3. Jonathan W. Valvano, "Real-Time Operating Systems for ARM Cortex-M Microcontrollers", Volume 3, Fourth Edition, 2017

References:

1. Rob Williams, "Real Time Systems Development"., First Edition, Elsevier 2006
2. Phillip A. Laplante, Seppo J. Ovaska, "Real Time Systems Design And Analysis: Tools for the Practitioner", Fourth Edition IEEE Press, 2012
3. Andrew S. Tanenbaum, Herbert Bos "Modern Operating Systems", Pearson, Fourth Edition, 2012

List of Experiments:

1. To develop the process scheduling algorithm.
2. TINY OS
3. Creation of tasks and task communication using TINY OS
4. Task pending and deletion from TINY OS
5. Task Suspension in TINY OS
6. Understand DEADLOCK in TINY OS
7. Porting TINY OS on microcontroller
8. Traffic light controller using TINY OS

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTES213		**Machine Learning**	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To know how to build simple knowledge-based systems.
2. To know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms).
3. Ability to apply knowledge representation, reasoning, and machine learning techniques to real world problems.

Course Outcomes (COs):

Upon completion of the subject, students will be able to:

1. Identify and describe artificial intelligence techniques, including search heuristics, knowledge, representation, automated planning and agent systems, machine learning, and probabilistic reasoning.
2. Identify and apply AI techniques to a wide range of problems, including complex problem solving via search, knowledge-base systems, machine learning, probabilistic models, agent decision making.
3. Analyze and understand the machine learning and various algorithms
4. Model the learning primitives and build the learning model.
5. Student will be able to tackle real world problems in the domain of Data Mining, Big data, Information Retrieval, Computer vision, Linguistics and Bioinformatics.

Syllabus

UNIT I **8 Hrs.**

Introduction to Machine Learning

Why Machine learning, Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Different Types of Machine Learning, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks.

UNIT II **8 Hrs.**

Classification, Regression and Clustering

Supervised Learning: Classification: Binary Classification- Assessing Classification performance, Class probability Estimation Assessing class probability Estimates, Multiclass Classification.

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Regression: Assessing performance of Regression- Error measures, Case study of Polynomial Regression.

UNIT III **8 Hrs.**

Linear Models

Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.

UNIT IV **10 Hrs.**

Logic Based and Algebraic Models

Distance Based Models: Neighbors and Examples, Nearest Neighbors Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, Rule Based Models, Tree Based Models

Probabilistic Models

Features, Feature types, Feature Construction and Transformation, Feature Selection, Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood.

Trends In Machine Learning

Model and Symbols- Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Deep Learning, Reinforcement Learning.

UNIT V **7 Hrs.**

Model Evaluations and Other Techniques

Model Evaluation: For Regression: MSE, RMSE, R2, Adjusted R2,

For Classification: Confusion Metrics, Accuracy, Precision, Recall, F 1 Score.

Complexity: Bias/Variance Dilemma, Model Selection Procedures, Over fitting and Under fitting

Text books:

1. Rich E and Knight K, "Artificial Intelligence", Third Edition, TMH, 2017.
2. Nelsson N.J., "Principles of Artificial Intelligence", First Edition, Springer Verlag, Berlin.
3. Oliver Theobald ,"Machine Learning For Absolute Beginners: A Plain English Introduction" , 2nd Edition , 2017
4. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
5. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition-2012.

References:

1. S.Rajasekaran and G.A. VijayalaksmiPai "Neural Network, Fuzzy Logic, and Genetic Algorithm Synthesis and Applications", Second Edition, Prentice Hall, 2017
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall,. 2002
3. Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, The MIT Press, 2010
4. Barr A, Fergenbaub E.A. and Cohen PR, "Artificial Intelligence", Addison Wesley,

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTES223		**Artificial Intelligence**	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
The student will have ability to:
1. Know how to build simple knowledge-based systems.
2. Know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms).
3. Ability to apply knowledge representation, reasoning, and machine learning techniques to real world problems.

Course Outcomes (COs):
Upon completion of the subject, students will be able to:
1. Describe the key components of the artificial intelligence (AI) field.
2. Identify and describe artificial intelligence techniques, including search heuristics, knowledge representation, automated planning and agent systems, machine learning, and probabilistic reasoning.
3. Identify and apply AI techniques to a wide range of problems, including complex problem solving via search, knowledge-base systems, machine learning, probabilistic models, agent decision making.
4. Analyze and understand the machine learning and various algorithms

Syllabus

UNIT I **10 Hrs.**
Introduction to AI and Production Systems
Introduction to AI, Problem formulation, Problem Definition Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics, Specialized production system, Problem solving methods, Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.

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UNIT II **6 Hrs.**

Representation of Knowledge

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation. Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III **8 Hrs.**

Knowledge Inference

Knowledge Inference -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory Bayesian Network-Dempster - Shafer theory.

UNIT IV **6 Hrs.**

Deep Learning

Deep Learning: The Neuron, Expressing Linear Perceptrons as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons, Multilayer Perceptron (MLP), Artificial Neural Networks (ANN), Convolution Neural Network, Recurrent Neural Network, GAN , LSTM, GRU,BERT.

UNIT V **4 Hrs.**

CNN Architectures

Transfer Learning like VGG16, Alexnet, Mobilnet etc, Computer Vision, Natural Language Processing (NLP).

Text books:

1. Rich E and Knight K, "Artificial Intelligence", Third Edition, TMH, 2017.
2. Nelsson N.J., "Principles of Artificial Intelligence", First Edition, Springer Verlag, Berlin.
3. Oliver Theobald ,"Machine Learning For Absolute Beginners: A Plain English Introduction" , 2nd Edition , 2017

References:

1. S.Rajasekaran and G.A. VijayalaksmiPai "Neural Network, Fuzzy Logic, and Genetic Algorithm Synthesis and Applications", Second Edition, Prentice Hall, 2017
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall,. 2002
3. Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, The MIT Press, 2010
4. Barr A, Fergenbaub E.A. and Cohen PR, "Artificial Intelligence", Addison Wesley,
5. Kos Ko B, "Neural Networks and Fuzzy system" Prentice Hall India Learning Private Limited.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES233		Hardware/Software Codesign	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
To give students a clear understanding of state-of-the-art hardware/software co-design methodology for computing systems

Course Outcomes (COs):
Student will be able to
1. Understand the Co design model and algorithms.
2. Identify and implement design specification and verification.
3. Learn and analyze compilation technique and tool for embedded system

Syllabus

UNIT I **8 Hrs.**
Co- Design Issues: Co- Design Models, Architectures, Languages, A Generic Co-design Methodology. Co- Synthesis Algorithms: Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

UNIT II **10 Hrs.**
Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure. Target Architectures: Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT III **7 Hrs.**
Compilation Techniques and Tools for Embedded Processor Architectures: Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

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UNIT IV **8 Hrs.**

Design Specification and Verification: Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

UNIT V **8 Hrs.**

Languages for System – Level Specification and Design-I: System – level specification, design representation for system level synthesis, system level specification languages, Level Specification and Design-II: Heterogeneous specifications and multi-language co-simulation, the cosyma system and lycos system.

Text Books:

1. Jorgen Staunstrup, "Hardware / Software Co- Design Principles and Practice", Wayne Wolf – 2009, Springer.
2. Giovanni De Micheli, Mariagiovanna Sami, "Hardware / Software Co- Design", 2002, Kluwer Academic Publishers

References:

1. Patrick R. Schaumont, "A Practical Introduction to Hardware/Software Co-design", 2010, Springer

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTES214		**Sensors and Actuators**	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. Be able to identify the different sensors available for specific engineering applications
2. Be able to understand the construction and working of different types signal conditioning
3. Understand the various measurement techniques.
4. Understand the errors in measurements and their rectification.

Course Outcomes (COs):

Student will be able to

1. Understand the different types of Sensor.
2. Sense and analyze different physical parameter.
3. Identify and implement different signal conditioning circuit as per the physical requirement.

Syllabus

UNIT I **10 Hrs.**

Primary Sensors

Temperature sensors: Bimetals, Pressure sensors, Flow velocity and Flow-rate sensors, Level sensors, Force and torque sensors, Acceleration and inclination sensors, Velocity sensors.
Materials for Sensor: Conductors, semiconductors, and dielectrics, Magnetic materials, Thick-Film technology, Thin-Film technology, Micromachining technologies.

UNIT II **9 Hrs.**

Reactance Variation and Electromagnetic Sensors its signal Conditioning

Capacitive Sensors: variable and differential capacitor. Inductive Sensors: Variable Inductance, eddy current sensor, LVDT, Electromagnetic Sensor.
Signal Conditioning for Reactance Variation Sensors: problems and alternatives, AC Bridges: Sensitivity and linearity, Capacitive bridge analog linearization, ac amplifiers and power supply decoupling, Electrostatic shields and driven shields.

UNIT III **10 Hrs.**

Resistive Sensors and its Signal Conditioning

Resistive Sensors: Potentiometers, Strain Gauges Fundamentals: Piezoresistive effect, types and applications. Resistive Temperature Detectors (RTDs), Thermistors: Models, Thermistor Types and Application, Magneto-resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas Sensors, Liquid Conductivity Sensors.

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UNIT IV **9 Hrs.**

Self-Generating Sensors and its Signal Conditioning

Thermoelectric Sensors: Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Photovoltaic Sensor, Electrochemical Sensors.

Signal Conditioning: Chopper and Low-Drift Amplifiers, Electrometer and Trans-impedance amplifiers, Charge Amplifiers.

UNIT V **8 Hrs.**

Actuators

Pneumatic and Hydraulic Actuation Systems: Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators.

Mechanical Actuation Systems, Types of motion, Kinematic chains, Cams, Gears, Ratchet and pawl – Belt and chain drives, Bearings, Mechanical aspects of motor selection.

Electrical Actuation Systems, Mechanical switches, Solid-state switches Solenoids, D.C. Motors, A.C. motors, Stepper motors.

Text Books:

1. Ramón Pallás-Areny, John G. Webster, "Sensors and Signal Conditioning", 2nd Edition, John Wiley & Sons, 2012.
2. Walt Kester, "Practical Design Techniques for Sensor Signal Conditioning", Analog Devices, 1999.
3. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.
4. W. Bolton – "Mechatronics" –Pearson Education Limited.

References:

1. E.O. Doebelin, D.N. Manik, "Measurement systems", 6th Edition, Tata McGraw Hill, 2012.
2. R. Pallas-Areny and J. G. Webster, "Analog Signal Processing", John Wiley & Sons, 1999.

List of Experiment:

1. To study various Primary sensor.
2. To study RTD for Temperature measurement.
3. To study Strain Gauge for pressure measurement.
4. To study LDR and Photodiode for sensing light intensity.
5. To study Thermocouple for Temperature measurement.
6. To study Photovoltaic for sensing light parameter.
7. Case study on Temperature sensing.
8. Case study on light sensing.
9. Case study on Humidity sensing.
10. Case study on Distance measurement.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTES224		**Internet of Things**	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. Introduce evolution of internet technology and need for IoT.
2. Discuss on IoT reference layer and various protocols and software.
3. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms.
4. Make the students to apply IoT data for business solution in various domain in secured manner.

Course Outcomes (COs):

1. Identify the IoT networking components with respect to OSI layer.
2. Build schematic for IoT solutions.
3. Design and develop IoT based sensor systems.
4. Select IoT protocols and software.
5. Evaluate the wireless technologies for IoT.

Syllabus:

UNIT I **8 Hrs.**

Evolution of IoT:

Review of computer communication concepts: OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges, IPV6 addressing. IoT architecture reference layer.

Introduction to IoT components:

Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardware, Examples of IoT infrastructure

UNIT II **8 Hrs.**

IoT protocols:

Introduction and specifications of various protocol: MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, Features and Message format for COAP Protocol,Overview of XMPP: standards and features, Classification of gateway protocols: Interior gateway and Exterior gateway protocols.

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UNIT III **8 Hrs.**

IoT point to point communication technologies:

IoT Communication Pattern, IoT protocol Architecture, Various types of Wireless technologies: 6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi, Widi

UNIT IV **8 Hrs.**

Introduction to Cloud computation and Big data analytics:

Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop.

UNIT V **10 Hrs.**

IoT security:

Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security.

IoT application and its Variants:

IoT for smart cities, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0, IoT standards.

Text Books:

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016
2. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

References:

1. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
2. Tanenbaum, Andrew S"Computer Networks",Pearson Education Pte. Ltd., Delhi, 4th Edition
3. Stallings, William,"Data and Computer Communications", Pearson Education Pte. Ltd., Delhi, 6th Edition
4. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.
5. Barrie Sosinsky,"Cloud Computing Bible, , Wiley-India, 2010
6. Ronald L. Krutz, Russell Dean Vines,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing" , Wiley-India, 2010

List of Experiments:

1. Familiarization with Arduino and perform necessary software installation.
2. To interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings.

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5. To interface motor using relay with Arduino and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino to upload temperature and humidity data to ThingSpeak cloud.
10. Write a program on Arduino to retrieve temperature and humidity data from ThingSpeak cloud.

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Master of Technology (Embedded System)

SUBJECT CODE	Cate-gory	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	T	P	CREDITS
MTES234		Wireless Sensor Networks	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
This course discusses protocols and architectures for wireless sensor network design. It covers wireless sensor node and network architectures, and communication protocols in different layers. The course focuses on topics for wireless sensor networks such as time synchronization, localization, and topology management.

Course Outcomes (COs):
After the completion of this course, the student should be able to:

1. List various applications of wireless sensor networks,
2. Describe the concepts, protocols, and differences underlying the design, implementation, and use of wireless sensor networks, and
3. Propose, implement, and evaluate new ideas for solving wireless sensor network design issues.

Syllabus

UNIT-I **8 Hrs.**
Introduction: Definition, challenges and constraints of Wireless Sensor Networks (WSN), Advantages of Sensor Networks, Applications of Sensor Networks, Enabling technologies for WSN, Operating systems and execution environments.

UNIT-II **8 Hrs.**
Node architecture: Sensor Node Technology, sensing subsystem, processor subsystem- architectural overview, communication interfaces. Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints.

UNIT-III **8 Hrs.**
Deployment and Configuration: Localization and positioning, different types of localization, Coverage and connectivity, Single-hop and multihop localization, self configuring localization systems, sensor management, ranging techniques.

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UNIT-IV **9 Hrs.**

Routing protocols: Classification of routing protocols, Routing Challenges and Design issues in WSN, Routing Strategies in WSN, Data Dissemination and Gathering, Concepts of Flooding, Directed Diffusion, Negotiation and Clustering Hierarchy.

UNIT-V **9 Hrs.**

Data Storage and Manipulation: Data centric and content based routing, Energy-efficient routing, Geographical routing. Storage and retrieval in network, compression technologies for WSN, data aggregation techniques. Security attacks in wireless sensor networks.

Text Books:

1. Kazem, Sohraby, Daniel Minoli, Taieb Zanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory & Practice", John Wiley and Sons, (ISBN: 978-81-265-5125-5).

References:

1. Holger Kerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9)
2. Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, "Wireless Sensor Network", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
3. Feng Zhao, Leonidas Guibas, " Wireless Sensor Network",Elsevier, 1st Ed. 2004 (ISBN: 13- 978-1-55860-914-3)
4. B. Krishnamachari, "Networking Wireless Sensors", Cambridge University Press.
5. N. P. Mahalik, "Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications" Springer Verlag.

List of Experiments:

1. Study of various open source network simulator tools.
2. Study of the Network Simulator tool selected and learning its installation process.
3. Study of GUI for the packet transmission between different nodes.
4. Study of various routing protocols/algorithms available for wireless sensor networks.
5. Simulating the simple routing protocols/algorithm for transmitting packet between two nodes.
6. Simulating the Flooding routing protocol.
7. Simulating the Directed Diffusion routing protocol.
8. Comparing the above two protocols based on different quality of service parameters (QoS) w.r.t to network area and network size.

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