Uka Tarsadia University

B. Tech.

CSE / CSE (AI&ML) / CSE (CC) / CSE (CS) / CE / CE (SE) / IT

Semester VI

Program Elective -IV

WEARABLE, TV, AND AUTOMOTIVE PROGRAMMING

IT5054

EFFECTIVE FROM December-2024

Syllabus version: 1.00

Subject Code	Subject Title
IT5054	Wearable, TV, and Automotive Programming

Teaching Scheme				Examination Scheme			
Hours		Credits		Theory Marks		Practical Marks	Total Marks
Theory	Practical	Theory	Practical	Internal	External	CIE	
3	0	3	0	40	60	0	100

Objectives of the course:

- To understand sensor fundamentals, physical principles, and diverse sensor applications.
- To comprehend role of IoT in wearable devices.
- To get knowledge in designing embedded systems, encompassing hardware/software selection, implementation, testing, and comprehension of AVR microcontroller and RTOS concepts.

Course outcomes:

Upon completion of the course, the student shall be able to,

CO1:Understand the fundamental concepts of sensors including classification, units, characteristics, calibration, stimulus computation, and performance factors.
CO2:Understand physical sensing principles and optical sensor components.
CO3:Acquire knowledge of various occupancy and motion detectors, velocity and acceleration sensors, and other related sensors.
CO4:Understand role of IoT in wearable devices.
CO5:Get Knowledge in embedded systems design, hardware/software selection, implementation, testing, and understanding of AVR microcontroller and RTOS concepts.
CO6:Understand and experiment automotive control systems.

Sr. No.	Topics	Hours
	Unit – I	
1	**Data Acquisition:** Sensors, Signals, and systems,Sensor classification, Units of measurements. **Sensor Characteristics:** Transfer function,Calibration, Computation of stimulus,Full Scale Input, Full-Scale output, Accuracy, Calibration error, Hysteresis, Nonlinearity, Saturation, Repeatability, Dead band, Resolution, Special properties, Output impedance, Output format, Excitation, Dynamic characteristics, Environmental factors, Reliability.	6
	Unit – II	
2	**Physical Principles of Sensing:** Electric charges, fields, and potentials,Capacitance, Magnetism, Induction, Resistance, Piezoelectric effect, Sound waves, Temperature and thermal properties of materials, Light, Dynamic Models of sensor elements. **Optical Components of Sensors:** Radiometry, Photometry, Windows, Mirrors, Lenses, Fresnel lenses, Fiber optics and waveguides, Concentrators,	8
	Unit – III	
3	**Occupancy and Motion Detectors:** Ultrasonic detectors, Microwave motion detectors, Capacitive occupancy detectors, Triboelectric detectors, Optoelectronic motion detectors, Optical presence sensors, Pressure-Gradient sensors. **Velocity and Acceleration:** Accelerometer characteristics, Capacitive accelerometers, Piezoresistive accelerometers, Piezoelectric accelerometers, Thermal accelerometers,Gyroscopes, Other sensors –Force, strain, and tactile sensors, Pressure sensors, Acoustic Sensors, Light detectors.	9
	Unit – IV	
4	**Introduction to Measurements and Sensors:** Smart connectivity and big picture of IoT – smart devices, networks, Wireless technologies and need for dataanalysis. **Role of IOT in Wearable Devices and Case Study:** Evolution of wearable technology, Wearable IoT use cases – Smart	8

	watches, Android wear, Smart glasses, Fitness trackers, Health care devices, Cameras, Smart clothing, Case studies – Health care, Fitness and sports, Defence and security, Fashion and apparel.	
Unit – V		
5	**Design of Embedded Systems:** Hardware design, Selection of processor, Software design, Implementation, Integration and testing, Types of testing, Types of hardware platforms, Hardware description ofAVR microcontroller development and its features, Introduction to RTOS, Architecture of the kernel, Scheduling Algorithms, FIFO, Round Robin, Shortest job first,Semaphores.	6
Unit – VI		
6	**Automotive Control Systems:** Overview of control systemmodelling, Time/Frequency response analysis and stability analysis – PID, State variable analysis, Model based diagnosis, Faults, Fault modeling, Principles of model based diagnostics, Residual generator design, Residual evaluation, Vehicle control systems, ABS control systems, Torque balance at vehicle, Road contact, Control cycles of the ABS system, ABS cycle detection, Control of Yaw Dynamics, Derivation of simplified control law, Derivation of reference values.	8

Text books:

1. Jacob Fraden, "Handbook of Modern Sensors, Physics, Designs, and Applications", Fourth Edition,Springer.
2. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, SebastianLange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT ArchitectureReference Model", Springer Open, 2013.

Reference books:

1. Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier Inc., 2005.
2. Subhas C. Mukhopadhyay, "Wearable Electronics Sensors-For Safe and Healthy Living", Springer International Publishing, 2015.
3. Er. R.K. Rajput, "Electronic Measurements and Instrumentation", S. Chand & Company Ltd. 3rd Edition.

Course objectives and Course outcomes mapping:

- To understand sensor fundamentals, physical principles, and diverse sensor applications:CO1 and CO2
- To comprehend role of IoT in wearable devices: CO2, CO3 and CO4
- To get knowledge in designing embedded systems, encompassing hardware/software selection, implementation, testing, and comprehension of AVR microcontroller and RTOS concepts:CO5 and CO6

Course units and Course outcomes mapping:

Unit No.	Unit Name	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Data Acquisition and Sensor Characteristics	✓					
2	Physical Principles of Sensing and Optical Components of Sensors		✓				
3	Occupancy and Motion Detectors and Velocity and Acceleration			✓			
4	Introduction to Measurements and Sensors and Role of IOT in Wearable Devices and Case Study				✓		
5	Design of Embedded Systems					✓	
6	Automotive Control Systems						✓

Programme outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints.

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behavior, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able

to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: recognition of the need for, and an ability to engage in life-long learning.

Programme outcomes and Course outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1						
PO2	✓	✓			✓	✓
PO3	✓	✓			✓	✓
PO4						
PO5						
PO6						
PO7						
PO8						
PO9						
PO10						
PO11					✓	✓
PO12						