

Sixth Semester Syllabus

DSCSEL601: Paper - 7
Electronic Instrumentation and Biomedical Instruments

(Credits: Theory – 04, Practical – 02)

Total Teaching: 60 Hrs

Hours of Teaching: 4 Hrs / Week

Course Objectives:

- Acquire the knowledge of various types of measurement systems and to know the importance of measuring instruments.
- To know different types of errors due to the measurement systems
- Gain the knowledge of working principle of sensors and actuators
- Understand the working principles of data acquisition systems

Course Outcomes:

- Able to calibrate the instruments to minimize measurement errors.
- Use different data acquisition systems to acquire real-time data
- Set up testing strategies to evaluate performance characteristics of different types of data acquisition system and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

Unit 1

15 Hrs

Measurement System: Introduction to general measurement system, significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems.

Instruments Performance Characteristics: Definitions and problems as applicable.

Static Characteristics-Static error, static correction, scale range and scale span, reproducibility and drift, repeatability, Signal to noise ratio, sources of noise, accuracy, precision, linearity, hysteresis, threshold, dead time. Dynamic Characteristics-Fidelity, frequency response, dynamic error, etc.,

Measurement Errors: Introduction, gross errors and systematic errors, absolute and relative errors, basic concepts of accuracy, precision, resolution.

Transducers: Classification of transducers, basic requirement of transducers, principle of operation and construction details of resistive, inductive, capacitive, temperature, ultrasonic, photoelectric, pressure, fiber optic and MEMS based transducers. Measurement techniques for motion, seismic, flow, level, humidity, pH, viscosity.

Unit 2

15 Hrs

Sensors and Actuators: Sensors-Introduction to sensors, types of sensors, typical application of sensors, basic principles and operations of Thermal Sensors, Optical Sensors, Acoustic Sensors, MEMS, Nano-sensors, Ultrasonic Sensors, Thin Film Sensors, Liquid Level Sensors, Magnetic Sensors, Radiation Sensor

Actuators-Introduction to actuators, types of actuators, Logical and Continuous Actuators, Pneumatic actuator, Electro-Pneumatic actuator, cylinder, rotary actuators.

Unit 3

15 Hrs

Bio Potential Electrodes: Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half cell potential, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

Electrode Configurations: Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

Bio Amplifier: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier.

Unit 4

15 Hrs

Measurement Of Non-Electrical Parameter: Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

Reference Books

- 1 Electronic Instrumentation, H S Kalsi, TMH, 2nd Edition, 2010
- 2 Electronic Instrumentation and Measurements, David A Bell, PHI/ Pearson Education, 2nd Edition, 2012.
- 3 Modern Electronic Instrumentation and Measurement techniques, Albert D Helfrick, William D Cooper, PHI, 2007.
- 4 Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& sons, 18th Edition
- 5 Patranabis D, “Sensors and Transducers”, Wheeler publisher, 1994
- 6 Instrumentation measurement and analysis, Nakra, Choudhary
- 7 John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004
- 8 Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.
- 9 Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
- 10 Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.
- 11 Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGra-Hill Publisher 2003

DSCELP601: Paper - 7
Instrumentation and IoT Lab

(Credits: Theory – 04, Practical – 02)

Total Teaching: 60 Hrs

Hours of Teaching: 4 Hrs / Week

PART-A (Instrumentation Systems Practical)

1. Study of the characteristics of thermistors
2. Study of the characteristics of LDR
3. Study of the piezo electric transducer
4. Construction and study the VI characteristics of solar cell
5. Conversion of basic ammeter into multimeter and calibration of voltage, resistance and current
6. Calibration of thermistors for temperature measurement.
7. Characterize the Temperature sensor (RTD)
8. Simulate the performance of a bio Sensor.
9. Measurement of level in a tank using capacitive type level probe.
10. Characterize the LVDT
11. Design an orifice plate for a typical application.
12. Simulate the performance of a chemical sensor.
13. Characterize the strain guage sensor.
14. Characterize the temperature sensor (Thermocouple).

PART-B (IOT- Lab)

1. Starting Raspbian OS, Familiarization with Raspberry Pi components and interface, Connecting to Ethernet, Monitor, USB.
2. Displaying different LED patterns with Raspberry Pi.
3. Displaying Time over 4-Digit 7-Segment display using Raspberry Pi.
4. Raspberry Pi based Oscilloscope.
5. Controlling Raspberry Pi with WhatsApp.
6. Setting up wireless Access point using Raspberry Pi.
7. Fingerprint Sensor interfacing with Raspberry Pi.
8. Raspberry Pi GPS module interfacing.
9. IoT based Web Controlled Home Automation using Raspberry Pi.
10. Visitor Monitoring with Raspberry Pi and Pi Camera.

***Any five in each part**

DSC602: PAPER 8
Internet of Things and Robotics

(Credits: Theory – 04, Practical – 02)

Total Teaching: 60 Hrs

Hours of Teaching: 4 Hrs / Week

Course Objectives:

- Understand the basic concepts and principles of the Internet of Things.
- Gain knowledge of different IoT technologies and protocols.
- Acquire practical skills in designing and implementing IoT applications.
- Develop an understanding of IoT security and privacy considerations.
- To acquire the working principle of robots
- Understand the working principle of sensors
- To know the working principles of actuators

Course Outcomes:

- Understand the basic concepts and principles of the Internet of Things.
- Gain knowledge of different IoT technologies and protocols.
- Acquire practical skills in designing and implementing IoT applications.
- Develop an understanding of IoT security and privacy considerations.
- Design an embedded system for the working of a robot.
- Select the robot type depending on the application requirements.
- Acquire the basic robot programming skills

Unit 1

15 Hrs

Definition and evolution of the Internet of Things. IoT architecture and components. IoT communication protocols: MQTT, CoAP, HTTP. IoT application domains and use cases. Overview of IoT devices: microcontrollers, sensors, actuators. Types and characteristics of sensors used in IoT applications. Interfacing sensors with microcontrollers. Data acquisition and sensor fusion techniques.

Unit 2

15 Hrs

Wireless communication technologies for IoT: Wi-Fi, Bluetooth, Zigbee, LoRaWAN, NodeMCU and ESP 32 modules - Overview of these modules.

IoT network topologies: star, mesh, and hybrid networks. IoT data management and storage. IoT protocols for device-to-device and device-to-cloud communication. IoT application development platforms and frameworks. Design and implementation of IoT applications. IoT security challenges and solutions. Privacy and ethical considerations in IoT.

Unit 3

15 Hrs

Definitions of Robots: Robotics, Motivation, A Brief History of Robotics, A Robot System, Interdisciplinary Areas in Robots, Classification of Robots, Introduction to embedded system, Understanding Embedded System, Sensors, Classification of sensors(contact & non contact), characteristics of sensors, Touch sensor, Position sensor, optical sensor, IR, PIR, Ultrasonic, temperature, displacement sensor.

Unit 4

15 Hrs

Introduction to Robotics: Getting Started with Programming platform of Robots: Installation of IDE, Pin configuration and architecture of Microcontroller (Atmel series/Arduino), Device and platform features. Concept of digital and analog ports. Familiarizing with Interfacing Board, Introduction to Embedded C platform, Review of Basic Concepts, Arduino data types, Variables and constants, Operators, Control Statements, Arrays Functions, I/o Functions, Pins Configured as INPUT, Pins Configured as OUTPUT, Incorporating time delay() function, delay Microseconds() function, millis() function, micros() function.

Reference Books IOT

1. Internet of Things: Principles and Paradigms by Rajkumar Buyya, Amir, Vahid Dastjerdi, and Anton Y. Dongarra.
2. Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry by MaciejKranz.
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, and Robert Barton.
4. Internet of Things with Arduino Cookbook" by Marco Schwartz
5. Arduino Home Automation Projects" by Marco Schwartz and Oliver Manickum
6. Weste, Neil H. E.; Harris, David; Banerjee, Ayan, " CMOS VLSI Design: A Circuits and System Perspective," 3rd Edition, Pearson Education
7. Douglas A. Pucknell and Kamran Eshraghian, "BASIC VLSI DESIGN," 3rd ed.
8. John P. Uyemura, "Introduction to VLSI Circuits and Systems,".
9. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall.
10. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall.

Reference Books Robotics

1. Fundamentals of Robotics by D K Pratihari.
2. Robotics Simplified: An Illustrative Guide to Learn Fundamentals of Robotics, by Dr. Jisu Elsa Jacob, Manjunath N.
3. Introduction to Robotics | Fourth Edition by John Craig.
4. Arduino Robotics by John-David Warren (Author), Josh Adamsduino.

5. Programming in 24 Hours by Richard Blum.
6. Getting Started with Arduino: The Open Source Electronics Prototyping Platform Book by Massimo Banzi and Michael Shiloh.
7. Robotics for Engineers –Yoram Koren, McGraw Hill International, 1st edition, 1985.
8. Robotic Engineering - An Integrated approach, Klafner, Chmielewski and Negin, PHI, 1st edition, 2009
9. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk.

DSCELP 602: Paper - 8:

Project Lab

(Credits: Theory – 04, Practical – 02)

Total Teaching: 60 Hrs

Guidelines for evaluation of Projects: Project must be completed in the department in the supervision of faculty in charge. It must incorporate the fundamental concepts of Electronics and use the latest tools available to design the need of the problem. Scope for improving the model must be specified in conclusion along with detailed report on the project.

Department must conduct periodical seminars during the allotted lab hours to check the progress of the project. Internal assessment marks of 25 can be awarded based on the performance of the students in the regular lab hours, Seminar presentations, type of the project and application of the project.



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