Basics of Internet of things and Python Programming
DSE (Electronics) Sem III
(For Physics and Electronics as core subjects)
Credit: 04 (Theory-02, Practical-02)

Course Learning Objectives:

The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects. The course will also help the student to develop python programming skills for IoT and examine programming with Raspberry PI.

Course Learning Outcomes:

At the end of this course, students will be able to achieve the following learning outcomes:

1. The student will be able to describe various IoT enabled technologies.

2. The student will be able to describe understand the concepts of M2M with necessary protocols

3. Illustrate Python Programming for IoT

4. Examine the Python Programming with Raspberry PI

Syllabus- Theory

Unit I : Introduction to IoT: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Business processes in IoT (like ;Supply chain management,Predictive maintenance, Data management, energy management etc) (**7 Lectures)**

Unit II : Elements of IoT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python) for Communication Protocols-MQTT, ZigBee, Bluetooth, TCP**. (7 Lectures)**

Unit III : Introduction to Python: Language Features of Python, data Types, data structures, control of flow, functions, modules, packaging, file handling, data/time operations and classes.(**9 Lectures)**

Unit IV : IoT Physical devices and Endpoints: Introduction to Raspberry PI- Interface(Serial, SPI) programming- Python program with raspberry PI with focus of interfacing external gadgets, controlling output and reading input from pins.(**7 Lectures**)

Reference Books:

1.Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, —A Hands on Approachǁ, University Press

2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, —Introduction to Internet of Things: A practical Approachǁ, ETI Labs

3. Pethuru Raj and Anupama C. Raman, —The Internet of Things: Enabling Technologies, Platforms, and Use Casesǁ, CRC Press

4. Jeeva Jose, —Internet of Thingsǁ, Khanna Publishing House, Delhi

5. Adrian McEwen, —Designing the Internet of Thingsǁ, Wiley

6. Raj Kamal, —Internet of Things: Architecture and Designǁ, McGraw Hill 7. Cuno Pfister, —Getting Started with the Internet of Thingsǁ, O Reilly Media

7. Getting started with Raspberry PI, Matt Richardson and Shawn Wallace, O'Reilly (SPD), 2014, ISBN : 9789350239759

Practicals (Any five to be performed) :

1. To interface LED/Buzzer with Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
2. To interface Push button/Digital sensor (IR/LDR) with Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
3. To interface DHT11 sensor with Raspberry Pi and write a program to print temperature and humidity readings.
4. To interface Bluetooth with Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
5. To interface Bluetooth with Raspberry Pi and write a program to turn LED ON/OFF when ‗1'/'0' is received from smartphone using Bluetooth.
6. Write a program on Raspberry Pi to publish temperature data to MQTT broker.
7. Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print

ELECTRONIC INSTRUMENTATION
DSE (Electronics) Sem III
(For Physics and Electronics as core subjects)

Total Credits: 04 (Credits: Theory: 02, Practical: 02)
Total Hours: Theory: 30, Practical: 60

Course Objective

• This course aims to provide an exposure on basics of measurement and instrumentation and its various aspects and their usage through hands-on mode.
• It also aims to provide exposure of various measurement instruments such as power supply, oscilloscope, multivibrators, signal generators are discussed in detail.
• It also aims to develop an understanding of virtual instrumentation and transducers.

Course Learning Outcomes

At the end of this course, students will have understanding of:
• basic principles of the measurement and errors in measurement, specifications of basic Measurement instruments and their significance with hands on mode.
• principles of voltage measurement, advantages of electronic voltmeter over conventional multimeter in terms of sensitivity etc.
• measurement of impedance using bridges, Power supply, Filters, IC regulators and Load and line regulation.
• Specifications of CRO and their significance, the use of CRO and DSO for the measurement of voltage (dc and ac), frequency and time period.
• Multivibrators, working circuits of Astable and monostable multivibrators.
• Phase Locked Loop (PLL), Voltage controlled oscillators and lock-In amplifier.
• explanation and specifications of Signal and pulse Generators
• the Interfacing techniques, Audrino microcontroller & interfacing software, Understanding and usage of Transducers.

Unit 1 (12 Lectures)

Measurements: Shielding and grounding. Electromagnetic Interference. Basic Measurement Instruments: DC measurement-ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating). Digital Multimeter; Block diagram principle of measurement of I, V, C. Measurement of Impedance- A.C. bridges, Measurement of Self Inductance (Anderson's bridge), Measurement of Capacitance (De-Sauty’s bridge), Measurement of frequency (Wien's bridge).

Unit 2 (6 Lectures)

Power supply: Using IC Regulators (78XX and 79XX), Line and load regulation, Short circuit protection. Idea of switched mode power supply (SMPS) & uninterrupted power supply (UPS). Oscilloscope: Block Diagram, CRT, Deflection (Qualitative). Screens for CRT, Oscilloscope probes, measurement of voltage, frequency, and phase by Oscilloscope. Digital Storage Oscilloscope.

Unit 3 (4 Lectures)

Multivibrators (IC 555): Block diagram, Astable & Monostable multivibrator circuits. Signal Generators: Function generator (Black Box Approach)

Unit 4 (8 Lectures)
Virtual Instrumentation: Introduction, Interfacing techniques (RS 232, GPIB, USB). Idea about Audrino microcontroller & interfacing software like lab View). Transducers: Classification of transducers. Measurement of temperature (RTD, semiconductor IC sensors), Light transducers (photo resistors & photovoltaic cells).

PRACTICALS-LAB: ELECTRONIC INSTRUMENTATION LAB
"Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the lab, including necessary precautions.
Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab."
At least 08 experiments from the following
1. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
2. Measurement of Capacitance by De Sauty's bridge.
3. Design a regulated power supply of given rating (5 V or 9V).
4. To determine the Characteristics of LVDT.
5. To determine the Characteristics of Thermistors and RTD.
6. Measurement of temperature by Thermocouples.
7. To design an Astable Multivibrator of given specification using IC 555 Timer.
8. To design a Monostable Multivibrator of given specification using IC 555 Timer.
9. To design and study the Sample and Hold Circuit.
10. To plot the frequency response of a microphone.
11. Glow an LED via USB port of PC.
12. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.
References for Theory
Essential Readings
1. Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A. D. Helfrick, Prentice Hall (2005).
2. Measurement Systems: Application and Design, E.O.Doebelin, McGraw Hill Book - fifth Edition (2003).
3. Electronic Devices and Circuits, David A. Bell, Oxford University Press (2015).

Additional Readings
1. Instrumentation Devices and Systems, S. Rangan, G. R. Sarma and V. S. Mani, Tata McGraw Hill(1998).

References for Laboratory
1. "Measurement and Instrumentation Principles", Alan S. Morris, Elsevier (Butterworth Heinmann-2008).
2. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller,

Renewable Energy and Energy Harvesting
DSE (Electronics) Sem III
(For Physics and Electronics as core subjects)

Credit: 04 (Theory-02, Practical-02)

Course Objective

1. To provide knowledge and practical learning experiences about various alternative energy sources.
2. To explore methods of harnessing energy from wind, solar, mechanical, ocean, geothermal, and other sources, and review the functioning of different energy harvesting systems installed globally.

Course Learning Outcomes

At the end of this course, students will be able to achieve the following learning outcomes:

1. Gain knowledge of various energy sources for harvesting.
2. Understand the necessity of energy conversion and the different methods of energy storage.
3. Develop a thorough understanding of various renewable energy systems and their components.
4. Acquire knowledge about renewable energy technologies, different storage technologies, distribution grids, smart grids, including sensors, regulation, and control.
5. Design models for wind energy or solar energy plants.
6. Gain hands-on experience with:
   - Different types of alternative energy sources.
   - Converting vibration into voltage using piezoelectric materials.
   - Converting thermal energy into voltage using thermoelectric modules.

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Unit 1 (3 Lectures)

Fossil fuels and Alternate Sources of energy: Fossil fuels, their limitation, need of renewable energy, non-conventional energy sources. An overview of energy conversions using Offshore Wind Energy, Tidal Energy, solar energy, biomass, bio-gas generation, geothermal energy tidal energy, Hydroelectricity.

Unit 2 (10 Lectures)

Solar energy: Solar energy, its importance, solar spectrum and AM 1.5 radiation, storage of solar energy, solar pond, applications of solar pond and solar energy, Principle & working of solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell. Need and characteristics of photo-voltaic (PV) systems, PV models and equivalent circuits.

Unit 3 (3 Lectures)

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Unit 4 (7 Lectures)

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide Energy Technologies, Ocean Thermal Energy, Ocean Bio-mass. Geothermal Energy: Geothermal Resources.
Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Rain water harvesting.

Unit 5 (7 Lectures)

Piezoelectric Energy harvesting: Principle of piezoelectric effect, polarization tensor, and strain parameters, Piezoelectric materials (ZnO and PZT) and their characteristics, Piezoelectric generators and energy harvesting applications,

Electromagnetic Energy Harvesting: Linear generators, recent applications: Carbon captured technologies.

PRACTICALS

"Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab."

Teacher may give a long duration project based on this paper.

Demonstrations and Experiments:

1. Demonstration of Training modules on Solar energy,etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage-driven thermo-electric modules.
4. Demonstration of wind energy modules.

References for Theory/ Essential Readings

1. Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
2. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., 2012, Oxford University Press.

Additional Readings

1. Solar Energy: Resource Assessment Handbook, P Jayakumar, 2009
2. J.Balfour, M.Shaw and S. Jarosek, Photo-voltaics, Lawrence J Goodrich (USA).
3. http://en.wikipedia.org/wiki/Renewable_energy

References for Laboratory

1. Non-conventional energy sources, B.H. Khan, McGraw Hill 60