DSE (Electronics) Sem IV
(For Physics and Electronics as core subjects)

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

Digital & Analog systems & applications (DSE)

Course Title	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
	4	2	0	2	Class XII Pass with Science	Basic Electronics

LEARNING OBJECTIVES

This paper aims to cover the overall topics in Digital Electronics and is offered as elective papers in this curriculum. In this course, students will be able to understand the working principle of CRO, Analog and Digital circuits, 555 timer, Counters, Programmable Logic Devices. In addition, students will get an Introduction to basic principle of MOS transistor and basic CMOS Inverter

LEARNING OUTCOMES

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

- To understand the internal structure of CRO and its usage to measure the Voltage, Current, Frequency, and Phase Difference.
- Knowledge of Active and Passive components and scale of integration.
- To understand the use and applications of the 555 timer.
- Knowledge about various types of 4-bit counters.
- D/A and A/D conversion.
- Variety of memories, Programmable Logic Devices and Digital Logic families

THEORY COMPONENT

Unit 1

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **(3 Lectures)**

Analog & Digital Circuits

Integrated Circuits (Qualitative Treatment only) :- Active and Passive components. Discrete

Circuit Component. Wafer. Chip. Advantages and Drawbacks of ICs. Scale of integration : SSI, MSI, LSI and VLSI (Basic Idea and Definitions Only). Classification of ICs. Fabrication of Components on Monolithic ICs. Difference between Analog and Digital Circuits , Examples of Linear and Digital ICs. **(5 Lectures)**

Unit 2

Timers:IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. **(3 Lectures)**

Counters(4 bits): Asynchronous counter, Synchronous Counter, Ring Counters, Decade Counter. **(3 Lectures)**

D-A and A-D Conversion: 4 bit binary weighted and R-2R D-A converters, Accuracy and Resolution**,** A-D conversion characteristics, sampling techniques, successive approximation ADC. **(4 Lectures)**

Unit 3

Memories: ROM, PROM, EPROM, EEPROM, Bipolar RAM, static and dynamic RAM, Memory Expansion (Word size and Word Capacity). **(4 Lectures)**

Programmable Logic Devices: Combinational circuit Implementation using PROM, PLA and PAL. **(2 Lectures)**

Introduction to basic principle of MOS transistor and basic CMOS Inverter. **(2 lectures)**

Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison. **(4 Lectures)**

References:
Essential Readings:

1. Digital Principles and Applications, A.P.Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw.
2. Digital Fundamentals, 3rd Edition by Thomas L. Floyd (Universal Book Stall, India, 1998).
3. Digital Design by M. Morris Mano, 5th edition, Pearson.
4. Digital Electronics by R.P. Jain.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.

PRACTICAL COMPONENT

(15 Weeks with 4 hours of laboratory session per week)

Do any 6 of the following experiments.

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To design an astable multivibrator of given specifications using 555 Timer.
3. To design a monostable multivibrator of given specifications using 555 Timer and to measure the Pulse-Width of its output.
4. Design an asynchronous Up/Down counter using D Flip Flop.
5. Design an asynchronous Up/Down counter using JK Flip Flop.
6. Design a synchronous Up/Down counter using D Flip Flop.
7. Design a synchronous Up/Down counter using JK Flip Flop.
8. Design and study of R-2R DAC.
9. Design and study of ADC.

Additional Readings:

1. Digital design by M. Morris Mano, 5th edition, Pearson.

2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

3. Digital Electronics G K Kharate ,2010, Oxford University Press.

4. Digital Computer Electronics, A. P. Malvino, J.A. Brown, 3rd Edition, 2018, Tata McGraw Hill Education.

Physics of Electrical Machines
DSE (Electronics) Sem IV
(For Physics and Electronics as core subjects)

Credit: 04 (Theory-03, Practical-01)

(Credits: Theory-03, Practicals-01)

Theory Lectures 45

Unit- 1 **DC Machines:** (18 Lectures)

Basic constructional features and physical principles involved in electrical machines, armature winding (ac and dc), lap and wave connections, different types of pitches

D.C. Generators:

Construction and principles of operation of dc generator, brief idea about armature action and commutation, E.M.F. Equation, Characteristics of Separately and Self excited (Shunt, Compound and Series) generators, Losses and efficiency, applications.

D.C. Motors:

Comparison of generator and motor action & interchangeability, principle of operation, significance of back EMF, maximum power, Torque and speed relation, Characteristics of series, shunt and Compound excited motors & applications, losses & efficiency, necessity of motor starters, Three point starter, Speed control of DC motors, electronic speed control of DC motors, electric braking

Unit-2 **Transformers:** (15 Lectures)

Types of transformers, Transformer Construction, EMF equation, No load operation, operation under load, Phasor diagram, equivalent circuit of transformer, Transformer Losses, Voltage regulation, condition for maximum efficiency, All day efficiency, Short circuit and open circuit tests, Auto transformers. Three phase transformers, line and phase relations for Y-Y, delta-delta, delta –Y and Y-delta connection

Unit- 3 **Induction Motors** (12 Lectures)

Uniform and oscillating magnetic field production using Helmholtz's coil, Rotating magnetic field (Ferrari's Principle), Three Phase Induction Motors: General constructional features, Types of rotors,Induction motor as a generalized transformer, equivalent circuit, Production of torque, Slip, Torque equation, Torque-slip characteristics, Speed control of Induction motor. Comparison with DC motor

Single Phase Motors: Single phase induction motors, Construction, principle of operation based on starting methods, Split phase motors, capacitor start motors, capacitor start & run motors, Reluctance Motor, Stepper Motor, Single phase a.c. series motors, Universal motor.

Suggested Books:

1. A. E. Fitzgerald, Charles Kingsley, Jr. and Stephen D. Umans, Electric Machinery, McGraw
2. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw Hill.
3. G. Mc. Pherson, An introduction to Electrical Machines & Transformers, John Wiley & Sons.
4. H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi.
5. S. Ghose, Electrical Machines, Pearson Education.
6. N. K. De and P. K. De, Electric Drives, Prentice Hall of India.
7. P. C. Sen, Principles of Electric Machines and Power Electronics, Wiley.
8. Abhijit Chakrabarti, Sudipt Rath and Chandan Kumar Chanda, Basic Electrical Engineering, Tata McGraw-Hill Publishing Company Limited New Delhi.

Physics of Electrical Machines Lab

1. Study of performance characteristics of DC Series motor by conducting load test.
2. Study of performance characteristics of DC Shunt motor.by conducting load test.
3. Study of characteristics of single phase induction motor.
4. Study of characteristics of three phase induction motor.
5. Study of control of DC motor using SCR.
6. To perform Open Circuit Test and short circuit test on single phase transformer and find equivalent circuit parameters. Find the efficiency at various loads. Draw efficiency versus load curve. Find out the load at which is the maximum efficiency. Calculate the voltage regulation at full load, at power factor (i) 0.85 lagging and (ii) 0.85 leading.
7. To connect two single phase transformers in parallel and to obtain the data to study the load sharing of the transformers..
8. To connect three single phase transformers in various forms of three phase transformer connections and verify the voltage relationships.
9. To perform load test on a single phase transformer and determine (i) Polarity of primary and secondary Windings, (ii) Voltage ratio of transformer (iii) Voltage regulation of transformer.

Books:

1. N. K. Jain, A textbook of practicals in Electrical Engineering, Dhanpat Rai Publishing Company
2. S. G. Tarnekar et al, Laboratory courses in Electrical Engineering, S. Chand
3. S. K. Bhattacharya and K. M. Rastogi, Experiments in Basic Electrical Engineering, New Age International
4. T. Thyagrajan, Basic Electrical Engineering, Scitech Publications

Introduction to embedded system design
DSE (Electronics) Sem IV
(For Physics and Electronics as core subjects)
Credit: 04 (Theory-02, Practical-02)

Course Title & Code	Credits	Credit distribution of the course			Pre- requisite of the course	Department offering the course
		Lecture	Tutorial	Practical		
Introduction to Embedded System Design GE – 16	4	2	0	2	NIL	Physics and Astrophysics

LEARNING OBJECTIVES

This paper aims to introduce the basic concepts or fundamentals of embedded system design to students not majoring in physics. The course covers the comprehensive introduction to embedded systems, their role and application areas in our daily life. Basic elements needed to design a typical embedded system are discussed to provide the students a broader perspective. Specific applications of embedded systems which are a part of our daily life were discussed. In the end Arduino Uno is introduced.

LEARNING OUTCOMES

Upon completion of this course, students will be able to,

- Learn about an embedded system and how it is different than a general purpose computing system like computer or laptop etc.
- The student should be able to identify various embedded systems available around us in our daily life.
- Classify embedded systems based on generation, complexity and performance, major applications areas etc.
- Explain the domains and areas of applications of embedded systems. The students should be able to get a broader perspective of different embedded systems available in industry, telecom, photography, homes, automobile, aviation and ship industry etc.
- Explain the roles and uses of various components like microcontroller, memory, sensors and actuators, interface types etc. of embedded systems.
- Know the basic characteristics and quality attributes that any typical embedded system must possess.

- This paper is designed in such a way that the students will be able to connect the textbook knowledge with basic design and working of the various embedded systems present in our daily life. By the end of this course the student will have a fairly good idea of embedded systems and the gained knowledge will be helpful in predicting the possible design and working of an unknown system. Arduino Uno is introduced so that students can learn how to use different sensors to control different processes.

SYLLABUS OF GE - 16 THEORY COMPONENT

UNIT – I - Introduction to Embedded Systems (3 Hours)

Embedded systems, historical background, difference between an embedded systems and general computing systems, classification of embedded systems based on generation, complexity and performance, major applications areas, purpose of embedded systems like in data collection/storage/representation, data communication, data/signal processing, monitoring, control, application specific user interface.

Unit – II - Elements of Embedded System (6 Hours)

Core of the embedded system: General purpose and domain specific processors like microprocessors, microcontrollers and digital signal processors, application specific integrated circuits (ASICs), programmable logic devices (PLDs), commercial off-the-shelf components (COTS), reduced instruction set computing (RISC) and complex instruction set computing (CISC), Harvard vs Von-Neumann architecture, different types of memory (RAM, ROM, Storage etc) their classification and different versions, reset circuit, oscillator unit

Unit – III - Peripheral devices, sensors and actuators (6 Hours)

General discussion on light emitting diodes (LEDs), 7-segment LED display, piezo buzzer, push button switch, keypad or keyboard (discuss design using push button switches), relay (single pole single throw), LDR, thermistor, IR sensor, ultrasonic sensor, opto-coupler, DC motors, servo motor, stepper motor (unipolar and bipolar)

Unit – IV - Communication Interface (2 Hours)

Serial and parallel interface, universal serial bus (USB), Infra-red data transfer, bluetooth (BT), Wi-Fi, general packet radio Service (GPRS), 3G, 4G, LTE

Unit – V - Characteristics and quality attributes of an embedded systems (3 Hours)

Characteristics: Application and domain specific, reactive and real time, operation under harsh environments, distributed or stand alone, size and weight, power consumption Operational and non-operational attributes: response time, throughput, reliability, maintainability, security, safety, testability and debug-ability, evolvability, portability, cost and revenue

Unit – VI - Applications of Embedded Systems (4 Hours)

General discussion on the design and working of washing machine, refrigerator, microwave oven, automobiles, mobile phones, hearing aid device, electrocardiogram (ECG), AC or TV remote control system, smart watch, digital camera and laser printers etc.

Unit – VII - Introduction to Arduino (6 Hours)

Pin diagram and description of Arduino UNO, basic programming and applications

References:

Essential Readings:

1) Introduction to embedded system, K. V. Shibu, 1st edition, 2009, McGraw Hill

2) Embedded Systems: Architecture, Programming and Design, R. Kamal, 2008, Tata McGraw Hill
3) Embedded Systems and Robots, S. Ghoshal, 2009, Cengage Learning.
4) Embedded Microcomputer systems: Real time interfacing, J. W. Valvano, 2011, Cengage
Learning
5) Embedded System, B. K. Rao, 2011, PHI Learning Pvt. Ltd.

6) Programming Arduino: Getting Started with Sketches, S. Monk, 2nd edition, Mc Graw Hills

7) Arduino: Getting Started With Arduino and Basic Programming with Projects by E. Leclerc

Additional Readings:

1) The 8051 Microcontroller and Embedded Systems Using Assembly and C, M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, 2nd edition, 2007, Pearson Education
2) Microprocessors and Microcontrollers, K. Kant, 2nd edition, 2016, PHI learning Pvt. Ltd.
3) The 8051 Microcontroller, Ayala, 3rd edition, Cengage learning

PRACTICAL COMPONENT

(15 Weeks with 4 hours of laboratory session per week)

- Every student must perform at least six experiments from the following list
- Mandatory exercise for all students: Familiarization with power supply, function generator, CRO/DSO, multimeter, bread board etc. Measure the frequency and amplitude (pp or rms) of a given signal using CRO/DSO. (The purpose is to acquaint the students with these instruments so that they can have a basic understanding of these instruments).
  ARDUINO based Experiments:
  1) Flashing LEDs ON/OFF after a given delay.
  2) Design a simple transmitter and receiver circuit using IR LED and a detector and use it for obstacle detection.
  3) Interface a simple relay circuit to switch ON and OFF a dc motor/LED.
  4) Interface DC motor to Arduin UNO and rotate it clockwise and anticlockwise.

5) Interface Servo motor to Arduin Uno and rotate it clockwise and anticlockwise for a given angle.
6) Interface an ADC and read the output of the LDR sensor. Display the value on the serial monitor.
7) To design an alarm system using an Ultrasonic sensor.
8) To design a counter/Motion sensor alarm using IR Led and Detector
9) To design a circuit to control ON/OFF of LED light using LDR.
10) To design a circuit to control ON/OFF of a process using a thermistor.
11) To design a thermistor based thermometer.
12) Control the speed of the DC motor using LDR.

References for laboratory work:

1) Arduino Programming: 3 books in 1 - The Ultimate Beginners, Intermediate and Expert Guide to Master Arduino Programming, R. Turner
2) Arduino: Getting Started With Arduino and Basic Programming with Projects, E. Leclerc
3) Basic Electronics: A text lab manual, P. B. Zbar, A. P. Malvino, M. A. Miller, 1994, McGraw Hill.
4) Electronic Devices and circuit theory, R. L. Boylestad and L. D. Nashelsky, 2009, Pearson
5) Electronics: Fundamentals and Applications, J. D. Ryder, 2004, Prentice Hall.
6) Modern Electronic Instrumentation and Measurement Tech., Helfrick and Cooper, 1990, PHI Learning.