Course: Core Paper VII - HPHCR3072T & HPHCR3072P

Semester	III
Paper Number	HPHCR3072T & HPHCR3072P
Paper Title	DIGITAL SYSTEMS AND APPLICATIONS
No. of Credits	06 (Theory – 4, Lab – 2)
Theory/ Composite	Composite
No. of periods assigned	Th:4 periods/week Pr:3 periods/week
Name of Faculty member(s)	
Course description/ objective	This course is an amalgamation of the basics of digital electronics and its applications. Digital electronics is one of the very popular application areas in physics and has become part & parcel of modern day life. A proper exposure helps the student in strengthening ideas to follow practical approach towards this fast developing field. In the following course, the student: acquires a thorough understanding of the principles of Binary Numbers and the Boolean Algebra, gets familiar with the basic concepts of Integrated Circuit technology and its history of development, is able to understand the conceptual foundation of different circuits like analog & digital, data processing, arithmatic etc. In the applications part of this course, the course aims at facilitating an understanding of the importance of digital circuits in electronics, understanding CRO as an important signal detection instrument, understanding the basic design of a computer hardware system, understanding the concepts and applications of sequential circuit building blocks which are fundamental to digital circuits, understanding a popular timing signal generator (555 timer) as a source of clock in sequential circuit and as other timing sources and finally getting exposed to the basic features of microprocessors using 8085 as an example.
Syllabus	As enclosed
Texts	As enclosed
Reading/ Reference Lists	As enclosed
Evaluation	Total – 100 (Theory – 60, Practical – 40) Theory – CIA – 10 Semester Examination – 50 Group A (25 marks) Group B (25 marks) One 10 marks qs out of two qs One 10 mark qs out of two qs Three 5 mark qs out of five qs Three 5 mark qs out of five qs

Syllabus:

HPHCR3072T - DIGITAL SYSTEMS AND APPLICATIONS(Credits – Theory – 04, Practicals – 02)

Module A **[26 lectures]**

Integrated Circuits (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.
[4 Lectures]

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. **[8 Lectures]**

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **[6 Lectures]**

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. **[4 Lectures]**

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. **[6 Lectures]**

Module B[26 lectures]

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. **[4 Lectures]**

Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map. **[5 Lectures]**

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop. **[6 Lectures]**

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). [2 Lectures] Counters(4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter. **[4 Lectures]**

Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. **[4 Lectures]**

Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram. Components. Pin-out diagram. **[1 lecture]**

Reference Books

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw 2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

3. Digital Electronics G K Kharate ,2010, Oxford University Press
4. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
5. Digital Computer Electronics, Malvino & Brown

HPHCR3072P - Digital Systems and Applications Lab (Credits-2) (39 periods)

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. a) To design a switch (NOT gate) using a transistor.
   b) To verify and design AND, OR, NOT and XOR gates using NAND gates.
   c) To design a combinational logic system for a specified Truth Table.
   d) To convert a Boolean expression into logic circuit and design it using logic gate ICs.
   e) To minimize a given logic circuit.
3. Half Adder, Full Adder using IC
4. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
5. To build JK Master-slave flip-flop using Flip-Flop ICs
6. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
7. To design an astable multivibrator of given specifications using 555 Timer.

Reference Books

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
3. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
4. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning. ----------
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Paper Structure

(a) Marks for experiment : 30 marks

(i) Class performance on any one expt. – 8
(ii) Lab. Viva on the same experiment as (i) - 7
(iii) LNB for each of the three experiments - 5 x 3 = 15

(b) Grand Viva – 8 marks
(c) Attendance – 2 marks