

## PHY175:MODERN PHYSICS AND ELECTRONICS

L:3 T:0 P:0 Credits:3

**Course Outcomes:** Through this course students should be able to

- CO1 :: Explain the principles of solid-state physics and semiconductor materials
- CO2 :: Apply electrical laws to analyze the operation of semiconductor devices
- CO3 :: Examine number system conversions and K-Map to simplify digital logic expressions
- CO4 :: Analyze the operation and functionality of combinational logic circuits
- CO5 :: Analyze the characteristics and operation of sequential logic circuits
- CO6 :: Demonstrate Arduino programming and sensor interfacing

### Unit I

**Solid State Physics :** Introduction to free electron theory, diffusion and drift current (qualitative), fermi energy, fermi-Dirac distribution function, and theory of solids formation of allowed and forbidden energy bands, concept of effective mass-electrons and holes, Hall effect (with derivation), basics of semiconductors (intrinsic and extrinsic) and insulators, fermi level for intrinsic and extrinsic semiconductors, direct and indirect band gap semiconductors, solar cell basics

### Unit II

**Fundamentals of Electricity and Devices :** Fundamentals of electrical laws, voltage division rule, current division rule, PN junction diode (working and characteristics) and its applications (rectifiers and switch), BJT basic operations, CMOS technology, semiconductor memory devices (RAM, SSD), AI accelerator chips, sensor technology in IoT systems, introduction to computer network (CN), optical fiber and wireless communication, comparisons between CPU, GPU

### Unit III

**Introduction to Number System and Logic Gates :** Number system (conversion), codes (binary to gray/gray to binary), excess-3, BCD, compliments, binary arithmetic (addition and subtraction using 2's complement), logic gates, boolean algebra, SOP and POS, K-Map (up to 4 variables)

### Unit IV

**Introduction to Combinational Logic Circuits :** Combinational Logic Circuits: adders, subtractors, multiplexers, de-multiplexers, decoders, encoders, comparator upto 2-bit

### Unit V

**Introduction to Sequential Logic Circuits :** Latch (SR and D), flip-flop (SR, JK, D and T), master slave flip-flop, conversion of basic flip-flop, Registers: operation of basic shift registers (SISO, SIPO, PISO, PIPO), Counters: asynchronous counter (UP/DOWN/Mod-N)

### Unit VI

**Introduction of Arduino and Sensors :** analog and digital signals, arduino board (pin configuration and description), IR sensor, LDR, basic principle of ultrasonic sensor, temperature sensor (DHT11/DHT22)

### Text Books:

1. PRINCIPLES OF ELECTRONICS by V. K. MEHTA AND ROHIT MEHTA, S. CHAND & COMPANY

### References:

1. ELECTRONIC DEVICES AND CIRCUIT THEORY by ROBERT L. BOYLESTAD AND LOUIS NASHIELSKY, Pearson Education India
2. DIGITAL FUNDAMENTALS by THOMAS L. FLOYD, Pearson Education India

