Core I **Semester -I**

Electronic Devices and Circuits

Course Outcomes (COs):

- At the end of the course the student should be able to:
- Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research.
- To acquire experimental skills, analysing the results and interpret data.
- Ability to design/develop/manage/operation and maintenance of sophisticated electronic gadgets/systems/processes that conforms to a given specification within ethical and economic constraints.
- Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.
- Capability to use the Modern Tools / Techniques.

Unit-1

- Electronic Components: Electronic passive and active components, types and their properties, Concept of Voltage and Current Sources, electric energy and power (Qualitative only).
- Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity Theorems. DC and AC analysis of RC and RL circuits, RLC series and parallel Resonant Circuits.
- PN junction diode: Ideal and practical diodes, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance, Zener diode, Reverse saturation current, Zener and avalanche breakdown.
- Rectifiers: Half wave and Full wave (centre tap and bridge) rectifiers, expressions for output voltage, ripple factor and efficiency (mention only), Shunt capacitor filter. (Numerical examples wherever applicable).

Unit-2

- Voltage regulator: Block diagram of regulated power supply, Line and Load regulation, Zener diode as voltage regulator – circuit diagram, load and line regulation, disadvantages. Fixed and Variable IC Voltage Regulators (78xx, 79xx, LM317), Clippers (shunt type) and clampers (Qualitative analysis only), Voltage Multipliers.
- Bipolar Junction Transistor: Construction, types, CE,CB and CC configurations (mention only), VI characteristics of a transistor in CE mode, Regions of operation (active, cut off and saturation), leakage currents (mention only), Current gains α , β and γ and their inter-relations, dc load line and Q point. Applications of transistor as amplifier and switch - circuit and working. (Numerical examples wherever applicable).

Unit-3

- Transistor biasing and Stabilization circuits: Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor. Transistor as a two-port network, h-parameter equivalent circuit.
- Amplifier: Small signal analysis of single stage CE amplifier using h- parameters. Input and Output impedances, Current and Voltage gains. Advantages of CC amplifier. Class A, B and C Amplifiers (qualitative), Types of coupling, two stage RC Coupled Amplifier – circuit, working and its Frequency Response, loading effect, GBW product, Darlington transistor, Current gain.
- Special semiconductor diodes: Varactor diode, Schottky diode, Tunnel diode - construction, characteristics, working, symbol, and applications for each. LED, LCD and solar cell – construction, operation and applications, 7-segment display, concept of common anode and common cathode types (Numerical problems, wherever applicable)

Unit-4

- JFET–Types - p-channel and n-channel, working and I-V characteristics, n-channel JFET, parameters and their relationships, Comparison of BJT and JFET. MOSFET: E–MOSFET, D–MOSFET – n-channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics, VMOS, UMOS Power MOSFETs, handling, MOS logic, symbols and switching action of MOS, NMOS inverter, CMOS logic, CMOS – inverter, circuit and working, CMOS characteristics, IGBT construction and working. UJT: Construction, working, equivalent circuit and I-V characteristics, intrinsic stand-off ratio, Relaxation oscillator. SCR: Construction, VI characteristics, working, symbol, and applications – HWR and FWR. Diac and Triac: Construction, working, characteristics, applications, (Numerical examples wherever applicable)

Suggested References

- ✓ *Robert L Boylestad, "Introductory circuit analysis", 5thedition., Universal Book 2003.*
- ✓ *R S Sedha, "A Text book of Applied Electronics", 7thedition., S. Chand and Company Ltd. 2011.*
- ✓ *A.P. Malvino, "Principles of Electronics", 7thedition, TMH, 2011.*
- ✓ *Electronic devices and circuit theory by Boylestad, Robert Nashelsky, 11thEdn., Pearson, 2013*
- ✓ *David A. Bell "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2015*
- ✓ *Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia, (1994)*
- ✓ *"Electrical Circuits", Schaum"s Outline Series, TMH, 2005 S. A. Nasar,"*
- ✓ *Electrical Circuits", Schaum"s outline series, Tata McGraw Hill, 2004*
- ✓ *J. Millman and C. C. Halkias, "Integrated Electronics", Tata McGraw Hill, 2001*
- ✓ *A.S. Sedra, K.C. Smith, A.N. Chandorkar "Microelectronic circuits", 6thEdn., Oxford University Press, 2014*
- ✓ J. J. Cathey, "2000 Solved Problems in Electronics", Schaum"s outline Series, TMG, 1991.

Practical

1. Verification of Thevenin's and Maximum Power Transfer Theorem.
2. Verification of Superposition Theorem.
3. Study of the I-V Characteristics of (a) P-n junction diode, and (b) Zener diode.
4. Study of the I-V Characteristics of LEDs of two different colours and 7-segment display.
5. Study of Half wave rectifier without and with shunt capacitor filter– ripple factor for different values of filter capacitors.
6. Study of full wave bridge rectifier without and with shunt capacitor filter – ripple factor for different values of filter capacitors.
7. Study of Zener diode as a Voltage Regulator using bridge rectifier with shunt capacitor filter [Load and line regulation].
8. Study of Clipping, Clamping and Voltage Multiplier circuits.
9. Designing and testing of fixed positive and negative voltage regulators using 78xx and 79xx series ICs (Using bridge rectifier and shunt capacitor filter).
10. Designing and testing of variable voltage regulator using IC LM317 (Using bridge rectifier and shunt capacitor filter).
11. Study of Transistor characteristics in CE configuration – determination of h-parameters.
12. Study of Fixed Bias and Voltage divider bias circuits – comparison for different β values.
13. Study of single stage CE amplifier (frequency response, input and output impedances in mid-band
14. Study of two-stage RC-coupled CE amplifier (AV1, AV2, AV) at mid-band frequency.
15. Study of Series and Parallel Resonance circuits – determination of its
    (a) Resonant frequency
    (b) Impedance at resonance
    (c) Bandwidth
    (d) Quality Factor
16. Verification of truth tables of OR, AND, NOT, NAND, NOR, XOR and XNOR gates using
    respective ICs. Realization of XOR and XNOR using basic gates.
17. Universal property of NAND and NOR gates.