

2017

COMPUTER SCIENCE

(Major)

Paper : 1.2

(Basic Electronics)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Fill in the blanks with a correct choice as given in parentheses : 1×7=7
 - (a) A p-n junction diode begins to conduct when forward bias voltage is _____ its knee voltage. (smaller than/greater than/equal to)
 - (b) Bipolar junction transistors are _____ controlled devices. (voltage / charge / current)
 - (c) The magnitude of gate current for any metal oxide semiconductor field-effect transistor is always _____ in ideal condition. (zero/infinite/finite)

- (d) Inductors store electrical energy in the form of _____. (electric field/magnetic field/charge)
- (e) The role of filter in a rectifier circuit is to remove _____ components. (DC/AC/transient)
- (f) An 8-bit register contains _____ flip-flops. (2/4/8)
- (g) J-K flip-flop can be used as counter in _____ mode. (set/reset/toggle)

2. Write short answer of the following questions : 2×4=8

- (a) Convert decimal number $(15)_{10}$ into 4-bit binary format.
- (b) Draw *I-V* characteristic curve of a *p-n* junction Zener diode in both forward and reverse biases.
- (c) A BJT has current gain $\beta = 90$ in common emitter mode. Calculate collector and emitter currents when base current is $20 \mu\text{A}$.
- (d) State Kirchhoff current and voltage laws.

3. Answer any *three* questions of the following : 5×3=15

- (a) Justify that NAND gate is a universal logic gate.
- (b) Explain the working of basic RC-coupled bipolar junction transistor amplifier in common emitter mode.
- (c) Explain the different energy bands of a semiconductor with appropriate illustrations.
- (d) Discuss the operation of a 3-bit ripple counter with appropriate circuit diagram.
- (e) Mention the ideal characteristics of an operational amplifier (Op-Amp).

4. Answer any *three* questions of the following : 10×3=30

- (a) Distinguish between 'junction field-effect transistor' and 'metal oxide semiconductor field-effect transistor'. Explain the terms 'threshold voltage', 'pinch-off state' and 'transconductance' for metal oxide semiconductor field-effect transistor. 4+2+2+2=10

(4)

(b) Draw a basic full-adder circuit with logic gates and explain its operation. Distinguish between multiplexer and demultiplexer circuits. 6+4=10

(c) Draw a DC power supply circuit comprising of centre-tapped full-wave rectifier and shunt capacitance filter. Further, explain the terms 'RMS voltage & current', 'average voltage & current', 'ripple factor' and 'rectifier efficiency'. 2+3+3+1+1=10

(d) Compare and contrast the operation of normal $p-n$ junction diode to light-emitting $p-n$ junction diode. Define the term 'overall quantum efficiency of light-emitting diode'. Mention a few applications of light-emitting diodes. 5+2+3=10

(e) Implement the Boolean function $Y = AB + (BC \oplus AD)$ with logic gates. Distinguish between combinational and sequential logic circuits. Mention the important parameters of a logic gate. 4+4+2=10
