

B.Tech 7th Semester Exam., 2021

(New Course)

ELECTRONIC DEVICES

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.
- (v) Symbols used (if any) have their usual meanings.

1. Choose the correct answer of the following
(any seven) : 2×7=14

(a) Which one of the following materials has negative temperature coefficient of resistance?

- (i) Gold
- (ii) Germanium
- (iii) Platinum
- (iv) Silver

(b) When a trivalent impurity is added to a pure semiconductor, it becomes

- (i) an insulator
- (ii) an intrinsic semiconductor
- (iii) p-type semiconductor
- (iv) n-type semiconductor

(c) If e , μ and n represent the charge, mobility and concentration of electrons respectively, then the electrical conductivity of the metal is given by

- (i) $n/\mu e$
- (ii) $\mu e/n$
- (iii) ne
- (iv) $n\mu e$

(d) Schottky diode operates only with

- (i) minority carriers
- (ii) majority carriers
- (iii) capacitor
- (iv) inductor

(e) The Zener breakdown occurs

- (i) in highly doped p-n junction through a tunnelling mechanism
- (ii) in undoped p-n junction through a tunnelling mechanism
- (iii) in highly doped p-n junction without tunnelling mechanism
- (iv) in undoped p-n junction without tunnelling mechanism

(f) If the carrier lifetime of surface-emitting infrared InGaAsP LED is $\frac{1}{\pi}$ picosecond, its modulation bandwidth will be

(i) 0.5 Hz

(ii) 0.5 KHz

(iii) 0.5 MHz

(iv) 0.5 GHz

(g) Which of the following terminals of BJT is slightly doped?

(i) Base

(ii) Emitter

(iii) Collector

(iv) All the terminals are equally doped

(h) The terminals in a MOSFET are

(i) source and drain

(ii) source and gate

(iii) gate and drain

(iv) source, gate and drain

(i) Which one of the following breakdown voltages is directly proportional to the temperature?

(i) Avalanche

(ii) Zener

(iii) Both (i) and (ii) ✓

(iv) None of the above

(j) A silicon wafer has 100 nm of oxide on it and is inserted in a furnace at a temperature above 1000 °C for further oxidation in dry oxygen. The oxidation rate

(i) is independent of current oxide thickness and temperature

(ii) is independent of current oxide thickness but depends on temperature

(iii) slows down as the oxide grows

(iv) is zero as the existing oxide prevents further oxidation

2. Discuss the Kronig-Penney model for the motion of an electron in a periodic potential. Show from $E-k$ graph that the materials can be classified into conductors, insulators and semiconductors.

3. Sketch and describe basic structure of MOS capacitor. Also discuss energy-band diagram of MOS capacitor with an n -type substrate for—
- (a) positive gate bias;
 - (b) moderate negative gate bias;
 - (c) large negative gate bias. 4+10=14

4. (a) What are 'emitter efficiency' and 'base transport factor'? Derive an expression for common-base current gain (α) for a BJT. <https://www.akubihar.com>
- (b) By increasing the device temperature, what will happen to (i) the reverse saturation current of a p - n diode and (ii) the subthreshold source-to-drain leakage current of MOSFET? 10+4=14

5. Write short notes on the following : 7+7=14

- (a) Schottky diode
- (b) Poisson and continuity equation

6. (a) What is the main limiting factor in increasing the efficiency of a solar cell?
- (b) Why must a solar cell be operated in the fourth quadrant of the junction I - V characteristic?

- (c) What is the advantage of a quaternary alloy in fabricating LEDs for fiber optics?

- (d) In an LED a band gap of 3eV , calculate the wavelength of light that emits. 3+4+4+3=14

7. Write short notes on the following : 7+7=14

- (a) Oxidation and diffusion
- (b) Photolithography

8. Write short notes on : 7+7=14

- (a) Sputtering
- (b) Twin-tub CMOS process

9. (a) Define diffusion current, drift current, mobility and resistivity.

- (b) The sheet resistance of a diffusion layer is $100\ \Omega/\text{square}$. Find the aspect ratio, if a resistance of $6\ \text{k}\Omega$ is using the diffusion.

- (c) How can subthreshold slope of a MOSFET be decreased (improved)? 8+4+2=14
