

Con. 362-13.

KN-1883

(3 Hours)

[Total Marks : 100

N.B. :(1) All questions are **compulsory**.(2) Figures to the **right** indicate **full** marks.(3) Draw neat **diagrams** wherever **necessary**.(4) **Symbols** have usual meaning unless otherwise stated.(5) Use of **Logtable** or **non-programmable** calculator is **allowed**.1. Attempt any **two** :—

(a) Discuss the phenomenon of thermionic emission in metals. Obtain Richardson-Dushman equation for the emission current density. 10

(b) Give a brief account of the following properties of superconductivity— 10

(i) Critical field

(ii) Transition temperature

(iii) Meissner effect.

(c) Discuss the motion of an electron in a one dimensional periodic potential on the basis of band theory. Obtain the expression for effective mass of an electron. 10

2. Attempt any **two** :—

(a) Explain the classical Langevin-Debye theory of paramagnetism. Derive an expression for the paramagnetic susceptibility of material. 10

(b) Obtain an expression for concentration of electrons in an intrinsic semiconductor. State an expression for the concentration of holes in the same. Show that in an intrinsic semiconductor Fermi level lies half way between top of valence band and bottom of conduction band. 10

(c) Discuss the various current components in a biased p-n junction. Derive the expressions for the total current in p-n diode as a function of applied voltage. 10

3. Attempt any **two** :—

(a) Explain the construction and working of n-channel enhancement type MOSFET. Draw its drain characteristics. 10

(b) With the help of neat circuit diagram and relevant waveforms, explain the working of a transistorized monostable multivibrator. 10

(c) What is a photo diode ? Explain its working with the help of relevant diagrams. Describe its use in optocoupler. 10

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4. Attempt any two :-

- (a) Draw the circuit diagram of an instrumentation amplifier using three OPAMP. 10
Explain its working. Derive an expression for its output voltage.
- (b) What is a shift register ? Explain in detail, the serial in-serial out operation 10
of a shift register.
- (c) What is the necessity of voltage regulation ? Draw two transistor voltage 10
regulator circuit and explain its working. State its disadvantages.

5. (a) Attempt any two of the following :-

- (i) The allowed energy state for an electron is positioned above the Fermi 5
energy level by $\frac{3K_B T}{2}$. Calculate the probability of occupancy of an electron
in that state.

- (ii) The magnetic susceptibility of a diamagnetic material is -1.08×10^{-5} . Determine 5
the flux density (B) and magnetization (M) in the material if a magnetic field
of strength 10^7 amp/m is applied to it.

Given : Permeability of free space $\mu_0 = 12.57 \times 10^{-7} \text{ N/A}^2$

- (iii) A silicon p-n junction has reverse saturation current, $I_0 = 8 \mu\text{A}$ at 27°C . Find 5
its static and dynamic resistance for an applied forward bias of 0.62V at
 27°C .

Given : Boltzman's constant $k = 1.38 \times 10^{-23} \text{ J/K}$

Electronic charge, $e = 1.6 \times 10^{-19} \text{ C}$.

(b) Attempt any two of the following :-

- (i) A SCR, Full Wave rectifier has load resistance of 100Ω . If peak ac voltage 5
is 120 V , find average load voltage and current for conduction angle of
 130° .
- (ii) An AM transmitter radiates total power of 25kW . The carrier is modulated 5
to a level of 60% . Calculate the power in the carrier and in each side band. 5
- (iii) The LM 7815 regulator has input voltage of 24 volt . What is head room
voltage ? If $R_L = 60 \Omega$, find power dissipation and efficiency of this
regulator.
