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Name.....

Reg. No.....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, MARCH 2020

(CUCSS)

Physics

PHY 4E 19—PHYSICS OF SEMICONDUCTORS

(2017 Admission onwards)

Time : Three Hours

Maximum : 36 Weightage

Section A

Answer **all** *questions.*

Each question carries weightage 1.

1. What are allowed and forbidden optical transitions ?
2. What are excitons? Distinguish between Wannier-Mott and Frenkel excitons.
3. Explain the process of doping in semiconductors.
4. What is the importance of Hall Effect studies in semiconductors ?
5. What are possible recombination processes in semiconductors ?
6. What is the origin of space charges in a p-n junction ?
7. Distinguish between ohmic contacts and Schottky contacts.
8. What is a solar cell ?
9. How can you get white light from a light emitting diode ?
10. What are quantum well and quantum dot structures ?
11. Explain any one method of fabrication for quantum dot structures.
12. What happens to the energy levels of electrons and holes inside a quantum well structure ?

($12 \times 1 = 12$ weightage)

Section B

Answer any **two** *questions.*

Each question carries weightage 6.

13. (a) Derive an expression for electrical conductivity in semiconductors;

    (b) Explain what happens to the total conductivity if there exists both holes and electrons in a semiconductor.

Turn over

14. Describe in detail how capacitance measurement is used to profile impurity levels in semicondu C 8

15. Explain the working principle of light emitting diodes (LED). Mention its merits and dem Describe various methods of white light generation in LED.

16. Write short notes on (a) Quantum well structures ; (b) Quantum Hall Effect ; and (c) High ele mobility transistor.

(2 × 6 = 12 weigh

Section C

Answer any **four** *questions.*
Each question carries weightage 3.

17. Certain semiconductor has an electron density of 9×10^{20} cm^{-3}. Calculate the change in band in this material due to Burstein-Moss shift. (Effective mass = 0.45 m_0).

18. In InP the electron effective mass is 0.05 m_0 and hole effective mass is 0.4 m_0. Calculate exciton Bohr radius and exciton binding energy in InP. Dielectric constant of InP = 9.6.

19. When a current of 15 mA is sent along the length of a semiconductor crystal of 10 mm long, 5 m wide and 1 mm thick placed in a region of magnetic flux density of 0.5 weber/m^2 exist, a voltage 17 μV is measured across its width. Calculate the Hall co-efficient and the density of charge carrie

20. Calculate the current across a p-n junction at room temperature, if a forward bias of 0.5 V applied across it. Take saturation current 1 μA.

21. A solar cell illuminated by an irradiance of 100 mW/cm^2 shows an open circuit voltage of 0.6 V a short-circuit current of 3 mA/cm^2. Calculate its efficiency if the fill factor is 0.7.

22 Plot the eigen functions and probability density for electrons trapped inside a quantum well f first three quantum numbers.

(4 × 3 = 12 weightag