Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (CBSS-Reg./Suppl./Imp.)
Examination, April 2020
(2014 Admission Onwards)
PHYSICS
PHY 4E06 : Optoelectronics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**).

1. a) i) Sketch and explain the reverse biased pn junction with minority carrier profiles and the origin of the reverse current.

   ii) Explain the depletion layer capacitance.

   OR

   b) What is Mode Locking ? Deduce the expressions for the Separation between pulses Δt_{sep} and pulse width Δt_p for a mode locked laser.

2. a) What is Pockels effect ? With a diagram explain the principle and operation of a transverse Pockels cell phase modulator.

   OR

   b) i) Explain the principle and operation of a pn junction photodiode.

   ii) Give an account of PIN photodiode.

   (2×12=24)

SECTION – B

Answer **any four**.

(**1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).

3. a) In which bands do the movement of electrons and holes takes place ?

   b) Sketch the energy band diagram of an n-type Si-doped with 1 ppm As.

c) Consider a GaAs LED, the band gap of GaAs at 300K is 1.42eV, which changes (decreases) with temperature as $dE_g/dT = -4.5 \times 10^{-4}$ eVK^{-1}. What is the change in the emitted wavelength if the temperature change is 10°C ?

4. a) What is meant by active mode locking ?

b) Give an account of LED materials.

c) Explain the evolution of a giant pulse through Q-switching.

5. a) What is a avalanche photodiode ?

b) Explain the principle and operation of a phototransistor.

c) A Si PIN photodiode has an active light receiving area of diameter 0.4mm. When radiation of wavelength 700nm (red light) and intensity 0.1m Wcm^{-2} is incident it generates a photocurrent of 56.6nA. What is the responsivity and quantum efficiency of the photodiode at 700nm.

6. a) What are photovoltaic devices ?

b) With a sketch explain the principle and operation of a solar cell.

c) A particular family house in a sunny geographic location over a year consumes a daily average electrical power of 500W. If the annual average Solar intensity incident per day is about 6kWhm^{-2} and a photovoltaic device that converts solar energy to electrical energy has an efficiency of 15%. What is the required device area ?

7. a) What is dichroism ?

b) Distinguish between quarter wave plate retarder and half wave plate retarder.

c) With a sketch explain the principle and working of a Kerr cell phase modulator.

8. a) What is meant by second harmonic generation ?

b) Briefly explain the phase matching.

c) Give an account of third order nonlinear optical process.   (4×9=36)