Reg. No ..... Name **19P4029**

MSc DEGREE END SEMESTER EXAMINATION - MARCH/APRIL 2019

SEMESTER 4 : PHYSICS

COURSE : **16P4PHYT15EL : OPTOELECTRONICS**

(For Regular - 2017 Admission and Supplementary - 2016 Admissions)

Time : Three Hours Max. Marks: 75

Section A
Answer all the following (1 marks each)

1. In a semiconductor the density of states $g(E)$ is proportional to
   (A) $g(E)\alpha(E+E_c)^{1/2}$ (B) $g(E)\alpha(E-E_c)^{1/2}$ (C) $g(E)\alpha(E-E_v)^{1/2}$ (D) $g(E)\alpha(E+E_v)^{1/2}$
2. Fermi – Dirac statistics can be replaced by Bose – Einstein statistics for
   (A) Non - Degenerate semiconductors (B) Degenerate semiconductors (C) Heavily doped semiconductors (D) Very heavily doped semiconductors
3. In passive mode locking
   (A) External power is required (B) No External power is required (C) Need passive circuit elements (D) Need Active circuit elements
4. In phototransistor, the photocurrent flowing in the external circuit is
   (A) $I_{PH} \approx \beta I_{PHO}$ (B) $I_{PH} \geq \beta I_{PHO}$ (C) $I_{PH} \approx \beta I_{PH}$ (D) $I_{PH} \leq \beta I_{PHO}$
5. In the case of Kerr effect (A) n = n(E) (B) $n = n(E^2)$ (C) $n = n(E^3)$ (D) $n = n(E^4)$

(1 x 5 = 5)

Section B
Answer any 7 (2 marks each)

6. Write short note on selection criterion for LED material.
7. Explain the quantum mechanical explanation for the distribution of charges in E – k diagram.
8. Explain optical and electrical band width of a photodetection system.
9. Explain briefly the working of a hetrojunction laser.
10. Give the difference between active and passive mode locking.
11. Explain the Q factor of a laser.
12. Differentiate between quantum efficiency and responsivity.
13. Explain the working of a phototransistor.
14. Explain the term phase matching in nonlinear optics.
15. Write a short note on two photon absorption.

(2 x 7 = 14)

Section C

Answer any 4 (5 marks each)

16. Show that n^+p structure is best suited for construction of high efficient LED`s.
17. Explain the structure of homojunction lasers.
18. Show the structure of vertical cavity surface emitting laser.
19. Define shot noise and quantum noise in photo detectors.
20. Describe the working of an avalanche photodiode. How it is superior to an ordinary PD.
21. Determine the change in refractive index in GaAs for an applied electric field of 2×10^5 V/cm. Given that for a GaAs crystal,the value of $r_{14} = 1.6 \times 10^{-12}$and $n_r = 3.6$.

(5 x 4 = 20)

Section D

Answer any 3 (12 marks each)

22.1. Explain Power and efficiency of LED and show how the efficiency can be made maximum.

OR

2. What is a wave guide? What are single mode and multimode waveguide? Distinguish between TE and TM modes.

23.1. Discuss high power laser pulses through Q- switching. Explain active and passive Q –switching.

OR

2. Write notes on heterostructure laser diode and optical laser amplifier.

24.1. Describe the working principle of an avalanche photodiode and phototransistor.

OR

2. What is meant by non-linear susceptibilities. Explain the phenomenon second Harmonic generation and obtain the condition for phase matching.

(12 x 3 = 36)