

APR 07 2017

KATHMANDU UNIVERSITY  
End-Semester Examination  
March/April 2017

Marks Scored:

Level : B.Sc.  
Year : IV

Course : PHYS 404  
Semester: I

Exam Roll No. :

Time : 30 mins.

F.M. : 20

Registration No.:

Date :

SECTION "A"

[20 Q. × 1=20 marks]

Choose and tick the most appropriate answer.

- The indirect band gap of Silicon is 1.1eV, what is the wavelength corresponding to this energy:  
[a] 1127.13nm      [b] 900nm      [c] 590nm      [d] 650nm
- Peak of the solar spectrum lies on the energy range of  
[a] uv      [b] infrared      [c] x-ray      [d] visible
- Electro-luminescence phenomenon was discovered in  
[a] 1900      [b] 1950      [c] 1907      [d] 1920
- Radiance is basic properties of  
[a] light source      [b] light reflector      [c] Sun      [d] Earth
- Band gap of compound III-V semiconductor InN is  
[a] direct, 0.7eV      [b] indirect, 0.7eV      [c] direct, 1.5eV      [d] indirect, 1.5eV
- Higher the fill factor of solar cell,  
[a] lower the band gap      [b] higher the band gap  
[c] lower the efficiency      [d] higher the efficiency
- Laser resonator are mainly made by  
[a] both plane mirrors      [b] one plane and another concave mirrors  
[c] both concave mirrors      [d] one convex and another plane mirrors
- Diode lasers are the \_\_\_\_\_ emitters.  
[a] edge      [b] surface      [c] corner      [d] bulk
- In higher order Gaussian modes the intensity profiles of rectangular coordinates are called  
[a] Gauss Leguerre profile      [b] Gauss Hermite profiles  
[c] Gauss Lorentz profile      [d] fundamental modes
- In TM modes of waveguide the \_\_\_\_\_ field propagates on the z-axis  
[a] electric      [b] magnetic  
[c] both      [d] circularly polarized electric

Fill in the blanks with appropriate word(s).

11. PIN diode is different from ordinary PN diode, where I refers to \_\_\_\_\_.
12. Three basic requirements of a photodetector are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
13. Change in wavelength spread of laser output with different phenomenon is called \_\_\_\_\_.
14. Major influencing factor on the choice of semiconductor material is \_\_\_\_\_.
15. Due to \_\_\_\_\_ valance band the effective mass of holes are not equal in all directions.
16. \_\_\_\_\_ helps the electron holes recombination in indirect bandgap semiconductors.
17. The refractive index on three rectangular optical wave guide follow the pattern \_\_\_\_\_.
18. There are \_\_\_\_\_ and \_\_\_\_\_ types of beam coherences.
19. \_\_\_\_\_ recombination is responsible for heating during light matter interaction.
20. Critical angle loss can be minimized by \_\_\_\_\_ and \_\_\_\_\_ in typical LED.

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Time : 2 hrs. 30 mins.

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Semester: I  
F.M. : 55

SECTION "B"

[5 Q.×4=20 marks]

1. Write some properties of photon including particle wave duality and uncertainty relation.
2. Explain the three basic interactions of light with matter with the help of schematic diagrams.

OR

Draw the geometry of Gaussian beam and clearly label each parts.

3. Draw the energy level diagram and structure of LED, also describe its working.
4. What are the working principle of three level and four level lasers. Which is more efficient and practical?
5. Explain the different modes of propagations in three layer waveguide.

SECTION "C"

[5 Q × 7= 35 marks]

6. Differentiate between ordinary and laser light on the basis of coherence and monochromaticity. Explain your answer with necessary theory.

OR

Derive the expression for line shape and width of light from a typical LED.

7. Show the different possible modes in a three layer planar waveguide (with index of refractions  $n_1 < n_3 < n_2$ ,  $n_2$  being the propagation medium) in connection with propagation constant.
8. Calculate the Goos Hnchen shifts as a function of thickness of guiding medium for a TE mode guided with  $\beta = 1.85 k$  in a guide like that of Question 7, with  $n_1 = 1.0$ ,  $n_2 = 2.0$ ,  $n_3 = 1.7$ .
9. Obtain the equation for ray matrix and discuss the stability of optical resonator.
10. Start from rate equations and relate the Einstein's coefficients.

OR

Setup the axially symmetrical paraxial wave equation and solve the fundamental mode of Gaussian beam to calculate the intensity profile.

