MAHATMA GANDHI UNIVERSIY
V SEMESTER B.Sc PHYSICS EXAMINIATION 20…
PH5B02U   PHYSICAL OPTICS AND PHOTONICS

Instructions:
1. Time allotted for the examination is three hours
2. Answer all questions in part-A. This contains 4 bunches of 4 objective type questions. For each bunch, Grade A will be awarded if all the 4 answers are correct, B for 3, C for 2, D for 1 and E for 0.Answer any 5 questions from part B, any 4 from part C and any 2 from part D
3. Candidates can use non programmable scientific calculator

Part A (Objective type-weight 1 each)

Bunch I

Choose the correct answer.

1. If white light is used instead of monochromatic light to form Newton's rings due to reflected light, the center will be

     (a) dark (b) bright (c) colored (d) uniform illumination throughout

2. In a zone plate,

     (a) the radii of the zones are proportional to squares of natural numbers.
     (b) the even numbered zones are transparent.
     (c) the odd numbered zones are opaque to light
     (d) the radii of the zones are proportional to square root of natural numbers.

3. In double refraction

     (a) o-ray and e- ray travels with different velocity along the optic axis.
     (b) the velocity of the e- ray is maximum along the optic axis in positive crystals.
     (c) the o-ray travels slower than e-ray in all directions except along the optic axis.
     (d) the principal refractive index for o-ray is larger than the principal refractive index for e-ray in positive crystals.

4. If n_1 is the refractive index of core n_2 is the refractive index of cladding, the numerical aperture is given by

     (a) $n_1 + n_2$ (b) $n_1 - n_2$ (c) $(n_1 - n_2)^2$ (d) $(n_1^2 - n_2^2)^{1/2}$

Bunch II

Fill in the blanks.

5. The condition for darkness of a thin film in reflected light is ----------
6. In the case of Fraunhoffer diffraction the wave front in incident on the aperture is
7. A quarter wave plate introduces a phase difference of ------------

8. The role of an optical resonator in a laser system is to provide --------------

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Bunch III

Write true or false; if false correct it

9. Two independent sources of light having same wave length can never be coherent.
10. The intensity of image form by a zone plate is more than that formed by a convex lens.
11. In positive crystals the e-ray velocity has a maximum value along the optic axis and a minimum value in a direction perpendicular to the optic axis.
12. Continuous wave laser operation is possible only in a three level pumping scheme

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Bunch IV

Match the following

A	B	C
13. Coherent sources	Zone plate	Colors of thin films
14. Half period zones	Grating	Numerical aperture
15. Fraunhofer diffraction	Interference	Diffraction at N slits
16. Total internal reflection	Optical fiber	Square roots of natural numbers

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Part –B (Short answer questions- weight 2 each)

17. What are the conditions to observe a well defined interference pattern?

18. Why should the lens used in Newton's rings apparatus be of large radius of curvature and thin?

19. Explain the difference between Fraunhoffer and Fresnel diffraction?

20. Distinguish between polarized and unpolarized light?

21. What is double diffraction?

22. What is a quarter wave plate? Deduce its thickness for a given λ in terms of refractive indices?

23. What is population inversion? Explain why population inversion is necessary for laser action?

24. Explain what is step index, graded index, single mode and multimode fiber?

Part-C (Short essay/Problems- weight 2 each)

25. In a Newton's Rings experiment the diameter of the 4th and 12th dark rings are 0.4 cm and 0.7 cm respectively. Find the radius of the 20th dark ring.

26. A diffraction grating used at normal incidence gives a line $\lambda_1 = 6000A^0$ in a certain order superimposed on another line $\lambda_2 = 4500\ A^0$ of the next higher order. If the angle of diffraction is 30^0, how many lines are there in a cm in the grating.

27. The wavelength of emission is 6000 A^0 and the life time τ_{sp} in 10^{-6}s. Determine the coefficient of stimulated emission. The refractive index of the medium $\mu = 1$.

28. Explain how will you determine the thickness of insulation of a thin wire by forming an air wedge.

29. Explain how will you produce and detect circularly polarized light.

30. Compare two level, three level and four level pumping schemes. What are the advantages of four level pumping scheme.

Part- D (Essay type questions-weight 4 each)

31. Describe Michelson interferometer and explain the formation of fringes in it.

32. Give the construction and working of Laurent's half shade polarimeter.

33. Explain the construction and working of He. Ne Laser.

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