Model Question Paper

MAHATMA GANDHI UNIVERSITY

COMPLEMENTARY- MATHEMATICS AND STATISTICS

IV SEMESTER B.Sc. Programme EXAMINATION……YEAR

MT4C01U – PHYSICAL OPTICS, LASER PHYSICS AND ASTROPHYSICS

Instructions:

Time allotted: 3 hrs Total Weight: 25

Answer all questions in part A. This contains 4 bunches of 4 objective 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 ……(type of calculator/tables)

Part A (Objective type- weight 1 each)

Bunch 1

1). Intensity of light is proportional to ----------of wave

a). amplitude b). $(\text{amplitude})^2$ c). $(\text{amplitude})^{1/2}$ d). 1/amplitude

2). Two waves of amplitudes 3 units and 2 units interfere constructively. What is the net intensity of bright band

a). 9/4 b). 13 c). 5 d). 25

3). In the Young's double slit experiment, wavelength of light is doubled and slit width is halved, the band width becomes--------- times

a). 2 b). 4 c). 8 d). 6

4). Constructive interference in a soap film occurs when the path difference between the reflecting rays is

a). $(2n-1)\Lambda/2$ b). $n\Lambda$ c). $(2n+1)\Lambda/2$ d). $(n+1)\Lambda$

Bunch 2

5). In diffraction experiment using a straight edge, the diffraction pattern is obtained ------ the edge of geometric shadow

a). above b). below c). parallel to d). close to

6). Expression that decides the diffraction in a grating under normal incidence is

a). $Nm \sin\theta = \Lambda$ b). $N\Lambda = m \sin\theta$ c). $m \Lambda = N \sin\theta$ d). $Nm\Lambda = \sin\theta$

7). Polarization is a confirmatory test of ---------- character of light wave

a). oscillatory b). longitudinal c). transverse d). vibrational

8). In the Brewster's experiment of polarization, when light ray is incident at the polarizing angle, the angle between reflected ray and refracted ray is

a). 45^0 b). 90^0 c). 0^0 d). 180^0

Bunch 3

9). Ratio of intensity of emerging plane polarized light from an analizer to the intensity of incident plane plarized light at an angle , is proportional to

a). $1/\sin^2\theta$ b). $\sin^2\theta$ c). $1/\cos^2\theta$ d). $\cos^2\theta$

10). Velocity of propagation of extraordinary ray in a calcite crystal will be ---------- in ---------- direction/directions

a). same, all b). different , different c). changing, same d). same only for particular colours, different

11). In quartz half- wave plate, velocity of ordinary ray v_0 is related to the velocity v_E of the extraordinary ray as

a). $v_0 > v_E$ b). $v_E > v_0$ c). $v_E = v_0$ d). $v_E = 2v_0$

12). Population inversion in an active medium means

a). more atoms in the upper state b). more atoms in the ground state c). atoms are uniformly distributed d). atoms are unstable

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Bunch 4

13). In general, an atom can interact with radiation over a range of frequencies and the strength of interaction is known as

a). delta function b). line-shape function c). gamma function d). Beta function

14). In Ruby Laser the excitation of active medium is done by

a). optical pumping b). electric discharge c). Heating d). rubbing

15). The most effcient gas laser is

a). Hydrogen Laser b). Oxygen Laser c). Helium laser d). carbon dioxide Laser

16). In the case of a star with core mass 1.4 M_O , its final stage is called

a). neutron star b). white dwarf c). black hole d). red giant

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Part B (Short answer questions- weight 1 each)

17). Explain coherent sources of light with an example. Explain the conditions to have constructive and destrucive interfernce.

18). With a neat diagram write a note on interfernce in thin films.

19). Briefly explain the resolving power of a microscope and a telescope.

20). What is polarization?. What is double refraction in crystals?.

21). Explain how the half- wave plate and quarter- wave plate work?

22). Explain spontaneous emission and stimulated emission in Laser.

23). With a neat diagram write a note on Nd-Yag laser.

24). Give a brief note on Neutron star.

Part C (Short Essay/Problems– weight 2 each)

25). Two coherent sources with intensities in the ratio 81:1 produce interference fringes. Deduce the ratio of maximum intensity to minimum intensity in the fringe system. In the above experiment if , d =1m.m ; D =1m; and Λ= 600nm, what is the band width of the interference pattern?.

26). A thin layer of oil is spread over a water surface. If the light of wavelength 600 nm is absent in the reflected light, what is the minimum thickness of the oil layer?. What can be the next higher thickness of layer to have the same situation as above?.

27). Microwave of wavelength 2 cm is incident normally on a slit of 5cm width. Deduce the angular spread of the central maximum. Find the resolving power of a telescope with diameter 1cm assuming that mean wavelength of white light is 500nm.

28). Angle of polarization of diamond is 67^0. Compute the refracive ibdex. If the angle between the optic axes of polarizer and analizer is 30^0, what is the ratio of intensity of light in between the polarizer and analizer to the intensity of light after the analizer?.
29). Define Brewster's law with a diagram. The critical angle of water is 48^0. What is the polarizing angle?.
30What is the Schwarzschild radius of a black hole?. Determine the Schwarzschild radius of a black hole with 5 solar mass

Part D (Essay type questions- weight 4 each)

31). Derive the expression for the band width of interference pattern in double slit experiment. What are the differences between Interference and diffraction?. Distinguish between Fresnel class of diffraction and Fraunhofer class of diffraction.
32). With necessary theory explain the Einstein's coefficients in Laser theory. Explain the working of He-Ne Laser. Give two uses of Laser.
33) . Write notes on (a). birth of a star (b). brightness and luminosity of star (c). white dwarf (d). Supernova (e). black hole.

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