

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), December 2015
B. Tech./B. Tech+M. Tech (Branch: CHE, CE, ME), Semester I

Roll No.....

PH101: Engineering Physics

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. Mobiles are not allowed during examination.
5. Non-programmable calculator is allowed.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. When a drop of oil is spread on a water surface, it displays beautiful colours in daylight because of _____.
(a) interference (b) diffraction (c) polarization (d) none
- ii. A ray of light is a straight line that is _____.
(a) parallel to the wave front (b) normal to the wave front
(c) aligned at 45° to the wave front (d) aligned at 120° to the wave front
- iii. A calcite crystal is placed over a dot on a piece of paper and then rotated. On viewing through calcite, we observe _____.
(a) a single dot (b) two stationary dots
(c) two rotating dots (d) one dot rotating about the other
- iv. Polarization of light proves the _____.
(a) corpuscular nature of light (b) quantum nature of light
(c) transverse nature of light (d) longitudinal nature of light
- v. To be a solution of the Schrodinger equation, the wave function should be multivalued, continuous, and continuous first derivatives. [YES/NO]
- vi. The average life time of the metastable state is _____.
(a) 10^{-15} (b) 10^{-10} (c) 10^{-8} (d) 10^{-3}
- vii. Numerical Aperture is independent of _____.
(a) refractive index change (b) refractive index of medium (c) acceptance angle

- (d) incidence and refractive angles
- viii. The correct choice for fabricating LED is _____
- (a) Si (b) Ge (c) GaAs (d) Carbon
- ix. Hamiltonian operator defines the _____
- (a) total energy of the system (b) potential energy of the system
- (c) kinetic energy of the system (d) all of these
- x. Maximum number of orders available with a grating is _____.
- (a) independent of the grating element
- (b) directly proportional to the grating element
- (c) inversely proportional to the grating element
- (d) directly proportional to the wavelength

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- i. Discuss the various characteristics of ordinary and extraordinary rays.
- ii. What is the dispersive power of a plane transmission grating? Derive the expression for it.
- iii. What particular spectra would be absent if the width of the transparencies and opacities of the grating are equal?
- iv. Show that the phase velocity of the de Broglie wave is greater than the velocity of light, but the group velocity is equal to the velocity of the particle with which the wave are associated.

Q.3A What are the Interference filters? Explain the fabrication of Interference filters.

05

Q.3B The red cadmium line has wavelength 643.8 nm. If coherent time be $\tau_c \sim 10^{-9}$ s. Find spectral purity of the line.

05

Q.4A Differentiate the function of step index and graded index optical fibre? Show that numerical aperture of a step index optical fibre is given by

05

$$NA = n_1 \sqrt{2\Delta} \quad \text{Where symbols have their usual meanings.}$$

Q.4B A particle of rest mass m_0 has a kinetic energy K. Show that its de Broglie

05

wavelength is given by $\lambda = \frac{hc}{\sqrt{k(k+2m_0c^2)}}$

- Q.5A A glass-clad fibre is made with the core glass of refractive index of 1.5 and the cladding is doped to give a fractional index difference of 0.005. Calculate (a) critical angle of an optical fibre (b) V-number or cut-off parameter. 05
- Q.5B An X-ray photon is found to have its wavelength doubled on being scattered through 180° . Find the (a) energy of the incident photon (b) energy of the recoiled electron? 05
- Q.6A Explain Malus law taking in to account the transmission of polarized and unpolarised light through a Nicol Prism. 05
- Q.6B Use the Malus principle for a pair of crossed polarizers with axes at angle 0° and 90° , which is placed in a beam of unpolarized light with intensity I_0 , so that light emerges from the first with $I_1 = \frac{I_0}{2}$ and from the second with $I_2=0$. If a third polarizer is placed between the two and it rotates at angular frequency ω than show that $I_2 = \frac{I_0}{16}(1-\cos 4\omega t)$. 05

OR

- Q.6B A retardation plate of thickness 8.56×10^{-7} m introduces a phase difference in the path of polarized light of wavelength $5890 \text{ \AA}$. The principal refractive indices are $\mu_o = 1.658$ and $\mu_E = 1.486$. Find the nature of the retardation plate. 05
- Q.7A Describe the plane transmission diffraction grating. Show with neat diagram how you would use it to find the wavelength of light. How are spectral lines affected if the rulings are made closer? 05
- Q.7B A grating has total ruled width 5 cm for normal incidence. It is found that a line of wavelength $6200 \text{ \AA}$ in as certain order superimposed on another line of wavelength $3200 \text{ \AA}$ of the next higher order. If the angle of diffraction is 30° , how many lines are there in the grating? 05

OR

- Q.7B The distance between the second and the fifth minimum in diffraction pattern due to single slit is 0.4 mm. The screen is 60 cm away from the slit. If wavelength of light used is $6000 \text{ \AA}$, determine width of slit. 05
- Q.8 Write down the Schrodinger's equation for a free particle enclosed in one dimensional box of size 'a'. Solve it for eigen values and eigen functions. Find lowest energy of the non-degenerate state. 10

Q.9A Describe the formation of dark and bright circular fringes by reflected monochromatic light in the Newton's rings experiment. Discuss how these rings can be used to measure the wavelength of light. What will happen if (a) a drop of water is introduced between the glass plate and the lens and (b) the lens is lifted up slowly from the flat surface? 10

Q.9B What do you understand by spontaneous emission and stimulated emission? Obtain a relation for Einstein coefficients A and B for spontaneous and stimulated emission. What are essential requirements for laser action? 10

OR

Q.9B Explain the working of Bi-quartz device. How will you determine specific rotation using Bi-quartz polarimeter? Discuss the relative merits of biquartz and half shade devices. 10