# B.Tech. Degree I&II Semester Examination in Marine Engineering May 2018

## MRE 1103 ENGINIEERING PHYSICS

*(2013 Scheme)*

Time : 3 Hours                                    Maximum Marks : 100

$(5 \times 20 = 100)$

I.   (a) Define interference?  Give the conditions for producing good interference fringes.   (5)

(b) Explain with theory, Newton's rings method to determine the wavelength of monochromatic light and discuss which source is preferred, point source or extended source.   (12)

(c) In Newton's rings experiment the diameter of $4^{th}$ and $25^{th}$ rings are 0.3 cm and 0.8 cm, respectively.  Find the wavelength of light.  Given R=100 cm.   (3)

**OR**

II.  (a) What are continuous and characteristics X-rays and how are they produced? What is the minimum wavelength limit and how it is related with the voltage applied across the X-ray tube?   (12)

(b) Why should anti-cathode have high atomic number and high melting point?   (2)

(c) An X-ray tube is operated at 25 kV.  Calculate the minimum wavelength of X-rays emitted from it?   (3)

(d) If the potential difference applied across an X-ray tube is 10 kV and current through it is 2.0 mA.  Calculate the velocity of electrons at which they strike the target.   (3)

III. (a) Explain Rayleigh's criterion for resolution.   (6)

(b) Define resolving power of a telescope.  How does it depend on the wavelength of light used?   (8)

(c) A telescope objective having diameter 20 cm is directed towards two points at a distance of 6 km from the objective lens.  If the wavelength of light used is 550 nm, evaluate the distance between the two points.   (3)

(d) White light containing wavelengths from 400 nm to 750 nm  falls on a grating with 6000 lines/cm.  How wide is the first order spectrum on a screen 2 m away?   (3)

**OR**

IV.  (a) What are negative and positive crystals? Give examples.   (4)

(b) Distinguish between linearly polarized, circularly polarized and elliptically polarized light?   (6)

(c) What is double refraction?  Describe the construction of Nicol prism.  How can it be used as a polarizer and as an analyzer?   (10)

V.   (a) Outline briefly the characteristics of laser light.   (4)

(b) How is population inversion achieved in a He-Ne laser?   (4)

(c) What is a metastable state?  Explain its importance in lasers.   (4)

(d) Determine the condition under which stimulated emission equals spontaneous emission?   (4)

(e) Evaluate the ratio of spontaneous emission to stimulated emission at a temperature of 300 K for transitions that occur in    (i)   the visible region  (ii)   the microwave region.   (4)

$\left(\text{Given } \lambda_{\text{visibile region}} = 5500 \text{ Å}, \lambda_{\text{microwaveregion}} = 1 \text{ } cm\right)$

**OR**

(P.T.O.)

VI.
(a) Distinguish between photography and holography? (3)
(b) Describe any three methods to achieve population inversion relating to lasers? (6)
(c) Explain any three applications of lasers. (6)
(d) Explain briefly on Einstein's coefficients. (2)
(e) Laser action occurs by stimulated emission from an excited state to a state of energy 30.5 eV. If the wavelength of laser light emitted is 690 nm, what is the energy of the excited state? (3)

VII.
(a) Higher order modes tend to send light energy into the cladding. Why? (4)
(b) Define numerical aperture? How is it related to the acceptance angle? (6)
(c) Explain how light is propagated in a step index fibre. (4)
(d) Discuss any three types of losses in optical fibres. (6)

**OR**

VIII.
(a) Explain the structure of a typical optical fibre used in practice. (5)
(b) Give an account of bending losses in fibres and how can you minimize them. (5)
(c) For a step index fibre having core index 1.43 and cladding index 1.4, calculate (i) Critical angle $\theta_c$ (ii) numerical aperture. (6)
(d) If the maximum angle of incidence is 45° for entrance of light for a fibre placed in air, calculate the numerical aperture? What is the acceptance angle? (4)

IX.
(a) Explain how piezoelectric effect is utilized for the production of ultrasonic waves. (8)
(b) Explain any two important applications of ultrasonic as a tool for non-destructive testing. (4)
(c) What is a gyroscope? (5)
(d) The fundamental vibrational frequency of a quartz crystal is 3 MHz, if it is vibrating at resonance, what is its thickness. Young's modulus of quartz $= 7.9 \times 10^{10}$ N/m$^2$ and density of quartz $= 2650$ Kg/m$^3$. (3)

**OR**

X.
(a) Distinguish between Type I and Type II superconductors. (6)
(b) Define Meissner effect and isotope effect. (4)
(c) Write a short note on quantum tunneling. (4)
(d) The penetration depths for lead are 396 Å and 1730 Å at a 3 K and 7.1 K respectively. Calculate the critical temperature for lead. (3)
(e) A long superconducting wire produces a magnetic field of $200 \times 10^3$ A/m on its surface due to current through it at temperature ($< Tc$). Its critical magnetic field at 0 K is $250 \times 10^3$ A/m. Tc of the material of wire is 12 K. Find the value of T. (3)

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