



National Institute of Technology Delhi

Mid Semester Examinations September 2017

Name of Specialization –B.Tech.(ECE+EEE)
Course Name-Electromagnetics & Quantum Physics
Course Code: PHL-100

Roll No:
Year- 1stSemester -1st
Maximum Marks – 25
Total Time: 2:00 Hours

Instructions: All questions are compulsory.
Symbols used in the questions are having their usual meaning.
Assume if any data is missing.

Q-1: [a]: Express the vector $\mathbf{V} = \frac{1.0}{r} \mathbf{a}_r + r \cos\theta \mathbf{a}_\theta + \mathbf{a}_\phi$ in the cylindrical coordinate and find out the value of $\mathbf{V} \left(5, \frac{\pi}{2}, -2 \right)$. (2)

[b]: A circular loop located on $x^2 + y^2 = 9, z = 0$ carries a current of 10A along \mathbf{a}_ϕ . Determine H at (0, 0, 4) and (0, 0, -4). (3)

Q-2: [a]: Define conduction and displacement currents. Show that in the parallel plate capacitor both are equal in magnitude. (2)

[b]: Define pointing vector. Derive an expression for it and explain its physical significance for electromagnetic waves. (3)

Q-3: [a]: Why does the stationary interference pattern not observe with two independent light sources rather it can be achieved for the microwaves as well as sound waves? How can one overcome with this problem? (2)

[b]: Light of wavelength 5000 \AA is incident normally on a slit. The first minimum of the diffraction pattern is observed to lie at a distance of 5mm from the central maximum on a screen placed at a distance of 2m from the slit. Calculate the width of the slit. (3)

Q-4: [a]: What do you understand by anti-reflection coating? A Michelson interferometer is set the white straight fringes. When a mica sheet of thickness 0.005cm is put in front of the fixed mirror, then in order to bring back the coloured fringes to their original position, the movable mirror is moved by 0.0025 cm. Calculate the refractive index of mica. (3)

[b]: What do you mean by polarized light? Plane polarized light wavelength 5000 \AA is incident on a quartz plate cut parallel to optic axis. Find the least thickness of the plate for which the ordinary and extra-ordinary rays combine to form a plane polarized light on the emergence. The indices of the refraction of the quartz corresponding to e-ray and o-ray are 1.5533 and 1.5442 respectively. (3)

Q-5: [a]: How is the Fraunhofer diffraction pattern different from Fresnel diffraction? Show that double slit Fraunhofer diffraction provides the intensity four times of the one obtained by single slit. (3)

[b]: Calculate the minimum thickness of the base of a prism which will just resolve the D1 and D2 lines of the sodium. Given refractive index, n for wavelength $656.3 \text{ nm} = 1.6545$ and for wavelength $572 \text{ nm} = 1.6635$. (2)
