M.Sc. 1st Semester Examination 2009

ELECTRONICS

(*Electromagnetic Fields and Plasma Electronics*)

PAPER—EL-1102

Full Marks : 50

Time : 2 hours

Answer **Q. No. 1** and any **three** questions from the rest

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. Answer *all* questions: 2×5

(*a*) In an antenna radiation intensity is given by

$$U = \sin^{n}\theta.$$

Calculate the directivity in dB. (Half power beam width is 90°).

(*b*) Can you view a waveguide as filter ? If yes , what kind of filter is it and why ?

(*c*) Why is the short-wave propagation generally better at night than the day time ?

(*d*) What is plasma ? Define plasma frequency.

(*e*) Explain the function of microwave grating.

2. (*a*) Derive an expression for voltage and current in terms of sending and receiving-end variables for a loss-less transmission line of finite length.

(*b*) Find also the expression for input impedance of this line.

(*c*) A 25 m long loss-less transmission line is terminated with a load having an equivalent impedance of $40 + 30j$ Ω at 10 MHz. The inductance and capacitance of this line are 310 nH/m and 38 pF/m respectively. Calculate the input impedance at the sending–end and mid point of the line. 5 + 2 + 3

3. (*a*) What is a cavity resonator ?

(*b*) How does the resonance occur in a cavity resonator ?

(*c*) Derive an expression of quality factor of a rectangular cavity resonator. 2 + 3 + 5

4. The current in a small loop (magnetic dipole antenna) of radius 10 cm is

$$100 \cos\left(\omega t - \frac{\pi}{6}\right) \text{amp},$$

where $\omega = 300$ Mrad/s. If the medium is free space, write an expression for the fields in the time domain. Calculate the power radiated by the loop and its radiation resistance. Derive all the formulae you use. 2 + 2 + 2 + 4

5. (*a*) What are the different layers of the ionosphere ? Describe their properties in brief.

(*b*) Explain the terms 'virtual height' and 'maximum usable frequency' in connection with sky-wave propagation. 1 + 5 + 4

6. (*a*) Describe the various types of discharges with respect to emission sources in connection with plasma oscillation.

(*b*) Derive the Debye screening distance with respect to plasma oscillation stating the assumptions involved in the derivation. 4 + 6

[*Internal Assessment* : 10 Marks]
