M.Sc. 1st Semester Examination, 2013

ELECTRONICS

(Electromagnetic Fields and Plasma Electronics)

(Theory)

PAPER—ELC-102

Full Marks : 50

Time : 2 hours

Answer **Q. No. 1** and any **three** 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

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1. Answer *all* the questions : 2 × 5

(*a*) What do you mean by 'dominant mode' and 'degenerate mode' as applied to waveguide ?

(*b*) What do you mean by perfectly matched transmission line and the voltage standing wave ratio ?

(*c*) A 50 Ω cable transmits a 1 MHz signal to a load having a 100 Ω resistance in series with a 10 μH inductance. Calculate the VSWR along the cable.

(*d*) What is meant by Debye screening distance ?

(*e*) A dipole antenna has a length of $\frac{3\lambda}{4}$. What is its radiation resistance ?

2. (*a*) Prove that in a quarter wave transformer characteristic impedance

$$z_0 = \sqrt{z_{in} \times z_l}$$

where the symbols have usual significance.

(*b*) A single stub tuner is to match a lossless line of 400 Ω to a load of $(800 - j300)\Omega$. The frequency is 3 GHz.

(*i*) Find the distance in meters from the load to the tuning stub.

(*ii*) Find also the length in metres of the short-circuited stub.

4 + (3 + 3)

3. (*a*) In a rectangular waveguide for TM mode

$$E_z = E_{oz} \sin \frac{m\pi x}{a} \sin \frac{n\pi y}{b} e^{-j\beta_g z}.$$

Find E_y, E_x, H_x, H_y, H_z.

(*b*) A rectangular air-filled copper waveguide with dimensions 0·9″ × 0·4″ cross section and 12″ length is operated, at 9·2 GHz with a dominant mode. Determine the cut-off wavelength and the characteristic impedance. 5 + 5

4. (*a*) What do you mean by 'radiation resistance' of an antenna ?

(*b*) Explain the operation of helical antenna in normal mode as well as in axial mode. Find the axial ratio in normal mode of operation.

(*c*) Calculate the directivity of a 20 turn helical antenna having pitch angle 12° and circumference equal to λ. 2 + (4 + 2) + 2

5. (*a*) What are the different layers of the ionosphere ?

(*b*) Explain the terms (*i*) virtual height and (*ii*) skip distance in connection with sky wave propagation.

(*c*) Derive the expression for the field strength of space wave propagation in tropospheric conditions.

$2 + (2 + 2) + 4$

6. (*a*) What is plasma ? What do you mean by plasma frequency ? Derive an expression of it in terms of maximum isonisation density.

(*b*) If the critical frequency of an ionised layer is 1.5 MHz, find the electron density of the layer.

$(1 + 2 + 5) + 2$

[*Internal Assessment* : 10 Marks]