PG/IS/ELC-102/15

M.Sc. 1st Semester Examination, 2015

ELECTRONICS

(*Electromagnetic Fields and Plasmal Electronics*)

[Theory]

PAPER –ELC - 102

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. (*a*) Define reflection coefficient and transmission coefficient. State a relation between them.

(*b*) What are the differences between ground waves and space waves ?

(*c*) Define Half Power Beam Width (HPBW) and antenna gain.

(*d*) Define Standing Wave Ratio(SWR). What are the minimum and maximum limit of SWR ?

(*e*) What is a quarter-wave plate ? Why it is called an impedance inverter ? 2×5

2. (*a*) Define directivity, radiation resistance and effective aperture of an antenna.

(*b*) Find an expression for the effective aperture of an antenna.

(*c*) A transmission station of total output power 25 kW is radiating in free space. Find the field strength at a distance 30 km from the station. $3 + 5 + 2$

3. (*a*) Derive an expression for the field strength of space wave propagation in tropospheric condition.

(*b*) Explain the terms "skip distance" and "critical frequency" in connection with sky wave propagation. 6 + 4

4. (*a*) Show that the critical frequency for propagation of e.m. waves in plasma is given by

$$f_c = 9\sqrt{n_0},$$

where n_0 = number of electrons/m^3.

(*b*) Calculate the plasma frequency and maximum penetration depth for a plasma containing 10^{18} electrons/m^3.

(*c*) What is Debye screening distance ? 4 + 4 + 2

5. (*a*) Deduce the field components E_x, E_y, H_x and H_y of a rectangular waveguide in TE mode of propagation. Also find out propagation constant and velocity of wave propagation. Comment on velocity of wave propagation above and below the cut-off frequency.

(*b*) Why waveguides are used for high frequency energy transfer in place of transmission line ? (4 + 2 + 2) + 2

6. (*a*) Draw the lumped parameter equivalent circuit of a two wire transmission line. What is the condition of a loss less line ?

(*b*) A 50 Ω line is terminated by a load impedance $25 + j35\Omega$. With the help of the Smith chart find :

(*i*) Reflection coefficient at load.

(*ii*) Reflection coefficient and impedance at a distance $\cdot 2\lambda$ from the load end.

(*iii*) VSWR and Return Loss in dB on the line.

(*c*) Consider a quarter-wavelength short circuited low loss line of chart impedance z_0 and propagation const $r = \alpha + j\beta$. Show that Q factor of the line is

$$Q = \frac{\beta}{2\alpha}.$$ 2 + 4 + 4

[*Internal Assessment* : 10 Marks]
