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

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

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 \( n_0 = \text{number of electrons/m}^3 \).

(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

PG/IS/ELC-102/15 (Turn Over)
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 \(\Omega\) 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 \(2\lambda\) 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

\[ Q = \frac{\beta}{2\alpha}. \]

[Internal Assessment: 10 Marks]