B.E. Electronics & Telecommunication / Communication Engineering /
Electronics Engineering Sixth Semester

EN602 - Fields & Radiating Systems

P. Pages : 2 **GUG/W/18/1688**

Time : Three Hours * 1 3 2 7 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Derive the expression for input impedance of a lossless line when the line is **8**
i) Short circuited ii) Open circuited
Also draw the variation of input impedance w.r.t. length of transmission line.

b) For a transmission line the primary constants are $R = 0.2\Omega/m, G = O, L = 0.3\mu H/m$ and **8**
$C = 15pF/m$. Find the phase and attenuation constants of the line at 900 MHz. Also find the characteristics impedance of the line.

OR

2. a) What is double stub matching technique? What is its advantage over the single stub matching technique? **8**

b) A 300Ω parallel wire transmission line is connected to an antenna of $75 + j35\Omega$ input impedance. Find the VSWR on the line. What is the maximum and minimum impedance seen on the line? Verify the results using smith chart. **8**

3. a) i) Does TEM Mode exist inside a rectangular waveguide? Explain. **8**
ii) What do you mean by Dominant mode of a rectangular waveguide?

b) The cross section of a rectangular waveguide is $20cm \times 5cm$. Find 6 lowest order modes which will propagate on the waveguide and their cut-off frequencies. **8**

OR

4. a) Derive the field expression for TM mode in a parallel plane waveguide. **8**

b) A rectangular waveguide of 4cm x 3cm cross-section carries the dominant mode of 6 GHz. The maximum peak electric field measured inside the waveguide is 50V/m. Find the expression for the electric and magnetic fields inside the waveguide and the power carried by the waveguide. **8**

5. a) Derive the expression for radiation resistance of a Hertzian dipole antenna. **8**

b) i) Draw E and H plane radiation patterns of a Hertz dipole antenna. **8**
ii) A Hertz dipole of 10cm length has 5A (rms) current at 100MHz. What is the total power radiated by the dipole?

OR

6. a) Define the following terms w.r.t. an antenna. **10**
i) Half power Beam width (HPBW) ii) Beam width between First Nulls
iii) Directivity iv) Antenna Gain.

b) The radiation pattern of an antenna is given as **6**

$F(\theta) = \cos^4\theta \qquad 0 \le \theta \le \pi/2,$

$0 \le \phi \le 2\pi$

$= 0 \qquad$ elsewhere

Find the directivity of the antenna.

7. a) Show that the directivity for a broadside array of two identical isotropic in-phase point sources spaced a distance d is given by **8**

$$D = \frac{2}{1+\frac{\lambda}{2\pi d}\sin\left(\frac{2\pi d}{\lambda}\right)}$$

b) Design a seven element broadside array which has the optimum pattern for a side-lobe-level of – 20dB. The spacing between element has to be $\lambda/2$. **8**

OR

8. a) Show that the directivity for an ordinary end fire array of two identical isotropic point sources spaced a distance d is given by **8**

$$D = \frac{2}{1+\left(\frac{\lambda}{4\pi d}\right)\sin\left(\frac{4\pi d}{\lambda}\right)}$$

b) What is Dolph- chebyshev distribution for linear broadside arrays. Show that it is the optimum distribution for obtaining beam width for given side lobe level and vice versa. **8**

9. a) What is the approximate maximum power gain of an optimum horn antenna with a square aperture 9λ on a side? Also calculate the half power beamwidth and the angle between first nulls? **8**

b) Design a Yagi – Uda six – element antenna for operation at 500MHz with a folded dipole feed. What are the lengths of **8**

a) Reflector element,
b) Driven element, and
c) Four-director element? What is the spacing
d) Between reflector and driven element and
e) Between director elements? What is
f) Frequency band width (Upper and Lower frequencies) and
g) Gain?

OR

10. a) Determine the length L, H-plane aperture and flare angles θ_E and θ_H (in E and H planes, respectively) of a pyramidal horn for which the E-plane aperture $a_E = 10\lambda$. The horn is fed by a rectangular waveguide with TE_{10} mode. Let path length difference, $\delta = 0.2\lambda$ in the E-plane and 0.375λ in the H-plane. What are beamwidths? What is the directivity? **8**

b) Describe the principle of working of **8**

i) A folded dipole antenna.
ii) Cassegrain method of feeding a parabolic reflector.

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