CBCS SCHEME

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15TE63

# Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
## Microwave Theory and Antennas

Time: 3 hrs. Max. Marks: 80

**Note:1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***Use of Smith Charts will be permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

### Module-1

1 a. Derive expressions for instantaneous voltage and instantaneous current at any point on the transmission line. **(06 Marks)**

b. A certain transmission line has a characteristic impedance of $75 + j0.01\ \Omega$ and is terminated in a load impedance of $70+j50\ \Omega$. Compute

(i) The reflection co-efficient ($\gamma$)
(ii) The transmission co-efficient (T)
(iii) Verify the relationship $\gamma + 1 = T$ **(06 Marks)**

**OR**

2 a. With the help of neat sketch, explain the mechanism of oscillations in reflex Klystron oscillator. Also discuss modes of oscillations. **(08 Marks)**

b. A transmission line has the following:

Characteristic impedance ($R_o$) = $400\ \Omega$
Load impedance ($Z_L$) = $200+j300\ \Omega$

The line is excited by a matched generator at 800 MHz. Find the location and length of a single stub nearest to the load to produce an impedance match. **(08 Marks)**

### Module-2

3 a. State and prove the symmetric property and unitary property of S-matrix. **(06 Marks)**

b. Derive the S-matrix of E-plane tee. **(05 Marks)**

c. Write short notes on:

(i) Co-axial connectors.
(ii) Adaptors. **(05 Marks)**

**OR**

4 a. What is magic tee? Derive the S-matrix of magic tee. Mention its applications. **(08 Marks)**

b. With the neat sketch, explain the working of two hole directional coupler and derive the S-matrix of a directional coupler. **(08 Marks)**

### Module-3

5 a. The width of a copper microstrip line conductor is 2 mm with h = 0.4 mm. The dielectric constant of the quartz substrate is $\theta_r = 3.8$ and $\tan\delta = 0.0001$ (Assume $\sigma = 5.8\times10^7$ ℧/m for copper).

Find (i) Effective permittivity $\in_{reff}$
(ii) $Z_0$
(iii) $\alpha_c$ and $\alpha_d$ at 9 GHz. **(10 Marks)**



b. With neat diagram, explain the operation of parallel strip line. And also write the expression for characteristic impedance and attenuation of the same. **(06 Marks)**

**OR**

6 a. Define the following with respect to antenna:
(i) Radiation intensity.
(ii) Gain.
(iii) Efficiency.
(iv) Directivity. **(06 Marks)**

b. The radiation intensity of an antenna is given by $U(\theta,\phi) = U_m \cos^4\theta \sin^2\phi$, for $0 < \theta < \frac{\pi}{2}$ and $0 < \phi < 2\pi$. Find directivity in dB and Half-Power Beam width. **(10 Marks)**

## Module-4

7 a. Derive an expression and draw the field pattern for an array of two isotropic point sources of same amplitude and opposite phase. Also determine its maxima, minima and HPBW. **(10 Marks)**

b. Derive expression for radiation resistance of short dipole. **(06 Marks)**

**OR**

8 a. Derive the expressions for electric and magnetic fields of a short dipole. **(10 Marks)**

b. A linear array consists of 4 isotropic point sources. The distance between the adjacent elements is $\frac{\lambda}{2}$. The power is applied with equal magnitudes and a phase difference $-d_r$. Find HPBW, BWFN. **(06 Marks)**

## Module-5

9 a. Determine the length L, H-plane aperature and flare angles $\theta_E$ and $\theta_H$ of a pyramidal horn for which the E-plane aperature $a_E = 10\ \lambda$. The horn is fed by a rectangular waveguide with $TE_{10}$ mode. Let $\delta = 0.2\lambda$ in the E-plane and $0.375\ \lambda$ in the H-plane. What are the beam widths? What is directivity? **(10 Marks)**

b. Find radiation resistance of small loop antenna. **(06 Marks)**

**OR**



10 a. Write short notes on:
(i) Parabolic reflectors (ii) Log-periodic antenna. **(06 Marks)**

b. Explain the practical design considerations for the monofilar axial mode helical antenna. **(10 Marks)**

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