USN ☐☐☐☐☐☐☐☐☐☐

**15EC71**

## Seventh Semester B.E. Degree Examination, July/August 2022
## Microwaves 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 chart is permitted.*

### Module-1

1   a.   With the aid of neat sketches, describe Reflex Klystron operation. What do you understand by velocity modulation? **(10 Marks)**
    b.   Derive the expressions for attenuation and phase constants for RF lines. **(06 Marks)**

**OR**

2   a.   Describe the importance and significance of transit time and mode curve of reflex Klystron tube. **(08 Marks)**
    b.   A lossless line of characteristic impedance $R_0 = 50\Omega$ is to be matched to a load $Z_\ell = 50/(2 + J(2 + \sqrt{3}))$ ohms by means of a lossless short circuitedstub. The characteristic impedance of the stub is $100\Omega$. Find the stub position (closest to the load) and length so that a match is obtained (using smith chart). **(08 Marks)**

### Module-2

3   a.   Justify "Microwave circuits are analysed using scattering parameters and not by the measurement of z, y and ABCD parameters". **(06 Marks)**
    b.   Show that impedance and admittance matrices are symmetrical for a reciprocal junction. **(04 Marks)**
    c.   With the aid of neat sketch, explain the working of a Magic–Tee. What are the applications of Magic Tee? **(06 Marks)**

**OR**

4   a.   State and prove symmetry and phase shift property of S-parameters, for junction of ports having common characteristic impedance. **(08 Marks)**
    b.   A lossless air filled rectangular waveguide has internal dimensions of 'a' cm X 'b' cm. If a = 2b and the cut off frequency of the $TE_{02}$ mode is 12 GHz. Find the cut off frequency of dominant mode. **(04 Marks)**
    c.   Describe the working of microwave phase shifters. **(04 Marks)**

### Module-3

5   a.   Write a brief note on coplanar and shielded strip lines. **(06 Marks)**
    b.   Prove that effective height and effective aperature are related via radiation resistance and the intrinsic impedance of the space. **(06 Marks)**
    c.   Define directivity and HPBW of an antenna. **(04 Marks)**

**OR**

6   a.   Obtain the expressions for characteristic impedance and attenuation losses of a parallel strip lines. **(06 Marks)**
    b.   Derive Frii's transmission formula. **(06 Marks)**
    c.   Define aperture efficiency of an antenna. **(04 Marks)**

## Module-4

**7**  a.  A source with a unidirectional radiation intensity pattern is given by :
$U = U_m COS\theta$
where n is any number n = 1, 2, 3 . . .
Show that the directivity of the source is D = 1(n + 1).  **(04 Marks)**

   b.  Derive expression for total field at par point 'P' when two point sources with currents in equal magnitude but in opposite phase and are separated by $\lambda/2$ apart. Draw the field pattern.  **(10 Marks)**

   c.  What are parasitic arrays?  **(02 Marks)**

### OR

**8**  a.  Using electric and magnetic potentials obtain the far field components of a short dipole.  **(08 Marks)**

   b.  Write the far – field $E_\theta$ of a symmetrical, center fed thin linear antenna. Write pattern factors for $\lambda/2$, full wave, three half wave antenna.  **(08 Marks)**

## Module-5

**9**  a.  Derive the instantaneous electric field at a large distance 'r' from a loop antenna of any radius a.  **(08 Marks)**

   b.  Describe Log-periodic array geometry. What is the basic concept of LPDA? What is YUCOLP array?  **(08 Marks)**

### OR

**10**  a.  Discuss the practical design considerations for the axial mode helical antenna. List the important applications of helical antenna.  **(08 Marks)**

   b.  With the aid of diagram, explain Fermat's principle as applicable to the horn antenna design.  **(06 Marks)**

   c.  What is Aperture matched horn?  **(02 Marks)**

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