



10EC54

Fifth Semester B.E. Degree Examination, July/August 2022
Microwaves and Radar

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, selecting atleast TWO questions from each part.
2. Use of Smith chart is permitted.

PART – A

- 1 a. Define and derive expressions for attenuation and phase constants, wave length and velocity of propagation in a transmission line. (10 Marks)
b. Obtain expression for line impedance in terms of reflection coefficient. (04 Marks)
c. A load impedance of $Z_L = 60 - j80\Omega$ is required to be matched to a 50Ω co-axial line, by using a short circuited stub of length ' l ' located at a distance ' d ' from the load. The wavelength of operation is 1 metre. Using smith chart, find ' d ' and ' l '. (06 Marks)
- 2 a. Derive an expression for frequency of oscillations for a cylindrical resonator and state applications of cavity resonator. (06 Marks)
b. When TM_{11} Mode is propagated inside a dielectric filled rectangular waveguide of dimensions $4\text{cm} \times 2\text{cm}$, at a frequency of 7.5GHz , the phase constant was measured to be 1.256rad/cm . Determine the dielectric constant of dielectric material. (06 Marks)
c. Obtain an expression for the power transmitted through the circular wave guide. (08 Marks)
- 3 a. Draw a neat diagram of a Hybrid Tee Junction and explain its operation. Write its [S] Matrix. (08 Marks)
b. Incident power to a directional coupler is 90W . The directional coupler has coupling factor of 20dB directivity of 35dB and insertion loss of 0.5dB . Find the output power @ mainarm, coupled and isolated ports. (06 Marks)
c. With neat diagrams explain the operation of a Faraday rotation isolator. (06 Marks)
- 4 a. With neat diagrams explain the construction and operation of IMPATT diode. (08 Marks)
b. Explain the operation of a basic parametric amplifier with square wave pumping. (05 Marks)
c. The forward resistance R_f of a shunt mounted PIN diode is 0.12Ω and the capacitance of the intrinsic layer is 0.025PF . The shunt mounted PIN diode switch is connected to a transmission line of characteristic impedance $Z_r = 50\Omega$. At a frequency of 2.5GHz , determine the insertion loss under reverse bias and isolation under forward bias. (07 Marks)

PART – B

- 5 a. With a neat diagram explain the operation of 4 port ferrite circulator. (06 Marks)
b. Three port circulator (y – circulator) provides an isolation of 25dB in anticlockwise direction and an insertion loss of 0.5dB in clockwise direction. If $VSWR = 1.2$, find all the scattering co-efficient of 3-port isolator. (08 Marks)
c. With the help of neat diagram explain how different modes are excited in rectangular waveguides. (06 Marks)

- 6 a. Obtain expressions for conductor and dielectric attenuation of parallel stripline. (06 Marks)
b. Design a shielded stripline transmission line for $(w/b) > 0.5$. The substrate thickness to be used is 0.22cm having a dielectric constant of 2.25. The characteristic impedance of strip line so designed must be exactly 56Ω . (07 Marks)
c. Obtain an expression for Q – factor of a microstripline due to conductor losses. (07 Marks)
- 7 a. Obtain an expression for minimum detectable signal power in terms of Noise figure of the receiver. (07 Marks)
b. A radar system operates at 6 GHz, 3MW power output. If the Antenna diameter is 5 m and the receiver bandwidth is 1.5MHz and has a 12 dB Noise figure, what is maximum detection range for $1m^2$ targets? (08 Marks)
c. What do you mean by maximum unambiguous range of radar? (05 Marks)
- 8 a. With a neat diagram, explain the operation of a CW radar. (07 Marks)
b. An MTI radar operates at a PRF of 1.5KHz. If the first blind speed of the target is found to be 60m/sec, then determine the frequency of the transmitted microwave signal. (04 Marks)
c. With a neat diagram, explain the operation of a pulse Doppler radar and obtain radial velocity of the target that can be measured. (09 Marks)

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