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BT–7 / M–14

MICROWAVE ENGINEERING

Paper – ECE-407-E (Opt. I)

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt any **five** questions by selecting at least **one** question from each section.*

Section–I

1. (a) Derive expressions for unloaded Q-factor of Coaxial resonator cavity. 10

(b) A cylindrical air filled cavity with radius 3cm and length 10 cm is excited in TE_{111} mode. The 3dB bandwidth is 2.5MHz. Calculate the resonant frequency and the quality factor ? 10

2. (a) Explain down conversion method of frequency Measurement ? 5

(b) Compare waveguide and cavity perturbation methods for the measurements of dielectric constant of a solid and give advantages and disadvantages of both ? 10

(c) Calculate the VSWR when the distance between half power points is 1mm. Assume the wave is in dominant mode and given that the dimensions of the waveguide are 4×2.5cm and frequency is 10GHz ? 5

Section–II

3. (a) How optimum distance at which the maximum fundamental component of current occurs is computed for a two cavity klystron amplifier, give necessary expressions and diagrams ?

(b) A traveling wave tube operates under the beam voltage of 3kV, beam current of 30mA and characeristic impedance of helix is 10Ω with circuit length of 50 at a frequency of 10GHz. Calculate (a) Gain parameter (b) Output power gain (c) All four propagation constant ? 3+3+4=10

4. (a) Derive expressions for power output and efficiency for Reflex klystron oscillator. 7

(b) Explain π-mode oscillations in cylindrical Magnetron. 7

(c) A X-band cylindrical magnetron operates under following parametric conditions :

Anode Voltage (V_0) = 26KV, Beam current (I_0) = 27A, magnetic flux density (B_0) = 0.336 wb/m². Radius of cathode cylinder (a) = 5cm and radius of vane edge to centre (b) = 10cm then

Calculate :

(i) Cyclotron Angular Frequency ?

(ii) Cut-off Voltage for fixed B_0 ?

(iii) Cut-off Magnetic Flux density for fixed V_0 ? 2+2+2=6

Section–III

5. (a) Explain the operation of a Faraday rotation isolator using suitable diagrams of each of its sections ? 10

(b) A matched isolator has a insertion loss of 0.5dB and the isolation 25dB. Find scattering coefficients ? 5

(c) A three port circulator has an insertion loss of 0.5dB isolation 23dB and VSWR = 1.7. Find S-matrix. 5

6. (a) A Magic-T is terminated at collinear ports 1 and 2 and difference port 4 by impedances of reflection coefficients 0.5, 0.6 and 0.8 respectively. If 1 W power is fed at sum port 3, calculate the power reflected at port 3 and power transmitted to other three ports ? 10

(b) Determine S-matrix of an ideal lossless match terminated Directional coupler with a coupling of 10dB and directivity of 30dB. 10

Section–IV

7. (a) Explain High Field domain formation in Gunn Diode with necessary diagrams ? 10

(b) Determine the criterion for classifying the modes of operation of Gunn diode, given that electron drift velocity is 2.5×10^5m/s, negative electron mobility $\mu_n = 0.015 \times 10^5$ m^2/Vs and $\varepsilon_r = 13.1$. 5

(c) Explain Limited Space Charge Accumulation mode of Gunn diode operation ? 5

8. (a) A Ku band IMPATT diode has a pulse operating voltage of 100 V and pulse operating current of 0.9A. If the efficiency is about 10% and pulse width is 0.01ns at frequency of 16GHz then calculate the output power and duty cycle. 4

(b) Explain principle of operation of BARITT diode with suitable diagram ? 6

(c) Explain the operation of Parametric Amplifier and discuss Manley-Rowe Power relations. 10