

5E3111-P

Roll No. : _____

Total Printed Pages : **4****5E3111-P****B.Tech. (V Sem.) Examination, December - 2011****Elec. & Comm. Engg.****5EC5: Microwave Engg. - I**Time : **3 Hours****[Maximum Marks : 80
[Min. Passing Marks : 24****Instructions to Candidates :**

Attempt any five questions selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. NIL 2. NIL

UNIT - I

- 1 (a) Derive the TE_{mn} field equations in a rectangular waveguides. 8
- (b) An air filled waveguide with a cross section 2×1 cm transports energy in the TE_{10} mode at the rate of 0.5 hp. The impressed frequency is 30 GHz. What is the peak value of the electric field occurring in the guide ? 8

OR

- 1 (a) Derive the field equations of TM_{np} modes in a circular waveguide. 8
- (b) An air filled circular waveguide has a radius of 1.5 cm and is to carry energy at a frequency of 10 GHz. Find all TE and TM modes for which transmission is possible. 8



UNIT - II

- 2 Describe the following using scattering matrix representation :
- (a) Magic Tees
 - (b) Hybrid Rings

8×2=16

OR

- 2 Describe the following using scattering matrix representation :
- (a) Directional coupler
 - (b) Microwave circulars.

8×2=16

UNIT - III

- 3 (a) Describe the working of two cavity Klystron using Applegate diagram.

8

- (b) A two cavity amplifier Klystron has the following parameters :

Beam voltage $V_0 = 900$ V

Beam current $I_0 = 30$ mA

Frequency $f = 84$ GHz

Gap spacing in either cavity $d = 1$ mm effective
shunt impedance $R_{sh} = 40$ K Ω

Determine :

- (i) The electron velocity
- (ii) The dc electron transit time
- (iii) The input voltage for maximum output voltage
- (iv) The voltage gain in dB

4×2=8

OR

- 3 (a) Explain the working and operation of reflex Klystron.

7

- (b) A reflex Klystron operates at the peak mode of $n = 2$ with

Beam voltage $V_0 = 300$ V

Beam current $I_0 = 20$ mA

Signal Voltage $V_1 = 40$ V

Determine :

- (i) The input power in watts
- (ii) The output power in watts
- (iii) The efficiency

3×3=9



UNIT - IV

- 4 (a) Explain the construction, operation and practical consideration of helix type TWT.

8

- (b) A TWT has the following characteristics :

Beam voltage $V_0 = 2$ kV

Beam current $I_0 = 4$ mA

Frequency $f = 8$ GHz

Circuit length $N = 50$

Characteristic impedance $Z_0 = 20 \Omega$

Determine :

- (i) The gain parameter C
- (ii) The power gain in decibels

4×2=8

OR

- 4 (a) Write brief note on following :

- (i) Pulsed dual mode TWT
- (ii) Coupled cavity TWT

3×2=6

- (b) A TWT operates under the following parameters :

Beam current $I_0 = 50$ mA

Beam voltage $V_0 = 2.5$ kV

Characteristics impedance of helix $Z_0 = 6.75 \Omega$

Circuit length $N = 45$

Frequency $f = 8$ GHz

Determine :

- (i) All four propagation constant
- (ii) The wave equation for all four modes in exponential form.

5×2=10

UNIT - V

- 5 (a) Explain the construction and operation of travelling wave magnetron.

8



- (b) A linear magnetron has the following parameters :

Anode Voltage $V_o = 20$ KV

Anode current $I_o = 17$ A

Magnetic flux density $B_o = 0.01$ Wb/m²

Distance between cathode and anode $d = 6$ cm

Calculate :

(i) The Hull cut off voltage for a fixed B_o

(ii) The Hull cutoff magnetic flux density for a fixed V_o .
4×2=8

OR

- 5 (a) Explain the working of backward cross-field oscillator.

7

- (b) A CFA operates under the following parameters :

Anode dc voltage $V_{ao} = 1.80$ kV

Anode dc current $I_{ao} = 1.30$ A

Electronic efficiency $\eta_o = 22\%$

RF input power $P_{in} = 70$ W

Calculate :

(i) The indirect RF power

(ii) The total RF output power

(iii) The power gain in dB

3×3=9

