5E3111-P

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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 x 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 vo = 900 V

Beam current Io = 30 mA

Frequency f = 84 GHz

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

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_o = 300 V
Beam current I_o = 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_o = 2 kV

Beam current I_o = 4 mA

Frequency f = 8 GHz

Circuit length N = 50

Characteristic impedance Zo = 20 Ω

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_o = 50 mA

Beam voltage V_o = 2.5 kV

Characteristics impedance of helix Zo = 6.75 Ω

Circuit length N = 45

Frequency f = 8 GHz

Determine :

(i) All four propagations 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/m^2

Distance between cathode and anode d = 6 cm

Calculate :

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

(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 η_e = 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
