

Kaferelsheikh University
Faculty of Engineering
Department of Electrical Engineering
Year: Forth
Subject: Microwave electronic engineering ECE4115
Name:



Date: 10/1/2019
Time allowed: 3 h
Full Mark: 90 degree
Final Exam: 2 page

Academic Number:

This exam measures ILOs no: a.3, a. 5,a.14 a.15 and a.20 b.6 and b.13 c.1, c.5, and c.15 d.1

Question#1: (15Mark)

1. Explain the difficulties of using tubes in microwaves bands, then analysis the lead inductance and interelectrode capacitance effect in triode circuit. (4marks)
2. Drive an expression of the voltage gain and the mutual conductance "Av, MC" of the two cavity amplifier klystron. (5marks)
3. A two-cavity amplifier klystron has the following characteristics: (6marks)

Voltage gain: 15 dB, Input power: 5mW

Total shunt impedance of input cavity Rsh: 30k Ω

Total shunt impedance of output cavity Rsh: 40 k Ω

Load impedance at output cavity Re: 40 k Ω

Determine:

- a. The input voltage (rms)
- b. The output voltage (rms)
- c. The power delivered to the load in watts

Question #2: (20 Mark)

1- Explain the Quality Factor and its effects. (3 marks)

2- Define Duty cycle. (2 marks)

3- A four-cavity klystron amplifier has the following parameters:

Beam voltage: $V_0 = 20$ kV, Beam current: $i_0 = 2$ A, operating frequency: $f = 9$ GHz

dc charge density: $P_0 = 10^{-6}$ C/m³, RF charge density: $p = 10^{-8}$ C/m³

Velocity perturbation: $V = 10^5$ m/s. Determine (10 marks)

- a. The de electron velocity
- b. The de phase constant
- c. The plasma frequency
- d. The reduced plasma frequency for $R = 0.5$
- e. The beam current density
- f. The instantaneous beam current density

4- Sketch the schematic diagram of the four cavity klystron amplifier. Then explain briefly the function of each component. (5 marks)

Question #3: (20 Mark)

1- 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: $V_i = 40$ v

Determine: **(6marks)**

- The input power in watts.
- The output power in watts.
- The efficiency.

2- Why beam velocity greater than field velocity in helical travelling wave tubes. **(4 marks)**

3-explain the amplification process of TWT. **(4 marks)**

4-A traveling-wave tube (TWT) has the following characteristics: **(6 marks)**

Beam voltage: 2Kv, Beam current: 4mA, Frequency: 8GHz, Circuit length: 50

Characteristic impedance: 20 Ω .

Determine:

- The gain parameter C
- The power gain in decibels

Question #4: (20 Mark)

1-A normal cylindrical magnetron has the following parameters:

Inner radius: $R_a = 0.15$ meter, Outer radius: $R_b = 0.45$ meter, Magnetic flux density:

$B_o = 1.2$ milliwebers/ m^2 **(6 marks)**

- Determine the Hull cutoff voltage.
- Determine the cutoff magnetic flux density if the beam voltage V_o is 6000 .

2- Explain the physical structure of magnetron, why the magnetron preferred heavily loaded. **(6 marks)**

3- List the two types of backward oscillator "BWO", then compare between them. **(Sketch the diagrams) (8 marks)**

Question #5: (20 Mark)

1- Explain the construction and operation of IMPATT diode. Why it's used in the transmitter rather than the receiver? **(7 marks)**

2- Drive an expression for power gain of tunnel diode amplifier when connected in series with a resistive load. How convert into oscillator system? **(8 marks)**

3- Define the avalanche multiplication and negative resistance, then discuss their importance. **(5 marks)**