

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), April-May 2016

B. Tech in Electronics and Communication Engineering, Semester IV

Roll No.....

MICROWAVE ENGINEERING I ECE-407

Time: 3 hours

Max. Marks: 100

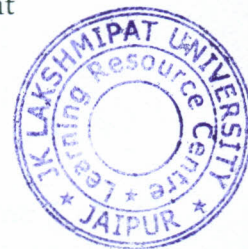
Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. A $(75 - j 50) \Omega$ load is connected to a coaxial transmission line of $Z_0 = 75 \Omega$, at 10 GHz. The best method of matching consists in connecting
 - (a) A short circuit stub at the load
 - (b) An inductance at the load
 - (c) A capacitance at some specific distance from the load
 - (d) A short circuit stub at some specific distance from the load
- ii. In a rectangular waveguide, which of the following modes are known as degenerate modes
 - (a) TM_{01} and TM_{10}
 - (b) TE_{11} and TM_{11}
 - (c) TM_{01} and TM_{10}
 - (d) TE_{10} and TM_{01}
- iii. Modes are **propagating modes** in a rectangular waveguide
 - (a) TE_{00} and TM_{00}
 - (b) TE_{00} and TM_{10}
 - (c) TM_{01} and TM_{10}
 - (d) TE_{10} and TM_{11}
- iv. Indicate the false statement. The **SWR** on a transmission line is infinity; the line is terminated in
 - (a) A short circuit
 - (b) a complex impedance
 - (c) an open circuit
 - (d) a pure reactance
- v. An air filled **rectangular cavity resonator** resonates at 8 GHz. If it is filled with a dielectric of permittivity 4.0, its resonant frequency will be
 - (a) 8 GHz
 - (b) 2 GHz
 - (c) 16 GHz
 - (d) 4 GHz
- vi. In general, a **rectangular waveguide** transmission line acts like a
 - (a) Band filter
 - (b) Low pass filter
 - (c) High pass filter
 - (d) Tuned filter
- vii. For a **rectangular guide** 2.5 cm X 1.0 cm, the cutoff wavelength of dominant mode is
 - (a) 1.25 cm
 - (b) 2.0 cm
 - (c) 1.0 cm
 - (d) 5 cm
- viii. At VHF, the **skin effect** losses in conventional tubes are proportional to
 - (a) $1/\sqrt{f}$
 - (b) $1/f$
 - (c) f
 - (d) $\sqrt{f}$
- ix. The following doping structure does not belong to the **IMPATT** family
 - (a) n^+pnp^+
 - (b) p^+nin^+
 - (c) p^+nn^+
 - (d) n^+pin^+
- x. The noise figure and transit time of **TRAPATT** device are and Than those of **IMPATT** device.
 - (a) Higher, larger
 - (b) lower, larger
 - (c) higher, smaller
 - (d) lower, smaller



- Q.2 Short answer type question (4 questions @ 2.5 marks) 10
- Two valley theory
 - Dominant mode of waveguide
 - Degenerate modes of waveguide
 - Draw electric field distribution diagram of TE_{12} , TE_{22} and TE_{32}
- Q.3A What are the advantages and disadvantages of **circular waveguide** over **rectangular waveguide**. 05
- Q.3B With the aid of cross sectional sketch of a **magnetron**, explain the operation of the device? 05
- Q.4A With the suitable figure, describe the basic operation of a **reflex klystron**. 05
- Q.4B Draw the schematic diagram of a helix **TWT** amplifier and explain the mechanism of operation. 05
- Q.5A Describe the operating principle of a **TRAPATT** diode. 05
- Q.5B Discuss the difference between transferred electron device and avalanche transit time device. 05
- Q.6A Define and explain the meaning of the term standing-wave ratio. What is the formula for it if the load is purely resistive? 05
- Q.6B Draw and explain the cavity resonator. 05
- OR
- Q.6B Define quality factor of a cavity resonator. 05
- Q.7A A **rectangular waveguide** of inner dimensions 2.5 cm X 1.2 cm is to propagate energy in TE_{10} mode. Calculate the cut off frequency. If the frequency of signal is 1.2 times of this cutoff frequency, compute the guide wavelength and phase velocity. 05
- Q.7B A **magnetron** having following operation parameters 05
- Anode voltage $V_o = 26\text{ kV}$
 - Beam current $I_o = 27\text{ A}$
 - Magnetic flux density $B_o = 0.336\text{ Wb/m}^2$
 - Radius of cathode cylinder $a = 5\text{ cm}$
 - Radius of vane edge to center $b = 10\text{ cm}$
 - $e/m = 1.759 \times 10^{11}$ (MKS system)
- Compute cutoff voltage for a fixed B_o
- OR
- Q.7B Compute cutoff magnetic flux density for a fixed V_o for the same value used in above question (Q.7B). 05
- Q.8A The bunching grids of a **Klystron amplifier** are 2 mm apart. The beam voltage is 2 kv and the drift space is 2.8 cm long. What must be the value of the RF voltage at the bunching grid to produce a maximum fundamental component of the current at the catcher? Assume the operating frequency is 2.8 GHz. Find Transit angle (θ_o), Average transit angle (θ_g), beam coupling coefficient (β_i) and voltage at the bunching grid at a Klystron for maximum fundamentals components of 10

the current at the catcher ($V_{1\max}$).

- Q.9A A transmission line of 100 m length and a characteristic impedance of 100 ohms is terminated by a load $Z_L = 100 - j200$ ohms. Using the smith chart, determine the line impedance and admittance at 25 m from the load end at a frequency of 10 MHz. 10
- Q.9B An air filled **cavity** with dimensions $a = 5$ cm, $b = 4$ cm and $c = 10$ cm is made of copper. It is filled with a lossless material ($\mu_r = 1$), ($\epsilon_r = 3$). Find the resonant frequency for TE_{101} mode. 10

OR

- Q.9B A **rectangular waveguide** has dimensions 2.5 cm X 5 cm, Determine the guide wavelength λ_g , phase constant β and phase velocity V_p at a wavelength of 4.5 for the dominant mode. 10



The Complete Smith Chart

