

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November-December 2017

B. Tech in Electronics & Communication Engineering, Semester V

Roll No.....

ECE 504: Microwave Engineering

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.	Given the range of frequencies, which of the following systems is best for transmission line load matching? (a) Adjustable single stub (c) Double stub (b) Quarter wave transformer (d) Single stub	
ii.	When the positive and negative waves have equal amplitude then the wave is called as (a) Pure standing wave (b) Flat line (c) Travelling wave (d) None of these	
iii.	Which one of the following can be used for amplification of microwave energy? (a) TWT (b) Magnetron (c) Reflex Klystron (d) Gunn Diode	
iv.	Which of the following are microwave sources? (a) Klystron (b) Magnetron (c) IMPATT (d) TWT	
v.	Why do slow wave structures are used in TWTs?	
vi.	Usually microwave signals are not used for ionospheric propagation. The reason is (a) Ionospheric layers absorb microwaves tremendously (b) Drastic dispersions takes place for microwave signal in ionosphere (c) Scattering prevents propagation of microwaves through ionosphere (d) Microwaves penetrate through ionospheric layers	
vii.	In a reflex klystron, the velocity modulation (a) Occurs near the reflector (c) occurs in the resonator gap (b) Occurs near the accelerating grid (d) doesn't occur at all	
viii.	Reproducibility is the main characteristics of (a) Substrate materials (c) Conductor materials (b) Dielectric materials (d) Resistive materials	
ix.	A uniform plane electromagnetic wave incident normally on a plane surface of a dielectric material is reflected with a VSWR of 3. What is the % of incident power that is reflected? (a) 10% (b) 25% (c) 50% (d) none of these	

x.	What is the frequency range for X-band according to IEEE? (a) 2-4 GHz (c) 4-8 GHz (b) 8-12 GHz (d) 12-18 GHz	
Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	Discuss about double stub matching in short.	
ii.	Explain the working principle of Gunn diode.	
iii.	Write down the properties of Dielectric materials.	
iv.	A linear magnetron has the following operating parameters: Anode Voltage: $V_0 = 10\text{kV}$ Cathode Current: $I_0 = 1\text{ A}$ Magnetic flux density: $B_0 = 0.01\text{ Wb/m}^2$ Distance between cathode and anode: $d = 5\text{cm}$ Compute: a. The Hull cutoff voltage for a fixed B_0 b. The Hull cutoff magnetic flux density for a fixed V_0 .	
Q.3A	Explain the working principle and operation of IMPATT diodes with the help of its VI Characteristic curve.	05
Q.3B	Explain Etching and Photoresist with proper diagrams. Also explain Vacuum evaporation and Electron-beam evaporation.	05
Q.4A	An X-band pulsed conventional magnetron has the following operating parameters: Anode Voltage: $V_0 = 5.5\text{kV}$ Beam Current: $I_0 = 4.5\text{A}$ Operating Frequency: $f = 9 \times 10^9\text{ Hz}$ Resonator Conductance: $G_r = 2 \times 10^{-4}\text{ mho}$ Loaded Conductance: $G_l = 2.5 \times 10^{-5}\text{ mho}$ Value Capacitance: $C = 2.5\text{pF}$ Duty Cycle: $\text{DC} = 0.002$ Power loss: $P_{\text{loss}} = 18.50\text{ kW}$ Compute: 1. Unloaded Quality factor 2. The external Quality factor 3. The circuit efficiency	05
Q.4B	An X-band pulsed conventional magnetron has the following operating parameters: Anode Voltage: $V_0 = 5.5\text{kV}$ Beam Current: $I_0 = 4.5\text{A}$ Magnetic flux density: $B_0 = 0.336\text{ Wb/m}^2$ Radius of cathode cylinder: $a = 5\text{ cm}$ Radius of vane edge to center: $b = 10\text{ cm}$ Compute:	05

	a. The cyclotron angular frequency b. The cutoff voltage for a fixed B_0 c. The cutoff magnetic flux density for a fixed V_0	
Q.5	Draw the schematic diagram of a helix-type travelling-wave tube. Explain its amplification process. And derive the circuit equation which gives the relation between axial electric field of slow-wave helix and spatial ac electron beam current.	10
Q.6A	Derive the equations for resonant frequencies for TE and TM modes for circular cavity resonator.	05
Q.6B	An air filled circular waveguide has a radius of 2 cm and is to carry energy at a frequency of 10GHz. Find all the TE_{np} and TM_{np} modes for which energy transmission is possible.	05
	OR	
Q.6B	Derive the line impedance at any point from the receiving end in terms of Z_1 and Z_0 .	05
Q.7A	Write down the characteristics of Smith Chart.	05
Q.7B	Prove that $T^2 = (Z_1/Z_0) \cdot (1 - \Gamma_1^2)$ where T is transmission coefficient and all other have their usual meaning.	05
	OR	
Q.7B	A silicon JFET at 300° K has the following parameters: Electron density = 10^{17} cm^{-3} , Hole density = 10^{19} cm^{-3} , $\epsilon_r = 11.8$, Channel height = $0.2 \cdot 10^{-4} \text{ cm}$, Channel length = $8 \cdot 10^{-4} \text{ cm}$, Channel width = $50 \cdot 10^{-4} \text{ cm}$, Electron mobility = $800 \text{ cm}^2/\text{V.s}$, Drain voltage = 10 V, Gate voltage = -1.5 V Determine the followings: (i) The pinch off voltage (ii) The built in voltage (iii) The drain current	05
Q.8A	Draw schematic diagram of Multi Cavity Klystron Cavity Amplifier and explain its working. Derive the beam current density equation for the Multi Cavity Klystron.	10
Q.9A	Derive the TM_{mn} mode field equations in rectangular waveguides.	10
Q.9B	A lossless line of characteristic impedance $R_0 = 50 \Omega$ is to be matched to a load $Z_L = 50/[2 + j(2+\sqrt{3})] \Omega$ by means of a lossless short-circuited stub. The characteristic impedance of the stub is 100Ω . Find the stub position (closest to the load) and length so that a match is obtained.	10
	OR	
Q.9B	A lossless line has characteristic impedance of 50Ω and is loaded by $60 - j60 \Omega$. One stub is at the load, and the other is at $3\lambda/8$ distance away from the first. Determine the lengths in wavelength of the two short-circuited stubs when a match is achieved.	10

The Complete Smith Chart

Black Magic Design

