Ref No. Ex/PG/ETCE/T/113D/2024

M. E. ELECTRONICS & TELE-COMMUNICATION ENGINEERING 1ST YEAR 1ST SEMESTER EXAMINATION, 2024

Subject: Microwave & Millimeter Wave Devices & Applications

Time: 3.0 Hours **Full Marks: 100**

No. of questions	Answer any **Four (4)** questions from the followings: 4×25	Marks
1.	a) Give the microwave equivalent circuits of BJT. How the cut-off frequency of BJT is determined? b) Explain the current-frequency, power–frequency and gain-frequency limitations of a high frequency Bipolar Junction Transistor. c) Mention some of the applications of a microwave Bipolar Transistors. c) A Si microwave transistor has reactance of 1 ohm, transit time cut-off frequency of 4 GHz, maximum **E** field 1.6×10^5 V/m and saturation drift velocity of 4×10^5 m/s. Determine the maximum allowable power.	(3+3) +10+ 4+5
2.	a) Give the doping profile, typical structure and equivalent circuit for this diode. Mention the applications of **Varactor** diode. b) Derive the expression for junction capacitance of a **Varactor** diode when it is reverse biased. Proof that this junction capacitance has the time varying property. c) Explain with suitable circuit diagram how the **Varactor** diode can be used as a parametric amplifier	8+ (8+3)+6
3.	a) Write down the special feature of the **MESFET.** b) Give the cross-sectional view and equivalent circuit of a **MESFET.** c) Explain the pinch-off phenomena of this device. d) A typical n-channel GaAs **MESFET** has the parameters as $N_d = 7\times10^{17}$ cm^{-3}, $a = 0.12$ μm, $\varepsilon_r = 13.25$, $L = 15$ μm, $Z = 40$ μm, $\mu = 0.08$ $m^2/V.s = 800$ $cm^2/V.s$, $V_d = 5.5$ V, $V_g = -2$ V and $v_s = 2.1\times10^5$ m/s. Calculate the (i) Pinch-off voltage, (ii) velocity ratio, (iii) saturation current at $V_g = 0$ and (iv) drain current I_d. Derive the necessary relation you use.	5+5+5+10
4.	a) Give the equivalent circuit of a **tunnel diode.** b) Draw the characteristic curve of a **tunnel diode** and explain the nature of	4+6+(5+4)+6

Ref No. Ex/PG/ETCE/T/113D/2024

M. E. ELECTRONICS & TELE-COMMUNICATION ENGINEERING 1ST YEAR 1ST SEMESTER EXAMINATION, 2024

Subject: Microwave & Millimeter Wave Devices & Applications

Time: 3.0 Hours **Full Marks: 100**

	this curve with suitable energy band diagram. c) Derive the expression for input impedance and resistive cut-frequency and self resonance frequency of this device. e) How a **tunnel diode** can be used as a negative resistance oscillator? Explain clearly with suitable circuit diagram.	
5.	a) Give the cross-sectional view, field distribution and doping profile of a **read diode**. b) Explain how the avalanche multiplication is occurred for this device? c) Derive the expression for input impedance of drift region of this device.	6+7+12
6.	a) Summarized the Ridley, Watkinson and Hilsum theory for two valley model of n-type ***GaAs***. b) Why ***Si*** and ***Ge*** are not used to fabricate a Gunn diode? c) i) For a **GaAs** Gunn diode derive the condition for negative resistance. From this condition what are concluded?	8+7+10
7.	a) Give the impurity distribution, space charge density and electric field distribution of a **PIN diode**. b) What do you meant by conductivity modulation? Why ordinary p-n junction diode does no exhibit this phenomena. c) Give the equivalent circuit of **PIN diode** under forward and reverse bias condition. d) Derive the expression for impedance of this diode under forward and reverse bias condition. e) How a PIN diode used as a switch? Explain the operation of a switch.	6+(3+2)+4+5+5