

Name:

Enrolment No:



**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**

**End Semester Examination, December 2020**

**Programme Name: B. Tech (ECE)**

**Semester : VII**

**Course Name : Microwave Engineering**

**Time : 03 hrs**

**Course Code : ECEG 4003**

**Max. Marks : 100**

**Nos. of page(s) : 02**

**Instructions: All Questions are Compulsory.**

**SECTION -A**

**(6x5=30)**

S. No.		Marks	CO
Q 1	Design maximally flat low pass filter using microstrip of order 3 with $Z_0=50$ ohms, $Z_i=20$ and $Z_h=120$ ohms. $g_1=1$ ; $g_2=2$ and $g_3=1$ . Design involves electrical length of filter sections and width of the line. Signal frequency is 4 GHz. Filter is realized with dielectric substrate of RT-duriod 5880 ( $\epsilon_r=2.2$ , $h=0.762$ mm).	5	CO2
Q 2	Design Maximally flat BPF and BSF using Quarter wave resonators. Center frequency is 3 GHz and bandwidth is 15%, port impedance is 40 ohms.( Find $Z_{01}$ , $Z_{02}$ and $Z_{03}$ ) in both cases.	5	CO2
Q 3	In O-type TWT, beam voltage is 3KV, $Z_0=10$ ohms, beam current is 20 mA, Operating frequency is 10 GHz, Determine the four propagation constants of the four modes	5	CO3
Q 4	Three port circulator has an insertion loss of 1 dB, isolation of 30 dB and SWR of 1.5. Find the S-matrix.	5	CO2
Q5.	a) An M-Si-M BARITT diode has the following parameters: Relative dielectric constant of Si=11.8, Si length (L) =6 $\mu$ m, Donor Concentration (N) = $3 \times 10^{21} \text{ m}^{-3}$ . Find the breakdown electric field. b) For a transit –time domain mode, domain velocity is equal to drift velocity and is about $10^7$ cm/s. Determine the drift length of the diode at a frequency of 8 GHz.	5	CO4
Q6.	Calculate $f_c$ , $\lambda_g$ , $\beta_g$ , $Z_g$ and $V_p$ for $TE_{23}$ modes in cylindrical waveguide operating at 2 GHz with the dimensions of $a=3$ cm filled with dielectric material of $\epsilon_r=3.1$ . Given $X'_{np}=9.970$	5	CO1

**SECTION -B**

**(5x10=50)**

Q 7	Derive the expression for efficiency of Reflex Klystron	10	CO3
Q 8	Derive the field expression for TE modes in Cylindrical Waveguide.	10	CO1

Q 9	Explain V-I characteristics of Tunnel diode and calculate the gain under series loading.	10	CO4
Q 10	With the neat sketch of Microwave test bench, how will you measure the frequency and SWR.	10	CO5
Q11	Establish the conversion relation between LPF into BPF and HPF	10	CO2
<b>SECTION –C</b>		<b>(1x20=20)</b>	
Q12	<p>Design an amplifier with matching networks using shunt stubs in both input and output for maximum gain at 5 GHz with GaAs FET that has S-parameters:</p> <p><math>Z_0=50</math> ohms</p> <p><math>S_{11}=0.65(-140 \text{ deg})</math></p> <p><math>S_{12} =0.04(60 \text{ deg})</math></p> <p><math>S_{21} =2.4 (50 \text{ deg})</math></p> <p><math>S_{22} =0.70(-65 \text{ deg})</math></p> <p>Calculate the gain of the amplifier and comment on the stability.</p>	20	CO2

-----XXXXXXXXXXXXXXXXXXXXXXXXXXXX-----