

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2021

Programme Name: B. Tech (ECE)

Semester : V

Course Name : Microwave theory & Techniques

Time : 03 hrs

Course Code : ECEG 3034

Max. Marks : 100

Nos. of page(s) : 02

Instructions: All Questions are Compulsory.

SECTION A

(5x4=20)

S. No.		Marks	CO
Q 1	An X-band Pulsed cylindrical magnetron has the following parameters: Anode voltage (V_0) =40 KV Anode Current (I_0)=96 amp Magnetic flux density $B_0=0.02$ Wb/sq.m Radius of cathode cylinder (a)=6 cm Radius of anode (b)=12 cm. Operating Frequency is 10 GHz. Compute: Cyclotron angular frequency, Cutoff Voltage for fixed B_0 and Cutoff Magnetic flux density for fixed V_0 .	4	CO3
Q 2	Twocavity klystron amplifier has the following parameters: Beam Voltage (V_0)=40 KV Beam Current (I_0)=2.5 amp Operating Frequency =3 GHz; input & output beam Coupling Co-eff =1 Signal voltage (V_1)=1.5V (rms) Dc electron charge density = 1.2×10^{-6} c/m ³ Cavity shunt resistance (R_{sh}) =4 K Ω Total Shunt resistance including load(R_{shl}) =1 K Ω ., Reduction factor (R) =0.5 Determine plasma frequency, induced voltage in the output cavity, power delivered to the load, electronic efficiency.	4	CO3

Q 3	Using double minima method it is observed that the variations in 3 dB points is 0.001. Distance between the two consecutive minima locations is $d_1 = 4.3$ cm and $d_2 = 8.75$ cm from the load. Find SWR, reflection coeff and find the load impedance if characteristic impedance of the line is 50 ohms.	4	CO5
Q 4	TE ₁₁ mode is propagating through a rectangular waveguide having the diameter of 3cm and 1.5 cm as 'a & b' respectively.. Guide is filled with dielectric material having $\epsilon_r = 2.2$. Find f_c , λ_g and Z_g in the guide for an operating frequency of 5 GHz.	4	CO1
Q5.	An IMPATT diode has the following parameters: Carrier drift velocity = 2×10^7 cm/s, drift region length = $5 \mu\text{m}$, Maximum operating voltage and current are 100V, 300 mA, efficiency = 10%, breakdown voltage of 85 Volts. Find output power, resonant frequency.	4	CO4
SECTION B (4x10=40)			
Q 6	Explain how will you measure the Insertion loss, Return loss and Attenuation of DUT.	10	CO5
Q 7	Explain Two valley model. What are the various modes of Oscillations of GUNN diode	10	CO4
Q8	Derive the Hartree voltage in case of linear magnetron.	10	CO3
Q9	A phase detector produces an output signal proportional to the difference between two RF input signals which are expressed as $V_1 = V_0 \cos(\omega t)$ and $V_2 = V_0 \cos(\omega t + \theta)$. If these two signals are applied to single ended mixer using 90 deg hybrid, show that output IF current after low pass filtering is $I = k V_0^2 \sin \theta$.	10	CO2
SECTION-C (2x20=40)			
Q11.	Design an amplifier to have gain of 10 dB at 6 GHz using transistor with the following parameters. $Z_0 = 50$ ohms, $S_{11} = 0.61(-170 \text{ deg})$, $S_{12} = 0$, $S_{21} = 2.24(32 \text{ deg})$, $S_{22} = 0.72(-83 \text{ deg})$. Plot $G_s = 1$ dB and $G_l = 2$ dB circles and use. Design matching circuits at input side using short circuited series stub and output side with open circuited shunt stubs.	20	CO2
Q12a	Deduce the field expression and Quality factor of TM ₁₁₀ mode of rectangular cavity resonator.	15	CO1
Q12b.	An M-Si-M BARITT diode has the following parameters: Relative dielectric constant of Si = 11.8; Si length = $8 \mu\text{m}$; Donor concentration is $5 \times 10^{21}/\text{m}^3$. Find breakdown voltage and break down electric field.	5	CO4

-----XXXXXXXXXXXXXXXXXXXXXXXXXXXX-----