Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: Electromagnetic Field Theory **Semester: IV**
Program: B. Tech (EE and BT)
Time: 03 hrs. **Max. Marks: 100**

SECTION A

S. No.		**Marks**	**CO**
Q 1	(a) What are the three most common types of structures that support the TEM mode of propagation?	[2]	CO3
	(b) Compare the advantages and disadvantages of coaxial cable and two-wire transmission line.	[2]	CO3
	(c) State Snell's of reflection and refraction.	[2]	CO2
	(d) What is meant by a "distortionless line"? What relation must the distributed parameters of a line satisfy in order for the line to be distortionlcss.	[2]	CO3
	(e) Explain the significance of displacement current.	[2]	CO1
Q.2	(a) A uniform plane wave of 400 MHz traveling in a free space impinges normally on a larger block of material having $\varepsilon_r = 2 \; and \; \mu_r = 4$. Calculate transmission and reflection coefficients at the interface.	[5]	CO2
	(b) A standing wave has a maximum field of 150 $\mu V/m$ and a minimum field of 30 $\mu V/m$. Find (a) the SWR and (b) the reflection coefficient for this wave.	[5]	CO2

SECTION B

Q.3	(a) A telephone line has R = 30 Ω/km, L=100 mH/km, G=0, and C= 20μF/km. At f = 1kHz, obtain: (i) The characteristics impedance of the line. (ii) The propagation constant. (iii) The phase velocity (b) A 75 (Ω) transmission line is terminated at a load impedance Z_L. If the line is $5\lambda/8$ long, calculate Z_{in} when (i) Z_L = j 45 (Ω) and (b) Z_L= 25 – j 65(Ω)	[10]	CO3
Q.4	(a) Give the Statement of Faraday's Law (b) Write the differential and integral form of Faraday's Law. (c) A conducting circular loop of radius 20 (cm) lies in Z=0 plane in a magnetic field $\vec{B} = 10\cos(377\,t)\widehat{a_z}$ m Wb/m^2. Calculate the induced voltage in the loop.	[10]	CO1
Q.5	For the case of oblique incidence of a uniform plane wave with perpendicular polarization on a lossless dielectric boundary (x-y plane), write the instantaneous	[10]	CO2

	expressions E(x, z, t) and H(x, z, t) for the total field in both mediums. Find the reflection coefficient and transmission coefficient and establish the relation between them.		
Q.6	(a) What are Γ and S for a line with an open-circuit termination? A short-circuit termination? (b) Where do the minima of the voltage standing wave on a lossless line with a resistive termination occur (a) if $R_L > R_0$ and (b) if $R_L < R_0$? (c) Sketch the standing wave patterns for voltage along a transmission line when it is terminated with (i) short circuit (ii) open circuit (iii) resistive load with $R_L > R_0$ (iv) resistive load $R_L < R_0$ (v) inductive load and (vi) capacitive load.	[2] [2] [6]	CO4
Q.7	Draw the equivalent circuit of a two-wire transmission line and then develop the transmission line equations for the same line.	[10]	CO3
Q.8	(a) Explain clearly the structure of field lines in strip lines and microstrip lines. Why are propagating modes along the microstrip lines are non-TEM and not pure TEM modes? (b) Discuss the various types of losses in the microstrip lines and write a note on quality factor of transmission line. **OR** (a) Determine the characteristic impedance and the effective dielectric constant for a microstrip line fabricated in an alumina substrate ($\varepsilon_r = 9.7$) if the W/b ratio is (i) 0.5, (ii) 5. Also find the velocity of propagation in each case.	[10] [10]	CO5
SECTION-C			
Q.9	(a) Describe how the characteristic impedance of a parallel plate transmission line depends on plate width and dielectric thickness. What is the difference between the surface resistance and the resistance per unit length of a parallel plate transmission line. (b) A coaxial cable contains an insulating material of conductivity σ. If the radius of the central conductor is a and that of sheath is b, show that the conductance per unit length is $G = \frac{2\pi\sigma}{\ln\left(\frac{b}{a}\right)}$. **OR** (a) Explain how the value of a terminating resistance can be determined by measuring the Standing wave ratio on a lossless transmission line. (b) The single stub method is used to match a load impedance 25 + j 25 (Ω) to a 50 (Ω) transmission line. Find the position and length of a short-circuited stub required to match the line. Use the Smith chart for this purpose.	[5] [15] [5] [15]	CO4 CO4 CO4 CO4

General Formulae for stripline and microstrip lines:

Stripline:

$$for \qquad \frac{W}{b} \leq 0.5$$

$$Z_0\sqrt{\varepsilon_r} = 30\ln\{2\left(\frac{1+\sqrt{k}}{1-\sqrt{k}}\right)\}\,ohms$$

$$and\ for \quad \frac{W}{b} > 0.5$$

$$Z_0\sqrt{\varepsilon_r} = 30\pi^2/\ln\{2[(\frac{1+\sqrt{k'}}{1-\sqrt{k'}})]\}\,ohm$$

Microstrip line:

$For\ \frac{W}{h} = 0.5 < 1$

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 0}{2}\left[\frac{1}{\sqrt{1 + \frac{12b}{W}} + 0.04\left(1 - \frac{W}{h}\right)^2}\right]$$

$$Z_0 = \frac{60}{\sqrt{\epsilon_r}}\ln(\frac{8h}{W} + \frac{W}{4h})$$

(i) $\frac{W}{h} = 5 > 1$

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left(\frac{1}{\sqrt{1 + \frac{12b}{W}}}\right)$$

$$Z_0 = \frac{120\pi}{\sqrt{\epsilon_r}}\left[\frac{1}{[\frac{W}{h} + 1.393 + 0.667\ln(1.444 + \frac{W}{h})]}\right]$$