Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: EC303

Course Name: APPLIED ELECTROMAGNETIC THEORY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

			Marks
1	a)	State Ampere's circuit law.	(3)
	b)	Derive an expression for magnetic energy of a continuous distribution of current in a volume.	(7)
	c)	Find the potential function and electric field intensity for the region between concentric right circular cylinders, where V=0 at r=1mm and V=100 V at r=30mm.	(5)
2	a)	State and derive Gauss's law in point form.	(7)
	b)	A square loop of 4m side is placed in xy-plane with its centre at the origin and sides long the coordinates axes. If the magnetic flux density in the region is given $B = (0.28a_x - 0.3a_y + 0.4a_z)e^{-0.1t}\ Wb/m^2$. Find the induced EMF in the loop at t=10 s	(8)
3	a)	List all Maxwell's equations in integral form	(4)
	b)	Derive the solution of uniform plane wave in lossy dielectric medium.	(6)
	c)	An air filled parallel plate capacitor is with following specification, area= 2 m^2 and spacing between the plates=0.1m. If a voltage $V = 20cos10^3t$ is applied across the capacitor plates, find the magnetic field between the capacitor plates.	(5)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	What is Snell's law?	(3)
	b)	Derive an expression for reflection coefficient of a plane wave under oblique incidence with parallel polarization at a dielectric interface.	(5)
	c)	Define reflection coefficient and VSWR of a transmission line and derive the relation between reflection coefficient and VSWR.	(7)

5 a) Derive an expression for net outward power flow associated with an electromagnetic wave, from a surface. (10)

b) State phase velocity of a wave (5)

6 a) Draw the circuit of small section of transmission line of length Δx and label the circuit parameters (3)

b) Derive the current and voltage equation of a transmission line. (7)

c) A lossless transmission line has primary constant L= 0.01μH/m, C=100pF/m. Find the characteristic impedance of the line. (5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) What are distributed elements (4)

b) Derive the expression for input impedance of a loss less transmission line (8)

c) A transmission line has primary constants R=0.1Ω/m, G=0.01/m, L=0.01μH/m and C=100pF/m. Find the characteristic impedance of the line at 2 GHz. Find the following (8)

i) Reflection coefficient at the load end when it is connected to a load impedance 10+j20Ω.

ii) The reflection coefficient at a distance of 20cm from load.

8 a) Derive the expressions for Transverse magnetic (TE) mode propagation in a parallel plane wave guide. (10)

b) A load impedance 90- j 25 is to be matched to 50Ω using single stub matching find the length and location of stub using smith chart. (10)

9 a) Derive the expressions for TE mode in a rectangular wave guide (10)

b) The longitudinal electric field for TM_{11} mode is given by $E_Z = \sin 5x \sin 8y\, e^{-j\beta z}\ V/m$ Find the cut off frequency of the mode. (7)

c) The cross section of a rectangular wave guide is 20 cm ˣ5 cm. Find 3 lowest order mode frequencies (3)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC303

Course Name: APPLIED ELECTROMAGNETIC THEORY

Max. Marks: 100 Duration: 3 Hours

Smith Chart to be supplied.

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Point charges 5 nC and -2 nC are located at (2,0, 4) and (-3,0, 5), respectively. (7)
(i) Determine the force on a 1nC point charge located at (1, -3, 7).
(ii) Find the electric field **E** at (1, - 3 , 7).

b) State and explain Maxwell's equations in the integral and differential forms. (8)

2 a) Give Poisson's and Laplace equation in electrostatics. Give application (7)

b) A plane wave propagating through a medium with $\varepsilon_r = 8$ $\mu_r = 2$ has E = $0.5e^{-z/3}\sin(10^8 t - \beta z)\, a_x$ V/m. Determine (8)
(i) β
(ii) The loss tangent
(iii) Intrinsic impedance
(iv) Wave velocity
(v) H field

3 a) Derive the expression of capacitance of two wire transmission line. (8)

b) State and prove boundary conditions for E and H in accordance with Maxwell's equations. (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) In free space, H = 0.2 cos (ωt — β x) a_z A/m. Find the total power passing through: (8)
(i) A square plate of side 10 cm on plane x + z = 1
(ii) A circular disc of radius 5 cm on plane x = 1.

b) Derive an expression for characteristic impedance of a transmission line and show that it is resistive at radio frequencies. (7)

5 a) What is polarisation? Explain the different types of Polarisation? (7)

b) A telephone line has R = 30Ω/km, L= 100mH/km , G=0,and C= 20μF/KM. At f=1 KHz, obtain: i) Characteristic impedance ii) propagation constant iii) phase velocity. (8)

6 a) Derive the expression for the ratio of reflected to incident electric field strength for an insulator with oblique incidence. (7.5)

b) Derive the expression of input impedance due to a transmission line terminated by a load .Also find the expression for SWR. (7.5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive the expression for r-circles and x-circles in Smith chart. (10)

b) Determine ,assuming TE_{10} mode of propagation ,the cut-off frequency, cut-off wavelength, guide wavelength ,phase constant, phase velocity, group velocity and wave impedance in the case of a hollow rectangular metallic waveguide of dimensions 6cm and 3 cm ,respectively, when the applied signal frequency is 5GHz (10)

8 a) A 100 + j150 Ω load is connected to a 75 Ω lossless line. Using Smith Chart, find: (10)

(i) Γ
(ii) s
(iii) The load admittance Y_L
(iv) Z_{in} at 0.4λ from the load

b) Obtain the waveguide solution to Maxwell's wave equations (10)

9 a) Explain single stub matching using analytical method. (10)

b) A hollow rectangular waveguide has dimensions of a= 4cm and b= 2cm. Calculate the amount of attenuation if the frequency is 3.5 GHz. Assume dominant mode. (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: EC303

Course Name: APPLIED ELECTROMAGNETIC THEORY (EC)

Max. Marks: 100 Duration: 3 Hours

(Smith Chart to be supplied on request)

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Given D = 2r cosΦ$a_Φ$ – (sinΦ/3r) a_z. Find flux crossing portion of z=0 plane defined by r ≤ a, 0 ≤ Φ ≤ π/2. (7)

b) Let μ_{r1}=3, region is defined by x<0 and region2, x>0 has μ_{r2}=5. If H_1=*4ax+3ay-6az* A/m, find H_2 and the angle it makes with normal. (8)

2 a) In spherical coordinates, V=-25 on a conductor at r=2cm and V=150 at r=35cm.the space between the conductors is dielectric filled for which ε_r=3.12. Find surface charge densities on the conductors. (7)

b) A travelling wave is described by y = *10 sin(βz-ωt)*. Sketch the wave at t=0, t=t_1 and t=t_2 where it advanced by λ/8 and λ/4 respectively. Velocity is 3x10^8m/s and ω=10^6rad/s. (8)

3 a) Derive the capacitance and inductance of a two-wire line. (8)

b) Write Maxwell's equation in phasor form. (4)

c) Draw electromagnetic flow diagram showing the relationship between potentials and vector fields of electromagnetic system (time varying case). (3)

PART B

Answer any two full questions, each carries 15 marks.

4 a) In free space (z≤0) a plane wave with H=*10cos(10^8t-βz)a_x* mA/m is incident normally on a lossless medium (ε=2ε_0,μ=8μ_0) in the region z≥0. Determine E_r, H_r and E_t, H_t (8)

b) Describe the following terms: (7)
i) Characteristic impedance ii) Lumped and distributed elements

5 a) Derive the expression for refraction and reflection coefficient of plane electromagnetic waves that undergoing oblique incidence with vertical polarization (considering boundary separation). (7)

b) Derive the ABCD parameters of a transmission line. (8)

6 a) An EM wave travels in free space with electric field component Es=100$e^{j(0.866y+0.5z)}$$a_x$ V/m. Determine ω, λ, magnetic field component and time average power in the wave. (8)

b) A distortion less line has Z_0=60Ω; α=20mNp/m; u=0.6c. Find R,L,G,C and λ at 100MHz. (4)

c) Distinguish between lossless line and distortion less line. (3)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Write note on half wave and quarter wave transmission lines. (5)

b) A lossless 60Ω line is terminated by a 60 + j60Ω load. Find **Γ** and **s**, if Z_{in} = 120 -j60Ω. How far is the load from generator (Solve with Smith chart)? (6)

c) What are called degenerate modes? Explain. (5)

d) Draw the field distribution pattern for TE_{20} mode inside a rectangular waveguide. (4)

8 a) Draw the input impedance variation of lossless line when shorted and opened for a 0 to 2π variation in phase. (3)

b) Design a stub to match 40+j30Ω load (antenna) to a lossless line of 100Ω (use Smith chart). (9)

c) List all the modes which are supported in rectangular waveguides and why? (8)

9 a) From Maxwell's equation derive the expression for E fields and H fields inside the waveguide for TE mode. (8)

b) By analytical method, get the value of position where stub has to be placed from load and stub length with single stub impedance matching in transmission lines. (7)

c) Derive the relationship between guide wavelength, free space wavelength and cut off wavelength in rectangular waveguide. (5)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: EC303

Course Name: APPLIED ELECTROMAGNETIC THEORY (EC)

Max. Marks: **100** Duration: 3 Hours

Smith Chart to be supplied on request.

PART A

Answer any two full questions, each carries 15 marks.

1 a) Derive the expressions for Energy stored in Electric Field. (8)
b) Eight identical charges,Q each are placed on the corners of a cube of side 'a'. Find the resultant force on a charge. (7)

2 a) Derive Maxwell's first and second equations from fundamental laws. (8)
b) Starting from Maxwell equation, derive the wave equation for a conducting medium. (7)

3 a) Determine the inductance of a Two- wire transmission line. (5)
b) A Parallel plate capacitor with plate area of $5cm^2$ and a plate separation of 3mm has a voltage $50\sin 10^3 t$ Volt applied to its plates.Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$. (4)
c) Derive the boundary conditions for electric field at the interface of two dielectrics. (6)

PART B

Answer any two full questions, each carries 15 marks.

4 a) State Poynting theorem. Derive the equation of complex vector. (8)
b) A lossless 50-Ω transmission line is terminated in a load with $Z_L = (50+ j25)\ \Omega$. Calculate (i) The reflection coefficient Γ. (ii) The standing-wave ratio. (7)

5 a) Derive the input impedance of a transmission line. For a shorted section of 75 ohm transmission line, $l = \lambda/4$, Find the input impedance assuming $\alpha = 0$. (7)
b) Differentiate circular and elliptical polarization. (8)

6 a) Derive standard Transmission line equations. (6)
b) Derive Brewster angle.A parallel-polarized plane wave is incident from air onto a dielectric medium with $\varepsilon r = 9$ at the Brewster angle. What is the refraction angle? (9)

PART C

Answer any two full questions, each carries20 marks.

7 a) A lossless transmission line with $Z_0=50\Omega$ is 30m long and operates at 2MHz. The line is terminated with a load $Z_L=60+j40\Omega$. If u=0.6c on the line, find (15)
i)Reflection coefficient ii) Standing wave ratio iii) Input impedance
b) Discuss the attenuation of waveguides. (5)

8 a) Explain single stub matching in detail using analytical method. (12)
b) Explain Group velocity and Phase velocity. When a wave of 6GHz propagates in parallel conducting plates separated by 3cm, find the V_P and $V_g$of the wave for dominant wave. (8)

9 a) Explain waveguides and its different modes of wave propagation. (10)
b) Explain Half Wave and Quarter Wave Transmission lines. Given that $Z_L=30+j40\Omega$, $Z_0=50\Omega$. Find the shortest length ('*l*') and point where stub has to be placed for a matching. (Use Smith chart) (10)

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