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(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 ^{x}5 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(R&S), DECEMBER 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 and explain Gauss' Law (8)

Write Poisson's and Laplace's Equation with applications

b) Derive the expression for capacitance of two wire transmission line. (7)

2 a) In free space, Expression of Electric field of a plane wave is given by (7)

$\bar{E} = 50 \cos (10^8 t - \square x) \hat{a}_y$, Find

i. Direction of propagation9

ii. Intrinsic Impedance

iii. Expression of Magnetic field

iv. Attenuation constant

v. Phase constant

vi. Skin depth

b) State and explain Maxwell's equation in Integral and differential form (8)

3 a) For a plane wave propagating in a lossy dielectric, derive the expression for Propagation constant. (8)

b) Explain Scalar and vector magnetic potential (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive the expression for reflection coefficient for a wave of perpendicular polarization , travelling from one medium to another at oblique incidence . (8)

b) Explain wave polarization

Find the polarisation of the following waves (7)

i. $\bar{E} = 10 \cos(\omega t - \square x) \hat{a}_y$

ii. $\bar{E} = 16 \sin(\omega t - \square x) \hat{a}_y + 25 \cos(\omega t - \square x) \hat{a}_z$

iii. $\bar{E} = 10 \sin (\omega t - \square x) \hat{a}_y + 10 \cos (\omega t - \square x) \hat{a}_z$

iv. $\bar{E} = 20 \sin (\omega t - \square x) \hat{a}_y + 20 \sin (\omega t - \square x) \hat{a}_z$

5 a) Derive the equation of input impedance of a transmission line due to line terminated by a load . (7)

b) Derive the expression of characteristic impedance of transmission line (8)

6 a) Show that Brewster angle does not exist for a non magnetic medium for perpendicular polarization (8)

b) A lossless transmission line has a characteristic impedance of 50Ω and phase constant of 3 Rad/ m at 100 MHz . Find Inductance per meter and Capacitance per meter of the transmission line . (7)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Explain single stub matching . (10)

For a load impedance of 60 – j80Ω , design a single stub short circuit shunt tuning network to match this load to a 50Ω line using smith chart .

b) A 50 + j200 Ω load is connected to a 100Ω lossless transmission line . Using smith chart , find (10)

i. Reflection coefficient at load

ii. VSWR

iii. Load admittance

iv. Input impedance at 0.2 λ from the load

v. Reflection coefficient at 0.2 λ from the load

8 a) Explain the propagation of Electromagnetic wave in a rectangular waveguide (10)

b) Derive the expression for Electric and magnetic field intensities for TM mode of propagation of rectangular waveguide. (10)

9 a) A rectangular wave guide has a dimension of 3cm x 5cm , and is operating at a frequency of 10 GHz . Calculate the cutoff wavelength, cutoff frequency , guide wavelength , phase velocity and group velocity . and the wave impedance for TE10 mode. (10)

b) Derive expression for length and position of stub for single stub tuning method using Analytical method. (10)

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth semester B.Tech degree examinations (S) September 2020

Course Code: EC303

Course Name: APPLIED ELECTROMAGNETIC THEORY

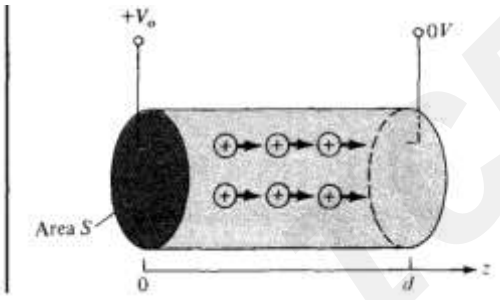
Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) State and explain Ampere's law and Coulomb's law (8)

b) Consider a region between two electrodes separated by a distance, d, having a uniform charge density of ρ_v .Voltage on one electrode is V_0 and other electrode is 0 V . Find the expression of electric field in terms of V_0, ρ_v and d . (7)



2 a) In a lossy dielectric medium , characteristic impedance of the medium is 173 + j100 Ω , Expression of Magnetic field of a plane wave is given by (7)

$\bar{H} = 10\, e^{-\alpha x} \cos(\omega t - 0.5x)\, \hat{a}_z$ A/m . Find

i. Direction of propagation

ii. Loss tangent

iii. Attenuation constant

iv. Phase constant

v. Skin depth

b) State and explain Skin Depth . For a good conductor , prove that $\alpha = \beta$, where , α is the attenuation constant and β is the phase constant . (8)

3 a) Derive continuity equation from fundamental laws. (8)

b) Explain boundary conditions for Electric field and Magnetic field. (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive the expression for reflection coefficient for a wave of parallel (8)

polarization, travelling from one medium to another at oblique incidence.

b) Explain wave polarization and different polarisation with example. (7)

5 a) A transmission line of length 0.2 λ and characteristic impedance 100Ω is terminated with a load impedance of 50+200j . Find input impedance, reflection coefficient at load end, reflection coefficient at the input end and VSWR. (8)

b) Explain lossless transmission line and distortion less transmission line (7)

6 a) Derive the expression for Brewster angle for parallel polarised wave. (7)

b) Derive the expression for propagation constant of transmission line. (8)

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. (8)

b) A 25 + j100 Ω load is connected to a 50Ω lossless transmission line. Using smith chart, find (8)

i. Reflection coefficient at load
ii. VSWR
iii. Load admittance
iv. Input impedance at 0.2 λ from the load
v. Reflection coefficient at 0.2 λ from the load

c) Briefly explain importance of quarter wave transformer. (4)

8 a) Explain the propagation of electromagnetic wave in a rectangular waveguide (10)

b) For TE_{10} mode of propagation in a rectangular wave guide, with length 8cm and 6 cm respectively , find the following when frequency of operation is 6 GHz . (10)

i. Cut off frequency
ii. Cut off wavelength
iii. Guide wavelength
iv. Phase constant
v. Phase velocity
vi. Group velocity
vii. Wave impedance

9 a) Derive the expression all the Electric and magnetic field components for Transverse Magnetic Modes. (10)

b) Explain single stub tuning method using Analytical method. (10)

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