INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**ELECTROMAGNETIC WAVES AND TRANSMISSION LINES**				
Course Code	AECB13				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Ms. K C Koteswaramma, Assistant Professor				
Course Faculty	Dr. P Ashok Babu, Professor & HOD. Ms. A Usha Rani, Assistant Professor. Ms. M Sreevani, Assistant Professor.				

COURSE OBJECTIVES

The course should enable the students to:	
I	Understand the 3D vector co-ordinate systems and electromagnetic field concepts.
II	Analyze the importance of Maxwell's equations in electromagnetic theory and wave propagation.
III	Study the propagation characteristics of electromagnetic waves at boundary.
IV	Demonstrate the ability to compute various parameters for transmission lines using smith chart and classical theory.

COURSE OUTCOMES (COs):

CO 1	Understand coloumb's law and gauss's law to different charge distributions, it's applications and applications of Laplace's and Poisson's equations
CO 2	Evaluate the physical interpretation of Maxwell's equations and applications for various fields.
CO 3	Understand the behavior of electromagnetic waves incident on the interface between two different media.
CO 4	Understand the significance of transmission lines and concept of attenuation, loading, and analyze the loading technique to the transmission lines.
CO 5	Formulate and analyze the smith chart to estimate impedance, VSWR, reflection coefficient, OC and SC lines.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

AECB13.01	Understand the different types of 3D co- ordinate systems, scalars and vectors, physical significance of divergence, curl and gradient.
AECB13.02	Illustrate the concepts of coloumb's law and gauss's law to different charge distributions like point charge, line charge, surface charge and volume charge also analyze its applications.
AECB13.03	Understand the applications of Laplace's and Poisson's equations to solve problems on capacitance of different charge distributions.
AECB13.04	Illustrate the physical significance of Biot- Savart's law and Ampere's Circuit law for different current distributions and analyze its applications.
AECB13.05	Evaluate the physical significance of Faraday's law and interpretation of Maxwell's equations for time-varying fields.
AECB13.06	Derive the boundary conditions between different media like dielectric to dielectric, dielectric conductor interfaces.
AECB13.07	Analyze and apply the Maxwell's equations to derive electromagnetic wave equations for different media.
AECB13.08	Understand the behavior of electromagnetic waves incident on the interface between two different media.
AECB13.09	Formulate and analyze problems in different media such as lossy, lossless with boundaries using uniform plane waves.
AECB13.10	Understand the significance of transmission lines and its types, derive their primary constants and secondary constants.
AECB13.11	Understand the concept of attenuation, loading, and analyze the loading technique to the transmission lines.
AECB13.12	Understand the design of various transmission lines characterization.
AECB13.13	Summarize the impedance transformation for different lengths such as $\lambda/4,\lambda/2,\lambda/8$ transmission lines.
AECB13.14	Understand the design of ultra high frequency transmission lines for different applications by using single and double stub matching techniques.
AECB13.15	Formulate and analyze the smith chart to estimate impedance, VSWR, reflection coefficient, OC and SC lines.
AECB13.16	Apply the concept of electromagnetic fields to understand and analyze land mobile communications.
AECB13.17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

TUTORIAL QUESTION BANK

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	MODULE-I **ELECTROSTATICS**			
	Part - A(Short Answer Questions)			
1	State Coulomb's law?	Remember	CO 1	AECB13.01
2	Write the expression for Coulombs law in vector form and explain the terms.	Understand	CO 1	AECB13.01
3	Define unit vector?	Understand	CO 1	AECB13.01
4	Specify the importance of divergence and stokes theorems?	Remember	CO 1	AECB13.01
5	State Gauss's law?	Understand	CO 1	AECB13.01
6	What is the first Maxwell's equation?	Remember	CO 1	AECB13.01
7	List the applications of Gauss law?	Understand	CO 1	AECB13.02
8	Define electric flux and give the relation between electric field intensity and electric flux density?	Remember	CO 1	AECB13.02
9	Give the relation between electric flux and flux density?	Understand	CO 1	AECB13.02
10	State the Divergence theorem and give the expression?	Remember	CO 1	AECB13.03
11	State stokes's theorem and give the expression?	Understand	CO 1	AECB13.03
12	Define electric potential?	Remember	CO 1	AECB13.03
13	Give the expression for the energy density for electrostatic fields?	Understand	CO 1	AECB13.03
14	Define convention current density?	Remember	CO 1	AECB13.03
15	Writ e boundary conditions for conducting media?	Remember	CO 1	AECB13.02
16	Define conduction current density?	Understand	CO 1	AECB13.03
17	Give the expression for relaxation time?	Remember	CO 1	AECB13.03
18	Define poison's and laplace's equations?	Understand	CO 1	AECB13.03
19	What are the different types capacitors and give the C value for all?	Remember	CO 1	AECB13.02
20	Define polarization?	Remember	CO 1	AECB13.03
	Part - B (Long Answer Questions)			
1	State and explain Coulomb's law in vector form.	Understand	CO 1	AECB13.01
2	State and Prove Gauss's law. List the limitations of Gauss's law.	Remember	CO 1	AECB13.01
3	Explain the following terms: i. Homogeneous and isotropic medium and ii. Line, surface and volume charge distributions.	Understand	CO 1	AECB13.01
4	Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two dielectrics.	Remember	CO 1	AECB13.01
5	Obtain the expression for the capacitance of a coaxial capacitor?	Understand	CO 1	AECB13.01
6	Derive poisons and Laplace's equations and mention their applications?	Remember	CO 1	AECB13.01
7	Explain the terms conduction current, convection current and relaxation time.	Understand	CO 1	AECB13.02

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
8	What is the second Maxwell's equation? Give the relation between E & V?	Understand	CO 1	AECB13.02
9	Using Gauss's law derive expressions for electric field intensity and electric flux density due to an infinite sheet of conductor of charge density ρs C/cm	Remember	CO 1	AECB13.02
10	Define conductivity. Obtain the expression for Continuity of current equation?	Understand	CO 1	AECB13.03
11	Derive the expression for electric field intensity due to the line charge?	Remember	CO 1	AECB13.03
12	Derive the expression for electric field intensity due to the surface charge?	Understand	CO 1	AECB13.03
13	Derive the expression for electric field intensity due to the volume charge?	Remember	CO 1	AECB13.03
14	State Gauss's law. Using divergence theorem and Gauss's law, relate the displacement density D to the volume charge density ρυ.	Remember	CO 1	AECB13.03
15	Obtain the expression for the capacitance of a parallel plate capacitor?	Understand	CO 1	AECB13.02
16	Derive the expression for Energy density in Electrostatic fields.	Remember	CO 1	AECB13.03
17	Obtain the expression for the capacitance of a spherical capacitor?	Understand	CO 1	AECB13.03
18	Explain conduction current and derive the expression for conduction current density?	Remember	CO 1	AECB13.03
19	Explain convection current and derive the expression for convection current density?	Remember	CO 1	AECB13.02
20	State Gauss's law and obtain the first MAXWELL's equation for electrostatic fields?	Understand	CO 1	AECB13.03
Part - C (Analytical Questions)				
1	Point charges 1mC and -2mC are located at (3,2,-1) and (-1,-1,4) respectively. Calculate the electric force on a 10nC charge located at (0,3,1) and electric field intensity at that point.	Remember	CO 1	AECB13.01
2	Point charges 5nC and -2nC are located at (2,0,4) and (-3,0,5) respectively. a) Calculate the electric force on a 1nC point charge located at (1,-3,7). b) Find electric field intensity E at (1,-3,7).	Understand	CO 1	AECB13.01
3	Determine D at (4,0,3) if there is a point charge -5π mC at (4,0,0) and a line charge 3π mC/m along the y-axis.	Remember	CO 1	AECB13.01
4	Two point charges -4μC and 5 μC are located at (2,-1,3) and (0,4,-2) respectively. Find the potential at (1,0,1), assuming zero potential at infinity.	Remember	CO 1	AECB13.01
5	A cylindrical capacitor has radii a=1 cm and b=2.5 cm. If the space between the plates is filled with an inhomogeneous dielectric with ϵ_r =(10+ρ) / ρ, where ρ is in centimeters, find the capacitance per meter of the capacitor.	Understand	CO 1	AECB13.01

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
6	Three point charges 2μC, 4μC and 8μC are located at (0,0,0) (0,0,1) and (1,0,0) respectively. Find energy in the system.	Understand	CO 1	AECB13.01
7	Given that D = $z\rho Cos^2\phi\ a_z$ C/m^2 , calculate the charge density at(1, π/4,3) and the total charge enclosed by the cylinder of radius 1m with $-2 \le z \le 2$ m.	Remember	CO 1	AECB13.02
8	For the current density J = $10zsin^2\phi\ a_\rho$ A/m^2, find the current through the cylindrical surface ρ=2, $1 \le z \le 5$ m.	Remember	CO 1	AECB13.02
9	Three point charges 5μC, 8μC and 2μC are located at (-2,4,6), (0,0,1) and (1,1,2) respectively. Find energy in the system.	Understand	CO 1	AECB13.02
10	If D = $(2y^2 + z)\ a_x + 4xy\ a_y + x\ a_z$ C/m^2, find a) The volume charge density at (-1,0,3). b) The flux through the cube defined by $0 \le x \le 1$, $0 \le y \le 1$, $0 \le z \le 1$. c) The total charge enclosed by the cube.	Understand	CO 1	AECB13.03
MODULE- II MAGNETOSTATICS				
Part – A (Short Answer Questions)				
1	State Biot- Savart's law?	Remember	CO 2	AECB13.04
2	State Ampere's force law?	Understand	CO 2	AECB13.04
3	State Ampere's circuital law?	Remember	CO 2	AECB13.04
4	Is magneto static field is conservative? Explain.	Remember	CO 2	AECB13.05
5	Write the Maxwell equation for magneto static fields	Understand	CO 2	AECB13.05
6	Define magnetic vector potential and magnetic scalar potential?	Remember	CO 2	AECB13.05
7	Write the expression for Lorentz force equation.	Understand	CO 2	AECB13.06
8	Define inductance? What's the energy stored in an inductor?	Understand	CO 2	AECB13.06
9	What is the value of permeability for free space and specify the units?	Remember	CO 2	AECB13.06
10	Write Maxwell's equations for steady magnetic field, both in point and integral form.	Understand	CO 2	AECB13.06
11	List the boundary conditions for Magnetic fields?	Understand	CO 2	AECB13.06
12	State Gauss law for magnetic fields?	Remember	CO 2	AECB13.06
13	Define displacement current density.	Remember	CO 2	AECB13.06
14	Define magnetic flux density along with equation?	Understand	CO 2	AECB13.06
15	Define faraday's law?	Remember	CO 2	AECB13.06
16	What is mean by transformer emf?	Understand	CO 2	AECB13.05
17	Give the expression for the energy density for magneto-static fields?	Remember	CO 2	AECB13.05
18	Define magnetic flux density? Specify the units?	Remember	CO 2	AECB13.06
19	What is the value of permeability for free space and specify the units?	Understand	CO 2	AECB13.06
20	What is the inconsistency of Ampere's circuital law.	Remember	CO 2	AECB13.06
Part - B (Long Answer Questions)				
1	State Biot-Savart's law and obtain the expression for magnetic field intensity at a point P due to line current	Remember	CO 2	AECB13.05

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	element?			
2	Describe the inconsistency in Ampere's Law? How it is rectified by Maxwell?	Remember	CO 2	AECB13.05
3	Describe in detail the Faraday's law of induction. Write down the mathematical statement of this law?	Understand	CO 2	AECB13.05
4	Derive Maxwell's equations in integral form and differential form for time varying fields.	Understand	CO 2	AECB13.06
5	Define and explain the terms scalar and vector magnetic potential? How to determine these quantities for a magnetic field?	Remember	CO 2	AECB13.06
6	Derive the expression for Lorentz force equation?	Understand	CO 2	AECB13.06
7	Derive the equation of force on a differential current element?	Remember	CO 2	AECB13.06
8	Show that $\nabla \times \mathbf{E_m} = \nabla \times (\mathbf{u} \times \mathbf{B})$ for time varying fields?	Understand	CO 2	AECB13.06
9	Obtain Maxwell's equations in phasor form?	Remember	CO 2	AECB13.06
10	Derive the magnetic boundary conditions between two different media.	Remember	CO 2	AECB13.05
11	Show that $\nabla \times \mathbf{H} = \mathbf{J} + {}^{\partial \mathbf{D}}/_{\partial t}$.	Understand	CO 2	AECB13.05
12	State and explain ampere's circuit law?	Understand	CO 2	AECB13.06
13	Explain the inconsistency of Ampere's circuital Law.	Remember	CO 2	AECB13.06
14	Using Ampere's circuit Law, find H due to an infinite sheet of current.	Remember	CO 2	AECB13.06
15	Using Ampere's circuit Law, find H due to an infinitely long coaxial transmission line.	Understand	CO 2	AECB13.05
16	Derive the equation for force between two current elements?	Understand	CO 2	AECB13.05
17	Obtain the expression for energy density in magnetic fields.	Remember	CO 2	AECB13.05
18	Explain four Maxwell's equations in static electric and magnetic fields.	Understand	CO 2	AECB13.06
19	Define Ampere's force law and derive the expression for it.	Understand	CO 2	AECB13.06
20	State Faraday's law. Derive the expression for Maxwell's equation of time varying fields.	Remember	CO 2	AECB13.06
Part - C (Analytical Questions)				
1	A circular loop located on $x^2 + y^2 = 9$, $z = 0$ carries a direct current of 10A along $\boldsymbol{a_\emptyset}$. Determine **H** at (0,0,4) and (0, 0,-4)?	Understand	CO 2	AECB13.04
2	Given the magnetic field vector potential $\mathbf{A} = \rho^2/4\ \mathbf{a}_z$ Wb/m, calculate the total magnetic flux crossing the surface $\emptyset = \pi/2$, $1 \leq \rho \leq 2$m, $0 \leq z \leq 5$m?	Remember	CO 2	AECB13.06
3	In a certain conducting region, $H = yz(x^2 + y^2)a_x - {}^{y^2}xz\ a_y + 4x^2y^2\ a_z$ A/m. a) Determine J at(5,2,-3) b) Find the current passing through x= -1, 0 < y,z < 2.	Understand	CO 2	AECB13.04
4	A current distribution gives rise to the vector magnetic potential $A = x^2y\ a_x + y^2x\ a_y - 4xy\ a_z$ Wb/m. Calculate the following. a) B at (-1,2,5) b) The flux through the surface defined by $z = 1$, $0 \leq x \leq 1$,	Understand	CO 2	AECB13.04

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	$-1 \leq z \leq 4$.			
5	If H = y a_x - x a_y A/m on plane z = 0, a) Determine the current density and b) Verify Ampere's law by taking the circulation of H around the edge of the rectangle z=0, 0<x < 3, -1 < y < 4.	Understand	CO 2	AECB13.06
6	Find the magnetic flux density B for each of these vector magnetic potential. a) A = e^{-x} sin y a_x +(1+cos y) a_y b) A = cos θ /r^2 a_r + sin θ/r a_θ	Remember	CO 2	AECB13.06
7	The magnetic field intensity in a certain conducting region is H = xy^2a_x + x^2z a_y - y^2z a_z A/m. a) Calculate the current density at point P(2,-1,3). b) What is ∂ ρ_v /∂ t at P?	Understand	CO 2	AECB13.02
8	An electron with velocity u = ($3a_x$ + 12 a_y - 4 a_z) * 10^5 m/s experiences no net force at a point in a magnetic field B = $10a_x$ + 20 a_y +30 a_z mWb/m^2. Find E at that point.	Remember	CO 2	AECB13.06
9	A point charge of 10C moves with a uniform velocity of $2a_x$ - 4 a_z m/s in an EM field having E = a_x - 3 a_y + 8 a_z V/m and B = $0.3a_x$ + 0.1 a_y Wb/m^2. Find a) F_e b) F_m c) The total force on the charge.	Understand	CO 2	AECB13.05
10	In a certain material, χ_m = 4.2 and H = 0.2x a_y A/m. Determine a) μ_r b) μ c) M d) B e) J.	Understand	CO 2	AECB13.06
	MODULE-III UNIFORM PLANE WAVES			
	Part - A (Short Answer Questions)			
1	Give the expression for attenuation constant?	Remember	CO 3	AECB13.07
2	Give the expression for phase constant?	Remember	CO 3	AECB13.07
3	Define skin depth?	Understand	CO 3	AECB13.09
4	Define Snell's law?	Understand	CO 3	AECB13.08
5	Define reflection coefficient?	Remember	CO 3	AECB13.08
6	Define transmission coefficient?	Understand	CO 3	AECB13.09
7	Define Brewster angle?	Remember	CO 3	AECB13.07
8	Define critical angle?	Remember	CO 3	AECB13.07
9	What is mean by total internal reflection?	Understand	CO 3	AECB13.09
10	Define surface impedance?	Remember	CO 3	AECB13.08
11	Define poynting theorem?	Understand	CO 3	AECB13.07
12	Give the expression for reflection coefficient for vertical polarization with oblique incidence?	Remember	CO 3	AECB13.07
13	Give the expression for transmission coefficient for horizontal polarization with oblique incidence?	Understand	CO 3	AECB13.09
14	Give the expression for reflection coefficient for normal incidence?	Remember	CO 3	AECB13.08
15	Give the expression for transmission coefficient for normal incidence?	Remember	CO 3	AECB13.08
16	Give the expression for attenuation constant?	Understand	CO 3	AECB13.09

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
17	What is mean by homogeneous medium?	Remember	CO 3	AECB13.07
18	Write the expression for Brewster angle when a wave is parallelly polarized?	Remember	CO 3	AECB13.07
19	Define transmission coefficient?	Understand	CO 3	AECB13.09
20	Distinguish between terms perpendicular polarization and parallel polarization.	Understand	CO 3	AECB13.08
Part - B (Long Answer Questions)				
1	Obtain wave equations for good conductors?	Remember	CO 3	AECB13.09
2	Explain the characteristics of wave in perfect dielectric?	Understand	CO 3	
3	Describe polarization of wave? When the wave is linearly polarized and circularly polarized?	Remember	CO 3	AECB13.07
4	Derive the expression for intrinsic impedance in a uniform plane wave in a lossy dielectric?	Remember	CO 3	AECB13.09
5	Explain skin depth and derive expression for depth of penetration for good conductor?	Understand	CO 3	AECB13.09
6	Derive Helmholtz equations?	Remember	CO 3	AECB13.07
7	State poynting theorem. What does the poynting vector represent?	Understand	CO 3	AECB13.09
8	Derive the relation between E and H in free space?	Remember	CO 3	AECB13.09
9	What is polarization? What are the different types of polarization?	Remember	CO 3	AECB13.07
10	Define conducting medium and obtain the expression for intrinsic impedance?	Understand	CO 3	AECB13.09
11	Derive the expression for reflection of a wave when incident on dielectric with oblique incidence with perpendicular polarization?	Understand	CO 3	AECB13.08
12	Define Brewster angle and derive an expression for Brewster angle when a wave is parallely polarized?	Understand	CO 3	AECB13.07
13	State and Prove Poynting theorem?	Understand	CO 3	AECB13.09
14	Explain the power loss in a plane conductor?	Remember	CO 3	AECB13.09
15	Derive the expression for power flow in a concentric cable?	Remember	CO 3	AECB13.08
16	Derive the expression for reflection of a wave when incident on dielectric with oblique incidence with parallel polarization?	Understand	CO 3	AECB13.08
17	Write short Notes on i) Total internal reflection ii) Brewster Angle	Understand	CO 3	AECB13.09
18	Derive the expression for propagation constant, attenuation and phase constants for an electromagnetic wave propagating in good dielectric medium.	Understand	CO 3	AECB13.07
19	State and Prove the Poynting Theorem.	Remember	CO 3	AECB13.07
20	Derive expression for Reflection and Transmission coefficients of an EM wave when it is incident normally on a dielectric-dielectric interface.	Remember	CO 3	AECB13.07
Part - C (Analytical Questions)				
1	In a lossless dielectric for which $\eta = 60\pi$, $\mu_r = 1$ and	Remember	CO 3	AECB13.09

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	$\mathbf{H} = -0.1\cos(\omega t - z)\mathbf{a_x} + 0.5\sin(\omega t - z)\mathbf{a_y}$ A/m. Calculate ε_r, ω and **E.**			
2	In a non magnetic medium $\mathbf{E} = 4\sin(2\pi \times 10^7 t - 0.8x)\mathbf{a_z}$ V/m. Findε_r, η and time average power carried by the wave?	Understand	CO 3	AECB13.08
3	A plane wave propagating through a medium with ε_r =8, μ_r= 2 has$\mathbf{E} = 0.5e^{z\ /}\ \sin(10^8 t - \beta z)\mathbf{a_x}$. Determine the loss tangent, **H** field and intrinsic impedance.	Understand	CO 3	AECB13.08
4	The magnetic field component of an EM wave propagating through a nonmagnetic medium($\mu_0 = \mu$) is $H = 25\sin(2*10^8 t+6x)a_y$ mA/m. Determine a)The direction of the wave propagation b) The permittivity of the medium c) The electric field intensity.	Remember	CO 3	AECB13.09
5	A plane wave propagating through in a non magnetic medium has $\mathbf{E} = 50\sin(10^8 t + 2z)\mathbf{a_y}$ V/m. Find λ, ε_r and **H**?	Understand	CO 3	AECB13.07
6	In a free space($z \leq 0$), a plane wave with $\mathbf{H} = 10\cos(10^8 t - \beta z)\mathbf{a_x}$ A/m is incident normally on a lossless medium ($\varepsilon = 2\varepsilon_0, \mu = 8\mu_0$) in region$z \geq 0$.	Remember	CO 3	AECB13.07
7	A 10 GHz plane wave travelling in a free space has an amplitude of E as Ex = 10 V/m. Find β, η, v, λ?	Remember	CO 3	AECB13.07
8	A plane wave travelling in free space has an average Poynting vector of 5 watts/m^2. Find magnitude of electric field intensity?	Understand	CO 3	AECB13.09
9	A uniform plane wave of 200 MHz travelling in a free space impinges normally on a large block of material having ϵr =4, μr=9, σ = 0. Calculate transmission and reflection coefficients at the interface.	Understand	CO 3	AECB13.08
10	At a particular frequency, a medium has α = 0 .1 Np/m, η = $250\angle 35.26^o$ Ω. Calculate the loss tangent, loss angle and wave length.	Remember	CO 3	AECB13.08
	MODULE-IV TRANSMISSION LINES CHARACTERISTICS			
	Part - A (Short Answer Questions)			
1	Define transmission line?	Remember	CO 4	AECB13.10
2	Draw the equivalent circuit of the transmission line?	Understand	CO 4	AECB13.10
3	Write the differential form of transmission line equations?	Remember	CO 4	AECB13.10
4	Describe the different types of distortions in a transmission line and condition for distortion less transmission?	Understand	CO 4	AECB13.11
5	Describe the distortion less transmission line?	Understand	CO 4	AECB13.11
6	Define intrinsic impedance or characteristic impedance of free space.	Remember	CO 4	AECB13.11
7	Define wave length and phase velocity.	Understand	CO 4	AECB13.11
8	Define group velocity.	Remember	CO 4	AECB13.10
9	Describe the the condition of loading in transmission lines?	Understand	CO 4	AECB13.10
10	Describe the the value of characteristic impedance of free space?	Remember	CO 4	AECB13.10
11	Write secondary constants in terms of primary constants?	Remember	CO 4	AECB13.11
12	Calculate the characteristic impedance of a quarter wave transformer if a 120 ohm load is to be matched to a 75ohm line.	Understand	CO 4	AECB13.11
13	Write solution for V and I in exponential form?	Remember	CO 4	AECB13.11

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
14	Give the condition for maximum attenuation in transmission lines?	Understand	CO 4	AECB13.10
15	Name and define the primary constants of transmission line?	Understand	CO 4	AECB13.10
16	What are the different types of transmission lines?	Understand	CO 4	AECB13.10
17	Name and define the secondary constants of transmission line?	Remember	CO 4	AECB13.10
18	Give the condition for lossless transmission in transmission lines?	Remember	CO 4	AECB13.10
19	Give the condition for distortion less transmission in transmission lines?	Understand	CO 4	AECB13.11
20	What are the different types of loading techniques?	Remember	CO 4	AECB13.11
Part – B (Long Answer Questions)				
1	Starting from the equivalent circuit, derive the transmission line equations for V and I, in terms of the source parameters.	Understand	CO 4	AECB13.10
2	From the fundamental voltage & current equations of transmission line, derive Expression for input impedance Zin of the line. Modify the expression for lossy & lossless cases.	Remember	CO 4	AECB13.10
3	Describe the different distortions on a line and derive the conditions for distortion less transmission.	Understand	CO 4	AECB13.10
4	Describe the loading? Explain the different types of loading in transmission lines?	Remember	CO 4	AECB13.11
5	Describe the different distortions on a line and derive the conditions for minimum attenuation?	Understand	CO 4	AECB13.11
6	Derive the characteristic impedance Zo from the initial equation of transmission line?	Understand	CO 4	AECB13.10
7	Derive the Propagation constant from the general equations of Voltage and current?	Remember	CO 4	AECB13.12
8	Derive the expressions for α and β in terms of primary constants?	Remember	CO 4	AECB13.10
9	Define wave length, velocity of propagation and group velocity and write the respective equations?	Remember	CO 4	AECB13.10
10	Derive the expression for loss less transmission line?	Understand	CO 4	AECB13.10
11	Define a transmission line and explain the primary constants?	Understand	CO 4	AECB13.10
12	What is characteristic impedance? Obtain the relation between characteristic impedance and the propagation constant?	Understand	CO 4	AECB13.11
13	Define lossless and distortion less transmission lines and write the conditions for both?	Remember	CO 4	AECB13.11
14	Obtain the input impedance of a transmission line of length l characterized by Z_0 and γ.	Remember	CO 4	AECB13.11
15	Explain different types of Transmission lines with an example.	Remember	CO 4	AECB13.10
16	Explain different types of Transmission line parameters.	Understand	CO 4	AECB13.10
17	What is the condition for distortion less and minimum attenuation in transmission lines. Explain?	Understand	CO 4	AECB13.10
18	What are the primary constants? Derive the expressions for them.	Understand	CO 4	AECB13.10
19	What are the secondary constants? Derive the expressions for them.	Remember	CO 4	AECB13.10
20	Derive the expression for low loss transmission line?	Understand	CO 4	AECB13.11

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	Part - C (Analytical Questions)			
1	An air line has a characteristic impedance of 70Ω and phase constant of 3rad/m at 100 Mhz. Calculate R, C and L.	Remember	CO 4	AECB13.10
2	A transmission line operating at 500 MHz has Z_0=80Ω, α=0.04 Np/m, β=1.5 rad/m. Find line parameters R, L, G and C?	Remember	CO 4	AECB13.10
3	A distortion less line has Z_0=60Ω, α=0.04 Np/m, u=0.6c, where c is the speed of the light in a vacuum. Find R, L and G?	Understand	CO 4	AECB13.10
4	A telephone line has R= 30Ω/km, L= 100mH/km, G= 0 and C=20μF/km. at f=1 KHz obtain Z_0, γ and phase velocity (u).	Understand	CO 4	AECB13.11
5	A generator of 1V, 1 KHz supplies power to a 100 km long line terminated in Zo and having the following constants, R = 10.4Ω/km, L = 0.00367 H/km, G = 0.8x10-6 mho/km and C = 0.00835x10-6 F/km. Calculate Zo , attenuation constant α , phase constant β, wavelength λ and velocity V.	Remember	CO 4	AECB13.11
6	An open wire transmission line terminated in its characteristic impedance has the following primary constant at 1KHz. R=6 ohms/km, L=2mh/km, G=0.5 micro ohms, C=0.005 farad/km. Calculate the phase velocity and attenuation in decibels suffered by a signal in a length of 100kms.	Understand	CO 4	AECB13.10
7	The primary constants of a cable are R=80 ohms/km, L=2 milli henry /km and G=0.3 micro ohms/km. C=0.01 micro farad/km. Calculate the secondary constants at a frequency of 1K Hz.	Remember	CO 4	AECB13.11
8	A loss less transmission line has 115Ω characteristic impedance. The line is terminated in a load impedance of 100-j250 Ω. The maximum voltage measured on the line is 120V. Find the maximum current and minimum voltage on the line.	Remember	CO 4	AECB13.10
9	A certain transmission line 2m long operating at ω = 106 rad/s has α = 8 dB/m, β= 1 rad/m, Z_0 = 60 +j40Ω. If the line is terminated by a load of 20+j50 Ω, determine the input impedance.	Understand	CO 4	AECB13.10
10	A lossless transmission line with Z_0=50 Ω is 30 m long and operates at 2MHz. The line is terminated with a load Z_L = 60+j40 Ω. If u = 0.6c the line, find a) the reflection coefficient, b) the standing wave ratio c) The input impedance.	Remember	CO 4	AECB13.10
	MODULE-V **UHF TRANSMISSION LINES AND APPLICATIONS**			
	Part - A (Short Answer Questions)			
1	What is mean by standing wave?	Understand	CO 5	AECB13.12
2	Define reflection in transmission line?	Understand	CO 5	AECB13.12
3	Define refraction in transmission line?	Understand	CO 5	AECB13.12
4	Give the expression for reflection coefficient in transmission line?	Remember	CO 5	AECB13.13
5	What are types of standing wave ratios in transmission line?	Remember	CO 5	AECB13.14
6	Specify the relation between VSWR and reflection coefficient in transmission line?	Understand	CO 5	AECB13.13
7	Give the expression for input impedance inters of reflection coefficient?	Remember	CO 5	AECB13.13
8	What is the use of impedance transformation?	Understand	CO 5	AECB13.13
9	What is mean by stub matching?	Understand	CO 5	AECB13.14

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
10	What are the advantages of stub matching?	Remember	CO 5	AECB13.14
11	What is the use of smith chart?	Remember	CO 5	AECB13.12
12	What are the properties of stub matching?	Understand	CO 5	AECB13.12
13	List the application of smith chart?	Understand	CO 5	AECB13.12
14	Differentiate between single stub and double stub matching.	Remember	CO 5	AECB13.13
15	List the properties of smith chart?	Understand	CO 5	AECB13.14
16	Describe the meant by stub matching?	Understand	CO 5	AECB13.13
17	Describe the short circuited and open circuited lines?	Understand	CO 5	AECB13.13
18	Describe the a standing wave and how it is produced?	Remember	CO 5	AECB13.13
19	List the applications of smith chart?	Remember	CO 5	AECB13.14
20	Describe the relationship between the short circuited impedance, open circuited impedance and characteristic impedance?	Understand	CO 5	AECB13.14
Part - B (Long Answer Questions)				
1	Explain the principle of impedance matching with quarter wave transformer?	Remember	CO 5	AECB13.12
2	Explain the significance and utility of λ/8,λ/4 and λ/2 line?	Remember	CO 5	AECB13.12
3	Explain the significance and design of single stub impedance matching. Discuss the factors on which length depends?	Understand	CO 5	AECB13.12
4	Describe the construction of smith chart and give its applications?	Remember	CO 5	AECB13.13
5	Explain with neat sketches how the input impedance of a lossless line varies with frequency?	Remember	CO 5	AECB13.14
6	Derive the relation between reflection coefficient and standing wave ratio?	Understand	CO 5	AECB13.13
7	Derive the expression for the input impedance of an uniform transmission line terminated with load Z_L. Hence discuss the properties of a quarter wave length and half wave length lines assuming the line to be loss less?	Understand	CO 5	AECB13.13
8	Explain the significance of Vmax and Vmin positions along the transmission line, for a complex load Z_R. Hence obtain expression for impedances at these positions?	Remember	CO 5	AECB13.13
9	Explain the method of determining the input impedance of line using smith chart for a lossless of length L at any frequency f for a complex load of Z_R.	Understand	CO 5	AECB13.14
10	Derive expression for the input impedance of a lossless line. Hence evaluate Z_{OC} and Z_{SC}, also sketch their variation with line length?	Remember	CO 5	AECB13.14
11	Explain the significance and design of double stub impedance matching. Discuss the factors on which length depends?	Understand	CO 5	AECB13.12
12	Derive the expression $z_0 = \sqrt{Z_{oc}Z_{sc}}$.	Remember	CO 5	AECB13.12
13	Explain how an open circuit line acts as a circuit element?	Understand	CO 5	AECB13.12
14	Explain how a short circuit line acts as a circuit element?	Remember	CO 5	AECB13.13
15	Explain the construction of smith chart?	Understand	CO 5	AECB13.14
16	Write short notes on the following. a) Reflection coefficient b) VSWR	Understand	CO 5	AECB13.12
17	What are the differences between Single and double stub matching techniques?	Remember	CO 5	AECB13.12

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
18	Write short notes on the following. a)SC and OC lines; b) λ/4, λ/2 and λ/8 lines	Understand	CO 5	AECB13.12
19	Explain the design procedure of double stub impedance matching.	Remember	CO 5	AECB13.13
20	Explain the design procedure of single stub impedance matching.	Understand	CO 5	AECB13.14
	Part - C (Analytical Questions)			
1	Find the characteristic impedance of a line at 1600Hz if the following measurements have made on the line at 1600 Hz, Zoc =750Ω and Zsc= 500Ω.	Remember	CO 5	AECB13.12
2	A transmission line of length 0.4λ has a characteristic impedance of 100 and is terminated by a load impedance of 200+j180 ohm , by using smith chart find i. voltage reflection coefficient ii. VSWR iii. Input impedance of the line	Understand	CO 5	AECB13.12
3	Calculate the characteristic impedance of a quarter wave transformer if a 120 ohm load is to be matched to a 75ohm line?	Understand	CO 5	AECB13.12
4	A transmission line having 50 ohm impedance is terminated in a load of (40+j30) ohm. Describe the the voltage standing wave ratio?	Understand	CO 5	AECB13.13
5	A lossless line having an air dielectric has a characteristic impedance of 400 Ω. The line is operating at 200 MHz and Zin = 200 − j200 Ω. Use the Smith chart , find: (a) S; (b) ZL if the line is 1 m long; (c) the distance from the load to the nearest voltage maximum	Understand	CO 5	AECB13.14
6	A lossless transmission line with Z0=50 Ω is 30 m long and operates at 2MHz. The line is terminated with a load ZL = 60+j40 Ω. If u = 0.6c the line, find a)the reflection coefficient, b) the standing wave ratio c) The input impedance.	Understand	CO 5	AECB13.13
7	Find the sending end impedance of a line with negligible losses when Z0=55 ohms and the load impedance is 115+j75 ohms. Length of the line is 1.183 wavelengths.	Understand	CO 5	AECB13.13
8	A transmission line of characteristic impedance 600 ohms is terminated by a reactance of j150 ohms, find the input impedance of a section 25 cm long at a frequency of 300 MHz , smith chart may be used.	Understand	CO 5	AECB13.13
9	A 100 kms long transmission line is terminated by a resistance of 200 ohms ,it has the following constants: Z0=600 ohms , α =0.01 neper/km, β=0.03 radians/km. Find the reflection coefficient and the input impedance.	Understand	CO 5	AECB13.14
10	A low loss line with Z0=100 ohms is terminates in an impedance ZR= 115-j60 ohm, the wavelength of transmission is 3.5m using the given smith chart, find the VSWR.	Remember	CO 5	AECB13.14

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