BITS PILANI DUBAI CAMPUS
KNOWLEDGE VILLAGE, DUBAI
III Year EEE – II Semester 2004-05
Comprehensive Exam
E M FIELDS AND WAVES

Date: 29/5/05
Max. Marks: 80

Time: 3 Hrs
Weightage: 40%

Answer ALL Questions
All Questions carry equal marks
Attach the Smith chart to the answer book

1. (a) Two identical uniform line charges lie along the x and y axes with charge densities $\rho_L = 20\ \mu C/m$. Obtain D at (3,3,3) m.
   (b) Charge distributed throughout a volume 'v' with density ρ gives rise to an electric field with energy content

$$W_E = \frac{1}{2}\int \rho V\, dv$$

Show that an equivalent expression for the stored energy is

$$W_E = \frac{1}{2}\int \varepsilon\, E^2\, dv$$

(6+10)

2. (a) Find the capacitance of a coaxial capacitor of length L, where the inner conductor has a radius 'a' and the outer radius 'b'.
   (b) The region between two concentric right circular cylinders contains a uniform charge density ρ. Use Poisson's equation to find V. (8+8)

3. (a) A plane wave is incident normally on a boundary between two media. Determine the expression for the transmission coefficient and reflection coefficient.
   (b) A plane wave traveling in the +z direction in free space ($z < 0$) is normally incident at $z = 0$ on a conductor ($z > 0$) for which $\sigma = 61.7$ milli mhos/m, $\mu_r = 1$. The free space E wave has a frequency $f = 1.5$ MHz and an amplitude of 1 V/m. At the interface it is given by

$$E(0,t) = 1.0 \sin 2\pi f t\, a_y\ (V/m)$$

Find H(z,t) for $z > 0$.

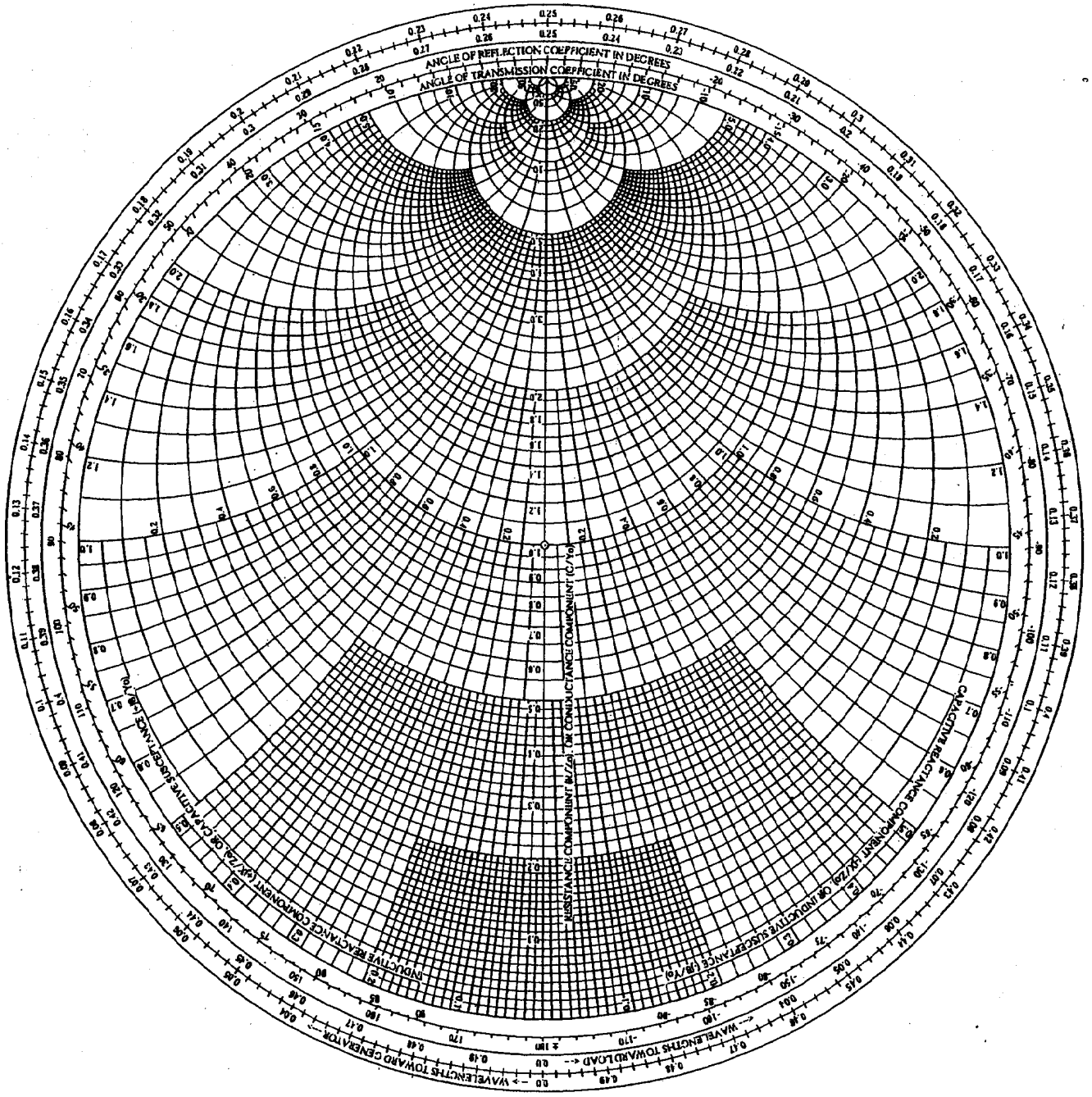
(8+8)

4. (a) A transmission line connects a transmitter of 1.2 MHz to an antenna located 100 m away from it. If Z_o of the line equals 500 Ω, what is the input impedance of this line is (i) open circuited (ii) short circuited.

(b) Find the distance from the load and the length of a shorted stub connected in parallel to a 300 Ω lossless line in order to match a load Zr = (600 + j300)Ω at 600 MHz. (8+8)

5. Write short notes on

(i) Antenna arrays
(ii) Retarded potentials
(iii) Broadband antennas
(iv) Antenna temperature. (4+4+4+4)


ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
RESISTANCE COMPONENT (R/Zo)
CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (jX/Zo)
CAPACITIVE SUSCEPTANCE (-jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo)
INDUCTIVE SUSCEPTANCE (jB/Yo)
WAVELENGTHS TOWARD GENERATOR
WAVELENGTHS TOWARD LOAD

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III Year EEE – II Semester 2004-05
Test 1
E M FIELDS AND WAVES

Date: 20/3/05
Max. Marks: 20

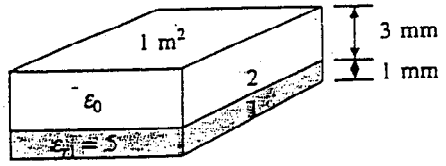
Time: 50mts
Weightage:20%

ANSWER ALL QUESTIONS

1. A circular disc of radius 'a' meters is charged uniformly with a charge density σ C/m^2. Find the electric field intensity at a point 'h' meters from the disc along its axis. (4 Marks)

2. Forty nano Coulombs of charge is uniformly distributed around a circular ring of radius 2 m. Find the potential at a point on the axis 5 m from the plane of the ring. Also find the potential at the center of the ring. (3 Marks)

3. Find the voltage across each dielectric in the capacitor shown in the figure Q3 when the applied voltage is 200 V. (4 Marks)



4 In free space $E(z,t) = 50 \cos(\omega t - \beta z)\, a_x$ V/m. Find the average power crossing a circular area of radius 2.5 m in the plane z. (3 Marks)

5. Give the Integral and differential form of the Maxwell's equations. (3 marks)

6. Find the impedance the ground at 200 MHz with $\varepsilon_r = 14$, $\mu_r = 1$ and $\sigma = 1$ mho/m (3 marks)

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III Year EEE – II Semester 2004-05
Test 2 (Open Book)
E M FIELDS AND WAVES

Date: 01/5/05 Time: 50mts
Max. Marks: 20 Weightage: 20%

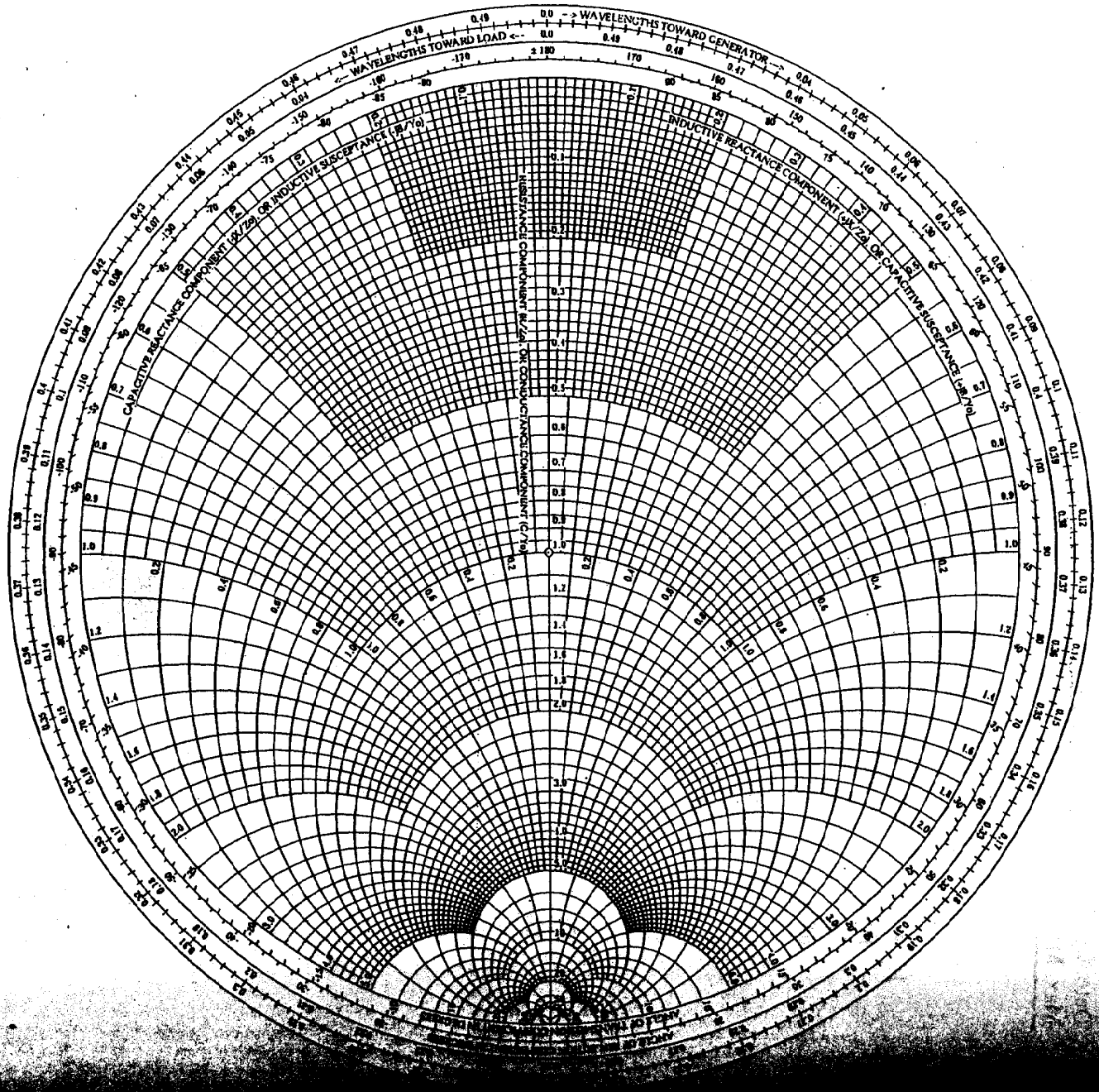
ANSWER ALL QUESTIONS
Attach the Smith Chart to the answer book

1. A low frequency transmission line has the following primary constants per km. R=6 Ω, L=2.2 mH, C=0.005μF, G= 0.05 μ mho. Calculate its secondary constants Z_o, α and β at frequency of 1 kHz. If the line length is 100km, determine the attenuation and phase shift suffered by the signal. (5 marks)

2. A load of (50-j100) Ω is connected across a 50Ω line. Design a short circuited stub in order to provide impedance matching between the two at a signal frequency of 30MHz. (5 marks)

3. Draw the radiation pattern of 2 element broadside array with a separation of λ and phase difference δ=0. (5 marks)

4. Find the current required to radiate a power of 100W at 100MHz from a 0.01 m dipole. Find the magnitude of E and H at 100m, 90^0. (5marks)


WAVELENGTHS TOWARD GENERATOR
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INDUCTIVE REACTANCE COMPONENT (+jX/Z0) OR CAPACITIVE SUSCEPTANCE (-jB/Y0)
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RESISTANCE COMPONENT (R/Z0) OR CONDUCTANCE COMPONENT (G/Y0)