King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE-407; Final Exam.

Prob.1	Prob.2	Prob.3	Prob.4	Prob.5	**Total**

Answer all the four questions. TIME : 2 hour 30 minutes.

Name: ***I.D.*** ***Sec.***

Q.1(a) If a 10 GHz wave is propagating through a material with $\mu_r = 11$ and $\sigma = 5.11 \times 10^7$ Mhos/m, find the related

(i) Skin depth
(ii) Surface resistance (assume the material is of square shape).

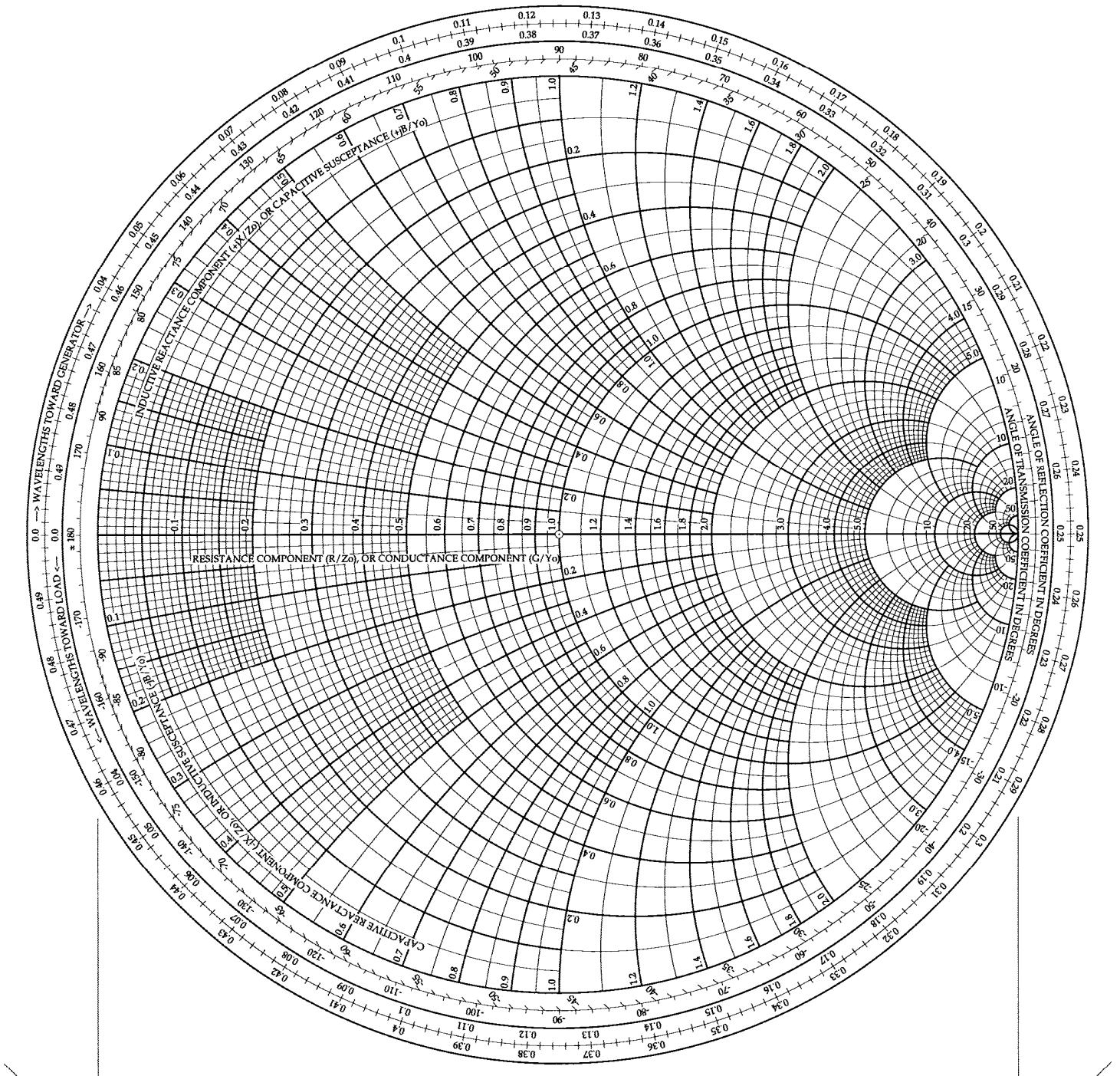
GIVEN: $\mu_0 = 1.2566 \times 10^{-6}$; $\varepsilon_0 = 8.84194 \times 10^{-12}$

Q.1(b) The characteristic impedance of a transmission line is $Z_0 = 100\ \Omega$. If it is terminated in a load of $Z_L = 100 + j100\ \Omega$ and the propagation constant of the line is 0.54+j3.53 per meter, calculate (without using the smith chart);

(i) The transmission coefficient on the line
(ii) The reflection coefficient at a point 2 meter away from the load.

Q.2 (a) In the figure, all the transmission lines are loss-free and with $\lambda \neq \lambda_0$. If the impedance at junction **AA′** is 75 Ω, find the propagation constant (γ).

Q.2 (b) A load impedance of Z_L=70Ω has to be matched to a 50 Ω line using a parallelly connected shorted-circuited single–stub matching, as illustrated in figure. Use smith-chart to determine the shortest required **length** l_1 and l_2 in fractions (terms) of wavelengths.



RADIALLY SCALED PARAMETERS

TOWARD LOAD —> <— TOWARD GENERATOR

SWR

RTN. LOSS (dB)

RFL. COEFF. P

RFL. COEFF. E or I

ATTEN. (dB)

S.W. LOSS COEFF

REFL. LOSS (dB)

S.W. PEAK (CONST. F)

TRANSM. COEFF. P

TRANSM. COEFF. E or I

CENTER

ORIGIN

Q.3 (a) A microstrip quarter-wavelength-transformer is to match a transistor input with a 50 Ω microstrip feed line. If the transformer has w =0.762 mm, h= 0.635 mm, t=0.035mm and ε_r=10. If the circuit is operating at a frequency of **3 GHz**, calculate the

(i) Effective dielectric-constant of the transformer.

(ii) The impedance of the transformer.

Q.3(b) The scattering parameter for transistor is given by: $S_{11}=0.65\angle -140°$; $S_{21}=2.4\angle 50°$; $S_{12}=0.04\angle 60°$; $S_{22}=0.70\angle -65°$. The transistor is used in a common-source amplifier at f=4 GHz. The signal source can be represented by a 10μV EMF in series with a 50Ω resistance, and the load is 50 Ω. Find

(i) Determine the stability of the device
(ii) Calculate the total gain
(iii) Show how to apply DC biasing of an Microwave transistor

Q.4(a) Briefly describe the difference between Ohmic contact and Shottky contact.

Q.4(b) Using microstrip stepped impedance technology, design a maximally flat low pass filter (that begins with shunt element) with passband of 0 to 3 GHz and an attenuation of 20dB at 5 GHz. Assume Z_0=50 Ω and for the microstrip Z_l=15 Ω, Z_h=150 Ω, ε_r=4.2, h=0.79 mm, t=0 to find

(i) Scaled values of the reactive elements and **draw** the circuit.

(ii) The electrical length of the 1st **two elements** of the filter.