Dept. of Electrical Eng.	**All Programs**
Faculty of Engineering	**Course: Electromagnetic Fields (2B)**
Assiut University	**2nd year – bylaw: 2004**
2nd Semester - 2014/2015	**Time: 3 Hours**
Final Exam– May, 2015	**Marks: 50**

Important remarks
- This exam measures ILOs no.: a2.1 & b6.3 & c4.1 & c4.2
- No. of pages: 4, No. of questions: 4
- Solve each question in the space that is provided for it.
- Smith chart is included. It should be returned with the exam.

$\varepsilon_o = 10^{-9}/36\pi$ and $\mu_o = 4\pi \times 10^{-7}$, $\sigma_{copper} = 5.7 \times 10^{7}$

Answer all the following questions:

Question # 1 (8 points, 3 points for (a), and 5 points for (b)):

(a) What is the frequency band, you think, that is suitable to practically use the regular waveguides? Why?

(b) Sketch the k-ω diagrams of a parallel-plate waveguide separated by a dielectric slab of thickness b and constitutive parameters μ, ε for TM_1, TM_2, and TM_3 modes. Discuss
(i) how b and constitutive parameters affect the diagrams,
(ii) whether the same curves apply to TE modes.

Question # 2 (15 points, 5 points for (a), and 10 points for (b)):

(a)A standard air-filled S-band rectangular waveguide has dimensions a=7.21 cm, and b=3.4 cm. What mode types can be used to transmit electromagnetic waves having the following wavelengths?

(i) λ= 10 cm

(ii) λ= 5 cm.

(b)A TE_{10} wave at 10 GHz is the only mode propagating in a brass ($\sigma_b=1.57\times10^7$S/m) rectangular waveguide with length a=1.5cm. The guide is filled with nonmagnetic polyethylene of ε_r=2.25. Determine,

(i)the guiding phase constant,

(ii)the guide wavelength,

(iii)the guide phase velocity,

(v)the wave impedance of the guided mode,

(vi)the group velocity of the guided mode.

Question # 3 (14 points, 6 points for (a), and 8 points for (b)):

(a) For a dielectric-filled rectangular copper cavity resonator the ε_r=2.4 and its dimension is a=b=3.6 cm. The cavity supports only the dominant mode at frequency of 5 GHz.

(i) What is the length *l* of the cavity.

(ii) What is the quality factor of the cavity.

(b) A 6 GHz signal is to be transmitted inside a hollow circular waveguide. Determine the diameter of the waveguide such that its lowest cutoff frequency is 10% below this operating frequency. Is there any other mode can be transmitted in this waveguide?

Note that the roots of Bessel function are:

n=0	n=1
2.405	3.832
5.52	7.016

and for the derivative Bessel function the roots are:

n=0	n=1
3.832	1.841
7.016	5.331

Question # 4 (13 points, 3 points for (a)m and 10 points for (b)):

(a)It is found that the attenuation on a 150 Ω distortionless two wire transmission line is 0.01dB/m. The line has an inductance of 0.2 μH/m.

(i)Find the resistance, capacitance, and conductance per meter of the line.

(ii)Determine the percentage to which the amplitude of a voltage travelling wave on this line decreases in 1 km distance from the transmitting end.

(b)A 100 Ω lossless T.L. The reflection coefficient at the load is $0.6\angle 60^{0}$ and the first voltage maximum is found at 4 m from the load. Calculate using smith chart:

(i)The load impedance.

(ii)The reflection coefficient at a distance 10 m from the load.

(iii)The voltage standing wave ratio, S, on the line.

(iv)The input impedance at a distance 0.5 km from the load.

(v)The shortest distance from the load to put a matching short circuited stub.

(vi)The length of the stub.

=====End of the questions=====Good Luck=======Prof. Elsayed Esam M. Khaled=====