KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELLOR OF SCIENCE (TELECOMMUNICATION AND INFORMATION TECHNOLOGY)

SPH 405: COMMUNICATION SYSTEM

DATE: Thursday 24th November 2011 **TIME: 2.00p.m – 4.00p.m**

INSTRUCTIONS

Attempt Question ONE and any other TWO questions

Question ONE carries 30 marks ;each of the questions carry 20 marks

Apply the following constants ,whenver required:

K=1.38X10^{-23} J/K –Boltzmann's constant

h=.6.62X10^{-34}J-S Planck's constant

e=.1.6X10^{-19}C –electric charge

Q1. (a) State Five primary benefits and Five secondary benefits of optical fibre Cables

(3 marks)

(b) An optic fibre is made of glass with refractive index of the core equal to 1.48 and that of the cladding 1.46 lauded in the air.Determine:

I. The numerical aperture of the fibre
II. The acceptance angle

(3 marks)

(c) Write a general expression for basic power budget in the design of an Optical link ;hence state three parameters which determine the design link

(3 marks)

(d) Define the following terms with respect to fibre optical cables:

I. Intermodal dispersion
II. Null wavelength
III. Normalized frequency or V-number

 (3 marks)

(e) Calculate the duty cycle for a pulse repetition time of 1250μs and a pulsewidth of 8μs . (3 marks)

(f) Describe and derive how you would evaluate the time period of a circular satellite orbit (3 marks)

(g) Define multiple access , hence explain briefly any three multiple access techniques used used in satellite communication (3 marks)

(h) With the aid of a basic block diagram ,describe fibre optical communication systems (6 marks)

(i) Calculate the responsivity if the efficiency is 0.015 and the wavelength of 0.85mm at which the fibre is operating (3 marks)

Q2 a) Derive an equation to show that the maximum entropy is

$$H_{max} = \sum_{K=1}^{M} P_k \log 1/P_k$$

Where P_k is any probability of messages (8 marks)

b) A multimode step –index optic fibre has $\eta 1 = 1.72$ for the core and $\eta 2 = 1.6$ for the cladding. Calculate :

I. The critical angle

II. The numerical aperture

III. The acceptance angle

(6 marks)

(c) Outline the principles of operation of the following modes of fibre waveguides :

I. Graded index multimode fibre

II. Stepped index monomode fibre

(6 marks)

Q3. (a) Explain briefly two types of sources for optical transmitters (4 marks)

(b) A communication satellite system carries 120 channels of telephony in a baseband extending from 0.01 to 0.5MHz .The baseband frequency modulates a carrier with a total mean square frequency deviation of 2.56 MHz . Calculate the RF spectrum. (8 marks)

c) Derive to show that in the beacon range the expression for the maximum range of interrogation link is:

$$r_{max} = \left[A_{PI}\, P_{IT} A_{OB} / \, 4\pi P_{rmin}\, B\right]^{1/4}$$

Where :

A_{PI} = Transmitting antenna aperture

P_{IT} = power transmitted

A_{OB}= the capture area of antenna

(8 marks)

Q4. (a) Derive an expression for the minimum free space radar range

(8 marks)

(b) Distinguish between peak power (P_{max}) and the average power (P_{av}) for a radar (4 marks)

(c) Using a suitable block diagram ,explain the principle of plan position indicator (PPI) used in the air –control and marine radars (8 marks)

Q5. (a) Explain and deduce that

$$C/No = EIRPXG_r / kT_sL_sL_mM$$

Where T_s = Systems noise temperature

L_s = free space loss

L_m = miscellaneous losses

M = Margin for multiple access (8 marks)

(b) calculate (C/No) at the earth receiving station from a satellite transmitting an EIRP of 49.5dBW on a frequency of 12GHz . The earth station antenna has an angle of elevation of 70 and the receiving figure of merit of 40.7dB. (7 marks)

(c) Outline the azimuth and elevation angles in locating the position of a Satellite (5 marks)