UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	OPTIC COMMUNICATION
COURSE CODE	:	DAE 38303
PROGRAMME	:	3 DAL
EXAMINATION DATE	:	OCTOBER 2012
DURATION	:	2 ½ HOURS
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

Q1 (a) Explain how a prism is capable of separating white light into a component colour.

(5 marks)

(b) As a consultant engineer of company ABC, your customer needs to build up a new data link system at their new building. The customer required you to point out what fiber optic system is with the aid of a diagram. From your experience suggest to customer,

(i) What type of cable is suitable for their new building?

(2 marks)

(ii) Explain **two** (2) the characteristic of the cable list at Q1(b)(i).

(4 marks)

(iii) List four (4) advantages of the suggested cable at Q1(b)(i).

(4 marks)

(iv) Draw the diagram of basic communication system for the link as suggested at Q1 (b).

(6 marks)

(c) From your knowledge of the electromagnetic wavelength spectrum chart, define wavelength for,

(i) Infra red

(2 marks)

(ii) Optical spectrum

(2 marks)

Q2 (a) Light traveling in air strikes a glass plate at an angle $\theta 1 = 33°$, where θ_1 is measured between the incoming ray and the glass surface. Upon striking the glass, part of beam is reflected and part is refracted. If the refracted and reflected beams make an angle of 90° with each other, compute,

(i) the refractive index of the glass

(5 marks)

(ii) the critical angle of the glass

(4 marks)

(iii) the critical angle of glass if $n_{air} = 1.2$ and $n_0 = 1.1$

(3 marks)

(b) The step index fiber having $n_1 = 1.48$ and $n_2 = 1.46$,

(i) Calculate the numerical aperture of the cable.

(4 marks)

(ii) compute the maximum entrance angle $\theta_{0,max}$ for this cable if the outer medium is air with n=1.00

(4 marks)

(c) A step index fiber has $n_{core} = 1.45$ and $n_{cladding} = 1.44$ with diameter 50 μm, if the wavelength of the cable is 6.55×10^{-7}, estimate the number of propagating modes for the fiber.

(5 marks)

Q3 (a) LED and laser diodes are widely used in semiconductor base for optical source in fiber communication system, explain why only lasers are attractive for use in fiber optics.

(4 marks)

(b) (i) Illustrate two types of LED configuration.

(4 marks)

(ii) Explain the operation and characteristic for each of the LED.

(4 marks)

(c) Laser diodes are complex semiconductors where signals are converted from electrical to light. The main operation for laser diode is population inversion , explain,

(i) what is population inversion

(4 marks)

(ii) sketch the graph operation of equilibrium Boltzmann distribution

(4 marks)

(d) A light emitting diode radiates 2 mW.

(i) Calculate the dBm value of this radiates power.

(2 marks)

(ii) This power travels through a group of components having a combined loss of 23 dB. Compute the output power.

(3 marks)

Q4 (a) Consider an avalanche photodiode operating with gain of 50 and the dark current is an unamplified of 15 nA. The responsivity of the device is also unamplified at 0.8 A/W. The surface dark current is 2 nA. The excess noise factor for the device is $M^{0.4}$ and it is operating into a 50Ω load at a noise temperature of 350K. The noise bandwidth is 13 MHz. Calculate the SNR (in dB) of this detector when irradiated with 8 nW of light.

(12 marks)

(b) A photomultiplier (PMT) has produce current, I = 6.4 nA and responsivity at unity multiplication gain 1.95×10^6 is used to detect an optical power of 2 μW at 0.9μm. The load is 50Ω. The excellent is 1% efficient. Calculate

(i) resposivity (R)

(3 marks)

(ii) photocurrent (I_p)

(3 marks)

(iii) output voltage (V_0)

(3 marks)

(c) Outline two major causes of signal degradation occurring during reception.

(4 marks)

Q5 (a) In optical fiber communication passive components are the main elements for its basic operation. Explain the operation for four major passive components.

(6 marks)

(b) A product sheet for a 2 x 2 single mode biconical tapered coupler with a 40/60 splitting ratio states that the insertion losses are 2.7 dB for the 60 percent channel and 4.7 dB for the 40 percent channel

(i) if the input power P0 = 200 μW, compute the output level P1 and P2

(6 marks)

(ii) compute the excess loss of the coupler

(3 marks)

(iii) from the calculated values of P1 and P2, verify that the coupling/ splitting ratio is 40/60

(6 marks)

(c) Describe Erbium Doped (EDFA) pump lasers and list the types of EDFA.

(4 marks)

Q6 (a) An engineer has the following components available

(i) A laser diode operating at 850 nm and capable of coupling 1 mW (0 dBm) into a fiber

(ii) Ten sections of cable where each section is 500 m long, has a 4 dB/km attenuation, and has connectors on both ends, with loss of 2 dB/connector

(iii) A pin photodiode receiver

(iv) An avalanche photodiode receiver

Using these components, the engineer wishes to construct a 5 km link operating at 20 Mb/s. If the sensitivities of the pin and APD receivers are -45 and -56 dBm, respectively.
Determine which receiver should be used if a 6 dB system operating margin is required.

(10 marks)

(b) (i) Describe briefly what is fusion splicing?

(2 marks)

(ii) Brief related step by step how to splices two glass fiber without any misalignments.

(7 marks)

(c) Connectors are important items in photonic system

(i) List **two** (2) types of the connectors

(2 marks)

(ii) Explain the connectors list at Q6 (c)(i) including its features and applications.

(4 marks)