السبت ٩ / ١ / ٢٠١٦

٣ اتصالات — اتصالات رقمية

بسم الله الرحمن الرحيم

كلية الهندسة بحلوان	Dept/Division : **Communications, Electronics & Computer Eng. /** Academic level: **Third Year** ***Communications*** Semester: **First** **2015/16** Course code & title: **(ELC 8322)** **Digital Communications** Instructors: **Prof. Ibrahim Ismail, Prof. Gamal Abdel Fadeel** Total mark: **120 mark** Time allowed: **3 hrs**	جامعة حلوان

Instructions: **The EXAM consists of TWO PARTS: PART: I = 60 Mark**

Question 1*....................................** ***(12 mark)

a) A PCM system using piece-wise linear quantizer consisting of 16-segments, 128 quantization level per segment. Calculate output bit rat.

b) Software Defined Radio (SDR) based systems can DEMODULAT different types of modulation schemes. Show how this is possible in S/W.

c) Sketch details of the Pair Gain System.

Question 2*....................................** ***(16 mark)

a) VOCODERS are based on physical structure of human speaking system. Using a block diagram, show that this is true.

b) Show how the SDR concept is used in the digital implementation of OFDM Tx/Rx.

Question 3*....................................** ***(20 mark)

a) Sketch SDH –frames at different parts of Optical Networks.

b) Calculate the bit rate of, i) STM-4 ii) OC-12

c) Sketch details of a compatible Digital Audio Broadcasting (DAB) receiver, and sketch its compatible broadcasting spectrum.

Question 4*....................................** ***(12 mark)

An audio signal with bandwidth of 4 KHz is applied at the input of a delta modulator (DM). ***a)*** **Find expression for the signal-to-quantization ratio (S/D) in dB.** ***b)*** **Calculate the improvement in S/D in dB, if a LPF is connected at the output of the DM.** ***c)*** **The Basic idea of the standard MPEG (audio compression) system is based on Psycho Acoustical perception of Human Auditory System. Using a block diagram, show how this is true.**

و دائما ... إليكم جميعا ... نهدى ... أجمل الأماني.

من فضلك اقلب الورقه (الجزء الثانى)

Part II...............(60 Points)...............................Prof. Ibrahim Ismail

ملحوظة هامة: يجب إجابـة الأسئلة بالترتيب

Answer the following questions:

Q 1: (21 Points)

Check the correct statement and correct the incorrect statement:

1. The spectral shape of the data must be matched with the characteristic of the channel.
2. There is no discrete spectrum component at the clock frequency for polar RZ and Manchester codes.
3. No self sync in large streams of 1's and 0's by using HDBN code.
4. The idea of spread spectrum is to spread the information signal over a narrow band to make jamming and interception more difficult.
5. To increase the required bandwidth and bit rate we must increase the number of levels by using M-ary signaling.
6. Matched filter is used to minimize the effects of ISI and AWGN.
7. Bits/Baud is equal to 8 if 256 QAM is used

Q 2: (18 Points)

a) Sketch and explain the following in some detail,
   i) Frequency and time responses of raised-cosine filter if $\alpha = 1$ and 2.
   ii) Adaptive tapped-delayed line equaling.
   iii) Minimizing the interference by using direct sequence-spread spectrum.

Q 3: (21 Points)

A PSK signal consists of bursts of frequency 10MHz. The binary data of 20kbps is transmitted and is corrupted by additive Gaussian noise of power spectrum density of $10X10^{-12}$ watts/Hz. The S/N power ratio at the output of the channel is 20 dB.

i) Determine the required transmission bandwidth.
ii) Design an optimum receiver suitable for the signal using Matched filter.
iii) Find the signal power at the receiver input in mW.
iv) Calculate the bit error rate probability of received bit error for the coherent PSK receiver.

x	Erfc(x)	x	Erfc(x)
3.1	10^{-3}	4.50	$2.33x10^{-4}$
3.7	10^{-4}	4.78	10^{-6}
3.9	$5 x10^{-5}$	339.04	10^{-9}

تصميم ومحاكاة الدوائر بالحاسب - ٣ اتصالات
١٢/١/٢٠١٦

كلية الهندسة بحلوان	**Dept/Division : Electronics , Communications and Computers** **Academic level:** Third **Semester:** First 2015/16 **Course code & title:** Elec 8313 - Computer aided design **Instructor: Dr. M. Elbably** **Total mark:** 90 mark **Time allowed:** 3 hrs	جامعة حلوان

Q 1 **(Mark 25)**

a-i) Explain the main items in entity block in VHDL

ii- Write the VHDL code for the full adder by data flow

b-i) Deduce the required VHDL codes to implement the following function (three outputs with four inputs) by case statement:

$F_1\ (x_4, x_3, x_2, x_1) = \Sigma m(0,1,2,4,5,7,9,10)$

$F_2\ (x_4, x_3, x_2, x_1) = \Sigma m(3,5,7,9,10,12,15)$

$F_3\ (x_4, x_3, x_2, x_1) = \Sigma m(0,1,4,8,11,14)$

ii- Random counter to count $(11, 3, 0, 5, 7, 4, 1, 9, 15, 11)_{10}$ with synchronous reset.

Q 2 **(Mark 30)**

Design and implement by VHDL code the following:

i- Comparator (by XOR) between A and B five bits each by data flow approach.

ii- Generic n (where n=64) bits shift register serial inputs –parallel output (SIPO) with synchronous reset.

i- Multiplexer 8-1.

Q 3 **(Mark 35)**

Design an ASM chart and write the VHDL (by behavior approach) for the automatic car washing machine to achieve the following sequences:

a- When the car stand at the right position and activate the bottom water valves for time T1

b- Move the stand to car back and activate the vertical brushes

c- Move the stand into car's front direction, when the vertical brushes reach to the back doors activate the horizontal brush

P.T.O

d- When the wheel brushes reach to back wheels stop the stand and activate the wheel brushes for time T2

e- Move the stand till the wheel brushes reach to front wheels stop the stand and activate the wheel brushes for time T3

f- Move the stand to the car front

g- Move the whole stand into car's back direction (note that the vertical and horizontal brushes "on" all the time from the procedure "c")

h- When the stand reach to the car's back stop the vertical and horizontal brushes and activate the air taps (parallel to the horizontal brush) to dry the car body

i- Move the stand while the air taps on into car's front

j- When the stand reach to the car's front, the car will be evacuated and the washing machine will be ready for automatic mode for another car or stop the washing machine.

<u>With my best wishes</u>

كلية الهندسة بحلوان

Dept/Division : Electronics, Communications and Computers
Academic level: Third **Semester:** First 2015/2016
Course code & title: Wave Propagations
Instructor: Instructor: Dr. Sabry M. Ibrahim & Dr. Ayman R. Mahmoud
Total mark: 100 mark **Time allowed:** 3 hrs

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Instructions: Smith Chart included should be attached in your Answer paper.

Answer the following questions

Question (1) **(Mark 15)**

(a) Use Maxwell's equations to **derive** the expression for E_x and H_y For a plane wave propagating in the z-direction in **a lossy dielectric medium.**

(b) A plane wave in free space ($z \le 0$) is incident normally on a large block of material with $\varepsilon_r = 12$, $\mu_r = 3$, $\sigma = 0$ which occupies $z \ge 0$. If the incident electric field is

$$\bar{E} = 30\cos(\omega t - z)\bar{a}_y \quad V/m$$

Find:

(i) ω
(ii) The standing wave ratio.
(iii) The reflected magnetic field.
(iv) The average power density of the transmitted wave.

Question (2) **(Mark 17)**

(a) A uniform plane wave propagating along the z-direction is incident normally on the boundary z = 0. **Derive** the Standing Wave ratio (SWR) and the positions at which the minimum (z_{min}) and maximum (z_{max}) of Electric field occur if $\varepsilon_1 > \varepsilon_2$ for lossless dielectric medium.

(b) Given region 1, $z < 0$, $\varepsilon 1 = 20$ pF/m, and $\mu 1 = 2$ μH/m; region 2, $0 < z < 8$ cm, $\varepsilon 2 = 50$ pF/m, and $\mu 2 = 2.5$ μH/m; and region 3, $z > 8$ cm, $\varepsilon 3 = 20$ pF/m, and $\mu 3 = 2$ μH/m; let $\sigma = 0$ everywhere.

(i) What is the lowest frequency at which a uniform plane wave incident from region 1 on the boundary at z = 0 will have no reflection?
(ii) If f = 200 MHz, what will SWR be in region 1?

Question (3) **(Mark 18)**

A parallel polarized uniform plane wave is incident on the interface between two lossless dielectric regions at an oblique angle $\theta_i = 28°$. If $\mu_{r1} = 1$, $\varepsilon_{r1} = 7$, $\mu_{r2} = 1$, $\varepsilon_{r2} = 3.5$, $f = 120$ MHz, and the incident electric field equals:

$$\bar{E}_{is} = 160(\cos\theta_i\,\bar{a}_x - \sin\theta_i\,\bar{a}_z)e^{-j\beta_1(x\sin\theta_i + z\cos\theta_i)} \quad V/m$$

Find:

(i) The reflected angle θ_r, and the transmitted angle θ_t.
(ii) The reflected and transmitted electric field.
(iii) The reflected and transmitted magnetic field.
(iv) The Brewster angle.

Hint: $\varepsilon_o = 8.854 \times 10^{-12}$ F/m $\mu_o = 4\pi \times 10^{-7}$ H/m

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Question no. 4 (15 Marks)

A lossless transmission line has :
$Z_0 = 70\ \Omega$, swr = 2 , and the distance between the load and first voltage maximum is 0.2λ. Use Smith chart to find :

(a) The load impedance Z_L, the reflection coefficient Γ_L

(b) The location (d) of a parallel stub required to match the line. Find also the length (ℓ_s) of the (short circuited) stub required

Question no. 5 (15 Marks)

A lossless transmission line has $Z_0 = 48\ \Omega$, and length $\ell = 0.4\ \lambda$ is terminated by load impedance $Z_L = 60 - j\,80\ \Omega$, $V_L = 80\,\angle 0^0$

(a) Find the reflection coefficient at the load Γ_L, the standing wave ratio (swr)

(b) Find the input impedance Z_{in}, the input voltage V_{in}, and the input current I_{in}

(c) Calculate P_{ave} for the incidence and the reflected voltage waves

Question no. 6 (20 Marks)

(a) Use Maxwell's equations to derive the expression for E_x and E_y in terms of E_z and H_z in rectangular waveguide

(b) An air-filled rectangular waveguide with a = 6 cm, b = 3 cm is operating at TE_{11} - mode

(i) If f = 8 GHZ, find U_p, U_g, and β

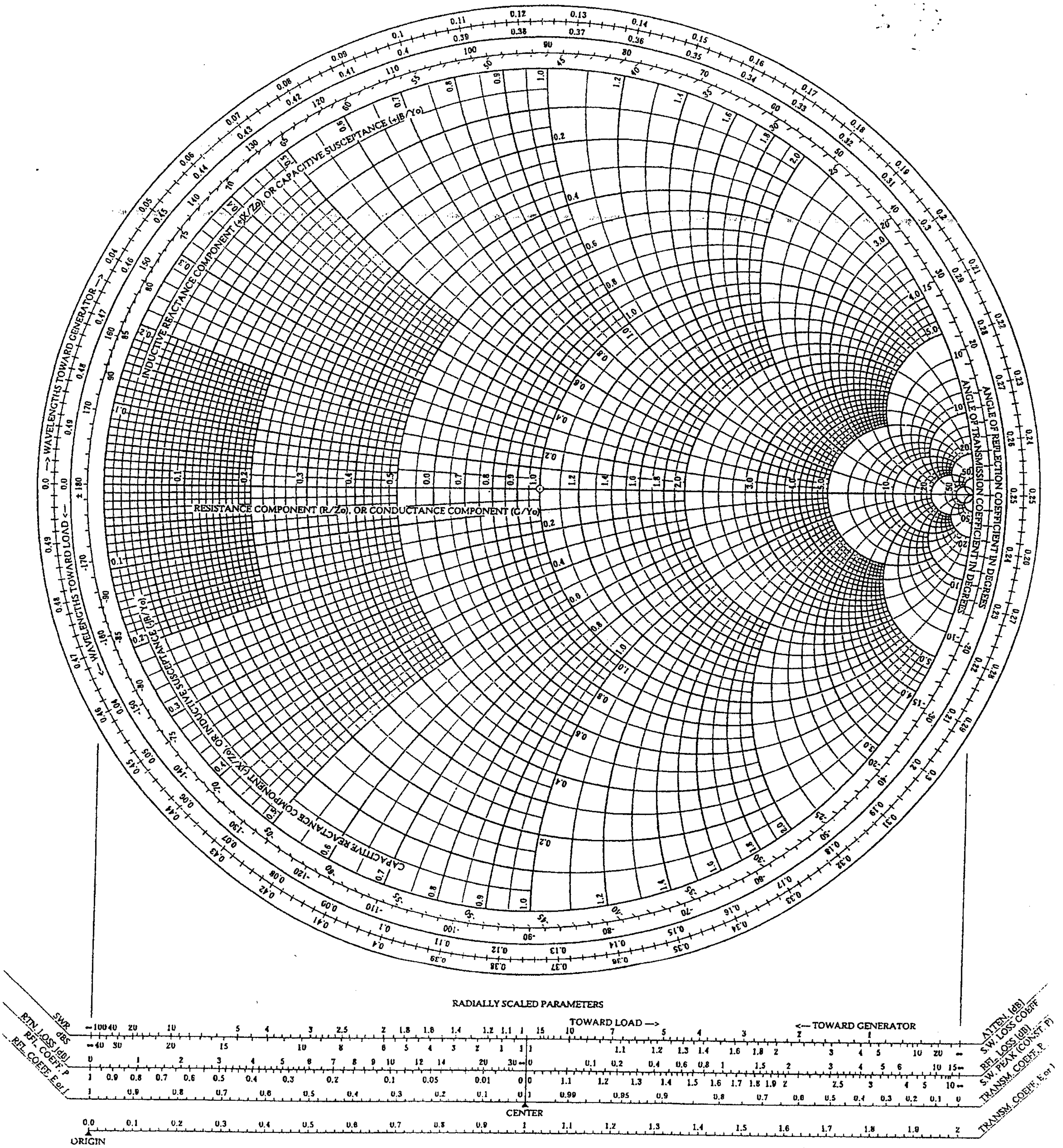
(ii) If $U_p = 4.5 \times 10^8$ m / sec, Find f , U_g , and β

(c) A rectangular cavity resonator with a = 3 cm , b = 2 cm , c = 4 cm List 5 modes which have the lowest resonant frequencies

Let $\mu_0 = 4\pi \times 10^{-7}$, $\varepsilon_0 = (1/36\pi) \times 10^{-9}$

The Complete Smith Chart

Black Magic Design



٣ اتصالات مقرر اختياري ٧) ١ اتصالات ضوئية ٢ / ١ / ٢٠١٦

كلية الهندسة بحلوان	**Dept/Division :** Elect., Comm., and Comp. Engineering **Academic level:** Third **Semester:** First 2015/2016 **Course code & title:** :ELC8327-Optical Communications **Instructor:** Dr. Salwa El-Sabban, Dr. Hesham Mahmoud Zarif **Total mark:** 100 marks **Time allowed:** 3 hrs

Answer the following questions

Part I

Q1) a) Answer the following questions as **True** or **False**. For the **False** ones give the correct answer or the reason. **(9 marks)**

1) Dispersion in a fiber increases with distance and wavelength.
2) The bandwidth of a single mode fiber is larger than step index fiber.
3) Material dispersion is due to existence of many modes in the fiber.
4) Insertion loss in an optical switch is more important than the reproducibility.
5) Tee network is recommended for large number of terminals.
6) Monochromatic optical source contains many wavelengths.

b) In an experiment designed to measure the attenuation coefficient α of an optical fiber, the output power from an optical source is coupled onto a length of the fiber and measured at the other end. If a 5 km long spool of fiber is used, the received optical power is -15 dBm. Under identical conditions but with a 10 km-long spool of fiber, the received optical power is -20 dBm. What is the value of α (in dB/km)? If a 15 km of the above fiber is used in a system that has Lambertian source with active diameter of 50μm which emits 2mW optical power into air. The fiber has core diameter of 20 μm and N.A. of 0.15. The receiver has a sensitivity of -25 dBm. Find the loss margin. Comment on your result. **(10 marks)**

Q2) a) A 32x32 port multimode fiber star coupler has 1mW of optical power launched into a single input port. The average measured optical power at each output port is 14 μW. Each connector has 1 dB loss. Obtain the total loss through the star coupler and the average insertion loss through the device. **(8 marks)**

b) A photodetector has responsivity 0.7 A/W and 1nA of average photocurrent. The receiver's bandwidth is 6MHz, T=300 K., and the load resistance is 50 Ω. Use Electron charge $e = 1.6 \times 10^{-19}$ C, Boltzman's constant $k=1.38\times10^{-23}$J/K. **(10 marks)**

(1) Compute the shot-noise current and the thermal-noise current.
(2) Compute the signal voltage, shot-noise voltage, and the thermal-noise voltage across the resistor.
(3) Compute the SNR and the NEP.

Q3) Design an optical communication system using a **TDM** technique satisfying the following requirements:

a) Four digital channels, each operating at 14000-8 bit words per second.
b) Three digital channels, each operating at 12000-8 bit words per second.
c) Three digital channels, each operating at 10000-8 bit words per second.
d) Total distance between transmitter and receiver is 100 km.
e) The fiber available exhibits a rise time due to intermodal dispersion of 18 ns/km, and a rise time due to intramodal dispersion of 3ns/km.
f) The detector has a rise time of 15 ns. The source has a rise time of 10 ns.

<u>Calculate the following</u>:

1) The transmitted bit rate for fixed TDM scheme.
2) If you will use NRZ format, is there a need for repeaters? If yes, specify the distance between them?
3) The transmitted bit rate for asynchronous TDM scheme. **(13 Marks)**

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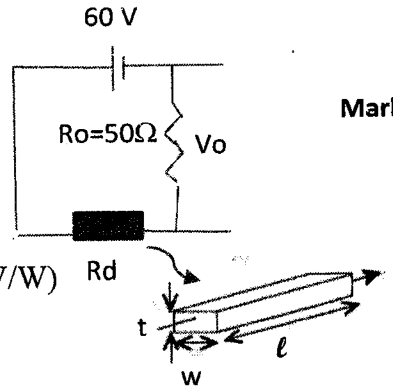
PART II

Q4. Consider the photoconductor circuit shown in figure where the photoconductor is an n-type silicon designed for a 633nm wavelength laser system. The photoconductor has a length ℓ=5 mm, a width w=2mm, and a thickness t=10 μm. The n-type doping concentration is $1x10^{15}$ cm^{-3}. Assume that the photocurrent is carried entirely by electrons.



Mark (20)

a) Calculate the dark current through the detector circuit.

b) Calculate the electron velocity in the photodetector at dark.

c) Calculate the transit time τ_{tr} for an electron across the length of the detector at dark.

d) Assume that the electron recombination time τ_n =4msec, then find the change in current if the electron-hole generation rate due to incident light is 10^{20} e-h pairs/cm^3.s.

e) Find the output voltage responsivity $R_v=\Delta V_o/\Delta P_{op}$ (units:V/W) assuming the quantum efficiency is 0.8.

f) What is the bandwidth of the detector.

Q5. I) Write the rate equations of a 3 level system (E_o, E_1, and E_2) with a pumping rate to E_2 (R_2). Assuming the atom lifetime at E_1 (τ_1) is very small, **use** these rate equations to **find** an expression for the intensity optical gain coefficient per unit length γ. Then **derive** an expression for the optical gain G of a bar of length L where G=I(L)/I(0) and I is the optical intensity.

II) A semiconductor laser diode with an active region of refractive index=3.4 is biased at a DC current of 30 mA to generate a DC optical power of 4 mW at the wavelength of 1320 nm. The relaxation oscillation angular frequency at this operating point is found to be $2.5*10^9$ rad/sec. When the laser is modulated at this point by an AC signal of amplitude 0.1 mA and angular frequency $2.5*10^9$ rad/sec, the output AC power has an amplitude of 0.2 mW, while when reducing the modulation frequency to $2*10^3$ rad/sec, the amplitude of the AC power is reduced to 0.125 mW. Knowing that the AC transfer function of laser diode has the form:

$$H=\frac{s_m}{j_m}=H_o\frac{1}{1+j\alpha\frac{w}{w_r^2}-\frac{w^2}{w_r^2}} \quad \text{where } H_o=\frac{\tau_{ph}}{ed}, \quad w_r^2=\frac{\Gamma' S_o}{\tau_{ph}}, \quad \text{and} \quad \alpha=\frac{1}{\tau_{sp}}+\Gamma' S_o$$

with all parameters defined as usual and neglecting the number of carriers(electrons) at transparency in the laser cavity with respect to their number at threshold, **show** that $\alpha=\frac{1}{\tau_{sp}}.\frac{I}{I_{th}}$ where I is current above threshold. Then **calculate**:

a. The damping factor of the diode at 30 mA.
b. The threshold current of the laser diode.
c. The carrier spontaneous emission lifetime in the laser diode
d. The photon lifetime in the LD
e. The length of the laser diode cavity and the separation between longitudinal modes.
f. The scattering loss inside the cavity.
g. The output power from the laser when the bias current is increased to 35 mA.

Useful information **Mark (30)**

Speed of light c = 3 x 10^8 m/sec Plank's constant h = 6.6256 x 10^{-34} J.sec ε_r (Si)=11.8
Electronic charge e = 1.6 x 10^{-19} C Eg of GaAs=1.42 eV Eg of Si=1.11 eV
Electron mobility in Si (μ_n) = 1200 cm^2 /V.s Free space dielectric constant ε_o=8.85*10^{-14} F/cm