Course Name: Optoelectronics
Course Code: ECE491
Autumn Semester Exam.
BME Program
Level 300
Exam Date: 17 -12-2017
Allowed Time: 2 Hours

Question One (25 mark)

Q.1.a) Drive an expression for the ratio between Einstein's stimulated emission coefficient to spontaneous emission coefficient? And how to make the stimulated emission is dominant? **[5 Marks]**

Q.1.b) A photodiode has a quantum efficiency of 65% when photons of energy $1.5 \times 10{-}19$ J are incident upon it. **[5 Marks]**

(a) At what wavelength is the photodiode operating?

(b) Calculate the incident optical power required to obtain a photocurrent of 2.5 μA when the photodiode is operating as described above.

Q.1.c) Briefly explain the differences between two level, three level and four level system for lasing emission? **[5 Marks]**

Q.1.d) Define longitudinal and transverse modes in LASER device? **[5 Marks]**

Q.1.e) An injection laser has an active cavity with losses of 30 cm^{-1} and the reflectivity of the each cleaved laser facet is 30%. Determine the laser gain coefficient for the cavity when it has a length of 600 μm. **[5 Marks]**

Question Two (25 mark)

Q.2.a) A He-Ne laser, operating at 632.8 nm has an output power of P=1 mW. The power in the cavity is 99P. a- Calculate the ratio between Einstein's stimulated emission coefficient to spontaneous emission coefficient? b- Refractive index of medium c- Determine the cavity gain if losses inside the cavity is 20 cm^{-1} and the frequency separation is 3 GHz. d- What is the effective blackbody temperature of laser beam in cavity if the radiation spectral density is $2.8\times 10^{-12}]. \frac{s}{m^3}$. e- Estimate the ratio between Einstein's stimulated emission coefficient to stimulated absorption coefficient if the degeneracies in lower and upper level are 41 and 43 respectively. **[6 Marks]**