PG/IVS/ELC-403/13

M.Sc. 4th Semester Examination, 2013

ELECTRONICS

(*Quantum Electronics*)

(Theory)

PAPER—ELC - 403

Full Marks : 50

Time : 2 hours

Answer **Q. No. 1** and any **three** from the rest

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. Answer *all* questions : 2 × 5

(*a*) Discuss the physical significance of Fermi Golden Rule.

(*b*) Why the barriers of SL structures are made narrow ?

(*c*) Discuss the necessity of intrinsic region in a *p-i-n* photodiode.

(*d*) How optical confinement could be enhanced in a double heterojunction diode ?

(*e*) What is a direct band gap semiconductor ? In which devices there are generally used ?

2. (*a*) Using time independent perturbation theory derive expression for first order perturbation in wave function.

(*b*) Find an expression for transition probability per unit time using time dependent perturbation theory. 5 + 5

3. (*a*) Mention the conditions for LASER action in a semiconductor.

(*b*) What are Fermi level and Fermi energy ?

(*c*) What are the drawbacks of homojunction semiconductor laser ? Describe the structure where these drawbacks could be removed. 2 + 3 +(2 + 3)

4. Define density of states function. Derive expression for density of states as a function of energy for a bulk device. Show graphically how it differs from that of a QW. Explain the cause of the nature of the graph for a QW. 2 + 4 + 2 + 2

5. (*a*) Discuss the noises present in APDs.

   (*b*) Show that for a photodiode working in photovoltaic mode the output voltage is a logarithmic function of incident irradiance.

   (*c*) How α_e/α_n could be increased in an APD ?

   (*d*) Discuss how solid state photomultiplication could be obtained in a superlattice APD. 2 + 4 + 2 + 2

6. (*a*) What are MQW and SL structures ?

   (*b*) Why MQW structures are important in two dimensional devices ?

   (*c*) The number of QWs in MQW could be increased infinitely for better performance – discuss.

(*d*) With neat diagram describe the construction and action of a quantum box. 2 + 2 + 3 + 3

[*Internal Assessment* : 10 Marks]
