# M.Sc 3rd Semester Examination 2010

## PHYSICS

PAPER—PH-2104

*Full Marks* : 40

*Time* : 2 hours

*The figures in the right-hand margin indicate marks*

(*Applied Electronics* -Spl.)

PAPER—PH-2104

GROUP—A

[*Marks*: 20]

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

**1.** Answer any *five* bits : 2×5

(*a*) How can you construct a band-pass filter from a given low-pass filter and a high-pass filter? What is the necessary condition?

(*b*) Why the gain of a 2nd order Butterworth high-pass filter must be 1·586?

(*c*) What are the characteristics features of a regulated power supply ?

(*d*) Explain the use of a D flip-flop as a phase comparator.

(*e*) Draw the circuit diagram of a triangular wave generator and write down the expression for the frequency of oscillation.

(*f*) Draw the circuit diagram of a logarithmic amplifier and write down the expression for the output voltage in terms of input voltage and circuit parameters.

(*g*) Explain the use of operational amplifiers as analog multiplier.

(*h*) How frequency multiplication can be done using phase Locked Loop ?

2. (*a*) What do you mean by instrumentation amplifier ? Draw the circuit diagram of an instrumentation amplifier using 3 op-amps and derive the expression for the output voltage. 1 + 5

(*b*) What do you mean by a series voltage regulator ? Draw the circuit diagram of a series voltage regulator using op-amp as comparator and a power transistor as a pass element. Derive the expression for the output voltage. 1 + 1 + 2

3. (*a*) Explain the circuit operation of an inverting Schmitt trigger and find out an expression for the hysteresis voltage. 5

(*b*) Draw the circuit diagram of a voltage controlled oscillator and derive the expression for the output frequency. 1 + 4

PAPER—PH-2104

GROUP—B

[*Marks* : 20]

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

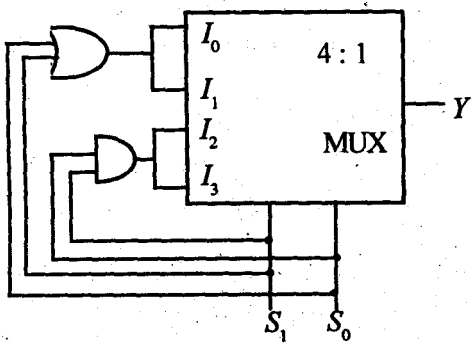
1. Answer any *five* bits : 2 x 5

(*a*) ECL gate is much faster than TTL. Justify.

(*b*) Design a 2-input CMOS NOR gate.

(*c*) Give the basic structure of 4 : 2 Encoder.

(*d*) Write the different outputs for the following multiplexer circuit.




(*e*) What do you mean by magneto-optical memory ?

(*f*) What are the advantages of 'totempole' connection in TTL gate ?

(*g*) What are the special features of EEPROM ?

2. (*a*) Give the basic structure of "two phase ratio-less dynamic shift" register.

(*b*) 'CCD memory is a sequential memory' : Justify this statement.

(*c*) Show how to design a 1 : 10 demultiplexure and state how it works. 4 + 3 + 3

3. (*a*) What do you mean by $I^2L$ gate ?

(*b*) Give the example of wire'd logic by proper circuit diagram.

(*c*) How the fan out is increased in TTL from DTL gate ?

(*d*) How do you convert 'octal number' to binary number ? Give the required block diagram.

2 + 2 + 3 + 3

(*Solid State Phy*- Spl.)

PAPER—PH-2104

[*Marks* : 40]

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

1. Answer any *five* bits : 2 x 5

(*a*) Draw the first three bands in a simple cubic lattice in [110] on the basis of empty lattice approximation.

(*b*) What is the origin of plasmon in a solid.

(*c*) How Fermi surface shape can be determined experimentally in a metal ?

(*d*) Explain why polarization direction changes in a perovskite structure as the temperature is lowered.

(*e*) Explain why lattice defects are inevitable in solids.

(*f*) Explain the mechanism of the formation of *F*-center in a solid.

(*g*) Find the shortest burger vector corresponding to stable dislocation in a B.C.C crystal.

2. (*a*) Derive Thomas Fermi dielectric function assuming an electron gas to an electrostatic field.

(*b*) Explain what is meant by soft optical phonon.

(*c*) Show the variation of W *vs.* K for a polariton. $7 + 1\frac{1}{2} + 1\frac{1}{2}$

3. (*a*) Derive energy of electron in a solid according to TBA. (Tight Binding Approximation)

(*b*) Find the bandwidth in a b.c.c crystal in 110 direction according to TBA. 8 + 2

4. (*a*) Derive the dispersion relation for a tightly bound exciton.

(*b*) Describe in details the mechanism of Thermo-luminescence in a solid. 5 + 5

5. (*a*) Find an expression of conductivity in an ionic crystal.

(*b*) What is screw dislocation ? Find an expression of dislocation energy in this case. 5 + 5

6. (*a*) Find an expression of dipolar polarizability assuming a dielectric in an alternating field.

(*b*) Show that the transition in Rochelle salt follows first order characteristics. 4 + 6

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