7. (a) Describe the essential features in a ferroelectric undergoing second order transition.

   (b) How will you determine experimentally dielectric constant in a solid ? 7+3

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2. (a) Derive the energy of electron in a solid according to Tight Binding Approximation.

(b) Derive a relation to show that effective mass becomes infinite in a narrow band of a solid. $7\frac{1}{2}+2\frac{1}{2}$

3. (a) Derive Thomas Fermi dielectric function considering electrostatic screening in a metal.

(b) What is Mott's Metal to Insulator transition. 8+2

4. (a) Assuming Boltzman Transport equation derive conductivity of a metal interms of relaxation time.

(b) Find an expression of equilibrium concentration of Schotky defect in an ionic crystal. 7+3

5. (a) Explain De Haas Van Alphen effect.

(b) Find the dispersion relation for Tightly Bound Exciton. 5+5

6. (a) Define optical reflectance and reflectivity. How can you determine reflectivity coefficient using Kramers Kronig relation.

(b) What is meant by Edge dislocation ? 7+3

(Solid State Special)

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

1. Answer any *five* questions : 2×5

(a) Draw the first four bands for simple cubic lattice along [110] according to empty lattice approximation.

(b) The density of Schotky defects in a certain sample sodium chloride is 5×10^{11} m^{-3} at 300K. If the interionic seperation is 2.82A°, what is the average energy required to create one Schotpy defect (Assuming change in thermal entropy is small).

(c) Sodium metal with a bcc structure consist of sodium atom of radius 1.85A°. Calculate the electrial resistivity at 0°C if the classical value of the mean free time at this temperature is 3×10^{-14} second.

(d) Explain what is meant by F-center.

(e) Find the electron plasma frequency censidering the motion of positive ions embedded in an electron sea.

(f) Explain what is meant by polarisation catastrophe.

(g) Find an expression of critical shear stress in solid according to Frenkel estimate ?

2. (a) Design a three input MOSFET NOR gate and explain briefly.

(b) Explain the operation as 'current source' and 'current sink' of a TTL NAND gate.

(c) Write a short note of any one from the following :

(i) Inter Network in computer communication ;

(ii) 1G Mobile communication.

3+3+4

3. (a) Give the unit cell structure of SRAM with MOSFET.

(b) What is DRAM ? Design a two phase ratio-loss DRAM circuit.

(c) Write a short note of any *one* from the following :

(i) Change transport in 3-phase CCD.

(ii) Octal to Decimal decoder.

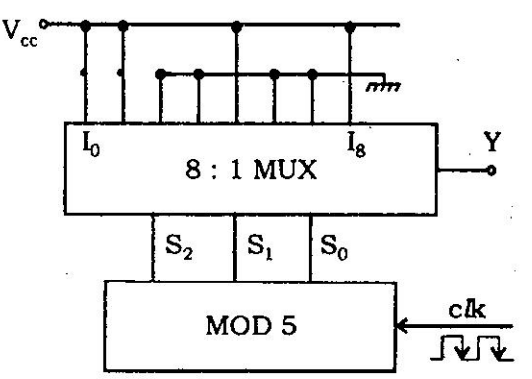
3+4+3

(b) Design a CMOS NOT gate.

(c) What is 'wire'd logic ? Give example.

(d) Design Ex-NOR and Ex-OR memory by FPLA circuit.

(e)



Counter

What will be the output (Y) for eight consequtive clock pulses ?

(f) What is sequential memory ? Give example.

(g) What is the role of mobile telephone switching office (MTSO) in mobile communication ?

(h) What are the basic differences between TTL and ECL logic families ?

(b) Differentiate between series and shunt voltage regulators. Draw the circuit diagram of a series voltage regulator using OP-Amp as comparator, a power transistor as pass element and a low power transistor as current limiting device. Derive the expression for the output regulated voltage. 2+1+2

3. (a) Draw the circuit diagram of a voltage controlled oscillator and find out the expression of its output frequency in terms of the input control voltage. What will be the nature of the output signal of a VCO, if its input control voltage is the modulating information signal. 1+4+1

(b) Explain the operation of a triangular wave generator with proper circuit diagram and find out the expression for the frequency of oscillation of this generator. 4

Group-B

[Marks : 20]

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

1. Answer any *five* questions : 5×2

(a) What is the difference between 'star' and 'tree' topology in computer communication ?

(ii) Draw the circuit diagram of a logarithmic amplifier using OP-Amps and matched pair of transistors.

(iii) Explain how a PLL can be used as programmable frequency synthesizer.

(iv) Suppose you have given a low pass filter (cut-off frequency f_H) and a high pass filter (cut-off frequency f_L). How these can be connected to get a band pass filter with lower cut-off frequency f_L and higher cut-off frequency f_H ? Explain.

(v) What type of digital phase detector should be used, if the input signals are pulse wave forms and explain its operation.

(vi) Show that an analog multiplier can be used as an analog phase detector.

(vii) Differentiate between active and passive filters.

2. (a) What is the need of an instrumentation amplifier ? Draw the circuit diagram of an instrumentation amplifier using 3 OP-Amps and show that it acts as a true differential amplifier by deriving the expression of its output voltage. 1+4

2016

M.Sc.

3rd Semester Examination

PHYSICS

PAPER—PHS-304

Full Marks : 40

Time : 2 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Use separate Answer-scripts for Group-A & Group-B.

(*Applied Electronics Special*)

Group-A

[Marks : 20]

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

1. Answer any *five* questions : 2×5

(i) Design a 2nd order high pass Butterworth active filter with lower cut-off frequency of 10 kHz.