2013

M.Sc. Part-II Examination

PHYSICS

PAPER—XI

Full Marks : 75

Time : 3 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 Gr. A & Gr. B.

[Special Paper]

(Solid State)

Attempt Q. No. *1* and any *five* from the rest.

1. Answer any *five* bits : 3×5

(a) Consider a system of N one dimensional harmonic oscillators of same frequency ν. The vibrational energy of the system for a temperature $T \gg \frac{h\nu}{k}$ is approximately equal to $NkT = nh\nu$, where n is the total number of vibrational quanta associated with N oscillators. Show that thermal entropy of the system

$$S_{th} \simeq Nk\left[1 + \log\frac{kT}{h\nu}\right] \text{ for } h\nu \ll kT .$$

(b) Find an expression of critical shear stress at which lattice becomes unstable assuming relative shear of two planes of atoms.

(c) The energy band relation in a linear chain with interatomic distance 'a' is given by $E(k) = E_0 - T. \cos ka$. When the width of the band is increased by 20%, calculate the effective mass of the electron at band top.

(d) Indicate the important characteristics of Ferroelectric material and also classify them.

(e) What is the physical origin of a magnetic domain?

(f) Find the spectroscopic notation and effective no of Bohr-magneton of M_n^{2+} having $3d^5$ electronic configuration.

(g) Explain the mechanism of the formation of F-cente in a solid.

(h) In DC Josephson effect μv is applied across the junction. How much frequency is generated.

2. (a) Derive an expression of Thomas Fermi dielectric function assuming electrostatic screening in a metal.

(b) Explain Mott's Metal to insulator transition.

9+3

3. (a) Find an expression of Diffusion Coefficient in an ionic crystal.

(b) Thermo luminescence in a solid & hence find an expression of intensity.

7+5

4. (a) Derive an expression of energy of electron in a solid according to Tight Binding Approximation.

(b) Derive the dispersion relation (E – k) for electron in a simple cubic crystal according to T-B-A.

10+2

5. (a) Derive an expression of Lorentz field assuming a dielectric.

(b) Show that the transition from ferro electric to dielectric of Rochelle Salt is second order.

6+6

6. (a) What do you mean by Coherence length in a superconductor? Find an expression of coherence length.

(b) What is meant by Flux Quantization in a Superconducting ring? Derice an expression of fluxoid in this connection.

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7. (a) Describe in details Wein theory of Ferromagnetism.

(b) What is Heisenberg's Exchange interaction energy.

(c) What is a Ferrite? Give two technological application of Ferrite.

6+3+3

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[Special Paper]

(Electronics)

Group—A

[Marks—40]

Attempt Q. No. *1, 2, 3* and any *two* from the rest.

1. Answer any *five* bits : 2×5

   (a) Define capture range and lock-in range of a PLL.

   (b) Explain how a VCO can be used as FM modulator.

   (c) How analog multiplier can be realised using log and antilog amplifiers ?

   (d) Explain how a band pass filter can be realised using a given LPF and a HPF. What is the necessary condition ?

   (e) Draw the circuit diagram of pulse generator.

   (f) How EHT is generated in a TV receiver ?

   (g) Find out the frequencies of picture carrier and sound carrier for the channel 7 in CCIR system-B TV transmission system.

2. Answer any *two* bits : 3×2

   (a) How frequency multiplication can be done using Phase Locked Loop ?

   (b) Draw the circuit diagram of a logarithmic amplifier using a single OP-Amp and a diode and derive the expression for the output voltage.

   (c) Explain how a triac can be used in a light dimmer, drawing the necessary circuit diagram.

3. Answer any one bit : 4×1

   (a) Explain the operation of a chopper stabilised amplifier.

   (b) Design an Yagi-Uda antenna to receive channel 4.

4. (a) Draw and explain the circuit diagram of an antilog amplifier using matched pair of transistors and derive the expression for the output voltage in terms of input voltage. 5

   (b) Explain how a Schmitt trigger circuit can be converted to generate triangular waves with proper circuit diagram. Derive the expression for the output frequency of oscillation and draw the output waveforms. 1+4

5. (a) Draw the circuit diagram of a series voltage regulator using OP-Amp with a current limiter. Explain its operation and derive the expression for the output voltage. 1+2+2

   (b) Draw the circuit diagram of an active All Pass Filter (APF) and derive the expression for its transfer function as a function of frequency. What is its use ? 1+3+1

6. (a) Sketch, level and explain the construction & operation of a B/W TV picture tube. 5

   (b) Discuss about the development of vertical blanking and sync pulses in CCIR- System B TV transmission standard. 5

Group—B

[Marks—35]

Answer Q. No. *1*, *2* and any *two* from the rest.

1. Answer any *three* bits : 3×2

(a) What should be the sampling frequency for a base band signal, where maximum frequency is 20 KHz and which requires 5 KHz guard band ?

(b) What do you mean by data and address multiplexing in 8085 μp ?

(c) What are the differences between SRAM and DRAM ?

(d) In a PCM technique if the system is changed from 3 bit to 6 bit then what will be the change in signal to noise ratio ?

(e) What are the different 'flag' register in 8086 μp ?

2. Answer any *three* bits : 3×3

(a) Write a programme for 8085 μp to exchange the content of two memory locations 3050 and 3051.

(b) Give the idea of any D/A convertor with block diagram.

(c) What do you mean by FSK modulation ? Explain briefly.

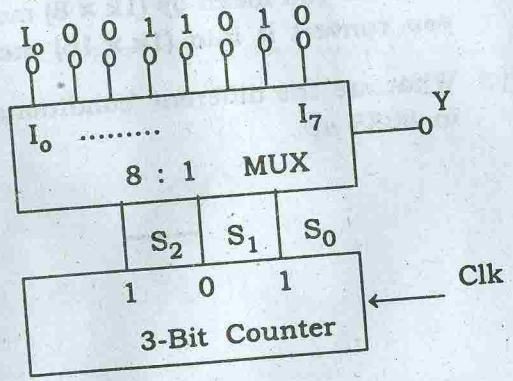
(d) Solve the following digital equation using 1 : 8 De MUX IC.

$$Y_1 = \bar{A}B\bar{C} + A\bar{B}C + ABC$$

(e) What is EEPROM ? What are the advantages and disadvantages of EEPROM ?

3. (a) Design a circuit to determine wheter $A > B$ or not where A (A_1 A_0) and B(B_1 B_0) are two binary numbers.

(b)



What will be the output waveform at Y if the clk pulse is applied in the counter which was initially set at 101 condition ?

(c) Describe different register system in 8086 μp. 3+3+4

4. (a) What do you mean by quantization error in PAM system. Derive the expression for it.

   (b) What do you mean by flat top sampling and natural sampling? Which one is better?

   (c) Give the idea of quadrature phase shift keying (QPSK).

5. (a) Write a short note on CCD or FPLA memory unit.

   (b) What do you mean by (1k × 8) memory cell? How can you convert it into (1k × 16) memory cell?

   (c) What are the different 'conditional jump' instruction in 8085 μp.

3+4+3
