PG/IIIS/PHS/303A,303B.1
303B.2/23

M.Sc. 3rd Semester Examination, 2023

PHYSICS

PAPER – PHS-303A, 303B.1, 303B.2

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

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

PAPER – PHS-303(A)

(*Solid State Physics Special*)

GROUP–A

Answer any **four** of the following questions : 2×4

1. Find the Burger vector for a stable dislocation in a FCC crystal.

2. Find out the condition of polarisation catastrophe in a ferroelectric material.

3. What is Mott's metal to insulator transition?

4. What is meant by ultra quantum region?

5. What is Plasmon and how can you determine its presence in a thin metal film?

6. What is Mott Wanier Exciton?

7. What is polaron and explain how it is originated in a solid?

GROUP–B

Answer any **four** of the following questions : 4×4

8. The energy of formation of a vacancy in copper is 1ev. Estimate the relative change in the density of copper due to vacancy for mation at a temperature just below it's melting point, 1356 k.

9. Show that the change in thermal entropy for a perfect crystal is zero.

10. Explain Thermoluminescence and hence find an expression of intensity.

11. Explain how you can experimentally measure the area of fermi surface in a metal?

12. Find elastic energy in a crystal per unit length of screw dislocation.

13. Explain the origin of Frenkel Exciton in a solid and find its energy eigen value.

GROUP – C

Answer any **two** of the following questions : 8×2

14. Explain electrostatic screening assuming electron gas in a solid and hence find an expression ofscreening length. 8

15. Derive the expression of energy corresponding to Landau levels. Mention the conditions necessary to observe these levels. 8

16. Assuming Boltzman Transport equation find an expression electrical conductivity of a metal? 8

17. Explain in details the characteristics of first order and second order transition occuring in ferroelectric solids. Explain on the basis of a model the origin of ferroelectricity in $BaTiO_3$. 8

[Internal Assessment — 10 Marks]

PAPER — PHS-303B.1

(Applied Electronics Special: Analog Electronics)

Full Marks : 20

GROUP–A

Answer any **two** of the following questions : 2×2

1. Draw the circuit diagram of a Voltage Controlled Oscillator (VCO) using OpAmps and MOSFETs.

2. How analog multiplier can be designed using log and antilog amplifiers?

3. Explain how a SR-flip flop can be used as a digital phase detector.

4. Explain how a PLL can be used as a frequency synthesizer.

GROUP – B

Answer any **two** of the following questions : 4×2

5. Draw the circuit diagram of an anti-logarithmic amplifier using OP-Amps and matched pair of transistors and derive the expression for its output voltage as a function of its input voltage and input reference voltage.

6. Draw the circuit diagram of a regenerative comparator using Op-Amp. Explain its operation and derive the expression for its hysteresis voltage.

7. What is the advantage of using chopper stabilized amplifier over a simple Op-Amp amplifier? Explain the operation of a chopper stabilized amplifier.

8. Draw the circuit diagram of an audio bridge power amplifier using audio power amplifier IC LM380 and explain how it can deliver 4 times the output power compared to a single power amplifier IC with the drawing of the necessary output waveforms.

GROUP – C

Answer any **one** of the following questions : 8×1

9. Draw the circuit diagram of a triangular wave generator using modified version of Schmitt Trigger. Derive the expression for the frequency of oscillation and peak-to-peak voltage of the output signal. Also draw the corresponding waveforms at different output points. 1+5+2

10. What do you mean by Butterworth response of active filters? Design a second order low pass Butterworth active filter at cut-off frequency f_H = 20 KHz. Derive the expression used in this design and show that this circuit will act as second order low pass Butterworth active filter at a particular condition. State the condition also. 1+1+5+1

PAPER — PHS-303B.2

(*Applied Electronics Special: Digital Electronics*)

Full Marks : 20

GROUP – A

Answer any **two** of the following questions : 2 × 2

1. Draw the circuit of 3-input CMOS NOR gate.

2. What do you mean by figure of merit of a logic gate?

3. What is the role of MTSO in mobile communication?

4. Why DRAM is preferred than SRAM for digital data storage?

GROUP–B

Answer any **two** of the following questions : 4×2

5. Give the basic structure of two phase ratio-less dynamic shift register and briefly explain the process of data shifting.

6. Design a circuit of two-input TTL NOR gate with totempole connection.

7. How does a call, from a land phone to mobile phone, get connected in mobile communication? What are the features of 2G mobile communication?

8. What do you mean by packet switch network in computer communication? Write down the difference between Star topology and Ring topology.

GROUP – C

Answer any **one** of the following questions : 8×1

9. (*a*) Explain the process of information shifting in a three phase charged couple device.

(*b*) What do you mean by FIFO memory and FPLA memory? $4 + 4$

10. (*a*) Design a simple not gate by

(*i*) DTL

(*ii*) TTL

(*iii*) ECL

(*iv*) IIL

(*b*) Design a circuit which can receive twenty different signals and can pass any one selectively at the output. 4 + 4

[Internal Assessment — 10 Marks]
