 PG/IVS/PHS/404(A, B.1 & B.2)/25

M.Sc. 4th Semester Examination, 2025

PHYSICS

PAPER—PHS-404(A, B.1 & B.2)

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

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

PHS-404A

(*Condensed Matter Physics*-II)

GROUP – A

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

1. A superconducting tin has a critical temperature of 3.7 K in zero magnetic

field and a critical field of 0.0306 T at 0 K. Find the critical field at 2 K.

2. Assuming the relation of Gibb's Free Energy for a normal metal and a superconductor at critical field He. Show that superconducting state is more ordered state than normal state.

3. Explain the Isotope effect on Hg and what conclusion you can draw out of it.

4. What is the physical origin of a magnetic domain ?

5. Find the spectroscopic notation for Fe^{3+} having $3d^5$ electron configuration.

6. In DC Josephson effect 1μV is applied across the junction. How much frequency is generated ?

GROUP – B

Answer any **four** questions : 4×4

7. What is meant by Flux quantization in a superconducting ring ? Derive an expression of fluxoid.

8. What is meant by coherence length ? Derive an expression of coherence length.

9. Explain DC Josephson effect and show that super current of a superconducting pairs across the junction depends on the phase difference.

10. With change of magnetic field there is change from superconducting state to normal state of a superconductor. What should be the order of transition ? Prove it and show the plot.

11. What are the assumptions involved by Wein to explain Ferromagnetism. What are the main drawbacks of the theory ?

12. Explain Ferrimagnetic order and show the spin arrangements in $FeO.Fe_2O_3$ to explain ferrimagnetism.

GROUP – C

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

13. (*a*) What is Magnon ?

(*b*) Derive the dispersion relation for Magnon assuming a ferromagnetic solid. $2+6$

14. (*a*) What is a Bloch Wall ? Calculate the thickness of the domain wall.

(*b*) What is a Ferrite ? Write two technological application of Ferrite. $5+3$

15. (*a*) Describe in details the molecular field theory of antiferromagnetism and hence find an expression of susceptibility.

(*b*) Explain nuclear magnetic resonance and hence find an expression of the resonance condition. 5 + 3

16. What is squid ? Explain Heisenberg's exchange interaction. How the formation of Cooper pairs is possible in a superconductor ? 3 + 5

[Internal Assessment — 10 Marks]

PHS-404B.1

(*Applied Electronics Special* : *Analog Electronics*)

(*Marks* : 20)

GROUP – A

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

1. Why intermediate frequencies (IF) are generated in a TV receiver ?

2. Find the picture carrier frequency, sound carrier frequency and colour subcarrier frequency for channel number 4 of Indian television transmission system.

3. What do you mean by interlaced scanning and why it is used in TV transmission system ?

4. Design a 3 element Yagi-Uda antenna for the reception of Indian TV channel 8.

GROUP – B

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

5. (*a*) Instead of transmitting individual colour signals, colour difference signals are transmitted in colour TV transmission system. Why ? (*b*) Which colour difference signal is not transmitted in colour TV signal transmission and why ?

6. Explain the construction details and operation of a PIL type colour picture tube with necessary diagrams.

7. Explain the detailed operation of ramp type digital voltmeter with proper block diagram.

8. (*a*) What is vestigial side band modulation and why it is used in TV picture signal modulation ? (*b*) What is the frame reception rate used in Indian TV transmission system and why it is not set at 24 as in Motion Pictures ?

GROUP – C

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

9. (*a*) Draw the detailed block diagram of a black and white TV receiver and explain the operation of its different blocks for reception and reproduction of picture and sound signals.

(*b*) Explain how colour differential signals disappear at the output of the signal combining matrix on white and grey shades. 5 + 3

10. (*a*) Explain in details the operation of Image Orthicon type TV camera with a neat diagram. (*b*) Show that TEM mode of propagation is not possible in a hollow waveguide with perfectly conducting walls. 5 + 3

PHS-404B.2

(*Digital Electronics Spl. Paper*)

(*Marks* : 20)

GROUP – A

Answer any **two** questions : 2 × 2

11. How do you generate a 20-bit physical address of an instruction in 8086 microprocessor ?

12. Write down the output of A and C register after execution of the following program in 8085 microprocessor :

MVI C 05/MOV A C / XRA C / HLT

13. What is Binary phase shift keying in digital modulation ?

14. A sinusoidal signal $m(t) = 2 \cos 8000\pi t + 6 \cos 1200\pi t$ is to be faithfully reconstructed at the receiver end. What is the minimum sampling rate from low pass and band pass sampling theorem consideration ?

GROUP – B

Answer any **two** questions : 4×2

15. Explain the structure of Bus Interface Unit and Execution Unit of 8086 microprocessor.

16. (*a*) 20 voice signals are to be transmitted simultaneously with 8 kHz sampling rate and

8-bit word length. If each frame requires 10 synchronization bit then what will be the bit transmission rate in that transmission line ? (*b*) If a 5kHz signal is sampled by 12 KHz pulse train then what are the frequency components that will be present in the transmitted signal ?

17. What is On-OFF keying ? Briefly describe the process of demodulation technique of FSK in coherent method.

18. What is the principle of delta modulation ? Find out the quantization noise in Delta modulation. 4 + 4

GROUP – C

Answer any **one** question : 8 × 1

19. (*a*) Write a program for 8085 microprocessor to find out the square root of a given number.

(*b*) Briefly describe the difference between 8085 and 8086 microprocessor. 4 + 4

20. (*a*) What is QPSK ? Schematically explain the process of modulation in QPSK.

(*b*) Represent the basic principle of differential pulse code modulation technique. Point out the advantage and disadvantage of this technique. 4 + 4

[Internal Assessment — 10 Marks]