PG/IIIS/PHS-303/18

M.Sc. 3rd Semester Examination, 2018

PHYSICS

PAPER – PHS-303

Full Marks : 40

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

Illustrate the answers wherever necessary

(Special Paper : *Solid State*)

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

1. Answer any *five* questions : 2×5

(*a*) Explain– why Schotky defects are inevitable in solids.

(*b*) An Aluminium crystal has fcc structure, which also have shear modulus $25{\cdot}94 \times 10^9\ Nm^{-2}$. Find elastic energy per unit length of dislocation ?

(*c*) Explain what is Moff's-Metal-Insulator transition ?

(*d*) What is Plasmon ? Find an expression of plasma frequency ?

(*e*) Clearly distinguish the configuration of luminescent and non-luminescent solids ?

(*f*) What is De Hass Van Alphen effect ? Show the variation of oscillation of magnetic moment vs. $\left(\frac{1}{H}\right)$.

(*g*) What is the mechanism of formation of V centers ?

2. (*a*) Derive LST relation for an ionic crystal.

(*b*) What is meant by soft optical phonon modes ? 8 + 2

3. (*a*) Derive the expression of diffusion coefficient in an ionic crystal.

(*b*) Find an expression of elastic energy of the crystal per unit length of screw dislocation ? 10

4. (*a*) Show in details the characteristics of transition in a ferroelectric solid as Rochelle salt ?

   (*b*) Explain what is meant by dielectric relaxation ?

   (*c*) Show the variation of polarisability with frequency for a dipolar solid. $7+1\frac{1}{2}+1\frac{1}{2}$

5. (*a*) Describe in details the Raman effect in solid.

   (*b*) Find an expression of luminescence intensity corresponding to thermoluminescence in a solid. 10

6. (*a*) Estimate and plot the first four bonds of a simple cubic crystal alloy [100] direction according to empty lattice approximation.

   (*b*) Assuming the expression of change in the distribution function under first order find an expression of electrical conductivity in a metal. 3 + 7

(Special Paper : *Electronics*)

GROUP – A

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

1. Answer any *five* questions : 2×5

(*a*) Explain how a 78XX fixed voltage regulator IC can be used to design a constant current source ?

(*b*) Is there any advantages of active filters over passive ones ? If so, write some of them.

(*c*) Explain how a phase locked loop can be used as a frequency multiplier ?

(*d*) Draw the circuit diagram of a voltage controlled oscillator using OP-Amps and MOSFETS and write down the expression for its frequency of oscillation.

(*e*) Draw the circuit diagram of a square wave generator using OP-Amp and explain how the duty cycle of the output waveform can be changed in this circuit ?

(*f*) Explain the operation of a precision rectifier with circuit diagram.

(*g*) Explain how a band stop filter can be designed using one low pass filter and one high pass filter with necessary condition.

2. (*a*) Draw the circuit diagram of an instrumentation amplifier using three OP-Amps, which does not load either input terminals and derive the expression for its output voltage in terms of input voltages.

(*b*) Draw and explain the circuit diagram of a logarithmic amplifier using matched pair of transistors and derive the expression for its output voltage in terms of input voltage and input reference voltage. (1 + 4) + 5

3. (*a*) Explain with proper circuit diagram how a Schmitt Trigger circuit can be converted to generate triangular waves. Derive the expression for the output frequency of oscillation and output offset voltage.

(*b*) What do you mean by Butterworth response of active filters ? Draw the circuit diagram of an active 2nd order high pass Butterworth filter and derive the expression for its transfer function as a function of frequency with the necessary condition for gain of the filter. (1 + 4) + 5

GROUP – B

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

1. Answer any *five* questions : 2 × 5

(*a*) What is the role of MTSO in mobile communication ?

(*b*) What is FDMA and CDMA ?

(*c*) Give the circuit of 3 bit (input) AND gate by NMOS.

(*d*) Explain DTL gate with proper example.

(*e*) What is ISDN ?

(*f*) Give the unit cell structure of DRAM.

(*g*) How can you use 8 : 1 MUX IC to produce the following waveform :

(*h*) Design 4 : 2 Encoder circuit.

2. (*a*) Design the following circuit by CMOS :

$$Y = \overline{AB + C}$$

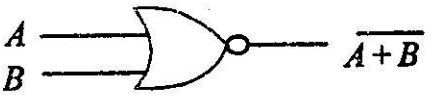
(*b*) Give the idea of charge propagation in 3 phase CCD.

(*c*) Give the truth table for Binary to BCD converter circuit. 3 + 4 + 3

3. (*a*) Define briefly LAN, WAN and FTP.

(*b*) Explain briefly the function of two phase ratio less dynamic shift register with proper circuit diagram.

(*c*) Design the following circuit with TTL totempole connection :



(*d*) What is the basic difference of 2G and 3G system in mobile communication ?

3 + 3 + 3 + 1
