8. (a) What is Madelung Constant? Show that for a one-dimension array of ions of alternate signs its value is 1.38. 2+2=4

   (b) Discuss the different types of interactions responsible for bineling among inert gas atoms. Discuss the Lennard-Jones potential energy between two inert gas atoms. 2+4=6

   (c) Derive the vibrational modes of a diatomic linear lattice. 4

UNIT - II

9. (a) Discuss Kronig-Penney model, using the model show that the energy spectrum of electron consist of a number of allowed energy bands seperated by forbidden bond. 8

   (b) Prove that effective mass of an electron is : 2

$$m^* = \frac{\hbar^2}{d^2E/dk^2}$$

   (c) Why a solid whose energy band are full cannot be a metal. 4

10. (a) Distinguish between type-I and type-II super conductors. 2

   (b) Derive the expression for two London-equations in terms of penetration depth (λ). 6

   (c) Discuss a.c Josephson effect. 6

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PG (NEP) EVEN SEMESTER EXAMINATION, 2023

PHYSICS

2nd Semester

Course No. : PHY - 554 A

(Electronics and Solid State Physics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer five questions, taking one from each unit)

UNIT - I

1. (a) Describe with a neat diagram the construction and working of a n-channel enhancement type MOSFET. Also discuss its static drain and transfer characteristic curve. 2+2+2+2=8

   (b) Describe the construction and working of UJT. Find the frequency of oscillation of an oscillatory circuit made with UJT. 2+2+2=6

2. (a) Discuss the working of a tunnel diode. 3

   (b) Calculate the noise voltage develop across the resistance R. 3

(c) Write short note (any two) 4+4=8

(i) Solar cell

(ii) Gunn diode

(iii) SCR

(iv) LASER diode

UNIT - II

3. (a) Find the expression for the total offset voltage of an op-amp due to input offset voltage and input offset current. 6

(b) Explain slew-rate and CMRR of an op-amp. 2+2=4

(c) Explain the concept of virtual ground and virtual short in context with op-amp. 2+2=4

4. (a) Explain, how an op-amp can be used as a comparator. 4

(b) Discuss with circuit diagram, op-amp as a substructor. 4

(c) Draw the circuit diagram of a astable multivibrator with 555 timer. Calculate its frequency of oscillation and duty cycle in terms of R and C. 2+2+2=6

UNIT - III

5. (a) Discuss the truth table of 1 : 4 DEMOX and 4 : 1 MUX with the help of logic gates. 3+3=6

(b) Discuss clocked JK F/F what do you mean by toggling. 4+2=6

(c) Draw the truth table for the following equations. 2

(i) $T = WX + XY$

(ii) $V = R (\overline{S} + \overline{T})$

6. (a) Discuss 4-bit, binary ripple counter with timing diagram. 5

(b) Using J-K F/F, discuss serial-in and serial-out shift register. 5

(c) Explain weighted resistor D/A convertor circuit. 4

Solid State Physics

UNIT - I

7. (a) What do you mean by reciprocal lattice? Derive the expression for the primitive translation vectors of the reciprocal lattice. Discuss how reciprocal lattice is constructed. 2+2+2=6

(b) Derive Laue's equations of diffraction of X-ray and obtain Bragg's diffraction condition from them. 4+2=6

(c) Why (100) (300) reflection lines are absent for metallic sodium but not for CsCl, even through both have bcc structure. 2