

Seat No. : \_\_\_\_\_

**JA2-101**

**January-2016**

**M.Sc., Sem.-I**

**404 : Physics**

**(Solid State Physics & Electronics-I)**

**Time : 3 Hours]**

**[Max. Marks : 70**

**Instruction :** Symbols used have usual meanings.

1. (a) Describe in detail the Kronig-Penney model and discuss how the energy band behaves as increasing the energy. 7
- OR**
- Write notes on : 7
- (i) Exact proof of Bloch theorem
- (ii) Origin of the energy gap
- (b) Derive the wave equation of electron in a periodic potential. 7
- OR**
- (i) Find the reciprocal lattice of f.c.c. lattice. 4
- (ii) Classification of materials on the basis of band theory of solids. 3
2. (a) Describe the tight binding method of band structure calculation and list its merits and demerits. 7
- OR**
- (i) Write notes on Pseudopotential theory. 4
- (ii) Calculate the Fermi energy and volume of Fermi sphere of aluminium with lattice constant  $3.8 \text{ \AA}$ . 3
- (b) What is the dHvA effect and how is it used to deduce the information to construct Fermi surface ? What are Landau levels ? 7
- OR**
- What is Extremal orbit ? Show the quantization of orbits in a magnetic field.
3. (a) Draw circuit diagram of a transformer coupled class A power amplifier and explain its working. Using graphical method of analysis show that its maximum theoretical conversion efficiency is 50%. 7
- OR**
- Write short notes on : 7
- (i) Complementary symmetry push pull amplifier
- (ii) Cross over distortion

- (b) Draw circuit diagram of astable multivibrator using BJT. Giving voltage timing diagrams explain its working. 7

**OR**

Draw circuit diagram of bistable multivibrator using transistors and explain its working.

4. (a) Describe application of operational amplifier as integrator and differentiator. 7

**OR**

Setup an analog computer to solve the following simultaneous equations :

$$3x + 6y - 10 = 0$$

$$2x - y - 8 = 0$$

Indicate where voltmeters should be connected to read the solutions.

- (b) Write a short note on : Frequency compensation in op-amps. 7

**OR**

Draw basic circuit of a square wave generator using Op-amp. Describe its operation with necessary waveforms.

5. Answer the following questions in brief :

- (1) Explain the behaviour of resistivity with increasing the temperature of pure metal and semiconductor. 1
- (2) Why Mg (Magnesium) fall in the category of metal ? 1
- (3) Write the condition for Magnetic breakdown. 1
- (4) What is Bloch function ? 1
- (5) What is the use of k.p perturbation theory ? 1
- (6) The valance band of a simple cubic metal has the form  $E = Ak^2 + B$  where  $A = 10^{-38} \text{ J m}^2$ . Calculate  $m^*/m$  2
- (7) List the main properties of Class C power amplifier. 1
- (8) What is the function of input transformer in a push-pull amplifier ? 1
- (9) Define monostable multivibrator. 1
- (10) Draw circuit diagram of Schmitt trigger circuit using op-amp. 1
- (11) What are the applications of current to voltage converter circuit ? 1
- (12) How virtual ground differs from actual ground ? 1
- (13) Define slew rate. 1