

**F.Y. B. Tech**  
**AS 102 – APPLIED SCIENCE -I**

**Instructions to Candidates:**

1. Neat diagrams must be drawn wherever necessary.
2. Assume suitable data, if necessary.
3. Figures to the right indicate full marks.
4. Use of only non-programmable calculator is allowed.
5. Start answer of each question on new page.

**Section I: Physics**

Constants:

- Speed of light in vacuum =  $3 \times 10^8$  m/s  
Acceleration due to gravity =  $9.8$  m/s<sup>2</sup>  
Mass of proton =  $1.67 \times 10^{-27}$  kg  
Mass of electron =  $9.1 \times 10^{-31}$  kg  
Electronic charge =  $1.6 \times 10^{-19}$  C  
Planck's constant =  $6.6 \times 10^{-34}$  J.s

**Solve any two of the following three questions.**

- Q.1 (a) (i) Draw the energy band structures of unbiased, forward biased and reverse biased p-n junction diode. [3]
- (ii) Calculate the energy gap of silicon in electron volt, given that it is transparent to radiation of wavelength greater than 11,000 angstrom. [2]
- (b) (i) State the fundamental laws of photoelectric emission. [3]
- (ii) A proton moves with a speed of  $2.5 \times 10^6$  m/s horizontally in a perpendicular magnetic field. What should be the strength of the magnetic field to just balance the weight of the proton and keep it moving horizontally? Should the direction of the magnetic field be in the horizontal plane or vertical plane? [2]
- (c) Define mass defect and binding energy. Draw the binding energy curve, and comment on the stability of elements with reference to the curve. [5]
- Q.2 (a) (i) With the help of a neat, labeled diagram, explain the working of Bainbridge mass spectrograph. [3]
- (ii) What is the minimum uncertainty in the speed of an electron, if it is confined in a region of length 8 angstrom. Assume that the situation is described in a one-dimensional space. [2]

- (b) (i) Discuss the meson theory of nuclear forces. [3]
- (ii) The interplanar spacing for NaCl crystal is 2.82 angstrom. If an X-ray diffraction pattern is obtained with X-rays of wavelength 0.98 angstrom, what will be the angle corresponding to the second order Bragg diffraction? [2]
- (c) Write the Fermi Dirac probability distribution function, explaining the symbols used. Show that in an intrinsic semiconductor the Fermi energy is always at the center of the energy gap. [5]
- Q.3 (a) (i) Explain the construction and working of modern Coolidge tube. [3]
- (ii) The magnetic flux within a stable orbit of a betatron changes from  $1.4 \times 10^3$  Wb to  $8.5 \times 10^2$  Wb in half a minute. What is the energy of an electron that undergoes  $2 \times 10^6$  revolutions? [2]
- (b) (i) Draw the typical IV characteristic curve for a solar cell. Explain the terms 'fill factor' and 'efficiency' in the context of a solar cell. [3]
- (ii) An n type semiconductor has  $5 \times 10^{21}$  majority charge carriers per cc. What are the sign and value of the Hall co-efficient? [2]
- (c) Describe Davisson-Germer experiment and discuss its outcome. [5]

## SECTION II

**Q. 4 : Answer any Two**

(10)

- a) (i) State Laws of crystallography and explain  
(ii) Discuss Weiss and Miller indices. Find the perpendicular distance  $d_{(hkl)}$  for the parallel planes of  $d_{(1,1,0)}$  and  $d_{(1,1,1)}$ .
- b) (i) State phase rule for single component system with example  
(ii) Discuss the advantages and limitations of phase rule.
- c) (i) Give distinction between Schottky defect and Frenkel defect.  
(ii) Discuss the types of Solid Solutions.

**Q. 5 Answer any two**

(10)

- a. (i) List the significant parts of Gas chromatography and explain the use of flame ionisation detector.  
(ii) Discuss the applications of Thermogravimetry.
- b) (i) What is HPLC ? Give two applications of HPLC.  
(ii) Discuss the applications of Ultra Violet spectroscopy.
- c) (i) With the help of neat diagram explain thermogravimetric technique of analysis.  
(ii) How will you determine unknown concentration of  $\text{KMnO}_4$  ?

**Q. 6 Answer any two**

(10)

- a. Give preparation, properties and uses of polyurathanes.  
b. Give detail classification of electroceramics.  
c. Discuss the mechanism of step growth polymerisation.  
d. Explain differential scanning colorimetry technique.