



Date:

Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
M.Sc. PHYSICS - II SEMESTER
SEMESTER EXAMINATION: APRIL 2022
(Examination conducted in July 2022)

PH8820/ PH8221 – EXPERIMENTAL PHYSICS II

Time- 2 ½ hrs

Max Marks-70

This question paper contains Two printed pages and Two parts

Part A

Answer any FIVE questions. Each question carries 10 marks

[5 x 10 = 50]

- (a). State Maxwell's velocity distribution law and write the expression for RMS, Average and Most Probable speeds. Derive the relation between them.

(b). Demonstrate the working of Diffusion pump with a suitable diagram. [5+5]
- (a). With a neat sketch, demonstrate the working of Pirani gauge.

(b). Explain the construction and working of cold cathode gauge with a suitable diagram. [5+5]
- (a). Describe the Joule-Thomson Throttling.

(b). Obtain the expression for the Joule-Thomson Coefficient.

(c). With the help of pressure-temperature diagram, explain the Joule-Thomson expansion. [3+4+3]
- Explain the construction and working mechanism of Gifford-McMahon refrigerator with the help of temperature-entropy (T-S) diagram.
- (a). With a neat sketch, explain the mechanism of electron gun in the scanning electron microscope.

(b). With a neat sketch, describe the physical principle of Scanning Tunneling Microscopy. [5+5]
- (a). Draw the regions of glow discharge during the sputtering process.

(b). Describe the thermal evaporation mechanism with a neat sketch. [5+5]
- (a). With a suitable diagram, explain the principle of pulsed laser deposition.

(b). Display the selected area electron diffraction (SAED) pattern for the following systems (i). Single crystal, (ii). Polycrystal (iii). Amorphous and (iv). Nanocrystal. [6+4]

Part B

Answer any Four questions. Each question carries 5 marks

[4 x 5 = 20]

8. Define the ultra-high vacuum. With a neat sketch, describe the essential components needed to construct the ultra-high vacuum system.
9. Compare the laminar flow and turbulent flow regimes in vacuum practice with a suitable sketch, explain how the Reynolds number is used to describe the flow.
10. Describe the mechanism of Liquid-Nitrogen shield vessel with a suitable diagram.
11. Draw and explain the phase diagram of liquid Helium (^4He).
12. (a). An electron of mass 'm' and charge 'e' is accelerated from rest through a potential difference V in vacuum. Calculate the final velocity.
(b). An electron beam has kinetic energy equal to 100 eV. Find its wavelength associated with an electron beam. ($1 \text{ eV} = 1.6 \times 10^{-19} \text{ J/eV}$). [3+2]
13. Write down the following mechanism with suitable examples for evaporation of compounds.
 - (i). Evaporation without dissociation
 - (ii). Decomposition
 - (iii). Evaporation with dissociation

List of Physics Constants

Speed of light in vacuum (c)	$2.997925 \times 10^8 \text{ ms}^{-1}$
Charge of electron (e)	$1.6021 \times 10^{-19} \text{ C}$
Rest mass of electron (m)	$9.109 \times 10^{-31} \text{ kg}$
Atomic mass unit (m_u)	$1.6604 \times 10^{-27} \text{ kg}$
Electron radius (r_e)	$2.828 \times 10^{-15} \text{ m}$
1 Angstrom unit (\AA)	10^{-10} m
Avogadro's number (N_A)	$6.02252 \times 10^{26} \text{ kmol}^{-1}$
Boltzmann constant (k_B)	$1.38054 \times 10^{-23} \text{ J K}^{-1}$
Thermal energy at 300K ($k_B T$)	0.0258 J
Planck's constant (h)	$6.626 \times 10^{-34} \text{ Js}$
Permeability of free space (μ_0)	$4\pi \times 10^{-7} \text{ Hm}^{-1}$
Permittivity of free space (ϵ_0)	$8.854 \times 10^{-12} \text{ Fm}^{-1}$
Rydberg constant for Hydrogen (R_H)	$1.0967758 \times 10^7 \text{ m}^{-1}$
Universal gas constant ($R_u = N_A k_B$)	$8.3143 \times 10^3 \text{ J kmol}^{-1} \text{ K}$