(Pages : 3) **J – 4866**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, May 2020

Branch : Physics

PH 242 : NUCLEAR AND PARTICLE PHYSICS

(2018 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer **any five** questions. **Each** question carries **3** marks.

I. (a) Write down the salient features of nucleon – nucleon interactions.

(b) Write down any three basic assumptions of Collective model.

(c) State the fundamental differences between leptons and mesons.

(d) Explain plasma confinement in fusion reactions.

(e) Explain the basic concepts in the working of GM counter.

(f) What is meant by flavours in quarks?

(g) Explain the term “resonance reactions”.

(h) Explain “Lawson criterion” in a nuclear reactor.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer each question. **Each** question carries **15** marks.

II. (A) (a) Outline the features of magic number nuclei.

(b) Discuss the meson theory of nuclear forces.

OR

(B) (a) Explain the concept of compound nucleus hypothesis.

(b) Derive the Breit- Wigner one level formula.

III. (A) (a) Explain the nitrogen cycle and explain the importance of the four factor formula.

(b) Give the general features and classification of nuclear fission reactors.

OR

(B) (a) Explain nuclear fission reactions in Stellar interior using pp interaction model.

(b) Explain how CNO cycle of thermonuclear reaction is used in the formation of star.

IV. (A) (a) Bring out the essential differences between particle accelerators and electrostatic accelerators.

(b) Explain in detail the principle and working of a cyclotron accelerator.

OR

(B) (a) Explain the quark model of elementary particles. Bring out the ideas of charm, beauty and truth.

(b) What do you understand by fundamental forces? Give the properties of strong, electromagnetic and weak forces.

(3 × 15 = 45 Marks)

PART – C

Answer **any three** questions. **Each** question carries **5** marks.

V. (a) A GM counter has a plateau slope of 3% per 100 volts. If the operative point is at 1100 volts, what is the maximum permissible voltage fluctuation if the counting is not to be affected by more than 0.1%.

(b) The first excited state of W^{182} is 2^+ and is 0.1 MeV above the ground state. Estimate the energies of the lowest lying 4^+ and 6^+ states of W^{182}.

(c) Calculate the fission rate for U^{235} required to produce 2 watt and the amount of energy that is released in the complete fissioning of $\frac{1}{2}$ kg of U^{235}.

(d) For the deuteron assume that b ~$\lambda/4$~$\pi/2$ K where the parameters have the usual meaning. From this obtain the approximate radius of the deuteron in the rectangular well model.

(e) ^{17}N nucleus decays to the nucleus ^{12}C with a Q value of 16.38 MeV. Estimate the maximum recoil energy of the ^{12}C nucleus.

(f) State the proton – proton interaction and the interactions between the proton and one of the nucleons in the deuteron nucleus.

(3 × 5 = 15 Marks)

———————

(Pages : 3) **J – 4989**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, May 2020

Physics

PH.241 : CONDENSED MATTER PHYSICS

(2014 – 2017 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. (a) Explain the term `London penetration depth'? What is its physical significance?

   (b) Give the principle of SQUID.

   (c) Explain the difference between edge and screw dislocations.

   (d) Derive Clausius-Moscotti equation.

   (e) What are the characteristic features of carbon nanostrucutres?

   (f) What are ferrites? Mention their uses?

   (g) State and explain Dulong and Petit's law.

   (h) What are Brillouin zones? Draw the Brillouin zones for a two-dimensional square lattice of side ‘a’.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions. Each question carries **15** marks.

2. (a) Discuss Kronig-Penney model. Using the model show that the energy spectrum of electron consists of a number of allowed energy bands separated by forbidden regions.

OR

(b) Explain the vibrations of crystals with monoatomic basis. Obtain the dispersion relation and discuss first Brillouin zone, long wavelength limit and phase and group velocities.

3. (a) Derive the expression for the densities of electrons and holes in the conduction and valence bands respectively in an intrinsic semiconductor. Show that the Fermi energy level in an intrinsic semiconductor lies approximately half way between the top of the valence band and bottom of the conduction band.

OR

(b) (i) Briefly discuss the piezo-pyro- and Ferro electric properties of crystals?.Also derive the Curie- Wiess law for Ferro electric crystals.

(ii) Briefly discuss the Ferroelectric domain theory. Also distinguish between Antiferro- electricity and Ferri-electricity.

4. (a) With proper theory, discuss in detail about the A.C and D.C. Josephson's effect.

OR

(b) (i) Explain the principle and working of Scanning Tunneling Microscope.

(ii) Briefly explain the Chemical Vapour Deposition technique? How is it different from Pulsed Laser deposition technique?

(3 × 15 = 45 Marks)

PART – C

Answer any **three** questions. Each question carries **5** marks

5. (a) A beam of X-rays incident on a sodium chloride crystal (lattice spacing 0.282 nm), the first order Bragg reflection is observed at a glancing angle of 8°35'. What is the wavelength of X-rays? At what angles would be the third order Bragg's reflections occur?

(b) (i) Find the lowest energy of an electro in a three–dimensional potential box of length 1A°

(ii) Find the temperature, at which the average energy of the molecule of a perfect gas that would be equal to the lowest energy of the electron.

(c) Determine the degree of degeneracy of the energy level $\frac{38h^2}{8mL^2}$ of a particle in a cubical box of side L.

(d) Calculate the intrinsic charge carriers of 300K. Given that $mc^* = 0.12\ m_o$. $m_n^* = 0.28\ m_o$ and the energy gap of A° germanium at 300k is 0.67 eV.

(e) The x–ray beam of wavelength 0.71 is diffracted by a cubic Kcl crystal of density 1.99×10^3 kg/m^3. Calculate the interlanar spacing for (200) planes and the glancing angle for the second order reflection from these planes. Given, the molecular weight of Kcl is 74.6 amu.

($3 \times 5 = 15$ Marks)

———————

(Pages : 3) **J – 4990**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, May 2020

Physics

PH 242 : NUCLEAR AND PARTICLE PHYSICS

(2014 – 17 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. (a) Define scattering cross-section and scattering length.

   (b) Give a brief account of collective model of the nucleus.

   (c) Define Q-value and threshold energy for a nuclear reaction

   (d) Define critical energy of the fissionable nucleus.

   (e) What are different types of nuclear fission?.

   (f) Explain the working principle of semiconductor detectors.

   (g) Explain the meaning of the terms: boson, fermion, hadron, lepton, and baryon and give example of particles of each.

   (h) Explain briefly and quantitatively the strength in the context of interactions, how the relative strength of these interactions are compared.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions. Each questions carries **15** marks.

2. (A) (a) Give a simple theory of deuteron. Obtain and plot the wave function of the deuteron ground state taken as an S-state.

(b) Deuteron forms a bound state of a neutron and a proton whereas a system consisting of two neutrons doesn't form a bound state, discuss.

OR

(B) (a) Give a brief account of single particle shell model which predict the magic numbers using spin-orbit potential.

(b) Discuss the limitations and failure of the single particle shell model.

3. (A) (a) Explain the Bohr-wheeler theory of Nuclear fission

(b) Discuss the energetic of fission process

OR

(B) (a) Discuss the source of energy in the sun and the stars.

(b) What are the conditions for the construction of nuclear fusion reactors?

4. (A) (a) Explain the difference between ionization chamber, proportional counter and GM counter. How is quenching achieved in Geiger counter?

(b) Explain briefly electrostatic accelerators.

OR

(B) (a) Discuss in detail with suitable example the different conservation laws of elementary particles.

(b) Give Gellmann-Okubo mass formula for hyperons and explain its use. Describe the production and properties of hyperons.

(3 × 15 = 45 Marks)

PART – C

Answer any **three** questions. Each questions carries **5** marks.

5. (a) Since ^{27}Si and ^{27}A1 are mirror nuclei, their ground states are identical except for charge. If their mass difference is 6MeV estimate their radius (neglecting the proton-neutron mass difference).

(b) What is spin-parity would the shell model predict for the ground state of ^{13}B, ^{13}C ,^{13}N and ^{17}O?

(c) Calculate the minimum energy of a proton to penetrate the coulomb barrier of a light nucleus. Assume radius of the nucleus is 1 fm.

(d) Explain why more energy is required to remove a proton than neutron (for heavy nucleus).

(e) In the shell model ^{16}O is good closed -shell nucleus and has spin and parity J^P = O+, what is J^P of ^{15}O and ^{17}O.

(f) Consider the following high-energy reactions or particle decay

(i) $\pi^- + p \rightarrow \pi^0 + n$

(ii) $\pi^0 \rightarrow \gamma + \gamma + \gamma$

(iii) $\pi^0 \rightarrow \gamma + \gamma$

(iv) $\pi^+ \rightarrow \mu^+ + \nu\mu$

(3 × 5 = 15 Marks

———————

(Pages : 3) **J – 4865**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, May 2020

Physics

PH : 241 — CONDENSED MATTER PHYSICS

(2018 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer **any five** questions. **Each** question carries **3** marks.

I. (a) Explain the concept of Reciprocal lattice.

(b) Define phonon and phonon momentum.

(c) Explain Fermi surface.

(d) Discuss the doner level in thermal equilibrium of semiconductors.

(e) Explain bravais lattics.

(f) Explain ferromagnetic domains.

(g) What do you meant by critical current.

(h) Write a short note on SEM.

(5 × 3 = 15 Marks)

PART – B

Answer **all** questions. **Each** question carries **15** marks.

II. (a) Discuss debye theory of specific heat.

OR

(b) Explain the motion of electron in a one dimensional periodic potential.

III. (a) Discuss :

(i) Hall effect in semiconductors and

(ii) Electrical conductivity of semiconductors.

OR

(b) Discuss different polarization mechanisms and derive Clausius- Mosotti relation.

IV. (a) Discuss ac and dc Josephson effect.

OR

(b) Derive London equations in superconductivity.

(3 x 15 = 45 Marks)

PART – C

Answer **any three** of the following questions. **Each** question carries **5** marks.

V. (a) Explain Brillouin zone.

(b) Explain thermal conductivity of metals and Wiedemann-Franz law.

(c) The intrinsic carries density at room temperature is Ge is 2.37×10^{19} m^{-3}. If the electron and hole mobilities are 0.5 and 0.3 $m^2/V/s$ respectively. Calculate the Resistivity.

(d) Explain Hall effect in semiconductors.

(e) Explain dc Josephson effect.

(f) Explain Type I and type II superconductors.

(3 × 5 = 15 Marks)

———————