13

13N17099 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2017

PHY3E07 - Experimental Techniques

(2016 Admission onwards)

ax. Time: 3 hours Max. Weightage: 36

Section A

Answer all questions.

Each question carries 1weightage.

1. Explain the role of gas ballast in a rotary pump.
2. Briefly explain the working of duoplasmatron.
3. Distinguish between on-line and off-line analysis in Neutron Activation Analysis.
4. What are the essential features of lubricants used in rotary pumps?
5. Outline the principle of Rietveld structure refinement in XRD?
6. Explain the terms 'energy straggling' and 'kinematic factor' used in RBS technique.
7. Give the physical principle of thin film antireflection coatings.
8. Explain the "lambda-point" of liquid helium.
9. Explain the flash evaporation technique of thin film deposition.
10. Give the operational principle of microtron.
11. Briefly discuss the working principle of Henning cryostat.
12. Explain the spectro-photometric technique for thin film thickness measurement.

(12 x 1 = 12 weightage)

Section B

Answer **any two** questions

(Each question carries 6 weightage)

13. Illustrate the working principle of Pirani and Penning gauges with appropriate diagrams. What are the pressure ranges within which these gauges are operated?
14. Give the phase diagram of Helium near absolute temperatures. With necessary theory, explain the working of Helium dilution refrigerator. What is the lowest attainable temperature using such a device?
15. What is a betatron? Obtain the expression for the maximum attainable energy of electrons in a betatron. Explain betatron conditions.
16. With the help of necessary theory discuss how quartz crystal oscillator is used in thin film thickness measurement.

(2 x 6 = 12 weightage)

Section C

Answer any four questions.

Each question carries 3 weightage

17. The pressure in a gas thermometer is 0.70 atm at 100°C and 0.512atm at 0°C.
    a) What will be the temperature when the pressure becomes 0.04atm?
    b) What is the pressure at 450°C?
18. Outline the working of a magnetic refrigerator.
19. In an RBS experiment with Helium ions of energy 2MeV on a target of Merc (A=201).The projectile ions are scattered at an angle of 180°. Calculate the distance closest approach.
20. A hollow cylindrical thin film deposition chamber is of 150cm high 30cm b diameter. How long does it take for a single stage rotary pump (pumping speed litres per minute) to reach a pressure of 10^{-3} Torr from atmospheric?
21. A cyclotron is operated at a frequency of 10MHz. Alpha particles are being acceler at a maximum radius of curvature of 50cm. The effective voltage applied to the de 50kV. Neglecting the gap between the dees, determine the total acceleration time o particles and the total distance covered by the particles during the complete cycl acceleration.
22. Outline the theory of "collinear four-probe" method of thin-film thick measurement.

(4 x 3 =12 weight

14

M3N17100 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2017

PHY3C09 - Quantum Mechanics

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage: 36

Section A

Answer *all* questions

Each question carries *1 weightage*

1. Obtain the validity criteria for WKB approximation.
2. Prove that the sum of reflection coefficient and transmission coefficient is equal to one in the case of penetration through potential barrier problem.
3. Bring out the essential difference between time independent and time dependent perturbation theories.
4. How is Zeeman effect in Hydrogen atom explained on the basis of perturbation?
5. In Helium atom problem using variational method, how can the atomic number Z be treated as a variable parameter?
6. Show that variational method can be used to obtain the zero point energy of one dimensional harmonic oscillator.
7. Explain how the consideration of dipole transition between two states lead to the selection rules.
8. Explain the Golden rule of time dependent perturbation theory .
9. Dirac operators $\hat{\alpha}$ and $\hat{\beta}$ are in the form of matrices. Why?
10. Show that the Dirac matrices are traceless and the eigen values are ± 1.
11. Construct the Dirac Hamiltonian for the free particle.
12. How will you quantize the Schrodinger field for a system of fermions?

(12 x 1 =12 Weightage)

Section B

Answer *any two* questions

Each question carries *6 weightage*

13. Using time dependent perturbation theory, derive the transition probability under harmonic perturbation and apply it to interaction of atom with electro- magnetic field.
14. Discuss in detail the method of time independent perturbation theory and obtain the first order correction for energy eigen values for a non degenerate case.
15. Obtain the free particle solutions to the Dirac equation.
16. Obtain the classical field equation in terms of the Lagrangian density.

(2 x 6 =12 Weightage)

Section C

Answer *any four* questions

Each question carries *3 weightage*

17. Find an upper bound on the ground state energy of the one dimensional infinite square well by variational method, using the triangular trial wave function

$$\psi(x) = \begin{cases} Ax, & \text{if } 0 \le x \le a/2 \\ A(a-x), & \text{if } \frac{a}{2} \le x \le a \\ 0. & \text{Otherwise} \end{cases}$$

18. Which of the following transitions are electric dipole allowed?

    (i) 1s → 2s (ii) 1s → 2p (iii) 2p → 3d (iv) 3s →5d.

19. Obtain the energy eigenvalues of an anharmonic oscillator using time independent perturbation theory.
20. Consider the problem of a ball of mass m bouncing elastically on the floor quantum mechanically. Find the allowed energies E_n in terms of m, g, and ħ using WKB approximation method.
21. Derive the equation of continuity from Dirac's theory.
22. Prove that $[p^2, V(r)] = -\hbar^2\nabla^2\hat{V} - 2i\hbar(\nabla\hat{V}.\hat{p})$

(4 x 3 =12 Weightage)

15

M3N17101 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2017

PHY3C10 - Nuclear and Particle Physics

(2016 Admission onwards)

ax. Time: 3 hours Max. Weightage: 36

Section A

Answer **all** *questions*

Each has weightage **1**

Why is it said that the central nuclear charge density is nearly the same for all nuclei?

Discuss any two methods for determining the binding energy of deuteron.

The nuclear force must be spin dependent. Justify this statement.

What is the basic assumption of extreme independent particle model?

What are intrinsic states? Give examples.

What are second forbidden decays? Give examples.

Explain the evidences for saying that the beta decay is not a two body process.

Explain different types of nuclear reactions.

What is doubly differential cross-section? Give the application of calculating it.

Explain D-D and D-T reactions.

State and explain TCP theorem.

Differentiate between isotopic spin and spin.

(12 x 1 = 12 weightage)

Section B

Answer any **two** *questions*
Each has weightage **6**

13. Discuss the main features of nucleon-nucleon interaction force
14. Explain how nuclear shell model predicts nuclear magnetic dipole moments and electrica quadrupole moments
15. State Fermi's Golden rule and explain the Fermi theory of beta decay.
16. Explain how the Eight-fold Way leads to the Quark model. What are the essential features of Quark model?

(2 x 6 = 12 weightage

Section C

Answer any **four** *questions*
Each has weightage **3**

17. Find the mass defect, the total binding energy, and the binding energy per nucleon of ${}^{62}_{28}Ni$.
18. Calculate the reaction energy for the reaction

$$ {}^{4}_{2}He + {}^{14}_{7}N \rightarrow {}^{1}_{1}H + {}^{17}_{8}O $$

and state whether the reaction is exoergic or endoergic.

19. What are the six known elements for which Z is a magic number? Discuss what properties these elements have as a consequence of their special values of Z.
20. Predict the angular momenta and parities for the ground states of ${}^{17}_{9}F$, ${}^{209}_{82}Pb$ and ${}^{43}_{20}Ca$ using nuclear shell model.
21. According to the standard model of the fundamental particles, what are the similarities between baryons and leptons? What are the most important differences?
22. Check the possibility of the following interactions. Explain the violation of conservation laws if any in each.

(a) $\pi^0 \rightarrow \mu^- + e^+ + \nu_e$

(b) $n + p \rightarrow n + p + p + \overline{p}$

(c) $p + \pi^- \rightarrow p + K^-$

(4 x 3 = 12 weightage

17102 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2017

PHY3C11 - Solid State Physics

(2016 Admission onwards)

Time: 3 hours Max. Weightage: 36

Section A
(Answer all questions, each question carries 1 weightage)

Find the interplanar spacing for (221) plane in a simple cubic lattice with lattice constant $3A^0$

What is Madelung interaction?

What is covalent bonding?

If Debye temperature is 1800 K what is Debye frequency?

Why Einstein model for specific heat failed?

What is effective mass of an electron?

What are Bloch functions?

What is polarisation catastrophe?

What are magnons

What are spin waves

What are Cooper pairs ?

Superconductors are diamagnets. Justify this statement

(1 x 12 = 12 weightage)

Section B
Answer any two.
Each carries 6 weightage

Obtain Debye's law for specific heat capacity of a solid at low temperature.

Obtain an expression for the product of electron concentration in conduction band and hole concentration in valence band in a semiconductor.

Obtain Curies law using Langevins theory of paramagnetism.

Obtain London equations. What is London penetration depth. How can you explain Meissner effect from London equations?

(6 x 2 =12 weightage)

Section C

Answer any four questions.
Each carries 3 weightage

17. Determine the wavelength of x-rays undergoing Bragg reflection at a glancing angle of 90^0 in a crystal with lattice spacing $3A^0$.

18. The potential energy of a system of two atoms is given by

$$U(r) = -\frac{a}{r^2} + \frac{b}{r^{12}}$$

Find the bond length if a = 6 x 10^{-76} Jm^6 and b = 6 x 10^{-136} Jm^{12} ?

19. A paramagnetic material which obeys Curies law has 10^{28} atoms/m^3. If its susceptibility at 340 K is 3 x 10^{-4} find its susceptibility at 500K.

20. The intrinsic carrier density of Germanium at room temperature is 2.3 x10^{19} /m^3. The electron and hole mobilities are 0.36 and 0.19 m^2 /V s respectively. Find the resistivity.

21. The dielectric constant of a material is 1.01. Calculate its electronic polarisability if the gas contains 3 x 10^{25} atoms/m^3.

22. A superconducting material has a critical temperature of 4 K at zero magnetic field. It ha a critical field of 0.04 Tesla at 0 K. Find the critical field at 3 K.

(4 x 3 = 12 weightag