PHHT18102

M.Sc. DEGREE EXAMINATIONS, May 2019

First Semester

PHYSICS

Mathematical Physics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. Define tensor and list their types.
2. State Cauchy's residue theorem
3. Differentiate eigen value and eigen function.
4. What do you mean by Fourier transform?

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. Discuss the Schmidt's orthogonalisation process.

(OR)

b. What are symmetric tensors? Give their properties.

6. a. Determine whether the following are analytic functions (i) $\frac{1}{z}$ (ii) $\sin z$

(OR)

b. Evaluate the integral $\oint_c \frac{dz}{z^2+z}$ where c is a circle defined by $|z| = |R > 1|$

7. a. Show that $nP_n = (2n-1) \times P_{n-1} - (n-1)P_{n-2}$

(OR)

b. Write notes on Sturm-Liouville's operators.

8. a. List the properties of fourier transform.

(OR)

b. Evaluate Laplace transform of the functions sinh *at* and cosh *at*.

SECTION – C (4 x 8 = 32 Marks)

Answer any THREE questions

10.a. Define inner product of two vectors and thereby state and prove Schwartz inequality.

(OR)

b. Explain in detail the various operations of the tensors

11. a. State and prove Cauchy's integral theorem.

(OR)

b. State and prove Laurent's theorem for a complex function

12.a. Obtain the four recurrence formulae for Hermite polynomials

(OR)

b. Derive orthogonality relation for Bessel's functions

13. a. Find the finite Fourier transform of sin *ax*.

(OR)

b. Obtain Fourier and Laplace transform of delta function.

PHHT18206

M.Sc. DEGREE EXAMINATIONS, MAY 2019

Second Semester

PHYSICS

Quantum Mechanics - I

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =10 Marks)

Answer ALL questions.

1. What is Potential barrier?
2. Define Projection operator.
3. Define spin angular momentum?
4. Write down the Principle of WKB approximation method.

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. obtains the wave equation for a linear oscillator and solves it.

(OR)

b. Calculate the energy difference between the ground state and first excited state for an electron in one dimensional rigid box of length 10^{-10} m. (Mass of electron 9.1 x 10^{-31} kg & h = 6.626 x 10^{-34} joule-sec)

6. a. Define Hilbert space and illustrate its significance in the study of Quantum mechanics

(OR)

b. Explain Matrix theory of Harmonic Oscillator.

7. a. Discuss time independent perturbation theory and obtain first order correction to Eigen energy and function.

(OR)

b. Explain electrons are indistinguishable in spin wave function of the system.

8. a. Use the theory of WKB approximation for the calculation of energy of the ground state of Helium atom.

(OR)

b. Explain the time independent perturbation theory and obtain the correction of energy value and energy function

SECTION – C (4 x 8 = 32 Marks)

Answer ALL questions

9. a. Solve the Schrodinger wave equation in three dimensional for a free particle and discus the salient feature of the wave function.

(OR)

b. Derive an expression of Schrodinger's equation for a three dimensional harmonic Oscillator and obtain its Eigen value and Eigen function.

10. a. Explain and discuss the significance of Schrodinger Heisenberg and interaction representation matrix.

(OR)

b. (i). Explain Dirac's Bra and Ket notation

(ii). What is significance of operator in quantum mechanics, state with specific example of space and momentum operator.

11. a. If L_x, L_y, L_z are orbital angular momentum oprator, show that components commute with $[L_x, L_y] = i\hbar L_z$

(OR)

b. Deduce Clebsch- Gordon coefficient when two angular momenta $j_1 = ½$ and $j_2 = ½$ are coupled.

12. a. Describe validity of W.K.B. approximation tunneling through a potential barrier.

(OR)

b. Apply the first order perturbation result to calculate the ground state of helium atom.

PHHT18207

M.Sc. DEGREE EXAMINATIONS, APRIL-MAY 2019

Second Semester

PHYSICS

Statistical Mechanics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. Define ensemble.
2. Differentiate bosons and fermions.
3. What is specific heat? Give its unit.
4. Define phase transition.

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. What is phase space? explain

(OR)

b. Explain translational partition function.

6. a. Discuss the limit of applicability of the three distribution laws.

(OR)

b. State and explain Viral theorem.

7. a. Write a note on photon gas.

(OR)

b. Explain the Plank's law of radiation.

8. a. Explain the theory of Brownian motion.

(OR)

b. Differentiate first order and second order phase transition.

SECTION – C (4 x 8 = 32 Marks)

Answer ALL the Questions

9. a. State and prove Liouville's theorem.

(OR)

b. Demonstrate Gibb's paradox by mixing of two different ideal gases.

10. a. Using Maxwell's law, derive the distribution of velocities.

(OR)

b. Explain briefly the law of Equipartition of energy

11. a. With necessary theory explain Bose Einstein condensation.

(OR)

b. Discuss in detail the Pauli's theory of paramagnetism.

12. a. Explain in detail the Fluctuation dissipation theorem.

(OR)

b. Discuss in detail the Ising model.

PHHT18208

M.Sc. DEGREE EXAMINATIONS, MAY 2019

Second Semester

PHYSICS

Condensed Matter Physics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)
Answer ALL questions.

1. What is Umklapp process?.
2. Define Wideman- Franz law.
3. What is Coercive force?.
4. Define Meissonier Effect.

SECTION – B (4 x 5 = 20 Marks)
Answer ALL the Questions

5. a. Explain mono-atomic lattice vibration of crystalline structure.

(OR)

b. Briefly explain Debye model of the lattice heat capacity.

6. a. Explain Fermi Dirac energy distribution function.

(OR)

b. Define Hall Effect, and derive an expression of electron concentration by Hall experiment.

(OR)

7. a. Explain Curie point and the exchange integral of Ferromagnetism.

(OR)

b. Briefly explain Hysteresis loop of magnetic materials.

8. a. Distinguish between Type –I and Type –II superconductors with examples.

(OR)

b. What is cooper pair?, and explain BCS theory of superconductivity.

SECTION – C (4 x 8 = 32 Marks)
Answer ALL the Questions

9. a. Describe the inelastic scattering of neutrons by phonons, and also prove it can absorb or emit an amount of energy equal to a quantum of phonon energy.

(OR)

b. Describe Lattice heat capacity of density of mode in the one dimension and three dimensions solid state physics.

10. a. Derive an expression for classical theory of electrical conductivity and thermal conductivity of a metal and also derive Wideman Franz law from it.

(OR)

b. Derive an expression of electron density in an intrinsic semiconductors and also explain Fermi function (E_F) variation with temperature.

11. a. Define domain and derive the expression of Weiss theory of ferromagnetism.

(OR)

b. Explain: (i) Temperature dependence of saturation magnetization.
(ii) Anti-ferromagnetism with symbolic representation.

OR)

12. a. Define Local electrical field at an atom and derive Clausisus–Mossotti equation from Local field.

(OR)

b. (i) Briefly explain Josephson Effect and SQUAD.
(ii) Short notes about London Equation.

PHSC18210

M.Sc. DEGREE EXAMINATIONS, APRIL-MAY 2019

Second Semester

PHYSICS

Laser and it's Applications

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. Give the significance of Einstein's coefficients.
2. List the applications of dye lasers.
3. Explain Self focusing.
4. Define total internal reflection.

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. Explain the line shape function of a laser system.

(OR)

b. Write a note on Q switching.

6. a. Discuss the working of Excimer lasers.

(OR)

b. Write a note on the colour centres.

7. a. Explain multiquantum photoelectric effect.

(OR)

b. Write a note on Laser fluorescence.

8. a. What is numerical aperture? Derive the expression for it.

(OR)

b. Explain the various losses in optical fibres.

SECTION – C (4 x 8 = 32 Marks)

Answer ALL the Questions

9. a. Derive the Einsteins coefficients for Laser systems.

(OR)

b. Explain In detail the working of a four level Laser system.

10. a. Describe the construction and working of a CO_2 Laser.

(OR)

b. With a neat diagram explain the working of semiconductor Laser.

11. a. Discuss in detail the Photo acoustic Raman scattering.

(OR)

b. Explain in detail the theory of two photon process.

12. a. Briefly discuss the Modal analysis of a step index fibre.

(OR)

b. Explain the Gaussian approximation for a single mode fibre.

PHHT17312

M.Sc. DEGREE EXAMINATIONS, MAY 2019

Third Semester

PHYSICS

Electrodynamics and Plasma Physics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. Explain Cherenkov radiation.
2. What is adiabatic invariant?
3. What are shock waves?
4. Give the Lawson Criterion.

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. Differentiate scalar and vector potentials.

(OR)

b. What is Bremsstrahlung?

6. a. Give a review of plasma production by laser.

(OR)

b. write a brief account on optical properties and magnetic susceptibility of plasma.

7. a. Derive an expression for motion of a charged particles in EM field

(OR)

b. Write a note on time varying magnetic field?

8. a. Briefly explain plasma oscillation.

(OR)

b. Explain the Tokamak reactor for nuclear fusion applications.

SECTION – C (4 x 8 = 32 Marks)

Answer any THREE questions

9. a. i) Explain motion of charged particle in time varying magnetic field.

ii) Discuss in brief about first adiabatic invariant.

(OR)

b. Discuss the second third adiabatic invariants corresponding to a different type of periodic motion.

10. a. Discuss the motion of a charged particle in uniform electric field.

(OR)

b. Write notes on (1) Debye shielding (2) Optical properties of plasma.

11. a. Write the short notes on: (1) Kinetic pressure of partially ionized gas, and (2) Mean free path diffusion on charged particle.

(OR)

b. Discuss the motion of a charged particle in uniform electric field.

12. a. Derive an expression for MHD.

(OR)

b. Obtain an expression for Lienard-Wiechart potential.

PHHT17416

M.Sc. DEGREE EXAMINATIONS, April-May 2019

Fourth Semester

PHYSICS

Principles of Spectroscopy

LTime: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)
Answer ALL questions.

1. Write any three uses of infrared radiation.
2. How are stoke's & Anti-stoke's line formed?
3. What is chemical shift?
4. Write a Short note on hyperfine structure.

SECTION – B (4 x 5 = 20 Marks)
Answer ALL the Questions

5. a. Write an essay on infrared spectroscopy.

(OR)

b. Explain the gaseous polyatomic molecules.

6. a .Explain the Difference between Raman Spectra and fluorescence Spectra.

(OR)

b. What is Rayleigh scattering? How is the blue of the sky explained?

7. a. Describe the quantum mechanical theory of NMR spectroscopy.

(OR)

b.Explain the structural determination.

8. a.Write the Advantage of biological studies.

(OR)

b.Brief the quantum mechanical theory of ESR.

SECTION – C (4 x 8 = 32 Marks)
Answer any THREE questions

9. a.Give an elementary theory of the origin of vibrational spectrum of a molecules.

(OR)

b. Explain the elementary ideas of FTIR spectroscopy.

10.a.What is Raman effect? Explain Raman spectrum with diagram.

(OR)

b. Describe the quantum theory of Raman effect.

11.a. Define the NMR spectroscopy and explain theory of NMR Spectra.

(OR)

b.Explain the high resolution continues wave NMR spectrometer.

(OR)

12. a. Write an essay on theory of electron spin resonance spectroscopy.

(OR)

b. Expand the triplet states study of ESR Spectra.

PHHT17417

M.Sc. DEGREE EXAMINATIONS, April-May 2019

Fourth Semester

PHYSICS

Nuclear and Particle Physics

Time: 3 Hours Max. Marks: 60

SECTION – A (4 x 2 =8 Marks)
Answer ALL questions.

1. What is nuclear core?
2. Write the merits of liquid drop model.
3. When a nucleus emits a gamma ray photon, what happens to its atomic number and it's actual mass?
4. Write a Short note on Hadrons &Mesons.

SECTION – B (4 x 5 = 20 Marks)
Answer ALL the Questions

5. a. Explain the spin dependence of nuclear Force.

(OR)

b. Give the shape Independence effective range theory.

6. a. Found that angular momentum and parity of the whole nucleus.

(OR)

b. Explain the spin orbit coupling model.

7. a. Explain the forbidden transitions with selection rule.

(OR)

b. Mention the properties of neutrino of beta decay.

8. a. Discuss the neutrino particle and antineutrino particles.

(OR)

b.Explain three generations of quarks and leptons.

SECTION – C (4 x 8 = 32 Marks)
Answer any THREE questions

9 .a. Express the ground state of deuteron.

(OR)

b. Write the evidence of proton – proton at low energies.

10. a. How the shell model of a nucleus account for the existence of magic number.

(OR)

b. Expression of Bohr wheeler theory of nuclear fission.

11. a.What is nuclear isomers and explain internal conversion.

(OR)

b. Explain the Fermi theory of beta decay mention shape line spectrum.

12. a. Classify as examples of these four fundamental interactions.

(OR)

b. Expand the Gellman-Nishijima relations.

PHHT17418

M.Sc. DEGREE EXAMINATIONS, May 2019

Fourth Semester

PHYSICS

NANOSCIENCE

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. How metal nanoclusters are fabricated?
2. Mention any two applications of carbon nanotubes.
3. Define quantum dot.
4. What is MEMS?

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. Discuss the classification of nanomaterials.

(OR)

b. Explain the optical properties of nanostructured materials.

6. a. What do you mean by buckyball? Explain

(OR)

b. Explain CNT based chemical sensors.

7. a. Write a note on colossal magnetic resistance (CMR).

(OR)

b. What do you mean by Ferro fluid? Explain.

8. a. Explain biologic nanostructures.

(OR)

b. Describe DNA chip or biochip.

SECTION – C (4 x 8 = 32 Marks)

Answer any THREE questions

9. .a. Describe the modelling of nanoparticles with magic numbers.

(OR)

b. Discuss rare gas and molecular clusters.

10. a. Explain structure of carbon nanotubes and its mechanical properties.

(OR)

b. Describe the application of carbon nanotubes in fuel cells.

11.a. Nanostructured ferromagnetism-discuss in detail.

(OR)

b. Explain any two spectroscopic techniques for the study of nanostructures.

12.a. Describe nanoelectro mechanical system.

(OR)

b. Explain targeted drug delivery using nanoparticles.

PHSC17420

M.Sc. DEGREE EXAMINATIONS, May- 2019

Fourth Semester

PHYSICS

General Concepts In Physics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)
Answer ALL questions.

1. What is physics? How it can be classified?
2. State Newton's law of gravitation.
3. Wave-particle duality-explain.
4. What are fermions?

SECTION – B (4 x 5 = 20 Marks)
Answer ALL the Questions

5. a. Brief the development of physics.

(OR)

b. What do you mean by length scale? Explain.

6. a. State and explain Kepler's law of planetary motion.

(OR)

b. What are inertial frames? Explain.

7. a. Define photoelectric effect and explain.

(OR)

b. State and explain Heisenberg's Uncertainty principle.

8. a. Derive Bose-Enistein distribution law.

(OR)

b. Classify the elementary particles and explain.

SECTION – C (4 x 8 = 32 Marks)
Answer any THREE questions

9.a. Discuss the time scales of physics.

(OR)

b. Explain energy scales in physics.

10.a. How universe is formed? Discuss in detail.

(OR)

b. Describe Einstein's theory of special relativity.

11.a. With a neat diagram explain Stern-Gerlach experiment.

(OR)

b. Explain discrete energy levels and spin.

12.a. Obtain Maxwell-Botlzmann distribution law.

(OR)

b. Briefly explain the fundamental interactions.

PHHT16102

M.Sc. DEGREE EXAMINATIONS, JAN-2019

First Semester

PHYSICS

Mathematical Physics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. Define Groups.
2. State Cauchy's residue theorem
3. Define gamma and beta functions.
4. What do you mean by Fourier transform?
5. Define a vector space.
6. Describe Rodriguez formula.
7. Describe Convolution theorem.
8. Define Taylor's series.
9. Explain scalars.
10. Explain Eigen functions.

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

11. a. Explain Linear independence and dependence of vectors.

(OR)

b.State and prove quotient law of tensors

12. a. Derive the Cauchy- Riemann

(OR)

b.Evaluate using residue theorem $\int_0^{2\pi} \frac{1}{13+12\sin(x)}\,dx$

13. a. Prove that $\Gamma(1/2) = \sqrt{\pi}$

(OR)

b. Explain in detail the various operations of the tensors.

14.a. Discuss Fourier cosine (sine) transform of a derivative in detail.

(OR)

b.Explain the relations between Gama and beta functions.

15. a. State and explain quotient rule in tensor analysis.

(OR)

b. Obtain the Recurrence of integral.

SECTION – C (4 x 8 = 32 Marks)

Answer ALL questions

16. Where are the singular points of Bessel's differential equation.

$x^2+xy'+(x^2-m^2)y=0$, located? Classify them.

17. Explain in detail

1. Covariant and Contra variant tensors 2. Symmetric and anti-symmetric tensors.

18. Drive the Cauchy integral formula.
19. Drive orthogonality relation for Bessel's functions.
20. Drive the Hermit differential equations.

PHHT16207

M.Sc. DEGREE EXAMINATIONS, MAY 2019

Second Semester

PHYSICS

Quantum Mechanics - I

Time: 3 Hours **Max. Marks: 60**

SECTION – A (10 x 1 =10 Marks)

Answer ALL questions.

1. What is Potential barrier?
2. Define Projection operator.
3. Define spin angular momentum?
4. Write down the Principle of WKB approximation method.
5. Define Operator method.
6. What is meant by Hilbert space?
7. What is selection rule?
8. Define degenerate and non degenerate state.
9. What is the principle of W.K.B. approximation?,
10. What is ground state?

SECTION – B (5 x 4 = 20 Marks)

Answer ALL the Questions

11. a. obtains the wave equation for a linear oscillator and solves it.

(OR)

b. Calculate the energy difference between the ground state and first excited state for an electron in one dimensional rigid box of length 10^{-10} m. (Mass of electron 9.1 x 10^{-31} kg & h = 6.626 x 10^{-34} joule-sec)

12. a. Define Hilbert space and illustrate its significance in the study of Quantum mechanics

(OR)

b. Explain Matrix theory of Harmonic Oscillator.

13. a. Discuss time independent perturbation theory and obtain first order correction to Eigen energy and function.

(OR)

b. Explain electrons are indistinguishable in spin wave function of the system.

14. a. Use the theory of WKB approximation for the calculation of energy of the ground state of Helium atom.

(OR)

b. Explain the time independent perturbation theory and obtain the correction of energy value and energy function

15. a. Solve the one dimensional Schrodinger's wave equation a free particle in a box.

(OR)

b. Write down the Eigen values of Harmonic Oscillator.

SECTION – C (3 x 10 = 30 Marks)

Answer ALL questions

16. Solve the Schrodinger wave equation in three dimensional for a free particle and discus the salient feature of the wave function.
17. Derive an expression of Schrodinger's equation for a three dimensional harmonic Oscillator and obtain its Eigen value and Eigen function.
18. Explain and discuss the significance of Schrodinger Heisenberg and interaction representation matrix.
19. . (i). Explain Dirac's Bra and Ket notation
    (ii). What is significance of operator in quantum mechanics, state with specific example of space and momentum operator.
20. . If L_x, L_y, L_z are orbital angular momentum oprator, show that components commute with $[L_x, L_y] = i\hbar L_z$

PHHT16419

M.Sc. DEGREE EXAMINATIONS, May 2019

Fourth Semester

PHYSICS

Nuclear And Particle Physics

Time: 3 Hours **Max. Marks: 60**

SECTION – A (10 x 1 =10 Marks)
Answer ALL questions.

1.Give any Two characteristics of nuclear Force.

2. What are spin orbital coupling?

3. Define activity? How will you the calculate mean life periods.

4. What does a Tau particle do?

5. What is nuclear core?

6. Write the merits of liquid drop model.

7. When a nucleus emits a gamma ray photon, what happens to its atomic number and it's actual mass?

8. What is Resonant states?

9. Why electron cannot be present inside nucleus?

10. What are the selection rules.

SECTION – B (5 x 4 = 20 Marks)
Answer ALL the Questions

11. a. Explain the spin dependence of nuclear Force.

(OR)

b. Distinguish between magnetic dipole moment and electric quadrupole moment

12. a. Describe the collective model of Bohr mottelson.

(OR)

b. Explain NILSON diagrams.

13. a. Write the properties of gamma rays.

(OR)

b. What are the selection rules? And explain forbidden transitions.

14. a. Difference between Hadrons and leptons?

(OR)

b. Why do quarks have charge? Describe the fundamental of three elementary particles.

15. a. Discuss the neutrino particle and antineutrino particles.

(OR)

b. Explain three generations of quarks and leptons.

SECTION – C (3 x 10 = 30 Marks)
Answer any THREE questions

16. Analyse the high energy nucleon in p-p scattering.

17 Give a evidence in favour of a level structure in a Nuclei. State main assumptions in shell model of nuclei.

18. What is magic number? Experimental evidence for shell model.

19. Brief discussion of electromagnetic multiple moments transitions in nuclei..

20. Write the evidence of proton – proton at low energies.

PHHT16420

M.Sc. DEGREE EXAMINATIONS, MAY 2019

Fourth Semester

PHYSICS

Nano Science

Time: 3 Hours Max. Marks: 60

SECTION – A (10 x 1 =10 Marks)
Answer ALL questions.

1. What is a nanotube?
2. Mention any two applications of carbon nanotubes.
3. What are fullenrences?
4. What is a fuel cell?
5. State one application of fuel cells.
6. What is a ferro fluid?
7. Define quantum dot.
8. What is MEMS?
9. Mention any two applications of carbon nanotubes.
10. What do you mean by drug delivery system?

SECTION – B (5 x 4 = 20 Marks)
Answer ALL the Questions

11. a. How did you classify the nanomaterials? Explain.

(OR)

b. Explain the optical properties of nanostructured materials.

12. a. Write a note on metal nanoclusters.

(OR)

b. What do you mean by buckyball? Explain

13. a. Write a note on small carbon clusters.

(OR)

b. Explain CNT based chemical sensors.

14. a. Discuss nanocarbon ferromagnets.

(OR)

b. What do you mean by colossal magnetic resistance? Explain.

15. a. Write a note on colossal magnetic resistance (CMR).

(OR)

b. Discuss any one nanodevice and its applications.

SECTION – C (3 x 10 = 30 Marks)
Answer any THREE questions

16. Distinguish between rare gas and inert gas molecular clusters.
17. What do you mean by Ferro fluid? Explain.
18. Explain carbon nanotubes in detail.
19. Explain i) colossal magnetic resistance and ii) gravitation magnetic resistance.
20. Describe DNA chip or biochip.

PHHT17311

M.Sc. DEGREE EXAMINATIONS, MAY 2019

Third Semester

PHYSICS

Quantum Mechanics-II

Time: 3 Hours **Max. Marks: 60**

SECTION – A (4 x 2 =8 Marks)

Answer ALL questions.

1. Define Fermi Golden Rule.
2. What are Green's functions?
3. Define Eigen states.
4. What is meant by quantum harmonic oscillator?

SECTION – B (4 x 5 = 20 Marks)

Answer ALL the Questions

5. a. Explain Golden rule for the transition rate from a given initial to final state of continuum.

(OR)

b. Explain periodic perturbation and harmonic perturbation.

6. a. Describe the coulomb potential scattering from Born approximation.

(OR)

b. Discuss the scattering length and effective range.

7. a. Derive an equations of charge and current densities.

(OR)

b. Obtain the Klein Gordan relativistic equation for a free particle.

8. a. Derive Electromagnetic wave as harmonic oscillators.

(OR)

b. Explain quantisation of electromagnetic fields in the absence of charge and currents.

SECTION – C (4 x 8 = 32 Marks)

Answer any THREE questions

9.a. Prove that the transition probability per unit time is $\frac{2\pi}{\hbar} p(k) |H_{km}|^2$

Where p (k) denotes the density of final states $|H_{km}|^2$ is the matrix element of the perturbation term.

(OR)

b. Discuss the Einstein's co efficient of spontaneous emission and induced emission of transitions. Derive a relationship between A and B co efficients.

10.a. Using particle wave analysis, deduce the equation for different scattering amplitude in terms of phase shifts.

(OR)

b. Give the theory of Born approximation discuss its validity for the scattering by square well potential.

11.a. Write down the Dirac relativistic equation for a free particles and obtain its solution. Discuss various implication of negative energy states.

(OR)

b. Explain how the spin and magnetic moment of the electron are obtained in Dirac's relativistic theory.

12.a. Show that an electromagnetic field can be thought of an mathematically equivalent to the system of harmonic oscillators.

(OR)

b. Write a short notes on: (i) Second quantisation (ii) number operator, creation and annihilation operators (iii) Photons-energy spectrum of wave functions.