R–3014

Sub. Code
521201/ 522201

M.Sc. DEGREE EXAMINATION, APRIL 2019

Second Semester

Physics/Physics (Spelization in Biosensor)

QUANTUM MECHANICS – I

(Common for M.Sc. Physics/ M.Sc. Physics (Spelization in Biosensor))

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. How does the mass of meson relate by uncertainty principle?

2. If $V = \frac{1}{2} m\omega^2 x^2$, find the wave equation from Schrödinger's time-independent equation.

3. Write down the postulates of quantum mechanics.

4. Define zero point energy of harmonic oscillator.

5. Write down the matrix representation of ψ .

6. If $|a>$ and $|b>$ are arbitrary kets, prove that $\overline{|a><b|} = |b><a|$.

7. What is the principle of perturbation theory?

8. Define Stark effect.

9. Mention your understanding of selection rules.

10. What are coherent and incoherent scattering?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Show that the probability current density as $J(r,t)=\frac{i\hbar}{2m}(\psi\nabla\psi^{*}-\psi^{*}\nabla\psi)$.

Or

(b) Establish the Schrodinger's equation for a linear harmonic oscillator and solve it.

12. (a) Deduce the expression of the radial part of Schrodinger's equation for hydrogen atom problem in spherical polar coordinates.

Or

(b) What is rigid rotator? Deduce the expression to find the moment of inertia of rigid rotator.

13. (a) Outline the Dirac' s bra and ket vector.

Or

(b) What is Schrodinger's picture? Explain the interaction representation for describing the dynamical behavior of a system.

14. (a) Obtain the expression of probability of penetration of a barrier and obtain transmission coefficients.

Or

(b) Calculate the first order Stark effect in ground state of hydrogen atom.

15. (a) What are Einstein's coefficients? Obtain its relations.

Or

(b) Explain the Fermi – Golden rule. Prove that the transition probability per unit time for j^{th} group is $\frac{2\pi}{\hbar}\rho(k)|< k|H'|m >|^2$.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. State and describe the Ehrenfest's theorem.

17. Find the eigen value and eigen function of a particle in one dimensional box.

18. Explain the simple harmonic oscillator problem by matrix representation.

19. State the principle and deduce the expression of W.K.B approximation.

20. Show that the polarizability of a medium as $\alpha = \frac{2N}{3\hbar}\sum_k \frac{\omega_{kn}|\mu_{kn}|^2}{\omega_{kn}^2 - \omega^2}$ from Rayleigh's scattering.

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R–3015

Sub. Code
521202/ 522202

M.Sc. DEGREE EXAMINATION, APRIL 2019

Second Semester

Physics/Physics (Spl. in Biosensor)

MATHEMATICAL PHYSICS – II

(Common for M.Sc. Physics/M.Sc. Physics (Spl. in Biosensor)

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Write down the Cauchy-Riemann condition in polar form.

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

3. Mention heat flow equation. Write the same in spherical coordinates form.

4. Write any two properties of one dimensional Green's function.

5. Define Quotient law.

6. What is equality of tensor?

7. What is group? Give examples.

8. Define reducible and irreducible representation.

9. Define empirical probability.

10. State the addition law of probability.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Expand $f(z)=\frac{1}{(z+1)(z+3)}$ as a Laurent's series valid, for $|z|<1$.

Or

(b) Find the poles and residues at the poles of the function $f(z)=\frac{z+1}{z^2+2z}$.

12. (a) State and prove Sturn - Liouville theory.

Or

(b) Obtain the solution of Laplace equation in Cartesian coordinates by method of separation of variables.

13. (a) Show that $[\mu v,\sigma]+[\sigma v,\mu]=\frac{\partial g_{\sigma\mu}}{\partial x^{v}}$.

Or

(b) Describe the theory of metric tensor.

14. (a) Describe Homomorphism and Isomorphism.

Or

(b) What is SU(2) group? Give its irreducible representation.

15. (a) Define Poisson's distribution. Discuss its importance.

Or

(b) Obtain the expression of Gauss normal distribution.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. (a) State and deduce Cauchy's integral formula.

(b) Evaluate $\int_C \frac{dz}{z^2-1}$ where c is a circle $x^2 + y^2 = 4$.

17. (a) Deduce the expression of Gram-Schmidt orthogonalization.

(b) Explain the completeness of eigen function.

18. State and deduce Geodesics.

19. Define and deduce the proof of orthogonality theorem.

20. (a) Deduce the expression of Binomial distribution and give the first four moments of it.

(b) The following data are the number of seeds germinating out of 10 on damp filter for 80 sets of seeds. Fit a Binomial distribution to this data.

X:	0	1	2	3	4	5	6	7	8	9	10
Y:	6	20	23	12	8	6	0	0	0	0	0

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R–3016

Sub. Code
521203/ 522203

M.Sc. DEGREE EXAMINATION, APRIL 2019.

Second Semester

Physics / Physics (Spl. in Biosensor)

ELECTROMAGNETIC THEORY

(Common for M.Sc. Physics / M.Sc. Physics (Spl. in Biosensor))

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

All questions carry equal marks.

1. What is meant by the characteristic impedance of a medium?

2. What is the source of vector potential?

3. What is called p-polarization of e.m. waves?

4. State Brewster's law.

5. What is the difference between dispersion and scattering of e.m. waves by a medium?

6. What is said to be long-wavelength scattering of e.m. waves?

7. What are the characteristics required for a wave-guide?

8. What are the different modes used for microwave propagation through waveguides?

9. What are plasma oscillations?

10. What is called bump-on-tail instability of plasma?

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

All questions carry equal marks.

11. (a) State and prove Poynting theorem.

Or

(b) Discuss the energy conservation of e.m. wave propagation.

12. (a) Discuss the boundary conditions to be satisfied by the e.m. waves across the interface between two dielectric media.

Or

(b) Discuss the theory of total internal reflection and deduce the condition for it.

13. (a) Explain an experimental study of anomalous dispersion in liquids.

Or

(b) Derive the Clausius-Mossotti equations to study the dispersion of light in a dielectric medium.

14. (a) Explain the working of Magnetron and production of microwaves.

Or

(b) Derive the formula for the retarded vector potential for a moving point charge.

15. (a) Discuss about the conditions required for plasma existence.

Or

(b) Discuss the theory of magnetic confinement of plasma.

Part C (3 × 10 = 30)

Answer any **three** questions.

All questions carry equal marks.

16. Derive the continuity equation for the propagation of e.m. waves in a medium.

17. Derive an expression for the transmission coefficient for the s-polarization of the e.m wave across the air-glass interface.

18. Discuss the theory of coherent scattering of light by a medium.

19. Discuss the theory and working of a Gunn diode.

20. Discuss the dynamics of charged particles in the uniform and combined electric and magnetic fields.

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R–3020

Sub. Code
521403/ 522401

M.Sc. DEGREE EXAMINATION, APRIL 2019

Fourth Semester

Physics/Physics (Spl. in Biosensor)

MATERIALS SCIENCE

(Common for M.Sc. Physics/M.Sc Physics (Spl. in Biosensor)

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Section A (10 × 2 = 20)

Answer **all** questions.

All questions carry equal marks.

1. Define viscoelastic deformation.

2. What is a polymer? Write their main characteristics?

3. What is diffusion barrier give two examples of diffusion barrier?

4. State Kinetic theory of gases.

5. Why Second Harmonic generation is important?

6. Define Kerr effect.

7. Define the term composite.

8. What is a hybride composite?

9. Write any two differences for amorphous and glassy materials.

10. Define MEMS.

Section B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) Briefly explain about the principle of corrosion.

Or

(b) Explain the types of bonding that exist in polymers.

12. (a) Discuss about the working and construction of Turbo Molecular Pump.

Or

(b) Elucidate the lattice mismatch and its influence on the introduction of strain.

13. (a) Briefly explain about the various methods of Q-switching.

Or

(b) Describe the construction and working of He-Ne laser.

14. (a) Under Iso stress condition, obtain the expression for Young's Modulus of a fibre-reinforced composites.

Or

(b) Mention three important limitations that restrict the use of concrete as a structural material and Why the glass fibres are most commonly used for reinforcement?

15. (a) What is MEMS? Write a note on application of MEMS in automotive industry.

Or

(b) Explain vibration control through shape memory alloys, with an examples.

Section C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Why are metals mostly ductile and ceramics brittle at room temperature?

17. State and briefly explain any four sources of defects in epitaxy thin films.

18. Discuss the features, lasing transitions, operations of Nd:YAG laser.

19. What is the difference between matrix and dispersed phases in a composite material? Contrast the mechanical characteristics of matrix and dispersed phase for fibre reinforced composite materials?

20. Describe the current generation actuator and give two examples.

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R–3022	Sub. Code 522504

M.Sc. DEGREE EXAMINATION, APRIL 2019.

Second Semester

Physics (Spl. in Biosensors)

BIOSENSORS — II

(CBCS – 2018 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is semiconductor?

2. Define field effect transistor.

3. What is DNA hybridization sensing?

4. Define immunosensing.

5. Define absorption.

6. State the principle of Surface Plasmon Resonance (SPR).

7. What is bio catalysis?

8. Mention the elemental properties of affinity based biosensors.

9. Define dielectric constant.

10. What is the use of strain gauge?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain the operation principle of Field Effect Transistor.

Or

(b) Explain principle and working of semiconductor based bio sensing.

12. (a) Explain voltammetry and amperometry techniques with suitable diagrams.

Or

(b) Describe in detail the immunosensing and also write its merits and demerits.

13. (a) Explain in detail on Attenuated Total Reflectance (ATR).

Or

(b) Describe the principle and operation of acoustic biosensors.

14. (a) Explain multiple enzyme based biosensors.

Or

(b) Explain microorganisms based biosensors.

15. (a) Define inductive type of sensor and explain Linear Variable Differential Transformer (LVDT).

Or

(b) Explain principle and working of potentiometer with neat diagram.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Explain the detection of urea by ion sensitive field effect sensing.

17. Describe in detail the DNA hybridization sensing.

18. Explain in detail the surface plasmon resonance based sensors.

19. Discuss in detail the carbon electrode enzyme based biosensors with neat sketch.

20. Describe in detail the capacitive sensors and also its types and operation.

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R–3230

Sub. Code
522301

M.Sc. DEGREE EXAMINATION, APRIL 2019

Third Semester

Physics (Spl. In biosensors)

CONDENSED MATTER PHYSICS

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Explain miller indices.
2. Define primitive cell.
3. What is meant by Fermi energy?
4. What are semiconductor materials?
5. Define Dielectric constant.
6. Explain polarization.
7. What is magnetization?
8. Define diamagnetism.
9. What is cooper pair?
10. Explain coherence length.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain the reciprocal lattice concept and obtain Bragg's diffraction conditions in terms of reciprocal lattice.

Or

(b) Draw neatly the structure of NaCl, Diamond and CsCl crystal and explain their structure.

12. (a) Write short notes on electrical properties of metal.

Or

(b) Explain in detail the diatomic lattices.

13. (a) Describe the Clausius —Mosotti relation.

Or

(b) Discuss on Lorentz electric field.

14. (a) Explain the classification of magnetic materials.

Or

(b) Discuss on Paramagnetism and ferromagnetism.

15. (a) Write the importance of London penetration depth.

Or

(b) Explain in detail about high temperature superconductors.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Describe the types of crystal structures and crystal defects.

17. Write the classification of Fermi energies of impurity semiconductors.

18. Write the short on dielectric properties of crystal.

19. Discuss on Langevin's theory of paramagnetism.

20. Briefly explain about isotope effect and Josephson effect.

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R–3231

Sub. Code
521302/522302

M.Sc. DEGREE EXAMINATION, APRIL 2019

Third Semester

Physics/Physics (Special in Biosensors)

QUANTUM MECHANICS – II

(Common for Physics/Physics (Special in Biosensors))

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is angular momentum?
2. What are eigen functions and eigen values?
3. What are Bosons?
4. What is Meant by Permions?
5. Explain the spin magnetic moment.
6. Define plane wave solutions.
7. Draw a schematic diagram of a scattering event.
8. What is meant by particle wave analysis?
9. What is elastic scattering?
10. Explain the band structure of semiconductor.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Discuss the eigen value spectrum.

Or

(b) Write in detail about addition of angular momentum.

12. (a) Explain the total wave function of spin angular momentum.

Or

(b) What is the difference between symmetric and anti symmetric wave function.

13. (a) Write short notes on non-relativistic Hamiltonian including spin.

Or

(b) Explain the Thomson-fermi model of the atom.

14. (a) Explain in detail about the Klein-Gordan equation.

Or

(b) Discuss the negative energy states.

15. (a) Write in detail about the scattering cross section.

Or

(b) briefly explain the diffusion scattering.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Describe the addition of spin and orbital angular momentum.

17. Derive Hartree-Fock equation.

18. Explain in detail the spin of the dirac particle.

19. Briefly explain about the quantization of electromagnetic field.

20. Describe the optical theorem.

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