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–3017

Sub. Code
521503

M.Sc. DEGREE EXAMINATION, APRIL 2019

Second Semester

Physics

THERMODYNAMICS AND STATISTICAL MECHANICS

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

All questions carry equal marks.

1. What are called intensive variables? Give two examples.

2. Pick out the microstate from the following :
   (a) Specific volume of an atom.
   (b) Instantaneous momentum of an atom.

3. What is called the partition function?

4. What is called the free energy of a thermodynamic system?

5. State Maxwell-Boltzmann law for a classical gas.

6. What is the classical limit of Fermi-Dirac distribution?

7. What is known as the Bose condensation?

8. What is called antiparticle?

9. What is called the Debye temperature?

10. What is called symmetry based phase transition?

Part B (5 × 5 = 25)

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

All questions carry equal marks.

11. (a) Derive the equation of state of a van der Waal's gas.

Or

(b) Derive the Maxwell relation $\left(\partial T / \partial V\right)_S = -\left(\partial P / \partial S\right)_V$.

12. (a) Deduce an expression for the distribution function of a microcanonical ensemble.

Or

(b) State and prove the viral theorem.

13. (a) Derive the energy fluctuation equation for a canonical ensemble.

Or

(b) Derive the Bose-Einstein distribution for a microcanonical ensemble.

14. (a) Discuss the theory of bosons and derive an expression for the number density of them.

Or

(b) Discuss the theory of Brownian motion.

15. (a) Discuss the theory of a heteronuclear diatomic gas.

Or

(b) Discuss the difference between first-order and second-order phase transitions.

Part C (3 × 10 = 30)

Answer any **three** questions.

All questions carry equal marks.

16. Derive the density of states of microstates of a thermodynamic system.

17. Prove the Gibbs paradox and obtain the correct formula for entropy.

18. Derive the Boltzmann equation for change of states, neglecting collisions.

19. Discuss the theory of fermions at zero Kelvin and derive equations for the pressure and energy density of them.

20. Discuss the theory of one-dimensional Ising model.

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R–3018

Sub. Code
521401

M.Sc. DEGREE EXAMINATION, APRIL 2019

Fourth Semester

Physics

CONDENSED MATTER PHYSICS

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

All questions carry equal marks.

1. How does a crystal differ from a grain?
2. Distinguish between covalent and ionic crystals with examples.
3. Give the order of band gap for a metal, a semiconductor and an insulator.
4. Why a solid whose energy bands is filled cannot be a metal?
5. Define electric displacement vector.
6. What is piezoelectricity?
7. What is the basic cause of paramagnetism?
8. What is exchange field?
9. What is vortex state of a superconductor?
10. Enlist the main applications of superconductors.

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

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

11. (a) What is meant by Symmetry? Explain different types of symmetries with suitable diagrams.

Or

(b) Explain the concepts of reciprocal lattice. Discuss its properties and importance.

12. (a) Describe the Einstein model of lattice heat capacity.

Or

(b) Deduce vibrational modes of a finite one-dimensional monoatomic lattice.

13. (a) Derive the Clausius-Mossotti relation expressing the relationship between the dielectric constant and atomic polarizability.

Or

(b) Explain the theory of Ferroelectrics.

14. (a) Explain how and why are the ferromagnetic domain formed. Draw a typical B-H loop and describe the different magnetization processes, which lead to the formation of a B-H loop.

Or

(b) Derive an expression for diamagnetic susceptibility using quantum theory.

15. (a) Derive London equations and explain its implication.

Or

(b) Explain how the electron-phonon interaction helps to produce the cooper pairs.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Draw a plan view of NaCl structure. In how many ways can this structure be interpreted?

17. Obtain the dispersion relation of diatomic linear lattice and indicate the behavior of acoustic and optic modes.

18. What are the characteristics of a ferroelectric crystal? Explain with examples, the order-disorder and dispersive type ferroelectrics.

19. Give an account of the Weiss theory of ferromagnetism. Discuss the temperature variation of saturation magnetization.

20. Describe the Josephson effect underlying a SQUID. Discuss the applications of SQUID.

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R–3019	Sub. Code
	521402

M.Sc. DEGREE EXAMINATION, APRIL 2019

Fourth Semester

Physics

NUCLEAR AND PARTICLE PHYSICS

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

All questions carry equal marks.

1. What are conservation laws retained in α-decay?
2. Distinguish between Alpha decay and Gamma decay.
3. What are inadequacies of liquid drop model?
4. Why is the interaction potential complex in optical model?
5. What is plasma?
6. Give four characteristics of nuclear forces.
7. Enumerate different types of modern nuclear reactor.
8. Write the names of various components of anyone nuclear reactor.
9. Give quark structure of protons and neutrons.
10. Give two points of distinctions between electron and positron.

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

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

11. (a) Define α-particle disintegration energy and derive an expression for it.

Or

(b) Discuss various methods for the determination of β-ray emergies.

12. (a) Describe the Fermi gas nuclear model. What are its successes and failures?

Or

(b) What are magic numbers? How magic numbers and energy levels were predicted by single particle model?

13. (a) What is nuclear fusion? What is its importance in the generation of nuclear energy?

Or

(b) Give a logical account of the nature of forces between a proton and a neutron in deuterons.

14. (a) Discuss the importance of delayed neutrons to control nuclear reactors.

Or

(b) Discuss how nuclear fusion is regarded as a source of stellar evolution and stellar energy.

15. (a) What do you understand by the classification of elementary particles? Why such a classification is required?

Or

(b) Explain the concept of strangeness and principles of associated productions.

Part C (3 × 10 = 30)

Answer any **THREE** questions.

16. Give Fermi theory of β -decay. Discuss the selection rules for allowed transitions. What are the forbidden transitions?

17. Discuss semi-empirical mass formula explaining meaning of each term in it and state its limitations.

18. Give the theory of n-p scattering at low energy. Discuss how the assumptions of spin dependence of nuclear force can explain the experimental results.

19. Discuss the construction and working of a nuclear reactor. Mention some reactors working in India. What are the differences between slow, fast and breeder reactors?

20. Describe main characteristics of strong, electromagnetic and weak interaction. Give their conservation laws.

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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–3021

Sub. Code
521507

M.Sc. DEGREE EXAMINATION, APRIL 2019

Fourth Semester

Physics

DIGITAL ELECTRONICS PRINCIPLES

(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 two state number system?
2. What is odd and even parity?
3. How karnaugh map is utilized?
4. State De Morgan's theorem and write down its Boolean representation.
5. Define modulus of a counter
6. What is the purpose of the registers?
7. Among serial shift register and parallel shift register, which one will take data pulse?
8. Explain the terms accuracy and resolution.
9. List out the uses of floppy disk.
10. What is destructive reading of a memory cell?

Part B (5 × 5 = 25)

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

All questions carry equal marks.

11. (a) Explain the method of conversion of octal to decimal.

Or

(b) Explain briefly about ASCII code and EBCDIC code.

12. (a) How a positive logic AND gate and Negative logic OR gate are equal? Explain with the necessary diagrams.

Or

(b) State and explain De Morgan's theorem and write down its Boolean representation.

13. (a) Explain the working of R-S flip flop with a diagram.

Or

(b) Discuss the working of ripple counter with suitable example.

14. (a) Explain the operation of half subtractor with necessary diagrams.

Or

(b) Explain the concept of construction of parallel subtractor with necessary diagrams.

15. (a) Write a short note on magnetic memory.

Or

(b) Explain how data is organized on a floppy disk.

Part C (3 × 10 = 30)

Answer any **three** questions.

All questions carry equal marks.

16. Briefly explain the binary to hexadecimal conversion.

17. Minimize the function, $F = \sum m(0, 1, 2, 3, 11, 12, 14, 15)$ using Karnaugh map, and realize it in NORlogic.

18. Define registers and explain their classification in detail.

19. Briefly explain the operation of Half adder and binary subtractor. Obtain the expressions for the circuit with suitable truth table.

20. Define ROM and briefly explain its types.

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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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R–3258

Sub. Code
521101/ 522101

M.Sc. DEGREE EXAMINATION, APRIL 2019.

First Semester

Physics / Physics (Spl. in Biosensors)

CLASSICAL MECHANICS

(Common for M.Sc. Physics/M.Sc. Physics (Spl. In Biosensors)

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What do you mean by degrees of freedom?
2. What are the constraints?
3. What is a cyclic coordinate?
4. What is a Hamiltonian for a simple pendulum?
5. How many generalized coordinates are needed to specify the motion of a rigid body?
6. Define inertia tensor.
7. Show that Lorentz transformation equations are superior to Galilean transformations.
8. What are coupled oscillators?
9. What are normal coordinated and normal frequencies?
10. What is dispersion relation?

Part B (5 × 5 = 25)

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

11. (a) State and prove D'Alemberts principle.

Or

(b) Define a Lagrangian expression for a charged particle in a electromagnetic field.

12. (a) Obtain the Hamilton's equation interms of polar coordinates.

Or

(b) Describe the Hamiltonian and Hamilton's equations for a ideal spring mass arrangements.

13. (a) What do you mean by inertia tensor. Explain what you understand by principal axes and the principal moments of inertia.

Or

(b) Discuss the Euler's angle as the generalized coordinates for a rigid body motion.

14. (a) Discuss the principle of relativity and the invariance of speed of light. Use this principle to deduce Lorentz transformation.

Or

(b) Obtain Einstein formula for addition of velocities.

15. (a) Discuss different types of equilibria with illustration.

Or

(b) Derive an expression for the equation of motion for the two coupled oscillators.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. What is Hamilton's principle? Derive an equation of motion for a particle moving under central force.

17. Derive Hamilton's canonical equations of motion. Obtain Hamilton's equation of motion for a particle moving in a central force field.

18. A rigid body rotating about an axis through the origin. Deduce the relations connecting the components of total angular momentum with the components of the angular velocity.

19. Describe the Michelson-Morely experiment. What was the purpose of this experiment and what was the conclusion? What significant change this experiment could introduce in the Galilean theory of relativity?

20. Discuss the vibrations of a linear triatomic molecule.

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R–3259

Sub. Code
522102/ 521102

M.Sc. DEGREE EXAMINATION, APRIL 2019

First Semester

(Physics/Physics (Spl. in Biosensors))

MATHEMATICAL PHYSICS — I

(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.

1. State Gauss divergence theorem

2. Evaluate $\int \vec{F}.d\vec{r}$ where $\vec{F}=xy\vec{i}+y\vec{j}$ and C is a curve $\vec{r}=t\vec{i}+t^2\vec{j}, t$ varying from –1 to 1.

3. Define Unitary matrix.

4. Find the Eigen values of the matrix.

5. Show that $\frac{2}{3}P_2(x)+\frac{1}{3}P_0(x)=x^2$.

6. Define Beta function.

7. Write Hermite's differential equation and its solution.

8. Find the value of $L_1(x)$.

9. State and explain the shifting property of Fourier transform.

10. Find the inverse Laplace transform of $\frac{e^{-\pi s}}{s^2+1}$.

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

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

11. (a) Prove that

(i) $div\ curl\ A = 0$ and

(ii) $curl\ grad\ \phi = 0$.

Or

(b) Obtain the expression for grad ψ and div A in general orthogonal coordinates.

12. (a) Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 7 \\ 3 & 6 & 10 \end{bmatrix}$.

Or

(b) Prove that any matrix can be expressed as the sum of symmetric and anti-symmetric matrices.

13. (a) Find the values of

(i) $\Gamma\frac{1}{9}\Gamma\frac{2}{9}\Gamma\frac{3}{9}.....\Gamma\frac{8}{9}$

(ii) $\Gamma(0.1)\,\Gamma(0.2).....\Gamma(0.9)$.

Or

(b) Show that $\int_{-1}^{1} x\,P_n(x)\,P_{n-1}(x)\,dx = \frac{2n}{4n^2-1}$.

14. (a) Prove that

(i) $H'_n(x) = 2n H_{n-1}(x)$

(ii) $2x H_n(x) = 2n H_{n-1}(x) + H_{n+1}(x)$.

Or

(b) Show that $L_n(x) = \frac{e^x}{n!}\frac{d^n}{dx^n}(x^n e^{-x})$.

15. (a) Find the Fourier sine transform of

$$f(x) = \begin{cases} \sin \omega_0 t; & |t| \le \dfrac{N\pi}{\omega_0} \\ 0\ ; & |t| > \dfrac{N\pi}{\omega_0} \end{cases}.$$

Or

(b) State and prove the first and second shifting's theorems of Laplace transform.

Section C (3 × 10 = 30)

Answer any **three** questions.

16. Use Gauss divergence theorem to prove the following results:

(a) $\iiint_V \nabla \phi \, dV = \iint_S \phi \, dS$

(b) $\iint_S dS \times F = \iiint_V (\nabla \times F)\, dV$.

17. Solve the linear equations

$2x - y + 2z = 2$
$x + 10\ y - 3z = 5$
$-x + y + z = -3$

18. Find the solution of Bessel's differential equation

19. Obtain the series solution of Hermite differential equation

$$\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ny = 0$$

And find its polynomial solution, n being a positive integer.

20. Define Fourier sine and cosine transforms and show that

(a) $\int_0^\infty \frac{\cos nx}{a^2+n^2} dx = \frac{\pi}{2a} e^{-ax}$

(b) $\int_0^\infty \frac{n \sin nx}{a^2+n^2} dx = \frac{\pi}{2} e^{-ax}$.

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R–3260

Sub. Code
521103/522103

M.Sc. DEGREE EXAMINATION, APRIL 2019.

First Semester

Physics/Physics (Spl. in Biosensors)

LINEAR AND INTEGRATED ELECTRONICS

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

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What is knee voltage and breakdown voltage?

2. How do donor and acceptor type impurities disturb the structure of semiconductor?

3. What is biasing? Mention its importance in the transistor circuits.

4. Define the amplification factors (α and β) of a transistor and obtain the relation between them.

5. How is threshold voltage of MOS transistor adjusted?

6. A JFET has g_m = 10 mS, I_{DSS} = 10 μA. Calculate V_{GS}.

7. Sketch the pin diagram of op amp.

8. Define slew rate.

9. What is an inverting op amp? Draw its circuit.

10. Mention the applications of low pass RC circuit.

Part B (5 × 5 = 25)

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

11. (a) Explain the construction and working of tunnel diode.

Or

(b) Sketch the circuit diagram to find out the zener diode characteristics. Describe its parameters.

12. (a) Draw and explain the working of CE configuration using NPN transistor.

Or

(b) Illustrate the DC load line graph of transistor. Discuss its importance.

13. (a) Explain the construction and working of JFET. State its characteristics.

Or

(b) What is an oscillator? Discuss the working function of Hartley oscillator with neat diagram.

14. (a) Explain the theory of CMRR and input offset voltage with necessary circuit.

Or

(b) Write down the electrical parameters of op amp.

15. (a) Draw and explain the adder circuit using op amp. Find its output.

Or

(b) Sketch the circuit of high pass RC circuit. Explain its response to a square wave input.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. What is Schottky diode? Explain its characteristics with neat diagram.

17. Describe the construction and working of voltage divider biasing in amplifier circuit. Also explain how it helps to amplify the input signal.

18. (a) Describe the construction and working of SCR with circuit.

(b) Explain the working of solar cell.

19. Discuss the block diagram of a typical op amp. Sketch and explain its schematic symbol.

20. Describe how op amp is working as a differentiator and integrator. Derive its output.

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R–3261

Sub. Code
521501

M.Sc. DEGREE EXAMINATION, APRIL 2019

First Semester

Physics

ELEMENTARY NUMERICAL ANALYSIS

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. Mention the different types of math function.

2. Write down the basic structure of C- Program.

3. Distinguish between Newton's and Secant methods.

4. What is propagation of error? Mention the different types of errors.

5. State the Newton's formula on interpolation.

6. What is linear interpolation? Mention the reasons to follow the interpolation methods.

7. Write down the error formulae of Simpson's and trapezoidal rule.

8. Using Euler's method, solve $y' = x + y$, $y(0) = 1$ for $x = 0.0(0.5)1.0$.

9. What is partial pivoting?

10. What is method of factorization?

Part B (5 × 5 = 25)

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

11. (a) Describe the function of *if...else* statement with flowchart.

Or

(b) Discuss about *GOTO* statement and write a simple program to use *GOTO* statement.

12. (a) Fit a straight line to the following set of data.

X:	1	2	3	4	5
Y:	3	4	5	6	8

Or

(b) Find the positive root of $x - \cos x = 0$ by bisection method.

13. (a) Define and obtain the formula for divided difference interpolation.

Or

(b) Show that the n^{th} divided differences of a polynomial of degree n are constant.

14. (a) Obtain the value of y at $x = 0.1, 0.2$ using third order Runge-Kutta method for the differential equation $y' = -y$, given $y(0) = 1$.

Or

(b) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by Trapezoidal and Simpson's rule. (Divide into 6 equal parts)

15. (a) Find the inverse of the given matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$.

Or

(b) Evaluate the given linear equations by Gauss – Elimination method.

$$a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n = b_2$$
.....
$$a_{n1}x_1 + a_{n2}x_2 + \ldots + a_{nn}x_n = b_n$$

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Give a short explanation on *getchar* and *putchar* function.

17. (a) Write down the principle of least square method.

(b) Using secant method, find the real root of $f(x) = \cos x - xe^x$, where $x_0 = 0$; $x_1 = 1$.

18. Find the value of $f(1.5)$ using Newton's interpolation formula for the given data.

X:	0	1	2	3	4
Y:	858.3	869.6	880.9	892.3	903.2

19. Using Taylor series method, find to correct four decimal places, the value of $y(0.1)$, given $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$.

20. Using Jacobi's iteration method, solve the following equations correct to three decimal place.
$x + 17y - 2z = 48$; $30x - 2y + 3z = 75$;
$2x + 2y + 18z = 30$.

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R–3262

Sub. Code
521301

M.Sc. DEGREE EXAMINATION, APRIL 2019

Third Semester

Physics

MOLECULAR SPECTROSCOPY

(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 the hybridization of carbon atom in CF_4?

2. State Heitler London theory.

3. Write two differences between Raman and FTIR spectra.

4. What are asymmetric top molecules?

5. Name the various types of bending and stretching vibrations.

6. What is dissociation?

7. State mutual exclusion principle.

8. Define stimulated Raman Scattering.

9. Write the principle of Electron Spin Resonance (ESR).

10. What dipole- dipole interaction?

Part B (5 × 5 = 25)

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

11. (a) Write a note on Sp, Sp^2 and Sp^3 hybridization.

Or

(b) Draw the parabola diagram of simple harmonic oscillator for diatomic molecules.

12. (a) What is the hybridization of the molecular bonds and molecular geometry of NH_3 and give an expression for it.

Or

(b) Define Stark effect and state its importance in microwave spectroscopy.

13. (a) Calculate the number of normal modes of vibrations for the molecules of H_2, HF, CO_2, O_2, NH_3, CH_4, and benzene.

Or

(b) Derive an expression of Heitler London theory for hydrogen molecule.

14. (a) Give a detailed account on principle, instrumentation and applications of Multi photon spectroscopy with neat diagram.

Or

(b) Discuss in detail the Franck Condon principle.

15. (a) Write a detailed note on interaction between spin and magnetic field.

Or

(b) State the principle of NQR and describe in detail its applications.

Part C (3 × 10 = 30)

Answer any **three** questions.

Each question carry equal marks.

16. Explain in detail the valance bond theory.

17. What are symmetric top molecules and derive an expression for determination of rotational spectra in microwave spectroscopy?

18. Give an expression for vibrational spectra of polyatomic molecules with examples.

19. Explain in detail the principle, working and applications of X-ray photoelectron spectroscopy.

20. Give an expression for the determination of crystal symmetry and molecular structure in Mössbauer spectroscopy.

R–3263

Sub. Code
521505

M.Sc. DEGREE EXAMINATION, APRIL 2019

Third Semester

Physics

BASIC CONCEPTS OF INSTRUMENTATION

(CBCS – 2016 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

All questions carry equal marks.

1. Define resolution and precision.

2. What do you understand about the percentage of errors?

3. Define harmonic signals.

4. What is phase of a wave form?

5. Give short notes on balanced bridge.

6. List the potentiometer applications.

7. Which elastic transducer can be used to measure high pressure?

8. State Seebeck effect.

9. Write is white noise?

10. Write is piezoelectric effect?

Part B (5 × 5 = 25)

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

All questions carry equal marks.

11. (a) Define and outline the general static characteristics of instruments.

Or

(b) Give an explanation on impedance loading and matching.

12. (a) Explain the first order electrical system with an example.

Or

(b) Give an explanation on time domain specifications of an under damped second order system.

13. (a) Describe the working of photo emissive transducer.

Or

(b) Describe the working of vibrating string transducer.

14. (a) How the pressure is measured in manometer?

Or

(b) How to temperature is measured by using thermocouple?

15. (a) Explain the working principle of the positive displacement flow meter.

Or

(b) Explain the working principle of condenser microphone.

Part C (3 × 10 = 30)

Answer any **three** questions.

All questions carry equal marks.

16. (a) Draw and explain hysteresis curve.

    (b) Explain different types of errors in measurements.

17. Describe the response of second order system with suitable examples.

18. Explain the principle of following transducers :

    (a) strain gauges and

    (b) Piezoelectric transducer.

19. How different types of high pressure measurements can be executed? Give examples.

20. What is self-generating transducer and explain its working principle with three examples.

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