M.Sc Physics

SYLLABUS

(Effective from 2019-20 Admitted batch)

ADIKAVI NANNAYA UNIVERSITY

Rajamahendravarm-533296

Course Structure for M.Sc physics

(With effect from 2019-20 admitted batch)

DEPARTMENT OF PHYSICS, ADIKAVI NANNYA UNIVERSITY

M.Sc Physics-I semester

Theory code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem marks	Total Marks	Credits
PHY-101	Classical Mechanics	4	1		5	75	25	100	4
PHY-102	Atomic and molecular physics	4	1		5	75	25	100	4
PHY-103	Mathematical methods of physics	4	1		5	75	25	100	4
PHY-104	Electronic Devices & circuits	4	1		5	75	25	100	4
PHY-105	Electronics Lab- I			6	6	100			4
PHY-106	Modern Physics Lab-I			6	6	100			4
	Total	16	4	12	32	500	100	600	24

M.Sc Physics-II semester

Theory code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem marks	Total Marks	Credits
PHY-201	Statistical Mechanics	4	1		5	75	25	100	4
PHY-202	Electrodynamics	4	1		5	75	25	100	4
PHY-203	Numerical methods & programming with C	4	1		5	75	25	100	4
PHY-204	Nuclear & particle physics	4	1		5	75	25	100	4
PHY-205	Electronics Lab-II			6	6	100			4
PHY-206	Modern Physics Lab-II			6	6	100			4
	Total	16	4	12	32	500	100	600	24

M.Sc Physics-III semester

Theory code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem marks	Total Marks	Credits
PHY-301	Introductory quantum mechanics	4	1		5	75	25	100	4
PHY-302	Solid State Physics	4	1		5	75	25	100	4
PHY-303	Lasers & Non-linear optics	4	1		5	75	25	100	4
PHY-304	Digital Electronics &Microprocessors	4	1		5	75	25	100	4
PHY-305	Digital Electronics Lab			6	6	100			4
PHY-306	Solid State Physics Lab			6	6	100			4
	Total	16	4	12	32	500	100	600	24

M.Sc Physics-IV semester

Theory code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem marks	Total Marks	Credits
PHY-401	Advanced Quantum Mechanics	4	1		5	75	25	100	4
PHY-402	Properties & Characterization of Materials	4	1		5	75	25	100	4
PHY-403	Communication electronics	4	1		5	75	25	100	4
PHY-404	Antenna theory & Radio Wave Propagation	4	1		5	75	25	100	4
PHY-405	Microprocessor Lab			6	6	100			4
PHY-406	Communication Electronics Lab			6	6	100			4
PHY-407	Comprehensive Viva					100			4
	Total	16	4	12	32	600	100	700	28

L: lecture Hours, T-Tutorial Hours, P-Practical Hours

Scheme of Examination

M.Sc., Physics

(W.e.f. 2019-20 Admitted batch)

S. No	**Evaluation**		**Total marks**
I	**Theory**		
	Internal assessment (Two mid-exams average: 15 Class tests/ assignments/ Presentation/Comprehensive viva: 5 Attendance: 5	25	100
	Semester end examination	75	
II	**Practical/Lab**		
	Semester practical end examination		100
III	Comprehensive viva		100

Scheme of Examination at the end of each semester:

Theory pass Minimum - 40%
Practical pass minimum - 50%

(Proceedings No.ANUR/LS/BoS/Physics/2019 dated on 31-10-19)

1. Practical examination marks(100 Marks) break up:
   Record -20 marks
   Theory cum Experimental viva-20 marks
   Lab Experiments-60 marks (i.e. Procedure-40, graph-10, result-10)

2. Comprehensive viva(100 Marks) break up:
   Semester -wise evaluation 25 marks -conducted at the end of second year only

DEPARTMENT OF PHYSICS,
ADIKAVI NANNAYA UNIVERSITY
I Semester :M.Sc. Physics
(w.e.f 2019-20 batch)
PHY101: CLASSICAL MECHANICS

UNIT-I: Mechanics of a particle. Mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange's equations, Velocity Dependent potentials and the Dissipation function Simple applications of the Lagrangian Formulation **5 Hrs.**

Chapter : 1. Section : 1, 2, 3, 4,5 & 6 .

Hamilton's principle, some techniques of the calculus of variations. .Derivation of Lagrange's equations from Hamilton's principle. Conservation theorems and symmetryproperties,Energy function and the conservation of Energy **6 Hrs.**

Chapter : 2. Section : 1, 2, 3, 5, 6

UNIT-II: Reduction to the equivalent one body problem. The equation of motion and first Integrals, The equivalent One – Dimensional problem and classification of orbits, The differential equation for the orbit, and Integrable power –law potentials, Conditions for closed orbits (Bertrand's theorem), The Kepler problem inverse square law of force , The motion in time in the Kepler problem, Scattering in a central force field.. **7Hrs**

Chapter : 3. Section. 1, 2, 3, 5, 6, 7, 8

Legendre transformations and Hamilton's equations of motion. Cyclic Coordinates and conservation theorems, Derivation of Hamilton's equation of motion from variational principle, Principle of Least Action. **6 Hrs**

Chapter : 7 Section: 1, 2,3,4 5 .

UNIT-III: Equations of canonical transformation, Examples of Canonical transformations, The harmonic Oscillator, Poisson brackets and other Canonical invariants, Equations of motion, Infinitesimal canonical transformations, and conservation theorems in the poisson bracket formulation, the angular momentum poisson bracket relations. **5Hrs**

Chapter : 8. Section : 1 , 2 ,4, 5, 6 & 7.

Hamilton – Jacobi equation of Hamilton's principal function, The Harmonic oscillator problem as an example of the Hamilton – Jacobi Method, Hamilton –Jacobi equation for Hamilton's characteristic function. Action – angle variables in systems of one degree of freedom. 8 **Hrs.**

Chapter : 9. Section : 1, 2, 3, & 5.

UNIT-IV: Independent coordinates of rigid body. , The Euler angles, Euler's theorem on theMotion of a rigid body, Infinitesimal rotations, Rate of change of a vector, The Coriolis Effect.

Chapter : 4. Section : 1, 4, 6, 8, 9 .

The Inertia tensor and the moment of inertia, The Eigenvalues of the inertia tensor and the principal axis transformation, Solving rigid body problems and Euler equations of motion, Torque – free motion of a rigid body

Chapter 5 Section: 3, 4, 5 & 6. **6 Hrs**

The Eigenvalue equation and the principal axis transformation, Frequencies of free vibration, and normal coordinates, Free vibrations of a linear triatomic molecule

Chapter 10 Section: 2, 3 & 4 . **6 Hrs**

TEXT BOOKS : Classical Mechanics H.Goldstein (Addison-Wleley, 1st & 2nd ed)

REFERENCE BOOKS: Classical Dynamics of Particles and Systems J.B.Marion.
Classical Mechanics Aruldas

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
I SEMESTER: M.Sc. PHYSICS
(Effective from 2019-2020 admitted batch)
PHY101 : CLASSICAL MECHANICS.
MODEL QUESTION PAPER

Time: 3 Hrs. **Max.Marks:75.**

SECTION –A.

Answer ALL Questions. **4 x 15 = 60.**

1. a) State D'Alembert's principle and derive Lagrange's equation of motion using it. 10
   b) Write the equation of constraint and the Lagrangian for a particle moving on the surface of a Sphere under gravity. 5

   OR

   c) Obtain Lagrange's equation of motion from Hamilton's principle for conservative Systems. 10
   d) For a conservative system when constraints are independent of time show explicitly that total energy is conserved. 5
2. a) What is the first integral of motion? Show that the orbit of a planet moving around the sun under the inverse square law of force is a conic 10 .
   b) What are generalized co-ordinates? When is a co-ordinate cyclic? What is its physical significance ? 5

   OR

   c) Obtain Rutherford's formula for the scattering of a charged particle from scattering Center. 10
   d) Explain rainbow Scattering. 5
3. a) Define moment of inertia tensor. Derive Euler's equations of rotational motion of a rigid body. 10
   b) What are Euler angles? Show them in a diagram. 5

   OR

   c) Using Hamilton – Jacobi technique solve the problem of one dimensional harmonic oscillator. 10
   d) Show that the solutions are time integrals of the Lagrangian. 5
4. a) What are the normal co-ordinates for a system of linear symmetrical tri-atomic molecule. 10
   b) Obtain an expression for the normal frequencies of oscillations. 5

   OR

   c) Derive Hamilton's equations of motion using Legendre transformations.Give the Physical significance of the Hamiltonian. 10
   d) Express canonical equations of motion in Poisson bracket form. 5

SECTION B

Answer any FIVE Questions. **5 x 3 = 15.**

5. A block of mass ‘m’ sits on a horizontal frictionless table. It is attached by a mass less string to another block of mass M. The string passes over a frictionless pulley. Use Lagrange’s equation to solve the motion of the system.

6. Construct the Hamiltonian and hence obtain the equation of motion of a simple pendulum.

7. Prove the Jacobian Identity. What is its significance?

8. Define Action angle variable. Determine the frequency of periodic motion using Action-angle variable.

9. Explain central forces. In the central force motion show that a real velocity is constant.

10. Obtain conservation theorem for total angular momentum of a system of particles.

11. Using variational principle show that the shortest distance between two points is a straight line.

12. Show that the Poisson bracket is invariant under canonical transformation.

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
I Semester
(w.e.f 2019-20 batch)

PHY102 : ATOMIC AND MOLECULAR PHYSICS.

UNIT-I **12 Hrs**

ONE ELECTRON ATOMS : Quantum numbers, Term values . Relation between Magnetic dipole moment and angular momentum of an orbiting electron. Stern–Gerlach experiment and electron spin.Spin- orbit interaction, relativistic kinetic energy correction and dependence of energy on J value only. Selection rules. Fine structure of Balmer series of Hydrogen and Fowler series of ionized Helium. Hyperfine structure of H_α line of hydrogen (I = ½).

ONE VALENCE ELECTRON ATOMS: Modified term values (quantum defect) due to lifting of orbital degeneracy by core penetration (penetrating orbits) and core polarization (non-penetrating orbits) by nl electrons. Term values and fine structure of chief spectral series of sodium. Intensity rules and application to doublets of sodium. Hyperfine structure of ^2P-^2S of sodium (I= 3/2).

UNIT-II **10 Hrs**

MANY ELECTRON ATOMS : Indistinguishable particles, bosons, fermions. Pauli's principle. Ground states. LS coupling and Hund's rules based on Residual coulombic interaction and spin-orbit interaction. Lande's interval rule. Equivalent and non-equivalent electrons. Spectral terms in LS and JJ coupling (ss,s^2 ,pp,p^2 configurations). Exchange force and Spectral series of Helium.

UNIT- III **8 Hrs**

ATOMS IN EXTERNAL MAGNETIC FIELD: Normal and Anomalous Zeeman Effects, Experimental study of Zeeman effect, Explanation of Normal and Anomalous Zeeman Effects, Quantum theory of Zeeman and Paschen-Back effects and its applications, Transition from weak to strong field, Examples of Zeeman effect in some transitions

ATOMS IN EXTERNAL ELECTRIC FIELD: Linear stark pattern of $H\alpha$ line of hydrogen, weak field and strong field Stark effects in Hydrogen, Quadratic stark pattern of D_1 and D_2 lines of Sodium.

UNIT-IV **20Hrs**

DIATOMIC MOLECULES: Molecular quantum numbers. Bonding and anti-bonding orbitals from LCAO's. Explanation of bond order for N_2 and O_2 and their ions. Rotational spectra and the effect of isotopic substitution. Effect of nuclear spin functions on Raman rotation spectra of H_2 (Fermion) and D_2 (Boson). Vibrating rotator. Spectrum. Combination relations and evaluation of rotational constants (infrared and Raman). Intensity of vibrational bands of an electronic band system in absorption.(The Franck-Condon principle). Sequences and progressions. Deslandre's table and vibrational constants.

BOOKS :

1. Atomic and Molecular Spectra - Rajkumar
2. Fundamentals of Molecular Spectroscopy - C.N.Banwell.
3. Group Theory - K.V.Raman.
4. Introduction to Atomic Spectra - H.E.White.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
I SEMETER
M.Sc PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY102: ATOMIC AND MOLECULAR PHYSICS
MODEL QUESTION PAPER

Time: 3 Hrs Max.Marks:75

SECTION-A

Answer ALL Questions 4×15=60

1. a) With the help of schematic diagram, describe the Stern-Gerlach experiment and evidence for the Spin of an electron. 10
   b) Establish the relation between magnetic dipole moment and angular momentum of an orbiting electron. 5
   (OR)
   c) Explain the quantum numbers associated with an electron of an atom. 10
   d) Explain the fine structure of chief spectral series of sodium. 5

2. a) Explain the spectral features of helium. Compare the higher energy levels of helium with Hydrogen. 10
   b) Explain Hund's rule based on residual columbic interaction. 5
   (OR)
   c) Explain the concept of indistinguisible particles and state Pauli's exclusion principle. 10
   d)What is L-S coupling? Deduce the various interaction energy terms for L-S coupling. 5

3. a) Give Quantum mechanical treatment of Zeeman effect. 10
   b) Calculate the Zeeman splitting of the terms $2p_{3/2}$ and $5F_1$ in terms of applied magnetic field. 5
   (OR)
   c) What is Paschen-Back effect? 5
   d) Explain the weak field and strong field stark effects in Hydrogen. 10

3. a) Explain the bonding and anti bonding orbital's from linear combination of atomic orbital's . 10
   b) Explain the Bond order for N_2. 5
   (OR)
   c) State Frank-Condon principle. 5
   d) Describe the principle features of vibrating rotator. 10

SECTION B

Answer any FIVE of the following. 5×3=15

5. Show the fine structure of H_α line of Hydrogen.
6. What is Lande's interval rule?
7. What is Normal and Anomalous Zeeman effect?
8. What are penetrating and non-penetrating orbits?
9. Draw the Paschen-Back pattern for 2P-2S transition of sodium.
10. Show that separation between consecutive rotational lines of pure rotational spectrum of Molecule is constant.
11. Explain briefly the rotational spectrum of a molecule.
12. Draw the quadratic stark pattern for 2P-2S transition of sodium.

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
I Semester
(w.e.f 2019-20 batch)
PHY103: Mathematical Methods of Physics

Unit I : Complex Variables **15 Hrs**
Function of complex number- definition-properties, analytic function-Cauchy –Riemann conditions-polar form-problems, Complex differentiation, complex integration –Cauchy's integral theorem- Cauchy's integral formulae-multiply connected region- problems, Infinite series-Taylor's theorem- Laurrent's theorem-Problems, Cauchy's Residue theorem- evaluation of definite integrals-problems.
Text Book:1. Mathematical Methods of Physics-G.Arfken,Academic Press
2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi
3.Complex Variables (Schaum's out line series) MurrayR.Spiegel
Ref Book: Mathematical Methods B.D.Gupta

Unit II : Beta , Gamma functions &Special functions **10 Hrs**
Beta & Gamma functions -definition, relation between them- properties-evaluation of some integrals
Special Functions- Legendre Polynomial, Hermite Polynomial, Laguerre Polynomial-Generating finction-recurrence relations-Rodrigue's formula-orthonormal property-associated Legendre polynomial- simple recurrence relation-orthonormal property-spherical harmonics
Text Book: **1.**Mathematical Methods of Physics-G.Arfken,Academic Press
2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi
3. Mathematical Physics B S Rajput
Ref book : Special Finctions .M.D.Raisinghania

Unit III : Laplace Transforms **15 Hrs**
Laplace Transforms – definition- properties – Laplace transform of elementary functions-Inverse Laplace transforms-properties- evaluation of Inverse Laplace Transforms-elementary function method-Partial fraction method-Heavyside expansion method-Convolution method-complex inversion formula method-application to differential equations
Text Book: **1.**Mathematical Methods of Physics-G.Arfken,Academic Press
2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi
3. Laplace n Fourier Transforms Goyal & Gupta,
Ref books: Integral Transforms M.D.Raisinghanna
Integral Transforms Goyal & Gupta
Mathematical Physics B S Rajput

Unit IV: Fourier series, Fourier Transforms **15 Hrs**
Fourier series-evaluation of Fourier coefficients- Fourier integral theorem-problems-square wave-rectangular wave-triangular wave
Fourier Transforms- infinite Fourier Transforms-Finite Fourier Transforms-Properties-problems-application to Boundary value problem
Text Book: **1.**Mathematical Methods of Physics-G.Arfken,Academic Press
2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi
3. Laplace n Fourier Transforms Goyal & Gupta,
Ref books: Integral Transforms M.D.Raisinghanna
Integral Transforms Goyal & Gupta
Mathematical Physics B S Rajput

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
I SEMESTER
M.Sc. PHYSICS
(Effective from 2019-2020 admitted batch)
PHY103: MATHEMATICAL METHODS OF PHYSICS.
MODEL QUESTION PAPER

Time: 3 Hrs. **Max.Marks:75**

SECTION –A.

Answer all Questions **15 X 4 =60**

1. a) State and prove the Taylor's theorem. 10
b) Prove that $H_n^1(x) = 2nH_{n-1}(x)$ 5

(OR)

c) State and prove the necessary and sufficient condition for the function to be analytic in a region R. 10

d) Show that 5

$$\int_{-\infty-}^{\infty} \frac{x^2 dx}{(x^2+1)^2(x^2+2x+2)} = 7\pi/50$$

2. a) Starting from the generating function of Laguerre polynomial obtain the differential equation satisfied $L_n(x)$. 9
b) Obtain two fundamental recurrence relations of Hermite polynomials 6

(OR)

c) Obtain the relation between Beta and Gamma functions 8
d) Evaluate the value of Gamma (1/2) 7

3. a) State and Prove Initial & Finial Value theorems of the Laplace Transformation 10 b) Evaluate the inverse Laplace transform of 5

$$\frac{7}{s^2-9}+\frac{5}{s-7}+\frac{1}{2s^{3/2}}$$

(OR)

c) Solve $(D^4+ 2D^2+1)\,Y(t) =0$ where $Y(0) =0$, $Y^1(0) =1$, $Y^{11}(0)=2$ and $Y^{111}(0) =3$ using Laplace transforms 10
d) State and Prove Convolution Theorem 5

4. a) Define Fourier series and write the conditions of its existence and also define the Fourier Transform . 7
b) Find the Fourier Transform of (i) Sinωt (ii) Cosωt 8

(OR)

c) State and Prove Fourier Integral Theorem 15

SECTION B

Answer Any Five Questions **5 X 3 = 15**

5. Prove orthogonal property of Laguerre polynomials

6. Given u = $3x^2y + 2x^2 - y^3 - 2y^2$ Find v such that +(z) =u +iv is analytic

7. Evaluate $\int_0^{\infty} \frac{\cos aux}{x^2+1} dx$

8. Evaluate $H_o(x)$, $H_1(x)$, $H_2(x)$, $H_3(x)$ from Rodrigue's formula for Hermite polynomials.

9. Find the Fourier transform of
   + (x) = {x, |x| ≤a
   {0, |x| >a

10. Apply convolution theorem to evaluate

$$L^{-1}\{\frac{s}{(s^2+a^2)^2}\}$$

11. Find the Fourier series for function defined by
   f (x) = -π if - π<x<0
   f (x) = x if 0<x<π

12. State and prove Cauchy's Theorem.

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
I Semester
(**w.e.f 2019-2020 batch**)

PHY104 : ELECTRONIC DEVICES AND CIRCUITS

UNIT-I

SEMICONDUCTOR DEVICES: 10 Hrs.

Tunnel diode, photo diode, solar cell, LED, APD, PIN Diode, Schottky Barrier Diode, Silicon controlled Rectifier, Uni Junction Transistor, Field Effect Transistor, (JFET & MOSFET), CMOS (Principle, working and Applications for all devices)

UNIT-II

MICROWAVE DEVICES: 15 Hrs.

Varactor diode, Parametric Amplifier, Thyristors, Klystron, Reflex Klystron, Gunn Diode, Magnetron,CFA,TWT, BWO, IMPATT, TRAPATT (Principle, working and Applications for all devices)

UNIT-III

OPERATIONAL AMPLIFIERS : 10 Hrs.

The ideal Op Amp – Practical inverting and Non inverting Op Amp stages. Op Amp Architecture – differential stage, gain stage, DC level shifting, output stage, offset voltages and currents

.

Operational Amplifier parameters- input offset voltage, input bias current, Common Mode Rejection Ratio, Slew Rate

UNIT-IV 15 Hrs.

OP- AMP APPLICATIONS:

Summing amplifier, Integrator, Differentiator, Voltage to Current converter, Current to Voltage converter Oscillators – Phase shift oscillator, Wien-Bridge Oscillator, Voltage Controlled Oscillator, Schmitt Trigger Special applications – Monostable and Astable multivibrators using 555, Phase locked Loop, Voltage regulators.

TEXT BOOKS:

1. Integrated Electronics - Jacob Millman & C.C. Halkies (TMH)
2. Op.Amps and Linear Integrated Circuits – Ramakant A.Gayakwad (PHI)
3. Electronic Communication Systems – George Kennedy(PHI)

REFERENCE BOOKS:

1. Microelectronics - Jacob Millman & Arvin Grabel (McGraw Hill)
2. Electronic Devices and Circuits – G.K. Mithal (Khanna)
3. Op-amps and Linear Integrated Circuits – D. Mahesh Kumar (MacMillan).

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
I SEMESTER
M.Sc. PHYSICS
(Effective from 2019-2020 admitted batch)
PHY104 :ELECTRONIC DEVICES AND CIRCUITS
MODEL QUESTION PAPER

Time : 3 Hrs **Max. Marks:75**

SECTION - A

Answer ALL Questions **4 x 15 = 60**

1. a) Describe the working of a FET and explain its Characteristics. 10
   b) Explain briefly the small signal model of FET. 5

   OR

   c) Give the construction and Characteristics of an SCR and explain its working. 10
   d) Show how an SCR can be used to control power in a circuit. 5
2. a) Describe the working of Reflex Klystron and explain its Characteristics 10
   b) Explain briefly the working of diac 5

   OR

   c) Describe the working of Magnetron and explain its Characteristics 10
   d) Explain why magnetron is called as CFA 5
3. a) What are the important parameters of an operational amplifier. 5
   b) Describe the method of their measurement. 10

   OR

   c) Explain the terms differential gain and DC level shifting of an op-amp 10
   d) What are the characteristics of an ideal op-amp 5
4. a) Draw the circuit diagram of a V C O and discuss its operation 10
   b) Mention some its applications 5

   OR

   c) Describe with necessary theory, the working of a wein-bridge oscillator using op-amp 10
   d) How do you account for its frequency stability? 5

S E C T I O N - B

Answer any F I V E Questions **5 x 3 = 15 Marks**

5. Explain the principle and working of solar cells.
6. Explain the characteristics of a varactor diode.
7. Explain the working of an Astable Multivibrator using 555.
8. Explain the principle of working of a series voltage regulator.
9. Explain what is meant by negative resistance in a tunnel diode.
10. Explain how an UJT can be used as a relaxation oscillator.
11. Explain the working of op-amp as voltage to current converter
12. Explain the working of a Schmitt trigger.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. Physics
I Semester
(w.e.f 2019-20 batch)

PHY105 : ELECTRONICS LAB-I

LIST OF EXPERIMENTS

1. FET amplifier	(BFW 10/11)
2. Negative feedback amplifier	(BC 147)
3. Colpitts Oscillator	(BF 194)
4. Phase shift Oscillator	(BC 147)
5. Astable Multivibrator	(BF 194)
6. Op.Amp.Characteristics	(IC 741)
7. Power Supply	
8. UJT Characteristics	(2 N 2646)
9. R.F.Amplifier	(BF 194)
10. Boot-strap time based generator	(2N 2222)

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. Physics
I Semester
(w.e.f 2019-20 batch)

PHY106 : MODERN PHYSICS LAB-I

LIST OF EXPERIMENTS

1. Atomic Spectrum of Zinc.

   a) Verification of Lande's interval rule

   b) Study of relative intensities

2. Grating spectrometer

   a)Wavelengths of Hg spectrum,

   b) Wavelength of Balmer series, Rydgberg constant

3. Reciprocal dispersion curve

4. Application of Point Groups.

   a)Identification of symmetry operations in H_2O, BH_3 , NH_3 and H_2CO

   b)Reducible representations and Vibrational modes of H_2O.

5. Determination of Planck's constant, work function and threshold frequency

6. Band gap of a semiconductor.(Two Probe Method)

7. Thermo emf

8. The Franck-Hertz experiment

9. Band spectrum of CN in the violet

   a)conversion of given wavelengths to wavenumbers and assignment of (v', v'')

   b)Deslandres' table and Vibrational constants.

DEPARTMENT OF PHYSICS

ADIKAVI NANNAYA UNIVERSITY

M.Sc. Physics

IISemester

(w.e.f 2019-20 batch)

PHY201 : STATISTICAL MECHANICS

UNIT-I : Basic Methods and Results of Statistical Mechanics: **13 Hrs**

Specification of the state of a system, phase space and quantum states,
Liouvilles theorem, Basic postulates, Probability calculations, concept of ensembles, thermal interaction, Mechanical interaction, quasi static process, distribution of energy between systems in equilibrium, statistical calculations of thermo dynamic quantities, Isolated systems(Microcanonical ensemble). Entropy of a perfect gas in microcanonical ensemble. Canonical ensemble - system in contact with heat reservoir, system with specified mean energy, connection with thermodynamics, Energy fluctuations in the canonical ensemble . Grand canonical ensemble, Thermodynamic function for the grand canonical ensemble. Density and energy fluctuations in the grand canonical ensemble. Thermodynamic equivalence of ensembles. Reif Ch:2, 3.3,3.12 Ch:6

UNIT-II : Simple Applications of Statistical Mechanics: **12 Hrs**

Partition functions and their properties. Calculation of thermo dynamic quantities to an ideal mono atomic gas. Gibbs paradox, validity of the classical approximation. Proof of the equipartition theorem. Simple applications – mean K.E. of a molecule in a gas. Brownian motion. Harmonic Oscillator, Specific heats of solids (Einstein and Debye model of solids), Paramagnetism, Partition function for polyatomic molecules, Electronic energy, vibrational energy and rotational energy of a diatomic molecule. Effect of Nuclear spin-ortho and para Hydrogen. Reif Ch:7, Ch:9.12

UNIT-III: Quantum Statistics: **15 Hrs**

Formulation of the statistical problem. Maxwell–Boltzmann statistics. Photon statistics, Bose-Einstein statistics, Fermi–Dirac statistics, Quantum statistics in the classical limit, calculation of dispersion for MB, BE & FD statistics Equation of state of an Ideal Bose Gas, Black body radiation, Bose-Einstein condensation, Equation of state for a weakly degenerate and strongly degenerate ideal Fermi gas. Thermionic emission. The theory of white dwarf stars. Reif Ch:9

UNIT – IV: RELATIVISTIC MECHANICS

Introduction: Postulates of relativistic mechanics. Minkowski Space, Geometrical representation of Lorentz transformation of space and time. Application to Lorentz transformation. Geometrical representation of Simultaneity, length-contraction and time dilation. Space like and time like intervals. Relativistic classification of particle, Basic ideas of general theory of relativity.

(Sathya Praksah)

Text Books

1. Fundamentals of Statistical and Thermal Physics F. Reif
2. Statistical Mechanics, Theory and Applications S.K. Sinha
3. Statistical Mechanics R.K. Pathria
4. Statistical Mechanics,B.K. Agarwal and M. Eisner, New International (P) Ltd., New Delhi, 2007.
5. Relativistic Mechanics, Satya Prakash, Pragathi Prakashan, Meerut,1987.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
II SEMESTER
M.Sc.PHYSICS
(Effective from 2019-2020 admitted batch)
PHY201 :STATISTICAL MECHANICS.
MODEL QUESTION PAPER

Time : 3 Hrs. **Max. Marks:75**

Answer ALL Questions. **4 x 5 = 60.**

1. a) State and prove the equipartition theorem.
   b) Calculate the specific heat at constant volume of an ideal gas with i degrees of freedom.

   OR

   c) Explain the concept of ensemble. Mention the different types and their properties.
   d) Derive an expression for the most probable distribution of energy among the various systems of a canonical ensemble.

2. a) Distinguish between classical, Bose – Einstein and Fermi Dirac Statistics.
   b) Obtain an expression for Fermi – Dirac distribution law.

   OR

   c)Derive the Planck formula for black body radiation using Bose-Einstein Statistics.
   d) Calculate the pressure ρ of the electromagnetic radiation in a cavity of volume ν.

3. a) Derive an expression for the specific heat of diatonic gases.
   b) Discuss how the results compare with experiments.

   OR

   c) Discuss in detail the Einstein's theory of specific heat of solids.
   d) Mention the salient features of the theory.

4. a) Derive the Expression for Lorentz Transformations.

   OR

   b) Explain Time Dilation as well as length Contract with Mathematical Analysis
   c) Briefly write general theory of relativity

SECTION - B

Answer any FIVE Questions **5 x 3 = 15 Marks.**

5. Explain the phenomena of thermionic emission.
6. Explain the Vander walls theory of liquid gas transition.
7. Calculate the average energy per particle of the Fermions at absolute Zero temperature.
8. Show that at low temperatures a diatomic gas behaves like a monoatomic gas.
9. Explain the ortho and para states of hydrogen.
10. State and prove Liouvellie's theorem.
11. Explain Gibbs paradox
12. Explain Relativistic classification of particle

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
II Semester
M.Sc. Physics
(w.e.f 2019-20 batch)
PHY202 : ELECTRO DYNAMICS.

UNIT-I: Gauss Theorem, Poission's equation, Laplaces equation, solution to Lapalaces equation in cartesian coordiantes, spherical coordinates, cylidrical coordinates, use of Laplaces equation in the solutions of electrostatic problems. **6Hrs**

Ampere's circuital law, magnetic vector potential, displacement current, Faraday's law of electromagnetic inducation, **4Hrs**

UNIT-II; Maxwell's equations, differential and integral forms, physical significance of Maxwell's equations. **4 Hrs**

Wave equation, plane electromagnetic waves in free space , in nonconducting isotropic medium, in conducting medium, electromagnetic vector and scalar potentials, uniqueness of electromagnetic potentials and concept of gauge, Lorentz gauge, Coulomb gauge **6Hrs**

Charged particles in electric and magnetic fields: charged particles in uniform electric field, charged particles in homogerous magnetic fields, charged particles in simultaneous electric and magnetic fields, charged particles in nonhomogeneous magnetic fields. **6Hrs**

UNIT-III: Lienard-Wiechert potentials, electromagnetic fields from Lienard-wiechert potentials of a moving charge, electromagnetic fields of a uniformly moving charge, radiation due to non-relativistic charges, radiation damping, Abraham-Lorentz formula, cherenkov radiation, radiation due to an oscillatory electric dipole, radiation due to a small current element. Condition for plasma existence, occurrence of plasma, magneto hydrodynamics, plasma waves 10**Hrs**

UNIT-IV: Transformation of electromagentic potentials, Lorentz condition in covariant form, invariance or covariance of Maxwell field eqations in terms of 4 vectors, electromagnetic field tensor, Lorentz transformation of electric and magnetic fields. **12 Hrs**

Text books:

1. Classical Electrodynamics : - J.D. Jackson
2. Introduction to Electrodynamics : - D.R. Griffiths
3. .Electromagnetic Theory and Electrodynamics - Satyaprakash
4. Electrodynamics - KL Kakani

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
II SEMESTER
M.Sc. PHYSICS
(EFFECTIVE FROM 2019-2020 ADMITTED BATCH)
PHY 202 : ELECTRO DYNAMICS
MODEL QUESTION PAPER

Time : 3 Hours **Marks 75**

SECTION A

Answer all questions **15 x 4 = 60**

1. a) State and prove Gauss Theorem.
   b) Derive Laplace's and Poisson's equations from Gauss law.
   OR
   c) Explain the method of separation of variables in spherical polar co-ordinates. Obtain potentials inside and outside a dielectric sphere in a uniform electric field.

2. a) State Ampere's circuital law. Define magnetic vector potential and discuss its utility in magnetostatics
   OR
   b) Write down Maxwell equations in differential and integral forms.Explain their physical significance.

3. a) What re ienard–Wiechart potentials.Calculate the electric and magnetic field using these potentials.
   OR
   b) What are gauge transformations. Explain Coulomb and Lorentz gauges. Mention their importance.

4. a) Discuss the conditions for the existence of plasma.Discuss the motion of a charged particle in uniform electric and magnetic fields
   OR
   b) Show that the Maxwell's electromagnetic field equations are invariant under the Lorentz transformation

SECTION- B

Answer any FIVE Questions **5 x 3 = 15**

5. Cherenkov radiation
6. Radiation damping
7. Displacement current
8. Electromagnetic field tensor
9. Faraday's law of electromagnetic induction
10. Electromagnetic scalar and vector potentials
11. Significance of retarded potentials
12. Maxwell's equations in terms of scalar and vector potentials.

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
II Semester
(w.e.f 2019-20 batch)

PHY203 – NUMERICAL METHODS & PROGRAMMING WITH C

UNIT- I: NUMERICAL TECHNIQUES

Solution of algebraic and transcendental equations: Bisection method, Method of false position and Newton-Raphson method. Principle of least squares – fitting of polynomials.
Interpolation: Finite differences(forward, backward and central difference), Newton's formula for Interpolation, Central difference Interpolation formula (Gauss's & Sterling formula), Lagrange's Interpolation formula, Inverse Interpolation. **(Sastry)**

UNIT-II: NUMERICAL DIFFERENTIATION & INTEGRATION

Differentiation: Cubic Spline Method, Maximum and Minimum values of a Tabulated function
Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule and 3/8 Rule. Solutions of linear systems- Direct methods: Matrix Inversion method, Gaussian Elimination method, Modification of Gaussian Elimination method(Gauss-Jordan Method). Iterative methods: Jacobi method, Gauss Seidel method. Numerical solutions of ordinary differential equations: Solution by Taylor's series, Picard's method of successive approximations, Euler's method (Error estimates for the Euler's method, Modified Euler's method) and Range-Kutta method. **(Das & Sastry)**

UNIT- III: INTRODUCTION TO 'C' LANGUAGE

Character Set, C tokens, Key words and Identifiers, Constants and Variables, Data types, Declaration of variables. Operators and expressions: Arithmetic, Relational, Logical, Assignment, Increment and Decrement operators, Conditional, Bitwise and special operators. Precedence in evaluating arithmetic operators. Reading and Writing a character. IF, IF-ELSE, Nesting IF-ELSE, ELSE IF ladder and GOTO statements, WHILE, DO, FOR loop statements. Simple programs

(Balaguruswamy & Kanethkar)

UNIT- IV: PROGRAMMING IN C -LANGUAGE

Arrays: One and Two dimensional arrays, Declaring and initializing string variables. Reading strings from terminal and writing strings to screen. User defined functions: definition of functions, Return values and their types. Function calls and function declaration. Pointers: Declaring and initializing pointers, Accessing a variable through its pointer. C- Programming: Linear regression,
Sorting of numbers, Calculation of standard deviation and matrix multiplication

(Balaguruswamy & Kanethkar)

BOOKS FOR STUDY:

1. Numerical Methods. B.S.Gopal& S.N.Mittal
2. Numerical Methods. S.Sastry
3. Mathematical Physics. H.K.Das, S.Chand & Co.
4. Programming in ANSI C, E Balaguruswamy, TMH New Delhi, 2004.
5. Let us C, Yashavant Kanetker, BPB Publications, New Delhi, 1999.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
II SEMESTER
M.Sc.PHYSICS
(Effective from 2019-2020 admitted batch)
PHY203 : NUMERICAL METHODS & PROGRAMMING WITH C
MODEL QUESTION PAPER

Time : 3 Hrs **Marks :75**

SECTION - A

Answer all Questions **4 X 15 = 60.**

1. (a). Find the root of the following equation using (i) Bisection Method and (ii) Newton-Raphson method as, correct the result upto 3 decimal places $x^3 - 3x-5=0$.

(OR)

(b) Find f(2) for the data f(0) = 1, f(1) = 3 and f(3) = 55. By using Newton's divided difference formula and Lagrange's formula

2.(a) Solving a system of equations by the Gauss-Seidel method

$$4x_1 + x_2 - x_3 = 3$$
$$2x_1 + 7x_2 + x_3 = 19$$
$$x_1 - 3x_2 + 12x_3 = 31$$

(OR)

(b) 1 From the following table, find the area bounded by the curve and x axis from x=7.47 to x=7.52 using trapezodial, simplson 1/3, simplson 3/8 rule.

x	7.47	7.48	7.49	7.50	7.51	7.52
f(x)	1.93	1.95	1.98	2.01	2.03	2.06

(c) Evaluate $I = \int_0^1 \frac{1}{1+x}\,dx$ by using simpson's rule with h=0.25 and h=0.5

3. (a) What is keyword? Write any five keywords and explain them.
(b) Distinguish between local and global variables.
(c) Write a program to compute roots of quadratic equation using switch-case statement.

(OR)

(d) Write the precedence rules for arithmetic operators and give example.
(e) What are loops? Explain various loop statements with suitable example.

4. a) Explain the following concepts associated with functions: i) Function declaration ii) Function definition iii) Function call.

b) Explain various parameter passing mechanisms.

(OR)

c) What is a Pointer? How is it initialized? What is the function of a pointer variable? What are its uses?

d) Explain the concept of pointers to structures with suitable example.

SECTION B

Answer any FIVE Questions **5 x 3 = 15**

5. Explain Principle of least squares Technique

6. Discuss about Gaussian Elimination method for solution of equations

7. Write about Increment and Decrement operators in C language with their Syntax

8. Write the various Character Sets in C

9. How to Declaring and initializing string variables in C

10. Briefly write Picard's method of successive approximations

11. Find the root of the following equation using Bisection Method correct the result upto 2 decimal places $x^2 - 3x-3=0$.

12. Draw the flow chart for calculation of Linear regression

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
II Semester
(w.e.f 2019-20 batch)

PHY204 : NUCLEAR AND PARTICLE PHYSICS

UNIT - I

INTRODUCTION :
Objective of Studying Nuclear Physics, Nomenclature, nuclear radius, mass & Binding energy, angular momentum, magnetic dipole moment, Electric quadrupole moment, parity and symmetry, domains of instability, mirror nuclei.

NUCLEAR FORCES : Simple theory of the deuteron, scattering cross-sections, qualitative discussion of neutron- proton and proton- proton scattering, exchange forces, Yukawa's Potential, Characteristics of Nuclear Forces.

UNIT – II 15 hrs

NUCLEAR MODELS . Liquid drop model:, Weissacker's semi-emperical mass formula, Mass – parabolas. Nuclear shell model : Spin orbit interaction, magic numbers, prediction of angular momenta and parities for ground states, Collective model

NUCLEAR DECAY : Fermi's Theory of β - decay, parity violation in β -decay, detection and properties of neutrino. Energetics of gamma deacay, selection rules, angular correlation, Mossbauer effect.

NUCLEAR REACTIONS : Types of reactions and conservation laws, the Q – equation, Optical model.

UNIT – III 15 hrs

NUCLEAR ENERGY Stability limit against spontaneous fission, Characteristics of fission, delayed neutrons, Four factor formula for controlled fission, Nuclear fusion, prospects of continued fusion energy.

ELEMENTARY PARTICLE PHYSICS: Particle interactions and families, conservation laws (energy and momentum, angular momentum, parity, Baryon number, Lepton number, isospin, strangeness quantum number(Gellmann and Nishijima formula) and charm), Elementary ideas of CP aand CPT invariance, Quark model. **10 hrs.**

UNIT - IV

DETECTING NUCLEAR RADIATION: Interaction of radiation with matter. Gas filled counters, scintillation detectors, semiconductor detectors, energy measurements, buble chamber, magnetic spectrometers.

ACCELERATORS: Electrostatic accelerators, cyclotron accelerators, synchrotrons, linear accelerators, colliding beam accelerators.

TEXT BOOKS :. "Introductory Nuclear Physics" Kenneth S. Krane

Reference Books:

1. "Introduction to Nuclear Physics " Harald A.Enge
2. "Concepts of Nuclear Physics " Bernard L.Cohen.
3. "Introduction to High Energy physics" D.H. Perkins
4. "Introduction to Elementary Particles" D. Griffiths

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
II SEMESTER
M.Sc.PHYSICS
(Effective from 2019-2020 admitted batch)
PHY204 :NUCLEAR AND PARTICLE PHYSICS
MODEL QUESTION PAPER

Time : 3 Hrs **Marks :75**

SECTION - A

Answer all Questions **4 X 15 = 60.**

1 a) What is meant by Nuclear spin and nuclear magnetic moment? How the magnetic moment is determined experimentally 10

b) Discuss one important method used to study the nuclear size 5

OR

c) What is a tensor force? Explain how it accounts for the observed quadrapole moment of deuteron 10

d) Briefly explain the characteristics of nuclear forces 5

2. a) Discuss the formulation of Weizacker's semi – empirical mass formula and obtain the condition for stable isotope 8+2

b) Briefly discuss the collective model of the nucleus. 5

OR

c) Give a brief account of Fermi's theory of β – decay. 10

d) Discuss two important selection rules in β – decay. 5

3. a) What are different types of nuclear reactions 8

b) Describe the Q- equation of a nuclear reaction. What information can you get from the Q- equation 7

OR

c) Discuss Bohr – Wheeler theory of nuclear fission and derive stability limit against spontaneous fission 10

d) Explain carbon – nitrogen cycle in nuclear fusion 5

4. a) With the help of a diagram explain the classification of elementary particles 5

b) Explain briefly various interactions among the elementary particles 10

OR

c) Discuss the conservation laws that explain the behaviour of elementary particles 10

d) Briefly explain the charge conjugation 5

SECTION - B

Answer any Five Questions **5 x 3 = 15**

5. Explain the parity and symmetry of the nucleus

6. Briefly explain the nature of information that you can get from scattering experiments

7. Discuss what are Schmidt's limits of the nuclear magnetic moments

8. What are the selection rules in γ – decay

9. Discuss briefly about synchrotron

10. Explain the operation of colliding beam accelerators

11. Discuss briefly about Rutherford back scattering experiment

12. Briefly explain the quark model of the nucleus

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. Physics
I Semester
(w.e.f 2019-20 batch)

PHY205 : ELECTRONICS LAB-II

LIST OF EXPERIMENTS

1. Active Low pass and High Pass filters (IC 741)
2. Twin -T filter (IC 741)
3. Logarithmic Amplifier (IC 741)
4. Wein Bridge Oscillator (IC 741)
5. Monostable multivibrator (IC 555)
6. Voltage Regulator (IC 723)
7. Phase Shift Oscillator (IC 741)
8. Astable multivibrator (IC 555)
9. Active band pass filter (IC 741)
10. Voltage controlled oscillator ((IC 741, IC 555)

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
I Semester
(w.e.f 2019-20 batch)

PHY206 : MODERN PHYSICS LAB-II

1. Atomic Spectrum of Sodium.

    a)identification of sharp and diffuse doublets

    b) Doublet separation

    c) Assignment of principal quantum numbers

2. Raman Spectrum of Carbon Tetrachloride

    a) Raman shifts

    b) Fermi resonance

3. Vibrational analysis of AlO Green system.

    a)identification of sequences, assignment of vibrational quantum numbers,

    b) Deslandre's table and Vibrational constants.

4. Determination of Specific Charge of an electron by Thomson's Method.

5. Experiments with He- Ne laser.

    a)Polarization of laser light

    b)Divergence of laser beam and monochromaticity.

6. Band gap of a semiconductor (Four probe method).

7. Dielectric constant as a function of temperature and determination of Curie Temperature

8. Susceptibility of a substance Gouy's method

9. Dissociation energy of Iodine molecule from the given data.

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
III Semester
M.Sc. Physics
(w.e.f 2019-20 batch)
PHY301 : INTRODUCTORY QUANTUM MECHANICS

UNIT-I: The Conceptual aspect :Wave particle duality,Uncetainty principle, Principle of superposition - Wave packets – phase velocity and group velocity- Schrodinger Wave Equation - , wave function interpretation and admissibility conditions, probability current density, expectation value, Erhenfest theorem, stationary states. **8hrs**

UNIT-II: Bracket notation, orthonormal functions, linear operators and their properties, - Hermitian operator, Schmidt orthogonalisation, Postulates of quantum mechanics, simultaneous measurability of observables, commutator algebra, equation of motion of an operator (Schrodinger representation), Momentum representation- - Dirac delta function and properties. **12 hrs**.

UNIT-III: One dimensional problems - Particle in a potential well with (i) infinite walls, (ii) finite walls. Potential step, Potential Barrier. Linear Harmonic Oscillator (Schrodinger method). Free particle. Particle moving in a spherically symmetric potential, spherical harmonics, radial equation,. Eigen values and eigen functions of rigid rotator, hydrogen atom, hydrogenic orbitals, angular momentum operators, commutation relations, eigen values and eigen functions of L^2 , Lz, L+ and L- spin angular momentum, general angular momentum.. **15 hrs**.

UNIT-IV: Time- independent perturbation theory for **(i)** non degenerate systems and application to ground state of helium atom., effect of electric field on the ground state of hydrogen, spin orbit coupling ii) degenerate systems, application to linear stark effect in hydrogen.. Variation method and its application to helium atom., exchange energy and low lying excited states of helium atom. WKB method, barrier penetration. **15hrs.**

Text Book :

Quantum Mechanics R.D. RATNA RAJU

Reference Books :

1.Quantum Mechanics Aruldhas
2.Quantum Mechanics G. S. Chaddha
3. Quantum Mechanics B.H.Bransden and C.J.Joachain
4.Quantum Mechanics E. Merzbacher
5.Quantum Mechanics Richard Liboff

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
I SEMESTER
M.Sc. PHYSICS
(Effective from 2019-2020 admitted batch)
PHY301: INDRODUCTORY QUANTUM MECHANICS
MODEL QUESTION PAPER

Time: 3 Hrs. **Max.Marks:75.**

SECTION –A.

Answer ALL Questions. 4 x 15 = 60.

1. a) Derive Schrodinger wave equation. Obtain an expression for Probability current density.

 b) What are stationary states? Show that for stationary states probability current density is constant in time.

OR

 c) State and prove Ehrenfest's theorem.
 d) Write statistical ensemble averaging and Copenhagen interpretations of Quantum Mechanics.

2. a) Show that commuting operators have common Eigen functions.
 b) Define Dirac Delta function and write its properties.

OR

 c) State the postulates of Quantum Mechanics.
 d) Write the properties of wave functions and Eigen values of such Operators.

3. a) State the properties of a well behaved wave function
 b) Solve the Schrodinger equation for a linear harmonic oscillator and obtain eigen values.

OR

 c) Discuss the motion of a particle at a potential step for E < V and E > V conditions.
 d) Derive the wave equation in momentum space.

4. a) Show that L^2 and L_z commute. Obtain Eigen values and Eigen functions for these operators.
 b) Write Pauli spin matrices and discuss commutation relations among them

OR

 c).Write about Angular Momentum Matrices
 d) Explain various properties of Angular Momentum Operators

SECTION-B

Answer any FIVE Questions 5 x 3= 15

5. Explain wave and particle duality of microscopic particles.
6. State Heisenberg's uncertainty principle and discuss its origin.
7. Obtain Eigen values of rigid rotator.
8 .Show that Eigen functions belonging to different Eigen values are Orthogonal.
9. Discuss the principle of Superposition
10. Find the energy states of the one dimensional step barrier
11. Explain Unitary Transformations
12. Find Eigen values of J^2 and J_z

DEPARTMENT OF PHYSICS
ADIKAVI NANNAYA UNIVERSITY
M.Sc. Physics
III Semester
(w.e.f 2019-20 batch)
PHY302: SOLID SATE PHYSICS.

UNIT-I:
CRYSTAL STRUCTURE:
Periodic array of atoms—Lattice translation vectors and lattices, symmetry operations, The Basis and the Crystal Structure, Primitive Lattice cell, Fundamental types of lattices—Two Dimensional lattice types, three Dimensional lattice types, Index system for crystal planes, simple crystal structures-- sodium chloride, cesium chloride and diamond structures.
CRYSTAL DIFFRACTION AND RECIPROCAL LATTICE:
Bragg's law, Experimental diffraction methods-- Laue method and powder method, Derivation of scattered wave amplitude, indexing pattern of cubic crystals and non-cubic crystals (analytical methods). Geometrical StructureFactor, Determination of number of atoms in a cell and position of atoms. Reciprocal lattice, Brillouin Zone, Reciprocal lattice to bcc and fcc Lattices.

UNIT-II:
PHONONS AND LATTICE VIBRATIONS:
Vibrations of monoatomic lattices, First Brillouin Zone, Group velocity, Long wave length, Lattice with two atoms per primitive cell, Quantization of Lattice Vibrations-Phonon momentum.
FREE ELECTRON FERMI GAS:
Energy levels and density of orbitals in one dimension, Free electron gas in 3 dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Motion in Magnetic Fields- Hall effect, Ratio of thermal to electrical conductivity.

UNIT-III:
THE BAND THEORY OF SOLIDS:
Nearly free electron model, Origin of the energy gap, The Block Theorem, Kronig-Penny Model, wave equation of electron in a periodic potential, Crystal momentum of an electron-Approximate solution near a zone boundary, Number of orbitals in a band--metals and isolators. The distinction between metals, insulators and semiconductors

UNIT IV:
SUPERCONDUCTIVITY
Concept of zero resistance, Magnetic behavior, distinction between a perfect conductor and superconductor . Meissner effect, Isotope effect–specific heat behavior. Two-fluid model. Expression for entropy difference between normal and superconducting states. London's equations. Penetration depth. BCS theory. Josephson junctions–SQUIDS and its applications . Applications of superconductors. High T_C superconductors, Preparation, Properties.

TEXT BOOKS:

1.Introdcution to Solid State Physics, C.Kittel, 5^{th} edition,
2.Solid State Physics, A.J.DEKKER.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
III SEMESTER-M.Sc. PHYSICS
(Effective from 2019-2020 admitted batch)
PHY302: SOLID STATE PHYSICS.
MODEL QUESTION PAPER

Time: 3 Hrs. **Max.Marks:75.**

SECTION –A

Answer ALL Questions. 4 x 15 = 60.

1. a) What are the different fundamental types of 3 dimensional lattices
   b) Explain the index system for crystal planes.
   c) In a tetragonal lattice a=b=1/4nm and c=1/7nm. Deduce the lattice spacing between (1 1 1) planes.

   OR

   d) What is Bragg's law.
   e) Describe in detail experimental diffraction methods.

2. a) Obtain the dispersion relation for a monoatomic lattice considering interactions among nearest neighbour planes.
   b) Explain the first Brillouin zone and group velocity for the elastic waves. What is long wave length limit in the continuum theory

   OR

   c) Derive an expression for electron gas in three dimensions.
   d) Deduce expressions for fermi energy, density of orbitals and electron velocity at the Fermi surface

3. a) State Bloch's theorem
   b) Obtain the condition for energy states of electrons moving in a periodic Kronig – Penny potential.
   c) State the interesting conclusions from the above model.

   OR

   d) Distinguish between reduced and periodic Zone schemes for by construction of Fermi surfaces. Describe the construction of Fermi surfaces considering the analysis of a square lattice.
   e) Show that the slope of bands at Zone boundaries is Zero

4. a) Discuss BCS theory of SuperConductors
   b) Explain Josephson junctions of Super Conductors

   OR

   c) Explain Meissner effect, Isotope effect–specific heat behavior for Super Conductors
   d) Mention Various Applications of superconductors

Section B

Answer any FIVE Questions 5 x 3= 15

5. Describe the crystal structure of diamond and show the reciprocal lattice for B.C.C. is F.C.C. lattice.

6. What are the additional features of vibrational spectrum of a diatomic lattice Compared to a monoatomic lattice.

7. State and explain Hall Effect. How positive Hall Coefficients can be explained?

8. Obtain the effective number of free electrons in a partially filled band and hence Classify solids.

9. What are electron orbits, hole orbits and open orbits?

10. What are external orbits? In gold the magnetic moment has a period of 2×10^{-9} gauss^{-1}. Calculate the area of external orbit.

11. What are external orbits? In gold explain the concept of crystal momentum of an electron based on the restatement of Bloch's theorem

12. Explain Brillouin zones.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
III Semester
(w.e.f 2019-20 batch)
PHY303: Lasers and Nonlinear Optics

UNIT-I
LASER SYSTEMS :Light Amplification and relation between Einstein A and B Coefficients. Rate equations for three level and four level systems. Laser systems: Ruby laser, Nd-YAG laser, CO_2 Laser, Dye laser, Excimer laser, Semiconductor laser.

UNIT – II:
LASER CAVITY MODES: Line shape function and Full Width at half maximum (FWHM) for Natural broadening, Collision broadening, Doppler broadening, Saturation behavior of broadened transitions, Longitudinal and Transverse modes. ABCD matrices and cavity Stability criteria for confocal resonators. Quality factor, Q-Switching, Mode Locking in lasers. Expression for Intensity for modes oscillating at random and modes locked in phase. Methods of Q-Switching and Mode locking.

UNIT-III
OPTICAL FIBER WAVEGUIDES : Basic optical laws and Self focusing. Optical fiber modes and configurations Fiber types, Rays and Modes, Step-index fiber structure. Ray optics representation, wave representation. Mode theory of circular step-index wave guides. Wave equation for step-index fibers, modes in step-index fibers and power flow in step-index fibers. Graded – index fiber structure, Graded-index numerical aperture, modes in Graded-index fibers.
FIBER CHARACTERISTICS : Signal Degradation In Fibers - Attenuation, Absorption, Scattering and Bending losses in fibers, radiative losses, Core and Cladding losses. Signal distortion in optical wave guides: Group delay, material dispersion, waveguide dispersion and intermodal dispersion. Pulse broadening in optical fibers. Power launching in Optical fibers, Source-output pattern, Lensing schemes. Fiber-to-fiber joints: Mechanical misalignment, fiber related losses, Fiber and face preparation. fiber splicing techniques, fiber connectors.

UNIT-IV
HOLOGRAPHY AND FOURIER OPTICS
Introduction to Holography: Basic theory of Holography , Recording and reconstruction of Hologram, Fourier transform Holography, Acoustic and Holographic Microscopy, Pattern recognition and Applications of Holography.
Fringe contrast variation.Fourier Transformation spectroscopy. Michelson interferometer. Advantages of Fourier transforms.Optical data processing.Diffraction. (Meyer. Fowles)

TEXT BOOKS:
1. Lasers -Theory and Applications – K.Thyagarajan and A.K. Ghatak. (MacMillan)
2. Optical fiber Communications – Gerd Keiser (Mc Graw-Hill)
3. Lasers and Non Linear Optics. B.B.Laud, New Age International Publishers
4.Introduction to Modern Optics. Grant R. Fowles,Holt,Rinehart and Winston,Inc New York (1968)

REFERENCE BOOKS:
1. Laser fundamentals – William T. Silfvast (Cambridge)
2. Introduction to fiber optics – Ajoy Ghatak and K. Thyagarajan (Cambridge)
3. Optical Electronics – Ajoy Ghatak and K.Thyagarajan (Cambridge)
4. Opto- electronics – J. Wilson and J.F.B. Hawkes (Printice Hall)

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
III SEMESTER
M.Sc PHYSICS
(Effective from2019-2020 admitted batch)
PHY303: LASERS AND NONLINEAR OPTICS
Model Question Paper

Time 3 Hours **Max Marks 75**

Answer All Questions **4 x 15 =60**

1.a) By writing down rate equations, obtain the condition for steady state inversion In a three Level system.

OR

b) Explain in detail mechanism of population inversion and working of CO_2 laser. Explain why He and N_2 are used to enhance population inversion.

2.a) Explain emission broadening and arrive at an expression for Full width at half Maximum due to radiative decay of atoms.

OR

b)Derive an expression for Intensity for modes locked in phase.Describe a method of mode Locking.

3. a)Explain the various optical fiber modes and configurations. Evaluate an expression for the modes of polarization in case of a graded – index Fiber.
b) Explain the mode theory of circular wave guides.

OR

c) Describe various types of signal degradation contributing towards signal losses in optical fibers.
d) Explain in detail the various lensing schemes for power coupling

4 . a) . Write the Basic theory of Holography, Explain about Recording and reconstruction of Hologram

OR

b).Explain Fourier Transformation spectroscopy
c). Write various Applications of Holography

SECTION-B

ANSWER ANY five QUESTIONS **(5 x3 = 15 marks)**

5. Distinguish between Monomode and Multimode optical fibers.
6. Explain what is meant by Q-switching.
7. Deduce relation between Einstein A and B coefficients.
8. Using paraxial approximation, arrive at matrices for translation and reflection through homogeneous medium
9. Briefly explain about Excimer laser
10. Write a note on fiber splicing technique
11. Explain what is meant by pulse broadening in Optical Fibers.
12. Explain Optical data process

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
III Semester
(w.e.f 2019-20 batch)

PHY304 : Digital Electronics & Microprocessors

UNIT - I

Digital Circuits (i) Number Systems and Codes: Binary, Octal, Hexadecimal number systems, Gray code, BCD code, ASCII code.(ii) Logic Gates and Boolean Algebra: OR, AND, NOT, NOR, NAND gates, Boolean theorems, DeMorgan laws.

II) Combinational Logic Circuits: (i) Simplification of Boolean Expressions: Algebraic method, Karnaugh Map method, EX-OR, EX-NOR gates, ENCODER, DECODER, Multiplexer, Demultiplexers. (ii) Digital Arithmetic Operations and Circuits: Binary addition, Design of Adders and Subtractors, Parallel binary adder, IC parallel adder.(iii) Applications of Boolean Algebra: Magnitude Comparator, Parity generator, Checker, Code converter, Seven-segment decoder/ Driver display.

UNIT - II

Sequential Logic Circuits:(i) Flip-Flops and Related Devices: NAND latch, NOR latch, Clocked flip-flops, Clocked S-C flip-flop, J-K flip-flop, D flip-flop, D latch, Asynchronous inputs, Timing problem in flip-flops.(ii) Counters: Asynchronous counters (Ripple), Counters with MOD number $< 2^N$, Asynchronous down counter, Synchronous counters, Up-down counter, Presettable counter.

(iii) Registers: Shift Register, Integrated Circuit registers, Parallel In Parallel Out (PIPO), SISO, SIPO, PISO

(iv) Applications of Counters: Frequency Counter and Digital clock.

A/D and D/A Converter Circuits: D/A Converter, Linear weighted and ladder type, An integrated circuit DAC; Analog-to-Digital Conversion, Digital Ramp ADC, Successive Approximation Method, Sample and Hold Circuit, Digital Voltmeter.

UNIT - III

Intel 8085 Microprocessor:

Architecture, Functional diagram, Pin description, Timing Diagram of Read Cycle and write Cycle.

Programming the 8085 Microprocessor:

(i) Addressing Methods, Instruction set, Assembly language programming.

(ii) Examples of Assembly Language Programming: Simple Arithmetic - Addition/Subtraction of two 8-bit/16-bit numbers, Addition of two decimal numbers, Masking of digits, word disassembly.

(iii) Programming using Loops: Sum of series of 8-bit numbers, Largest element in the array, Multiple byte addition, Delay sub-routine.

UNIT - IV

Data Transfer Technique:

Serial transfer, Parallel transfer, Synchronous, Asynchronous, DMA transfer, Interrupt driven Data transfer.

8085 Interfacing:

I/O Interfacing: Programmable Peripheral Interfacing, 8255, Programmable Peripheral Interval Timer 8253, Programmable Communication Interface 8251, DAC 0800 and ADC 0800 interfacing.

TEXT & REFERENCE BOOKS:

1. “Digital Systems – Principles and applications” –Ronald.J.Tocci,
2. “Fundamentals of Microprocessors & Microcomputers” - B. RAM.
3. “ Introduction to Microprocessors for Engineers and Scientists” - P.K.Ghosh & P.R.Sridhar
4. “Microprocessor Architecture, Programming and Applications with the 8085 /8080A” – Ramesh. S. Gaonkar.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
III SEMESTER
(Effective from 2019-2020 admitted batch)
PHY304: DIGITAL ELECTRONICS & MICROPROCESSORS
Model Question Paper

Time : 3 hrs **Marks : 75**

SECTION - A **4 X 15 = 60.**

Answer all Questions

1. a) Construct a 3 to 8 line Decoder and explain its working.
   b) Discuss the functioning of a BCD to seven segment decoder/ driver.

   Or

   c) With neat logic circuit diagram explain the working of a EX-OR and Equivalence gates. Show that EX-OR is compliment of Equivalence
   d) With neat circuit diagram explain the working of a full adder

2. a) Discuss the working of digital frequency counter
   b) Explain with the help of necessary truth table the working of 3 – bit UP/ DOWN COUNTER.

   Or

   c) Explain the principle of a A/D and D/A converter in signal processing
   d) With a neat circuit diagram explain the successive approximation method of A/D conversion

3. a) Explain the functional description of 8085 microprocessor with a block diagram
   b) Explain the different addressing modes of 8085 microprocessor with suitable examples.

   or

   c) Explain the classification of Instruction set of 8085 microprocessor with suitable examples.
   d) Write an assembly language program to find the sum of series of 8-bit numbers

4. a) With the help of neat block diagram explain the functioning of 8255 PPI, Explain the different modes of operation
   b) Explain the control word of 8255

   Or

   c) Draw the block diagram of 8253 programmable interval timer and explain the functioning of each block
   d) Explain the operation of 8253 as square wave generator

SECTION - B

Answer any Five Questions 5 x 3 = 15

5. Explain the DMA data transfer scheme

6. Draw the timing diagram of memory read operation

7. Write a note on USART 8251

8. With a neat circuit diagram explain the Ladder type D/A converter

9. Write the circuit diagram of JK flip flop, Explain its operation What is Toggling

10. Explain the syntax and the operation of following instructions
(a) LDA (b) LXI (c) LHLD (d) SHLD

11. Explain the functions of
    (a) HOLD and HLDA signals
    (b) SID and SOD signals

12. Construct a ripple counter of MOD number 10 and explain its working.

ADIKAVI NANNAYA UNIVERSITY
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III Semester
(w.e.f 2019-20 batch)
PHY 305: Digital Electronics Lab

Digital electronics

1. Verification of Gates: AND, OR, NOT, NAND, NOR, EX –OR, EX – NOR gates

2. Encoder and Decoder

3 Multiplexer and De multiplexer

4. Adders: Half adder, Full Adder, Paraller Adder

5. Flip Flops (7400, 7402, 7408, and 7446)

6 Decade Counter (IC 7490)

7. Seven segment Decoder/ Driver (7490, 7447)

8 .UP/DOWN Counter IC 74193

9. Digital Comparator (7485)

10 Microprocessor 8085

a. Addition/ subtraction of 8 bit numbers

b. Sum of series of 8 – bit numbers

ADIKAVI NANNAYA UNIVERSITY
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M.Sc. PHYSICS
III Semesters
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PHY 306: Solid State Physics Lab

1. Hall Effect: Determination of Hall co-efficient and estimation of charge carrier concentration and mobility.
2. ESR Studies – DPPH - Determination of ‘g’ value of an electron.
3. X-ray diffraction studies : Determination of lattice constant and number of atoms per unit cell
4. Lattice Dynamics: Study of Phonon Dispersion characteristics.
5. Study of Magnetic Hysteresis loops of ferromagnetic materials (B-H Curve)
6. Measurement of Magnetoresistance of Semiconductors (Four probe arrangement).
7. Coupled Oscillators: Study of the normal modes of vibrations of coupled pendulum, strength of the coupling constant and exchange energy.
8. Determination of Dielectric constant – Determination of wavelength of the microwaves in the guide of an x-band test bench and determination of dielectric constant.
9. Measurement of magnetic susceptibility of Paramagnetic solution by Quink’s Method.
10. Measurement of magnetic susceptibility of Paramagnetic solids by Gouy’s Method.
11. Thermo e.m.f: Calculations of thermo electric power, Fermi energy and carrier concentration of a given sample.
12. Ultrasonic Diffraction study in Liquids

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc PHYSICS
IV SEMESTER
(w.e.f 2019-20 batch)
PHY401- QUANTUM MECHANICS-II

UNIT-I : IDENTICAL PARTICLES AND MOLECULES

Identical Particles: Symmetric and anti symmetric wave functions, Indistinguishability of identical particles, Pauli's exclusion principle. Hydrogen molecule ion, Hydrogen molecule: Hitler London treatment. Oscillations and Rotations of H_2.Concept of Ortho and Para Hydrogen.

(Gupta Kumar and Sharma,Pauling and Bright Wilson)

UNIT-I I: APPROXIMATION METHODS

Time-independent perturbation method. Effect of anharmonicity on the solution of harmonic oscillator problem. Time-dependent perturbation theory, transition probabilities. Variation technique: application to solve the ground state energy of He atom.WKB approximation method: α-particle decay. Sudden and Adiabatic perturbations. **(Gupta Kumar and Sharma)**

UNIT-III :THEORY OF SCATTERING

The scattering experiment. The method of partial waves. Scattering by a central potential. Zero energy scattering. Scattering by square-well potential, effective range. Resonance scattering**.** Born Approximation, Validity of Born Approximation. **(Aruldhas)**

UNIT-IV : RELATIVISTIC QUANTUM MECHANICS

Klein-Gordan equation, Probability and current density, Inadequacies of Klein-Gordan equation.Dirac matrices, Dirac relativistic equation for free particles and solution. Concept of negative energy states. Theory of holes**.** **(Gupta Kumar and Sharma)**

TEXT BOOKS

1. Quantum Mechanics, S.L.Gupta, V.Kumar, H.V.Sharama and R.C. Sharma, Jai Prakash Nath & Co. Meerut,(1996)
2. Quantum Mecanics, G. Aruldhas, Prentice Hall of India Pvt. Ltd, New Delhi (2002).
3. Introduction to Quantam Mechanics with applications to chemistry.Linus Pauling and E.Bright Wilson,Jr. McGraw Hill,Book Company,New York 1935 and London.

REFERENCE BOOKS

1. Quantum Mechanics. B.K.Agarval and Hariprakash, Prentice-Hall of India Ltd., New Delhi, (1997).
2. Quantum Mechanics. L.I.Schiff, Mc Graw Hill Book Co.,Tokyo, (1968)
3. Modern Quantum Mechanics. J.J.Sakurai, Addison- Wesley, Tokyo, (1968).
4. A Text Book of Quantum Mechanics. P.M.Mathews and K.Venkateswaran, Tata McGraw Hill, New Delhi, (1976).
5. Introduction to Quantum Mechanics, R.H.Dicke and J.P.Witke, Addison-Wisley Pub. Co. Inc.,London, (1960).
6. Quantum Mechanics, V.K.Tankappan, Wiley-Eastern Ltd.,New Delhi, (1985).

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
IV SEMESTER
(Effective from 2019-2020 admitted batch)
PHY401: ADVANCED QUANTUM MECHANICS

Time : 3 hrs **Model Question Paper** **Max. Marks: 75**

SECTION - A **(4 X 15 = 60)**

Answer all Questions

1 a) Explain Pauli's exclusion principle and describe the Oscillations and Rotations of H_2

OR

a) Discuss about (i) Symmetric and anti symmetric wave functions
(ii) Ortho and Para Hydrogen

b) Solve Harmonic oscillator problem in Heisenberg representation.

2. a) Derive Fermi Golden rule and write is importance in calculating transition probabilities.

OR

By using Variation technique find the ground state energy of He atom

3. a) Explain Born Approximation of Scattering and also explain its Validity

b)Describe How Scattering problem can be analyzed with the method of partial waves

OR

a) Derive Fermi Golden rule and write is importance in calculating transition probabilities.

b) What are tensor operators? Write down the defining equations of irreducible tensor operations. State and prove Wigner Eckart theorem
.

4. a) Explain Probability and current density . Expain the Klein-Gordan equation and its , , Inadequacies

Or

b) Obtain the free particle solutions (Dirac spinors) for a Dirac particle. Explain the probability density and the current density for a Dirac free particle.

SECTION – B

Answer any Five Questions (5 x 3 = 15)

5. Write a note on Indistinguishability of identical particles.

6. Describe WKB approximation method

7. Write notes on Sudden and Adiabatic perturbations

8. Write notes on optical theorem used in phase shift analysis.

9. *Explain briefly* Resonance scattering

10. Write the Concept of Hitler London treatment

11. Discuss the negative energy states and hole theory of Dirac.

12. Explain how shortcomings of the Klein – Gordon equation are removed by Dirac's equation.

ADIKAVI NANNAYA UNIVERSITY
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IV SEMESTER
(w.e.f 2019-2020 batch)

PHY402 : PROPERTIES AND CHARACTERIZATION OF MATERIALS

UNIT - I

THERMAL PROPERTIES:

Anharmonic crystal interactions-thermal expansion, thermal conductivity, lattice thermal resistivity, umklapp processes, and imperfections.

OPTICAL PROPERTIES :

Lattice Vacancies, Diffusion, Color Centers—F Centers, other centers in alkali halides, Alloys, Order-disorder transformations, Elementary theory of Order.

UNIT - II

Ferromagnetism and Anti-ferromagnetism

Ferromagnetism: Introduction – Weiss molecular field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Ferromagnetic domains – Magnetic bubbles – Bloch wall – Thickness and energy – Ferromagnetic spin waves – Magnons – Dispersion relations.

Anti-ferromagnetism: Introduction – Two sub lattice model of anti-ferromagnetism – Ferri magnetism - Ferrites – Structure – Applications – Multiferroics.

MICROSCOPIC EXAMINATION:

Fundamentals of Transmission electron microscopy and scanning electron microscopy, study of crystal structure using TEM, study of microstructure using SEM.

UNIT - III

RESONANCE METHODS:

Spin and an applied field—the nature of spinning particles, interaction between spin and a magnetic field, population of energy levels, the Larmor precession, relaxation times—spin- spin relation, spin-lattice relaxation,

Electron Spin Resonance: Introduction, g-factor, experimental methods.

Nuclear Magnetic Resonance—equations of motion, line width, motional narrowing, hyperfine splitting,

Nuclear Gamma Ray Resonance: Principles of Mossbauer Spectroscopy, Line Width, Resonance absorption, Mossbauer Spectrometer, Isomer Shift, Quadrupole Splitting, magnetic field effects, Applications.

UNIT - IV

ELECTRICAL AND MAGENTIC CHARACTERIZATION TECHNIQUES:

DC & AC Conductivity, Curie temperature, Saturation Magnetization and Susceptibility

OPTICAL SPECTROSCOPY:

Fundamentals of Infra-red Spectroscopy and Applications.

TEXT BOOKS:

Solid State Physics, 5th edition, C.Kittel
Fundamentals of Molecular Spectroscopy CN Banwell
Mossbauer Effect and its Applications VG Bhide
Solid State Physics M.A.Wahab

ADIKAVI NANNAYA UNIVERSITY

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DEPARTMENT OF PHYSICS

M.Sc. PHYSICS

IV SEMESTER

PHY 402 : PROPERTIES AND CHARACTERIZATION OF MATERIALS

Time : 3 Hrs **Model Question Paper** **Max.Marks :75**

SECTION - A **(4 X 15 = 60)**

Answer all QuestionS

1. a) Give the salient features of lattice thermal conduction in solids. Mention the importance of lattice thermal conductivity studies with temperature.

Or

b) What are anharmonic crystal interactions. Explain how lattice thermal conductivity variation can be explained by umklapp and normal processes

2. a) State and explain Fick's laws of diffusion. Obtain the solution for the Fick's second law of diffusion. Explain its applications.

Or

b) What are color centers? Describe the structure, models and production of color centres in crystals.

3. a) Describe in detail the Transmission Electron Microscopy Technique and explain the study of crystal structures using it.

Or

b) Explain the principle of ESR and its experimental set up.

4. a) Describe the principle of Mossbauer Spectroscopy and explain the hyperfine interaction using Mossbauer effect.

Or

b) Describe the fundamentals of IR Spectroscopy

SECTION - B

Answer any Five Questions (5 x 3 = 15)

5. Explain the order-disorder transformations in solids

6. What is SEM? Explain the operation of it.

7. Explain spin – lattice and spin – spin relaxation phenomena

8. Explain the variations of susceptibility and saturation magnetization with temperature

9. What is the significance of g-factor in ESR Spectroscopy? Explain.

10. Write a note on Larmor precession.

11. Discuss AC and DC conductivity of materials

12. Give a brief account on lattice vacancies.

ADIKAVI NANNAYA UNIVERSITY
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IV SEMESTER
(w.e.f 2019-2020 batch)

PHY403 : COMMUNICATION ELECTRONICS

UNIT 1: **CW Modulation**:

Amplitude Modulation (AM): **8 periods**

Introduction, Amplitude modulation, modulation index, Frequency spectrum, Average power for sinusoidal AM, Amplitude modulator and demodulator circuits, Double side band suppressed carrier (DSBSC) Modulation, Super heterodyne receiver.

Single Side Band Modulation (SSB): **4 periods**

SSB principles, Balanced Modulator, SSB generation

Angle Modulation**:** **8 periods**

Frequency modulation (FM), sinusoidal FM, Frequency spectrum for sinusoidal FM frequency deviation, modulation index, Average power in sinusoidal FM, FM generation Phase Modulation: Equivalence between PM and FM, FM detectors: Slope detector, Balanced slope detector, Foster – Seley discriminator, Ratio detector, Amplitude limiter, FM receiver.

UNIT 2 : **Pulse Modulation :**

Digital Line Codes: Symbols, Functional notation for pulses, Line codes and wave forms: RZ, NRZ, Polar, Unipolar, AMI , HDBn and Manchester codes, M-ary encoding, Differential encoding **8 periods**

Sampling theorem, Principles of pulse Amplitude Modulation (PAM) and Pulse Time Modulation(PTM) ,Pulse code modulation (PCM), quantization, Nonlinear quantization, companding, differential pulse code modulation (DPCM), Delta Modulation(DM) .

Digital Carrier Systems: **8 periods**

ASK, PSK, FSK and DPSK

UNIT 3: **Special Communication Circuits:** **6 periods**

Tuned amplifiers :Single tuned amplifier-Hybrid π – equivalent for the BJT, Short circuit current gain for the BJT in CE and CB amplifiers, CE and CB tuned amplifiers, Cascode amplifier.

Mixer Circuits : Diode mixer, IC balanced mixer.

Filters : Active filters, Ceramic, Mechanical and crystal filters.

Oscillators: Crystal oscillator, Voltage controlled oscillator, phase locked loop(PLL).

UNIT 4: **Noise in Communication Systems:** 8 periods

Thermal Noise, Shot Noise, Partition noise, Signal - to – Noise ratio, Noise factor, Amplifier input noise in terms of F, Noise factor of amplifiers in cascade (Friss formula), Noise temperature, Noise in AM, Noise in FM systems. Noise in pulse modulation systems: Intersymbol interference (ISI) , eye diagrams.

Text Books:

1. Electronic Communications D. Roody and John Coolin
2. Electronic Communications Systems G. Kennedy
3. Modern Analog & Digital Communications B.P. Lathi.

ADIKAVI NANNAYA UNIVERSITY
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IV SEMESTER
(Effective from 2019-2020 admitted batch**)**
PHY403 : COMMUNICATION ELECTRONICS

Time : 3 Hrs **Model Question Paper** **Max. Marks :75**

SECTION - A **4 X 15 = 60.**

Answer all Questions

1 a) Explain the generation and demodulation of PAM signals
b) Explain what is meant by Pulse Time Modulation

Or

c) Sketch the PCM transmitter and explain about each block
d) Derive an expression for quantization noise in terms of step size

2. a) Explain the principle of working of a super hetero dyne receiver with the help of a block diagram
b) Explain about image rejection and double spotting in super heterodyne receivers

Or

c) Explain in detail the frequency spectrum for sinusoidal FM. Arrive at an equation of average power in sinusoidal FM
d) Explain what is meant by FM Radio detection.

3. a) Derive an expression for the input impedance of tuned amplifiers
b) Draw the circuit diagram of a IC balanced mixer and explain its working

Or

c) Distinguish between ceramic and mechanical filters
d) Draw the ∏ equivalent circuit of BJT and explain the various parameters

4. a) Explain how thermal noise power varies with (i) temperature (ii) frequency and bandwidth
b) Explain why inductances and capacitances do not generate noise.

Or

c) Give a detail account of antenna parameters
d) Explain what is meant by YAGI –UDA antenna

SECTION - B

Answer any Five Questions 5 x 3 = 15

5. Explain the need of Mixer circuits. Draw the circuit diagram of diode mixer

6. Draw the equivalent circuit of piezoelectric crystal and explain how it can be used as a filter

7. Explain the uses of phase locked loop

8. Give a brief sketch of ASK

9. Describe the DPSK transmitter

10. Explain the principle of operation of frequency synthesizer

11. Give a brief account on delta modulation

12. Explain what is meant by DSBSC.

ADIKAVI NANNAYA UNIVERSITY
DEPARTMENT OF PHYSICS
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(w.e.f. 2019-2020 batch)
PHY404 : ANTENNA THEORY AND RADIOWAVE PROPAGATION

UNIT - I

Radiation

Potential functions of electromagnetic fields. Potential function for sinusoidal oscillations. Fields radiated by an alternating current element. Power radiated by a current element and radiation resistance. Radiation from a quarter wave monopole or a half wave dipole. EM field close to an antenna and far field approximation.

(Chapter 10 in Jordan and Balmain) ***6 Hrs***.

Antenna Fundamentals

Definition of an antenna. Antenna properties – radiation pattern, gain, directive gain and directivity. Effective area. Antenna beam width and band width. Directional properties of dipole antennas.

(Chapter 11 in Jordan and Balmain and Chapter 2 in Kraus) ***8Hrs.***

UNIT - II

Antenna Arrays

Two element array. Linear arrays. Multiplication of patterns and binomial array. Effect of Earth on vertical patterns. Mathematical theory of linear arrays. Antenna synthesis – Tchebycheff polynomial method. Wave polarization.

(Chapter 11 and 12 in Jordan and Balmain and Chapter 4 in Kraus) ***10 Hrs.***

Impedance

Antenna terminal impedance. Mutual impedance between two antennas. Computation of mutual impedance. Radiation resistance by induced emf method. Reactance of an antenna. Biconcal antenna and its impedance.

(Chapter 14 in Jordan and Balmain and Chapters 8.1 –8.5 in Kraus) ***6 Hrs.***

UNIT - III

Frequency Independent (FI) Antennas

Frequency Independence concept. Equiangular spiral. Log Periodic (LP) antennas. Array theory of LP and FI structures.

(Chapter 15 in Jordan and Balmain and Chapter 15 in Kraus) ***6Hrs.***

Methods of excitation and Practical Antennas

Methods of excitation and stub matching and baluns. Folded dipole, loop antennas. Parasitic elements and Yagi-Uda arrays and Helical antenna.

(Chapter11.15 in Jordan and Balmain) ***6Hrs.***

UNIT - IV

Radio Wave Propagation

Elements of Ground wave and Space wave propagation. Tropospheric propagation and Troposcatter. Fundamentals of Ionosphere. Sky wave propagation – critical frequency, MUF and skip distance.

(Chapter 16 and 17 in Jordan and Balmain) ***8Hrs.***

BOOKS

1."Electromagnetic waves and Radiating Systems" by E.C.Jordan and K.G.Balmain

2."Antennas" by J.D.Kraus. (Second Edition)

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(Effective from 2019-2020 admitted batch)

PHY404 : ANTENNA THEORY AND RADIOWAVE PROPAGATION

Time : 3 Hrs **Model Question Paper** **Max. Marks :75**

SECTION - A **(4 X 15 = 60)**

Answer all Questions

1 a) Derive an expression for power radiated by a current element and find the radiation resistance.

Or

b) Give the mathematical theory for linear arrays.
c) What are the directional properties of dipole antennas?

2. a) How do you define a resonant length? What is the shortest resonant length of a wire antenna?
b) Derive expressions for the radiated fields from a quarter wave monopole.

Or

c) Define Schelkunoff's theorems relating linear arrays with polynomials.
d) Discuss how Schelkunoff's polynomial method can be used in antenna .synthesis.

3. a) What do you understand by an optimum radiation pattern?
b) Discuss in detail the Tschebycheff polynomial method of designing an antenna array that gives optimum pattern.

Or

c) Define Huygens's principle and obtain an expression for the field radiated by a secondary Huygens's source.
d) What is an electromagnetic horn? Derive an expression for the field radiated by a horn antenna.

4. a) What are the principal modes of propagation of radio waves?
b) Describe tropospheric propagation in detail.

Or

c) Describe the structure of ionosphere.
d) How does the ionosphere effect radio wave propagation?

SECTION - B

Answer any Five Questions (5 x 3 = 15)

5. Explain the terms (a) power gain (b) directivity and (c) effective area.

6. While defining the radiation pattern of an antenna explain briefly the principal plane patterns of a dipole.

7. Write a short note on binomial array.

8. A four element linear array with separation between the elements equal to one half wave length is fed with equal currents in equal phase. How do you obtain the directional characteristic of such an array.

9. Design a five element broadside array having a spacing of half wave length between elements. The pattern is to be optimum with side lobe level 20dB down.

10. Explain Babinet's principle.

11. Define a complementary screen. If Z_s and Z_d are impedances of the slot and its complementary dipole and Z_0 is the intrinsic impedance of the surrounding medium, show that $Z_s Z_d = Z^2_0 / 4$.

12. Write a short note on log periodic antennas.

ADIKAVI NANNAYA UNIVERSITY
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PHY 405 : Microprocessor Lab

1.Decimal addition of 8 – bit numbers

2 Addition of two 16 – bit numbers

3 Multibyte addition

4.Sum of series of 16 – bit numbers

5.Word Disaasembly

6. Largest number in an array

7. Ascending order of array of 8 - bit number

8. Interfacing of 8255 PPI: generation of square wave and rectangular waves

9. Interfacing of 8253 programmble timer: Mode 1, Mode2, Mode3, Mode 4, Mode5

10 0800 DAC interfacing : generation of square, triangular and stair case wave forms

ADIKAVI NANNAYA UNIVERSITY
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M.Sc. PHYSICS
IV Semester
(w.e.f 2019-20 batch)

PHY 406: Communication Electronics Lab

LIST OF EXPERIMENTS

1. AMPLITUDE MODULATION
2. FREQUENCY MODULATION AND DETECTION
3. MIXER
4. BUTTERWORTH FIRST ORDER LOWPASS AND HIGHPASS FILTERS
5. CHEBYSHEV SECOND ORDER LOWPASS FILTER
6. PHASE LOCKED LOOP (PLL)
7. PULSE MODULATION-PAM-AND SAMPLING
8. STUDY OF PRE- EMPHASIS AND DE- EMPHASIS CIRCUITS
9. GENERATION OF PWAM, AND PPM USINGPLL AND 555 TIMER
10. STUDY OF FSK TRANSMISSION AND RECEPTION
11. OPTICAL FIBRE –BENDING LOSSES AND NUMERICAL APERTURE
12. MEASUREMENT OF BIT ERROR RATE (BER)
13. MEASUREMENT OF SPEED OF LIGHT IN OPTICAL FIBRE
14. DETERMINATION OF FREQUENCY AND WAVELENGTH IN A RECTANGULAR WAVEGUIDE IN $TE_{1,0}$
15. DETERMINMATION OF STANDING WAVE RATIO AT REFLECTION COEFFICIENT
16. STUDY OF ISOLATOR /CIRCULATOR
17. MEASUREMENT OF GAIN ,FRONT TO BACK RATIO,BEAM WIDTH OF RADIATION PATTERN IN HALF WAVE DIPOLE
18. FIVE ELEMENT YAGI UDA ANTENNA
19. HELICAL ANTENNA
20. CUT –PARABOIDAL REFLECTOR ANTENNA