GOVT. NAGARJUNA PG COLLEGE OF SCIENCE, RAIPUR

DEPARTMENT OF PHYSICS

SYLLABUS AND MARKING SCHEME

M. Sc.
(Ist and IInd Semester System)

2019-2020

Course out comes (cos):-

We offer graduation and post graduation level courses in physics. We define. Objectives for graduate student.

Levels of outcomes:-

1) A graduate student after completing his degree should be able to understand scientific facts and figures clearly. He should also have sufficient knowledge about the subject
2) During the course, a student becomes able to develop skill to write scientific theory and concepts in a proper manner. It improves his/her skills regarding science attitude in every span of like.

- A student attains a certain level of experimental as well as the theoretical Knowledge.
- In these years of graduation course, A student understands, apply, analyze, and evaluates scientific facts and figures.
- A student also develops communication skills, which develop their overall personality.
- During the course students interact will the society through N.C.C , N.S.S , and Red cross. During this process they develop a deep understanding about the problems in society.
- A student also learns to express scientific facts and figures objectively as well as descriptively.

Program Outcome (For science Graduation)

- During the graduation degree students develop analytical and critical thinking especially in the field of science.
- It is also desirable that students should understand the basic problems of society and develop their scientific views to overcome the problems specially superstitions, unhygienic living, drugs etc.)
- Student develops effective communication skills to explore and express their scientific thoughts in general.
- During science graduation the students become a responsible citizen of society.
- During the course students develop moral values and professional ethics in all their endeavors.
- This course makes students aware about environmental hazards and sustainable development.
- The process of imparting Knowledge is such that the students possess interest in the subject , even after completion of his graduation.

Program specific out come

Psos of M.Sc. Physics

- Students understand the basic concepts of Quantum Mechanics, mathematical physics , solid state physics, Electronics, classical mechanics as well as the most recent topics of physics such as nanotechnology and Lasers
- Student learns computational methods and programming to solve different problems of physics
- Students study papers on basic electronic devices, Photonic devices & Operational amplifier, Microprocessor and microcomputer and Digital and fiber communication.
- While doing the projects in the surrounding industrial area of city and acquire the experiential Knowledge and be prepared for future job.
- PG students give seminar on various topics that improve their communication as well as teaching skills.

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M. Sc. PHYSICS
Scheme of Semester Examination (2019-2020)

Semester I

Paper Number	Title of the paper	Mark					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Mathematical Physics	80	16	20	04	100	4
II	Classical Mechanics	80	16	20	04	100	4
III	Basic Quantum Mechanics	80	16	20	04	100	4
IV	Basic Electronics Devices	80	16	20	04	100	4
Lab. Course I -General						100	2
Lab. Course II Electronics (Basic Electronic Devices)						100	2
	TOTAL MARKS					**600**	**20**

Semester II

Paper Number	Title of the paper	Mark					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Electrodynamics	80	16	20	04	100	4
II	Computational Methods and Programming	80	16	20	04	100	4
III	Advance Quantum Mechanics	80	16	20	04	100	4
IV	Digital Electronics	80	16	20	04	100	4
Lab. Course- I Programming in C						100	2
Lab. Course - II Electronics (Digital Electronics)						100	2
	TOTAL MARKS					**600**	**20**

M. Sc. PHYSICS
Scheme of Semester Examination (JULY to DECEMBER- 2019)

Semester I

Paper Number	Title of the paper	Mark					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Mathematical Physics	80	16	20	04	100	4
II	Classical Mechanics	80	16	20	04	100	4
III	Basic Quantum Mechanics	80	16	20	04	100	4
IV	Basic Electronics Devices	80	16	20	04	100	4
Lab. Course I -General						100	2
Lab. Course II Electronics (Basic Electronic Devices)						100	2
	TOTAL MARKS					**600**	**20**

	Total Marks	Total Credits
Theory Papers	320	12.8
Internal Assessment	80	3.2
Lab Course	200	4.0
Grand Total	600	20.0

M. Sc. (PHYSICS)

SEMESTER - I (JUL. –DEC. 2019)

PAPER – I
(MATHEMATICAL PHYSICS)

UNIT –I

Vector Spaces and Matrices linear independence Bases; Dimensionality; Inner product; linear transformations; Matrices; Inverse; Orthogonal and unitary matrices; Independent elements of a matrix; Eigen values and eigenvectors; Diagonalization; Complete orthonormal set of functions.

UNIT – II

Special Functions; Solution by series expansion; Legendre Polynomial Generating function, recursion relations; Rodrique formula, orthogonal properties, Associated Legendre polynomials; Recurrence formulae and orthogonal properties,

Laguerre Polynomial Generating function, recursion relations; Rodrique formula, orthogonal properties, Associated Lagueree differential equation and polynomial. Bessel's Differential equations, First and Second kind, Recurrence formulae and generating function for $J_n(x)$, Jacobi series Bessel's Integrals, orthonormality of Bessel's functions, spherical Bessel's function : Recurrence relation and orthogonality.

Hermite Differential equation and polynomials, generating function, Recurrence relation, Rodrigue formula, orthogonality.

UNIT – III

Function of complex variables, limit ,continuity and differentiability, Analytic function, the necessary and sufficient condition for a function to be analytic, Cauchy-Riemann condition, Cauchy integral theorem, evaluation of line integral by indefinite integration, Cauchy integral formula, Derivative of an analytic function. Singularities of an analytic function, Residues and their evaluation, Cauchy residue theorem, contour integration.

UNIT-IV

Integral Transforms, Laplace transform; First and second shifting theorems; Inverse LT by partial fractions; LT of derivative and integral of a function.

Fourier series; FS or arbitrary period; Half-wave expansions; Partial sums; Fourier integral and transforms; Dirac delta function, three dimension delta function.

Text and Reference Books:

- Mathematical Methods or Physics, by g Arfken
- Matrices and Tensors for Physicists, by AW Joshi
- Advanced Engineering Mathematics, by E Kreyszig
- Special Functions, by ED Rainville
- Special Functions, by W W Bell
- Mathematical Method for Physicists and Engineers. By KF Reilly, M P Hobson and S J Bence
- Mathematics for Physicists, by Mary L Boas

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)
SEMESTER - I (JUL. –DEC. 2019)
PAPER – II
(CLASSICAL MECHANICS)

UNIT -I

Conservation Principles, Mechanics of a particle, conservation Principles for system of particles. Constrained motion, constraints and degrees of freedom, principle of virtual work, generalised coordinates, Generalised Notations (i) Generalised Displacement , velocity , Acceleration, momentum, force and potential , limitations of Newton's laws.

D'Alembert's Principle, Lagrange's equation from D'Alembert's principle . Application of Lagrange's equation of motion (i) Linear Harmonic oscillator (ii) Simple pendulum (iii) spherical pendulum (iv) Isotropic oscillator (v) Atwood's Machine, conservation of linear momentum, angular momentum and energy in Lagrangian formulation, Lagrange's equation for nonholonamic system, procedure to eliminate consideration of Ignorable coordinates the Routhian function.

UNIT – II

Variational Principle, calculus of variation, some techniques of calculus of variables , Euler Lagrange differential equation. Hamilton variational principle, Deduction of Hamilton's Principle from D'Alembert's principle, Deduction of Newton's second law of motion from Hamilton's Principle, Deduction of Lagrange's equations of motion from Hamilton's Principle for conservation and for non conservative systems, Non conservative forces, Dissipative system, Rayleigh's Dissipation function , Lagrangian for a charged particle in an electromagnetic field.

Methods of Non linear Dynamics, phase Portraits, critical point analysis of differential equations, non linear system in the plane, linearization at a critical point, stability of critical points, Liapunov function.

UNIT – III

Hamiltonian formulation of mechanics: Phase space and the motion of the system, Hamiltonian function, Hamilton's canonical equation of motion. Physical significance of H, Deduction of Canonical equation from variational principle, Hamilton's canonical equations of motion in different coordinate systems, Application of Hamilton equation of motion (i) Simple pendulum (ii) compound pendulum (iii) Two dimensional Isotropic Harmonic oscillator (iv) Linear Harmonic oscillator (v) Particle in central field of force. Hamiltonian for a charged particle in an electromagnetic field . Principle of least action statement and its proof.

UNIT – IV

Canonical or constant transformation, its advantage example of canonical transformation, necessary and sufficient condition for a transformation to be canonical , Infinitesional contact transformations, Hamilton-Jacobi partial differential equation for Hamilton's Principle function. Solution of Harmonic oscillator problem by Hamilton-Jacobi method. Hamilton- Jacoby theory. Poisson Bracket: Definition and properties. Invariance of Poisson-Brackets with respect to canonical transformation , Equations of motion in Poisson bracket form Jacoby identity. Infinitesimal contact transformations, interpretation in terms of Poisson Brackets. The angular momentum and Poisson Bracket, Lagrange's Brackets: definition & Properties , Relation with Poisson Brackets .

Text and Reference Books:

- Classical mechanics . H. Goldstein
- Principle of mechanics – Synge and Griffith
- Classical mechanics – Gupta Kumar , Sharma
- Classical mechanics of particles and Rigid body- Kiran C. Gupta

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M. Sc. (PHYSICS)
SEMESTER - I (JUL. –DEC. 2019)
PAPER – III
(BASIC QUANTUM MECHANICS)

UNIT – I

Hertz experiment for particle nature of radiation, photoelectric effect and its explanation by plank's theory, Compton effect for particle nature of radiation, Davison - Germer experiment for wave nature of matter, interference experiment and uncertainty principle, probabilistic interpretation of matter waves, exact proof of uncertainty principle, Schrodinger equation physical interpretation of ψ and probability current density, Continuity equation, wave packet, time evolution of 1 D wave packet, group and phase velocities of a wave packet, operators and their commutation relation, Ehrenfest theorem, stationary state solution of schrodinger equation, boundary and continuity condition, degeneracy, orthogonality of eigen function, parity dirac delta function and completeness of eigen function, Gaussion wave packet.

UNIT - II

Some exact solutions for schrodinger equation like: 1D infinite potential well, particle in a 3 D box, density of states and application to free electrons in a metal, rectangular potential barrier, periodic potential wells and barriers, bracket notation properties and some applications, Hilbert space, and representation of states, matrix representation of operators; schrodinger picture, Heisenberg picture, interaction picture, unitary transformation U, V, W, linear harmonic oscillator problem using bracket notation, density operators.

UNIT – III

Angular momentum as infinitesimal rotation operator, Commutation relationship, angular momentum operator and spherical harmonics, Eigen values and eigen functions of Angular Momentum using bracket notation, concept of spin and Stern Gerlach experiment, Pauli's spin Matrices, Pauli's wave function and Pauli equation, angular momentum matrices for J=1, Addition of Angular Momentum and Clebsch-Gordon coefficients, calculation of Clebsch-Gordon coefficients for $J_1=J_2=1/2$

UNIT - IV

Central force problem: Solution of Schrodinger equation for spherically symmetric potentials; Hydrogen atom, center of mass frame, reduced mass,3D square well potential problem and eigen values and eigen function for hydrogen atom, Time-independent perturbation theory; Non-degenerate cases; First order Perturbation with the example of an Oscillator Degenerate cases, Applications of time independent perturbation theory such as Stark effect. Zeeman effect without electron spin , First order Stark Effect in Hydrogen .

Text and Reference Books:

- L I Schiff, Quantum Mechanics (McGraw-Hill)
- S Gasiorowicz, Quantum Physics (Wiley)
- B Craseman and JD Powell, Quantum Mechanics (Addison Wesley)
- A P Messiah, Quantum Mechanics
- J J Sakurai, Modem Quantum Mechanics
- Mathews and Venkatesan Quantum Mechanics

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M. Sc. (PHYSICS)
SEMESTER - I (JUL. –DEC. 2019)
PAPER – IV
(Basic Electronic Devices)
(UNIT – I)

Transistors : Bipolar Junction transistor (BJT) – basics working principle of NPN and PNP transistor, characteristic curve and different modes of transistor, current gain in different modes and relation between them. Junction Field Effect Transistor (FET) – N channel and P channel FET, Working principle, static and dynamic characteristic curves, pinched off voltage, Coefficient of FET, and relation between different coefficient.
Metal Oxide Field Effect Transistor (MOSFET) – DE MOSFET and E-MOSFET- construction and working principle, static and dynamic characteristics. Uni-junction transistor (UJT) – basics structure, working principle, Voltage – Current characteristics and important parameters .

UNIT – II

MIS Diode : Introduction , Energy band diagram, accumulation, depletion and inversion condition concept of surface space charge, surface potential, surface capacitance, Ideal MIS curves . Charged Couple Device (CCD) : Basic structure, working principle, charge transfer with clock voltage. IMPATT Diode : Introduction, Structure, Principle of operation, Static and Dynamic Characteristics. Microwave devices: Tunnel DiodeTransfer Electron Devices: Transfer Electron Effect, Gun Diode, Backward Diode

UNIT – III

Other Electronic Devices: Electro-Optic, Magneto-Optic and Acousto-Optic Effects. Materail Properties related to get these effect. Important Ferro electric, Liquid Crystal and Ploymeric materials for these devices, Piezoelectric, Electrostrictive and magneto strictive Effects, Important materials exhibiting these properties, and their applications in sensors and actuator devices. Acoustic Delay lines, piezoelectiric resonators and filters.

UNIT – IV

Modulation : Definition , Types of Modulation, Mathematical expression of modulation, Percentage of modulation, Amplitude modulation, Generation of Amplitude modulation, Demodulation, Demodulation of Amplitude modulated wave, side bands, band width, DSBSC modulation, Generation of DSBSC waves. SSB modulation, Generation and Detection of SSB waves,

Multiplexing: Frequency division multiplexing (FDM)

Text and Reference Books:

1. Principles of Electronics – V.K. Mehta , Rohit Mehta (S.Chand & Company Ltd.)
2. Basic Electronics (Solid state) – B.L. Theraja (S. Chand & Company Ltd.)
3. Electronic Devices and Circuits – Jacob Millman , Christos C. Halkias (Tata McGraw Hill)
4. Optical Electronics by Ajoy Ghatak and K.Thyagarajan. Cambridge Univ. Press
5. Introduction to semiconductor devices, M.S. Tyagi, John Wiley & Sons.
6. Physics of semiconductor Devices – S.M. Sze (Wiley Eastern Ltd.)

Signatures :

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Departmental Members : 1----------2----------3----------4----------5----------

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Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - I (JUL. –DEC. 2019)

Lab. Course – I
GENERAL

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical

1. Determination of Young's modulus of a metallic rod by using Searle's optical interference Newton's ring method.
2. Determination of wavelength of unknown spectral line of Hg (mercury) light using Hartmann's
3. To study the plank's constant h.
   (a) Determination of material constant.
   (b) Determination of temperature coefficient of current.
4. To study the temperature dependence of total radiation and to verify the Stefan's law.
5. To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula.
6. To study the variation of refractive index with concentration of sugar solution by Abbe's refractometer method.
7. To find the ionization potential of mercury using gas filled diode.
8. To study the rise and decay of photo current using a thin film photocell.
9. To find the thickness of a wire using optical bench.
10. To study the characteristic curve of LDR (Light dependent resistor).
11. To study the characteristic curve of Opto-coupler.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

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Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - I (JUL. –DEC. 2019)

Lab. Course – II
(Electronic Devices)

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical

1. To Study of characteristics of PNP/NPN transistors .
2. To Study of transistor as amplifier.
3. To Study of characteristics of JFET.
4. To Study of characteristics of MOSFET.
5. To study the characteristic curve of SCR.
6. To study the characteristic curve of UJT.
7. To study the process in Amplitude Modulation and Demodulation.
8. To study the process in Frequency Modulation and Demodulation.
9. To study the process in Pulse Modulation and Demodulation.
10. To measure by hybrid parameter i.e. h_{11}, h_{12}, h_{21}, h_{22} of a transistor at a difference current values.

Signatures :

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Student Members: 1----------2----------3----------

Scheme of M. Sc. (PHYSICS)
Semester - II (January to June 2020)

Paper Number	Title of the Paper	Mark					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Electrodynamics	80	16	20	04	100	4
II	Computational Methods and Programming	80	16	20	04	100	4
III	Advance Quantum Mechanics	80	16	20	04	100	4
IV	Digital Electronics	80	16	20	04	100	4
Lab. Course- I Programming in C						100	2
Lab. Course - II Electronics (Digital Electronics)						100	2
	TOTAL MARKS					**600**	**20**

	Total Marks	Total Credits
Theory Papers	320	12.8
Internal Assessment	80	3.2
Lab Course	200	4.0
Grand Total	600	20.0

M.Sc. (PHYSICS)
SEMESTER - II (January to June 2020)
PAPER – I
(ELECTRODYNAMICS)

UNIT – I

Equation of continuity, Maxwell's equations (SI unit) and its derivation, Integral form of equation, Maxwell's equations in some particular cases: a) In Free space (b) In linear isotropic medium (c) for harmonically varying fields, Electromagnetic energy: Poynting Theorem, The wave equation. Plane electromagnetic waves in free space. Plane electromagnetic waves in a non-conducting isotropic medium (i.e. Isotropic dielectrics) . Plane electromagnetic waves in Anisotropic Non-conducting medium (Anisotropic dielectric) , Plane electromagnetic waves in conducting medium 1) skin depth 2) Poynting vector. A simple model for dynamic conductivity. Propagation of electromagnetic waves in ionized gases.

UNIT – II

Boundary conditions at the interface of two media, Reflection and Refraction of electromagnetic waves at the interface of Non-conducting media,. Fresnel's equations :case- 1 E-vector is perpendicular to the plane of incidence,case-2 E-vector is parallel to the plane of incidence, experimental verification of Fresnel's equations.

Reflection and transmission coefficients at the interface between two non conducting media, Brewster's law and degree of polarisation , Total internal reflection , Group velocity , Propagation of Electromagnetic waves between parallel conducting planes. Wave guides: TM modes and TE modes, Rectangular wave guides.

UNIT – III

Postulates of Einstein's special theory of relativity, Galliean transformations. Lorentz's transformations and it's consequences: Length Contraction, Time Dilation, Velocity addition, Variation in mass. Transformation of differential operator, Invariance of D'Alembertian operator, Invariance of charge, Transformation of charge density, Electric field measured in different frames of reference, Minkowski space, concept of four vector, Lorentz transformation of space and time in four vector form, Transformation for charge and current density: Equation of continuity in covariant form, special case, Invariance of charge. Transformation of electromagnetic potential A and . Lorentz condition in covariant form, Covariance or invariance of Maxwell field equation in terms of four vectors.

UNIT – IV

Electromagnetic vector and scalar potential , Lorentz Gauge, Lienard Wiechart potentials, the electromagnetic field of a uniformly moving point charge, Radiation from an accelerated charge at low velocity – Larmer's formula , Relativistic generalization of Larmer's formula, Angular distribution of radiation emitted by an accelerated charge, Radiation damping, The Abraham Lorentz formula, Cherenkov radiation, Radiation due to an oscillating electric dipole, electric quadra pole radiation, Radiation due to small current element, Radiation from linear antenna, Half wave antenna, Antenna array: Work, Radiation, Pattern.

Text and Reference Books:

1. Classical electrodynamics by –J.D. Jackson
2. Electromagnetic theory and electrodynamics by Satyaprakash.
3. Classical theory of fields – by Landau L.D. and lifshitz
4. Electrodynamics of continuous media- Landau L.D. and lifshitz
5. Electromagnetic theory – Chopra and Agrawal .

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - II (January to June 2020)

PAPER – II
(COMPUTATIONAL METHODS AND PROGRAMMING)

UNIT - I

Problem analysis and solving scheme. Computational procedure, programming outline, flow chart. Branching and looping writing.
Character set, constants, (numeric string) variables(numeric string) rules for arithmetic expressions and hierarchy of operators, rational expressions, logical expressions, and operators, library functions. Identifiers, qualifiers, define statements, value Initialized variables, operators, and expressions. Operator precedence and associativity.

Scanf with specifier, search set arrangements and suppression Character, format specifier for scanf.

UNIT - II

Control structure, If statement, if else statement, multiway decision, compound statement.
Loops: for loop, while loop, do while loop, break statement , compound statement continue statement , go to statement
Function: function main , function accepting more than one parameter, user defined and library function concept associatively with functions, function parameter, return value, recursion comparison.

Arrays , strings, multidimensional array, array of strings function in string

UNIT - III

(Without Programming)

Solution of algebraic and transcendental equations – Basic properties of equation, transformation of equation and rate of convergence. Methods –Bisection Method, Regula falsi method, Secant method, iteration method, Newton Raphson method, Muller's method.
Solution of simultaneous linear equations Gaussian elimination pivoting, iterative method matrix inversion method, cramer's rule, Gauss-Jordan method.
Eigen values and Eigen vectors of matrices. Power and Jacobi method , curve fitting polynomial least squares

UNIT - IV

(Without Programming)

Finite deference interpolation with equally spaced and unequally spaced points, Numerical differentiation and Integration, Newton cote's quadrature formula–trapezoidal rule, simpson1/3 rule,simspson3/8 rule, Boole's rule, Weddle's rule, Monte Carlos evaluation of Integral

Numerical solution of ordinary differential equation . Euler and Runga Kutta methods. Predictor corrector method

Text and Reference Books:

1. Sastry: Introductory methods of numerical analysis
2. Vetterming, Teukolsky press and Flannery : Numerical Recipes
3. Let Us C : Yashwant Kanitkar
4. Programming in C : E. Balaguruswami.
5. Numerical Methods : P.Kandasamy

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - II (January to June 2020)
PAPER – III
(ADVANCED QUANTUM MECHANICS)

UNIT – I

Variational method, Ground state energy of H atom, Ground state energy of He atom, Ground state energy of 1D harmonic oscillator. WKB method, Classically accessible & inaccessible region ,Turning points, condition of validity of semi classical approximation, connection formula to join two WKB solutions at turning points, Sommerfield quantization condition, Energy levels of potential well, quantization rule, Probability of penetration through potential barrier, tunneling through potential barrier, Theory of α decay.

UNIT – II

Time dependent perturbation theory:-Basic Concept, Transition probability, harmonic perturbation, constant perturbation, Fermi's Golden rule, adiabatic approximation ,sudden approximation, Semi classical theory of radiation:-The interaction of radiation with atomic system, Applications of time dependent perturbation theory, Transition probability for absorption and induced emission, Electric dipole transition, transition Probability, Einstein's A & B coefficients, selection rule, forbidden transition

UNIT - III

Scattering, scattering amplitude scattering cross section, Laboratory & centre of mass frame, Techniques for calculating the scattering amplitude, Born approximation, Integral form of Schrodinger equation, First Born approximation, Born approximation for spherically symmetric potential, condition for validity of Born approximation, Applications of Born approximation:- screened coulomb potential, square well potential, Partial wave analysis:-Formalism & strategy, Optical theorem, phase shift, Applications of partial wave analysis, scattering by Perfectly rigid sphere and square well potential.

UNIT – IV

Identical particles : Physical meaning of identity, Symmetric & Anti symmetric wave function, Construction from unsymmetrized function, the Exclusion principle, spin angular momentum.

Relativistic quantum mechanics:- Klein Gorden equation for free particle and for particle in electromagnetic field, continuity equation, Dirac equation for free particle, α and β matrices, charge and current densities, free particle solution, existence of spin and magnetic moment, theory of positron.

Text and Reference Books:

- Davidov: Quantum Mechanics.
- L.I. Schiff : Quantum Mechanics.
- Powell and Craseman : Quantum Mechanics.
- Ghatak and Loknathan : Quantum Mechanics.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - II (January to June 2020)
PAPER – IV
(Digital Electronics)
UNIT - I

Number system : Decimal, Binary, Octal and Hexadecimal Number System with mutual conversion, BCD addition and subtraction, 1's and 2's compliments, multiplication & division BCD code (8421), Excess –3 code, gray code, binary to gray code and gray code to binary code conversion.

Logic gates: Positive and negative logic , Basic gates, Universal building block. Basic laws of Boolean Algebra, De-Morgan's Theorem, two, three and four variable K-Map, mapping and minimization of SOP and POS expressions, pairs, quads, octet, overlapping, Rolling, concepts of Don't care condition.

UNIT – II

Ex-OR gate, Ex-NOR gate circuitry, Half adder, Full adder, binary parallel adder, Serial adder, Half Subtractor, Full Subtractor, 1's complements Subtractor circuit and 2's complements Subtractor circuit.
Digital logic Families : Introduction, Basic concepts of RTL, DTL, TTL, ECL and CMOS logic. Decoder : 2 line to 4 line decoder, 1 of 16 decoder, BCD to decimal decoder, BCD to seven segment decoder, Encoder : decimal to BCD encoder.
Multiplexer : 2-input, 4-input, 16 input Multiplexer, DeMultiplexer : 1 line to 2 line , 1 line to 4 line and 1 line to 16 line DeMultiplexer.

UNIT – III

Flip-flop and timing diagram, RS flip-flop using NOR gate, RS flip-flop using NAND gate, Clocked RS flip-flop, D- latch flip-flop, Preset and Clear, JK flip-flop, Positive and negative edge triggered flop-flops., JK Master Slave flip-flop.
Counters : Binary ripple counter , up counter , down counter, decade counter and Ring counter and time diagram
Registers : Parallel and shift Register, Scaling, PIPO, SIPO, PISO, SOSI Bi-directional shift Register, Application of shift register.

UNIT – IV

Digital to analog converter and Analog to Digital converters : D/A converters using binary weighted resistor network and R-2R ladder Network; Counter type A/D converter, Successive approximation A/D converter and dual slope converters , applications of DACs and ADCs.
Intergraded Circuit : Introduction, Technology, Advantages and disadvantages, Basic technology of monolithic IC, Basic processes used in monolithic technology, Fabrication of components on monolithic IC, IC packing, symbol and scale of Integration.

Text and Reference Books :

1. Digital Principles and applications – Malvino and Leach, Tata McGraw Hills, New Delhi, 1991.
2. Digital and Analogue Technique- Navneet Gokhale and Kale, Kitab Mahal
3. Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan, Meerut, 2008
4. Digital integrated Electronics _ Taub and Schilling, McGraw International Edition, 1977
5. Fundamentals of Digital Circuits – A.Anand Kumar, Prentice Hall of India, N.Delhi. 2007.

Signatures :

HOD : ----------

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6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - II (January to June 2020)

Lab. Course – I
Programming in C

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical

1. Write a program for using bisection method.
2. Write a program for using Regula -falsi method.
3. Write a program for using Newton -Raphson method.
4. Write a program for multiplication of two matrices.
5. Write a program for using Gauss- Elimination method.
6. Write a program for using Gauss- Jordon method.
7. Write a program for using Gauss- Seidal iteration method.
8. Write a program for using Newton -forward interpolation formula.
9. Write a program for using Lagrange's - interpolation formula.
10. Write a program for using Trapezoidal rule.
11. Write a program for using Simpson rule.
12. Write a program for using Runge-Kutta method.
13. Write a program for using Muller's method
14. Write a program for using method of Least Squares
15. Write a program for using Euler's method

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M.Sc. (PHYSICS)
SEMESTER - II (January to June 2020)
Lab. Course- II
(Digital Electronics)

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical :

1. Study of RS, D Filp-flop.
2. Study of JK Flip –flop.
3. Study of Half Adder and Full Adder.
4. Study of Half subtractor and Full subtractor.
5. Study of Decimal to BCD encoder using IC 74147.
6. Study of BCD to 7 segment decoder using IC 7447.
7. Study of BCD to Decimal decoder using IC 7442.
8. Study of Binary to Gray code converter using EX-OR gate.
9. Study of 16:1 multiplexer using ICs 74150 and 74154 and analyse.
10. Study of 1:160 demultiplexer using ICs 74150 and 74154 and analyse.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

GOVT. NAGARJUNA PG COLLEGE OF SCIENCE, RAIPUR

DEPARTMENT OF PHYSICS

SYLLABUS AND MARKING SCHEME

M. Sc.
(IIIrd and IVth Semester System)
2020-2021

M. Sc. PHYSICS
Scheme of Semester Examination (2020-2021)

Semester III

Paper Number	Tital of the Paper	Marks					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Nuclear and Particle Physics	80	16	20	04	100	4
II	Statistical Mechanics	80	16	20	04	100	4
III Special Paper I	Condensed Matter Physics -I	80	16	20	04	100	4
IV Special Paper II	Electronics (Photonic Devices & Op Amp)	80	16	20	04	100	4
	Lab. Course – I Condensed Matter Physics and Materials Modeling Lab. Course - II Electronics (Photonic Devices & Op Amp)					100	2
	TOTAL MARKS					**500**	**18**
	Internal marks i.e. Unit test (Each Paper)					20	

M. Sc. PHYSICS
Scheme of Semester Examination (2020-2021)

Semester IV

Paper Number	Title of the Paper	Marks					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Atomic and Molecular Physics	80	16	20	04	100	4
II Elective Paper	1- Physics of Nanomaterials	80	16	20	04	100	4
	2- Laser Physics and Applications	80	16	20	04	100	4
III Special Paper III	Condensed Matter Physics - II	80	16	20	04	100	4
IV Special Paper –IV	Electronics (Microprocessor, Micro Computer, Digital and Fiber Communication)	80	16	20	04	100	4
	Lab. Course Electronics (Microprocessor, Micro Computer, Digital and Fiber Communication)					100	2
	Project					200	4
	TOTAL MARKS					**700**	**22**
	Internal marks i.e. Seminar (Each Paper)					20	
	GRAND TOTAL [SEMESTER I (600) + SEMESTER II (600) + SEMESTER III (500) + SEMESTER IV (700)]						**2400**

M. Sc. PHYSICS
Scheme of Semester Examination (2020-2021)

Semester III

Paper Number	Title of the Paper	Marks					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Nuclear and Particle Physics	80	16	20	04	100	4
II	Statistical Mechanics	80	16	20	04	100	4
III Special Paper I	Condensed Matter Physics -I	80	16	20	04	100	4
IV Special Paper II	Electronics (Photonic Devices & Op Amp)	80	16	20	04	100	4
	Lab. Course - I Condensed Matter Physics and Materials Modeling Lab. Course -II Electronics (Photonic Devices & Op Amp)					100	2
	TOTAL MARKS					**500**	**18**
	Internal marks i.e. Unit test (Each Paper)					20	

	Total Marks	Total Credits
Theory Papers	320	12.8
Internal Assessment	80	3.2
Lab Course	100	2.0
Grand Total	500	18.0

M. SC. (PHYSICS)
SEMESTER - III (JUL. – DEC. 2020)

PAPER – I
(NUCLEAR & PARTICLE PHYSICS)

UNIT – I

Nuclear Decay :

decay: Introduction, determination of q/M for particles (Rutherford and Royd's experiment), Range of particle, energy of particle, energy velocity-energy-life time relation, alpha particle spectra, some decay schemes, Gamow's theory of particle, its advantanges in theory of alpha decay, Geiger Nuttal law, properties of particle.

decay : Introduction, general theory of decay (Flat type spectrometers, Lanse type spectrometer), The neutrino hypothesis and its indirect method, Fermi theory of decay (Coulomb correction, screening by atomic electron, kurie plot, mass of neutrino, Life time of decay) classification of transitions (selection rules), parity violation of decay, decay schemes of some important nuclides.

UNIT – II

Nuclear Reactions and Energy:

Introduction, types, Conservation laws, kinematics and general solution of the Q equation, binding energy, nuclear transformations (by α particles, protons, neutrons, deuterons, particle of mass three, radiation, heavy ions with examples), nuclear cross section (partial wave analysis of reaction cross section)
Compound Nucleus : Mechanics (formation and breakup), Energy level of nuclei and level width, De-excitation, compound nucleus cross-section (Briet Wigner dispersion formula)
Nuclear fission and fusion : Introduction, Neutrons released in fission process; cross sections, nuclear chain reactions, nuclear reactor, four factor formula, critical size of reactor, , fusion, thermonuclear energy, prospect of controlled fusion energy.

UNIT – III

Counters: Types of counter, Gas filled counter, Solid State counter, scintillation counter with their principle, working method, applications and advantages & disadvantages. Neutron detection :- introduction, different types, principle, experimental detail with applications.
Accelerators : Types of accelerator, Cyclotron, linear accelerators, betatron, electron synchrotron, proton synchrotron with their principle, working method and applications.

UNIT - IV

Elementary Particles :
Classification of elementary particles, basic particle interactions, conservation laws, invariance under parity, CP, time, CPT, Electron and positron, proton and antiproton, neutrino and antineutrino, mesons and hyperons: (their masses, decay modes and reactions) elementary particle symmetry : unitary and eightfold way symmetries. Quark theory : experimental evidence, masses, numbers, mesons and baryons.
Text and Reference Books:

Nuclear Physics ,Ray and Nigam (Wiley Eastern ltd)
Nuclear Physics, I Kaplan (Narosa)
Introduction to nuclear Physics, H.A. Enge (Addison Wesley)
Concepts of Nuclear Physics, B.L.Cohen (TMGH)

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

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Student Members: 1----------2----------3----------

M. SC. (PHYSICS)
SEMESTER - III (JUL. – DEC. 2020)
PAPER – II
(STATISTICAL MECHANICS)

UNIT - I

Foundation of statistical mechanics, the microscopic and macroscopic state, specialization of states of a system, contact between statistics & thermodynamics physics significance of the omega (N V E), classical ideal gas, entropy of mixing & Gibb's paradox, Micro canonical ensemble, phase space of classical system, trajectories and density of states, Liouville's theorem and its consequences, equilibrium between a system and heat reservoir, Canonical & grand canonical ensemble; alternative expression for the partition function, energy fluctuation in the canonical ensemble, equilibrium between a system and partial energy reservoir, calculation of statistical quantities, Density and energy fluctuations in the grand canonical ensemble, physical significance of various statistical quantities.

UNIT - II

Quantum mechanical ensemble theory, Density of Matrix, Statistics of the various ensembles(microcanonical, canonical, grandcanonical), Statistics of indistinguishable particles, an ideal gas in a quantum mechanical microcanonical ensemble and other quantum mechanical ensemble, Maxwell Boltzman, Fermi Dirac, Bose Einstein statistics, thermodynamic behavior of ideal Bose and fermi gases, boson partical, Bose-Einstein condensation. Properties of ideal gas.

UNIT - III

Cluster expansion for a classical gas, Virial equation of the equation of state, evaluation of the virial coefficients, ising model, mean field theories of the ising model (elementary), critical exponents, the scaling hypothesis, dimensional analysis, Exact solution in one dimension, Landau theory of phase transition, critical indices, scale transformation & dimension analysis.

UNIT - IV

Fluctuation, thermodynamic fluctuation, the Einstein-smoluchowski theory of Brownian motion, Correlation of space-time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, Langevin theory of Brownian motion, fluctuation dissipation theorem, Approach to equilibrium- Foker-Plank equation.

Text and Reference Books:

1.Statistical & Thermal Physics, by F. Reif
2.Statistical Mechanics, by K. Huang
3.Statistical Mechanics, by R.K. Pathria
4.Statistical Mechanics, by R. Kubo
5. Statistical Physics, Landau and Lifshitz
6. Statistical Physics, R. K. Patharia

Signatures :

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M. SC. (PHYSICS)
SEMESTER - III (JUL. – DEC. 2020)

PAPER – III
Special Paper –I
(CONDENSED MATTER PHYSICS – I)

UNIT - I

Crystalline and amorphous solids:-Unit cells and direct lattice. Bravais Lattice Types of lattice:-Two and three dimensional Bravais lattices, Fundamental elements of symmetry(Translation, Rotation, Reflection ,Inversion), Symmetry groups(Point Groups, space Groups) concept of point group and space groups, crystal planes and Miller indices, simple crystal structure : closed packed structures (Hexagonal closed packed Structure, Face centered cubic Structure), Loose packed Structures: (Body Centered Cubic Structure, Simple cubic Structure) , X-Ray Diffraction(Laue's Equation, Bragg's law), Interaction of X rays, electrons and neutrons with matter, Electron Elastic scattering from an perfect lattice, Reciprocal latticeVectors, Reciprocal lattice vectors to SC lattice, Reciprocal lattice to BCC lattice, Reciprocal lattice vectors to FCC Lattice, Properties of Reciprocal lattice Ewald's construction, Brillouin Zones :- Brillouin Zone for Simple cubic lattice, Brillouin Zone for Body centered cubic lattice, Brillouin Zone for Face Centered Cubic Lattice

UNIT - II

Defects or imperfections in crystals and their classification Defects : Introduction, Classification of Defects ,Point defects, Line Defect, Plane Defect, Schottky and Frenkel defects, vacancies, interstitial

Colour center & their production:- Introduction, classification of Colour centre, Formation of F-centre, in ionic crystals, their types and production, Deformation (Plastic Deformation-Slip & Yield, Shear strength of Single Crystal, line defects or Dislocations:-Introduction to Disslocation, Edge and Screw dislocations, Burger Vectors, the role of dislocations in Plastic deformation and crystal growth.

UNIT - III

Electron's in a periodic lattice, The Periodic potential ,Block theorem, First Proof of Bloch theorem The Born Von Karman boundary condition, second Proof of Bloch theorem, General remarks of Bloch theorem, Kroning-Panny model, Band theory, Origin of the energy Gap, magnitude of energy Gap, Band gap, holes , Width of bands, Constant energy curve & surfaces, Classification of solids, Distinction between metal semiconductors & insulators, effective mass, equation of motion, velocity of electron, E-K curve, k-space, negative effective mass & holes, physical interpretation of effective mass , effective mass in semiconductors, Tight bonding:-general formulation remarks on calculating the band Structure, cellular and pseudo potential methods, Fermi surface and its construction, de Haas von Alfen effect, cyclotron resonance, magnetoresistance , quantum Hall Effect, Hall coefficient , hall resistance, Bloch Wave.

UNIT - IV

Magnetism, Ferromagnetism, Weiss theory of ferromagnetism, curie's temperature, Paramagnetic region nature & Origin of weiss molecular field, Exchange interaction, Heisenberg model and molecular field theory, Curie-Weiss law for susceptibility, concept of Domains & hysteresis ,Domains, Bloch wall energy origin of domains single domain particle, magnetic bubble domain, Ferri order, curie temperature & suscesptebility of ferrimagnets from garnets, Antiferromagnetic order, Antiferromagnetic magnons, Antiferromagnetic resonance, Doman's and Block wall energy. Quantization of Spin waves, Neudron magnetic scattering magnoins , susceptibility below Neel temperature.

Text and Reference Books:

Kittel: solid state physics
Azroff: Introduction to solids
Varma and Shrivastava: Crystallography for solid state Physics
Singhal: solid state physics
Ziman: Principal of theory of solids
Ascrroff and mermin: solid state physics
Madelung : Introduction to solid state theory
Huong: Theoretical solid state physics
Omar: Elementary solid state physics
Kittel : Quantum theory of solids

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

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Student Members: 1----------2----------3----------

M. SC. (PHYSICS)
SEMESTER - III (JUL. – DEC. 2020)
PAPER – IV
(ELECTRONICS)

(Photonic Devices & Operational Amp)

UNIT – I

Radiative and non-radiative transistors , Optical Absorption, bulk and thin film, photoconductive devices (LDR) , Emission spectra , Luminescent efficiency , method of excitation. Light emitting diode (LED) : high frequency limit, effect of surface and indirect combination current , operation of LED, Visible LEDs and Infrared LEDs. Diode Laser (Condition for population inversion in active region, light confinement factor , optical gun and threshold current for lasing, Fabry-Perrot Cavity Length for losing and the separation.

UNIT – II

Photo detectors: Photoconductor, equivalent circuit of photoconductor. Phototransistor. Bipolar phototransistor, photo – Darlington transistor, V-I characteristic of bilateral hetero structure phototransistor, Solar cells, Solar radiation, solar spectrum, ideal conversion efficiency, Energy band diagram of solar cell, IV characteristics of solar cell, PN junction solar cells, Hetero junction, Interface thin film solar cells.

UNIT – III

Basic Op-amp. Differential amplifier – circuit configurations, dual input, balanced output, differential amplifier –DC analysis, Ac analysis, inverting and non-inverting inputs, CMRR, Constant current bias level transistor.

Block diagram of a typical Op-amp. Analysis, open loop configuration, inverting and non-inverting amplifier, Op-amp. With negative feedback, Voltage series feed back, effect of feed back on closed loop gain input persistence output , resistance bandwidth and output offset voltage , voltage follower.

Practical Op-amp. Input offset voltage, Input offset current, total output offset voltage, CMRR frequency response

UNIT – IV

DC and AC amplifier - summing scaling and averaging amplifiers instrumentation amplifier, integrator and differentiator

Oscillators - principles, oscillator types, frequency stability response, The phase shift oscillator. Wein bridge oscillator, LC tunable oscillators –

Multivibrators - Monostable and Astable , Comparators, square wave and triangle wave generators.

Voltage regulator – fixed regulators – adjustable voltage regulators switching regulators

Text and Reference Books :

1. Semiconductor Devices – Physics and Technology – S.M. Sze, Wiley, 1985
2. Introduction to Semiconductor Devices – M.S.Tyagi, John Wiley & sons
3. Electronic Devices and circuit theory – Robert Baylested and louis Nashdsky, PHI, New Delhi, 1991
4. Electronic Fundamentals and applications – John D. Ryder PHI, New Delhi, 1987.
5. Operational Amplifier and their applications – Subir Kumar Sarkar, S.Chand & Sons, New Delhi1999.
6. Op-amps & linear integrated circuits- Ramakanth A. Gayakward, PHI, 2 Ed. 1991

Signatures :

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M. SC. (PHYSICS)
SEMESTER - III (JUL. – DEC. 2020)

Lab. Course-I
Condensed Matter Physics and Materials Modeling

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical : Condensed Matter Physics

- To study the variation of thermo e.m.f. with temperature for the copper iron thermocouple.
- To determine the wavelength of laser with the help of grating.
- To determine the temperature coefficient of resistance of platinum wire with the help of Wheatstone bridge.
- To determine the specific resistance and the energy band gap of a semiconductor.
- Dispersion relation of the monatomic and diatomic (lattice dynamics).
- To determine the braise lattice and point group.
- To study the characteristics of JFET.
- To study the characteristics of MOSFET.
- Characteristics of solar cell :-
  1. to find efficiency of solar cell inverter.
  2. I-V characteristic .
  3. to find intensity in different directions.
- Characteristics of solar mobile charger: -
  1. Efficiency of solar mobile charger.
  2. I-V characteristics

List of Practical : Materials Modeling

1. To creat input file for H2O molecule using Jmol and/or avogadro and run to find optimum energy of the system.[Students can also take pseudopotential files and H2O.fdf from https://departments.icmab.es/leem/siesta/ and test directory of siesta program]

2. To compile eig2dos, gnubands, pdosxml, rho2xsf using fortran compilers and run sample files to verify the compiled utilities.

3. To optimize basis sets and correlations functions using test example of H2O molecule.

4. To optimize the structure of CH4 using mesh-cutoff, kpints and lattice-optimization routes.

5. To study DOS PDOS and energy bands of CH4.

6. To optimize the structure and study the charge density using eig2dos of graphene nanoribons.

7. To analysis the band structure of MgO and calculate direct indirect band gaps at various symmetry points.

8 . To study the magnetic properties of Fe2O3 using spin-polarized technique.

9. To study the optical properties of crystal strutured CdS.

10. To study the different charge populations implemented in siesta and study the bond strength using COOP/COHP tools for Benzen ring.

11. To study the mechanical properties of B2O3.

12. To study the electronic tranport properties of Benzen using graphene electrodes in Transiesta.

[A separate mannual should be prepared with the help of siesta mannual and test files.]

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

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Student Members: 1----------2----------3----------

M. SC. (PHYSICS)
SEMESTER - III (JUL. – DEC. 2020)

Lab. Course -II
(Photonic Devices & Operational Amp)

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical

1. To study the characteristic of RD-5 .
2. To study the characteristic of LED.
3. To study the characteristic of LDR.
4. To study of operational amplifier as Integrator.
5. To study of operational amplifier as Differentiator
6. To study the op-amp. as scalar
7. To study of operational amplifier as voltage follower
8. To study op-amp as a differential amplifier.
9. To study op-amp as a subtractor
10. To use op-amp as summing amplifier.
11. To use op-am as a inverter.
12. To study the characteristic of Photo transistor.
13. To study the characteristic of Opto coupler.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

Scheme of M. Sc. (PHYSICS)
Semester - IV (JAN. – JUN. 2021)

Paper Number	Name of Paper	Mark					Credits
		Theory		Internal		Total	
		Max.	Min.	Max.	Min.		
I	Atomic and Molecular Physics	80	16	20	04	100	4
II Elective Paper	3- Physics of Nanomaterials	80	16	20	04	100	4
	4- Laser Physics and Applications	80	16	20	04	100	4
III Special Paper III	Condensed Matter Physics - II	80	16	20	04	100	4
IV Special Paper –IV	Electronics (Microprocessor, Micro Computer, Digital and Fiber Communication)	80	16	20	04	100	4
	Lab. Course – Electronics (Microprocessor, Micro Computer, Digital and Fiber Communication)					100	2
	Project					200	4
	TOTAL MARKS					**700**	**22**
	Internal marks i.e. Seminar (Each Paper)					20	
	GRAND TOTAL [SEMESTER I (600) + SEMESTER II (600) + SEMESTER III (500) + SEMESTER IV (700)]						**2400**

	Total Marks	Total Credits
Theory Papers	320	12.8
Internal Assessment	80	3.2
Lab Course	100	2.0
Project	200	4.0
Grand Total	700	22.0

M. Sc. (PHYSICS)
SEMESTER - IV (JAN. – JUN. 2021)
PAPER – I
(ATOMIC AND MOLECULAR PHYSICS)

UNIT – I

Bohr theory of spectra of hydrogen and hydrogen like atoms, reduced mass of electron, variation of Rydberg constant. Sommerfeld's elliptical orbit. Space quantization, Larmor's theorem Pauli's vector atom model, four quantum numbers.
Spectra of alkali atoms, The effective quantum number and quantum defect, Fine structure in alkali spectra, selection and intensity rules for doublet, The spinning electron and vector model ,selection and intensity rules Spectral terms arising from l-s coupling, spin orbit interaction, screening constants for alkali spectra
Atom model for two valence electrons, equivalent and non-equivalent electrons, Spectra of Alkaline earth atoms, singlet-triplet series, LS and JJ coupling, interaction energy, selection and intensity rules.

UNIT – II

The magnetic movement of the atom, Effect of magnetic field on energy levels (mono valent atoms) Gyromagnetic ratio for orbital and spin motion, vector model, Lande's g-factor, normal and anamolous Zeeman effect, Paschen Back effect. Stark effect Hyperfine structure (Qualitative) Line broadening mechanism. Electron spin resonance, Nuclear magnetic resonance.

UNIT – III

Introduction to the theoretical treatment of molecular system Types of molecules-Diatomic linear symmetric top, asymmetric top and spherical top molecules, energy levels and spectra. Rotational energy and spectra of diatomic molecules as rigid rotor and non rigid rotor, inter nuclear distance and isotope effect.
Vibrational energy levels and spectra of diatomic molecules as harmonic oscillator - Anharmonicity of molecular vibrations, energy levels and spectrum, Morse potential energy curve, isotope effects and force constants

UNIT – IV

Molecule as vibrating rotor- rotator vibrational spectrum of diatomic molecules-PQR branches, Rotational spectra, the vibrations of polyatomic molecules, Electronic spectra of diatomic molecules- Born Oppenheimer approximation-vibrational coarse structure of electronic bands-progression and sequences-Intensity of electronic bands-Franck Condon principle-Rotational fine structure of electronic bands.

Text and Reference Books

1. H.E. White — Introduction to atomic physics
2. Barrow — Introduction to molecular physics
3. G.Herz berg — Molecular spectra and molecular structure
4. H.Kuhn — Atomic spectra
5. Walker and straugh — Spectroscopy Vol I,II,III.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)
SEMESTER - IV (JAN. – JUN. 2021)
PAPER – II (Elective)
(PHYSICS OF NANOMATERIALS AND DEVICES)

UNIT I
(PHYSICAL AND CHEMICAL PROPERTIES)

Introduction: Emergence of Nanotechnology, Challenges in Nanotechnology, Nano Hazards; Societal and Ethical Implications; **Physical Properties of Nanomaterials**: Melting points and lattice constants, Mechanical properties, Optical properties, Surface plasmon resonance, Quantum size effects. Electrical and Magnetic Properties: Surface scattering, Change of electronic structure, Quantum transport, Effect of microstructure. Ferroelectrics and dielectrics, Superparamagnetism**.; Chemical Properties** : Surface Energy, Chemical Potential as a Function of Surface Curvature, Electrostatic Stabilization, Surface charge density, Electric potential at the proximity of solid surface, Van der Waals attraction potential, Interactions between two particles: DLVO theory.

UNIT II
(NANO FABRICATION TECHNIQUES)

Bottom-Up and Top-Down Approaches; **Lithography:** Photolithography, Electron beam lithography, X-ray lithography, Focused ion beam (FIB) lithography ; **Nanomanipulation and Nanolithography**: Scanning tunneling microscopy (STM) , Atomic force microscopy (AFM) , **Soft Lithography**: Microcontact printing, Dip-pen nanolithography; **Self Assembly of NanoMaterials,**
Semiconductor quantum dots synthesis, electronic structure and characterization,
Synthesis of 1-D nanowires VLS (Vapour- Liquid –Solid)growth, and SLS (Solid – Liquid – Solid) growth.; Thin Films (2-D) growth **by** Chemical Vapor Deposition (CVD) **,** Atomic Layer Deposition (ALD), Langmuir-Blodgett Films, Sol-Gel Films.

UNIT III
(MATERIALS AND CHARACTERIZATION)

Structural Characterization: X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning probe microscopy (SPM),
Chemical Characterization: Optical spectroscopy, Electron spectroscopy, Ionic spectrometry
Special Nanomaterials: Carbon fullerenes, Fullerene-derived crystals, Carbon nanotubes, Ordered and random mesoporous structures, Crystalline Microporous Materials: Zeolites, Intercalation Compounds, Types, Properties and Applications of Core – Shell Nanoparticles.

UNIT IV
(DEVICES AND APPLICATIONS)

Band Gap Engineered Quantum Devices**,** Quantum well devices**,** Quantum dot devices, Photonic Crystals and Plasmon Waveguides**.** Nanobots, Catalysis by Gold Nanoparticles**,**
Active Microfluidic Devices , Smart Passive Microfluidic Devices, Lab-on-a-Chip for Biochemical Analysis, Targeted Drug Delivery mechanism, principle and working of Nano Sensors and nanobio Sensors.
Molecular Switches and Logic Gates, Pressure Sensor, Inertial Sensor, Optical MEMS , RF MEMS, Current Challenges and Future Trends of NEMs.

Text Book:

1. Nanostructures and Nanomaterials - Synthesis properties and Applications by Guozhong Cao (Empirical College Press World Scientific Pub., 2004).
2. Springer Handbook of Nanotechnology, Bharat Bhushan (Ed.), Spinger-Verlag Berlin Heidelberg New York, ISBN 3-540-01218-4
3. NANO: The essentials, T. Pradeep, Mcgraw Hill Edu Pvt Ltd, Tamilnadu (India), 2007, ISBN 978-0-07-061788-9

Reference Books:

1. Principles of Nanoscience and Nanotechnology by Shah and Ahmad
2. Nanotechnology: Synthesis and Application by N. K. Sharma
3. Encyclopedia of Nanotechnology, H.S. Nalwa.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)
SEMESTER - IV (JAN. – JUN. 2021)

PAPER – II (Elective)
(Laser Physics and Applications**)**

Unit- I

Spontaneous and stimulated emission, Einstein's quantum theory of radiation, theory of some optical processes, coherence and monochromacity, kinetics of optical absorption, line broadening mechanism, Basic principle of lasers, population inversion, laser pumping, two & three level laser systems, resonator, Q-factor, losses in cavity, threshold condition, quantum yield.

Unit – II

Solid state lasers- the ruby laser, Nd:YAG laser, ND: Glass laser, semiconductor lasers – features of semiconductor lasers, intrinsic semiconductor lasers, Gas laser -neutral atom gas laser, He-Ne laser, molecular gas lasers, CO2 laser, Liquid lasers, dye lasers and chemical laser.

Unit-III

Production of giant pulse -Q-switching, giant pulse dynamics, laser amplifiers, mode locking and pulling, Non-linear optics, Harmonic generation, second harmonic generation, Phase matching, third harmonic generation, optical mixing, parametric generation and self-focusing of light.

Unit – IV

Multi-photon processes; multi-quantum photoelectric effect, Theory of two-photon process, three-photon process, second harmonic generation, parametric generation of light, Laser spectroscopy : Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect, Coherent anti-stokes Raman Scattering, Photo-acoustic Raman spectroscopy.

TEXT AND REFERENCE BOOKS :

Laud, B.B.: Lasers and nonlinear optics, (New Age Int.Pub.1996).
Thyagarajan, K and Ghatak, A.K.: Lasers theory and applications (Plenum press, 1981).
Ghatak, A.K.and Thyagarajan, K : Optical electronics (Cambridge Univ. Press 1999).
Seigman, A.E.: Lasers (Oxford Univ. Press 1986)
Maitland, A. and Dunn, M.H. : Laser Physics (N.H.Amsterdam, 1969).
Hecht, J.The laser Guide book (McGraw Hill, NY, 1986).
Demtroder, W. : Laser Spectroscopy (Springe series in chemical physics vol.5,Springe verlag, Berlin (1981).
Harper, P.G.and Wherrett B.S. (Ed.): Non-linear-optics (Acad.press, 1977).

Signatures :

HOD : ----------

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6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)
SEMESTER - IV (JAN. – JUN. 2021)
PAPER – III
(CONDENSED MATTER PHYSICS – II)
UNIT – I

Superconductivity, critical temperature, persistent current, Destruction of Superconductivity by magnetic Field, Meissner effect, heat capacity, Isotopic effect, and flux penetration, type I and type II superconductors, single particle tunneling, thermodynamics of superconducting transitions, London's equations, Coherence length Interaction of electrons with acoustic and optical phonon, Cooper pairing due to phonons, BCS theory of superconductivity (qualitative).Flux quantization in superconducting ring.

Manifestation of energy gap in superconductors, superconducting tunneling, A.C./D.C. Josephson effect, Microscopic quantum interference, high temperature superconductivity (elementary).

UNIT – II

Polarization, depolarization field, local electric field at an atom, Lorenz field, dielectric constant and polarizability, Electronic polarizability, Ionic and orientational polarizability, Debye equation for gases, the complex dielectric constant, dielectric relaxation time, Normal and anomalous dispersion, classical theory of electronic polarizability.

Ferro electric crystal, classification, ferro-electric domains, structural phase transition, Landau theory of phase transition, first and second order phase transition, anti Ferro electricity.

UNIT – III

Energy bands in semiconductor, Intrinsic and Extrinsic semiconductors, Drift velocity, mobility, carrier concentration and Fermi level for intrinsic and extrinsic semiconductors. Electrical conductivity of semiconductors, semimetals.

P-N junction, junction transistors, The tunnel diode, Zener diode, Gunn diode, photovoltaic effect, Quantum wells and super lattices.

UNIT – IV

Interatomic forces and lattice dynamics of simple metals, ionic and covalent crystals, lattice dynamics of linear monoatomic and diatomic lattices, optical and acoustical modes.

Quantization of elastic waves, phonons, momentum of phonons, inelastic neutron scattering by phonons, Anharmonicity, thermal expansion, lattice thermal conductivity.

Text and Reference Books:

Kittel: solid state physics
Azroff: Introduction to solids
Varma and Shrivastava: Crystallography for solid state Physics
Singhal: solid state physics
Ziman: Principal of theory of solids
Ascrroff and mermin: solid state physics
Madelung : Introduction to solid state theory
Huong: Theoretical solid state physics
Omar: Elementary solid state physics
Kittel : Quantum theory of solids

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)
SEMESTER - IV (JAN. – JUN. 2021)
PAPER – IV (ELECTRONICS)
(Microprocessor, Micro Computer, Digital and Fiber Communication)

UNIT – I

Microprocessor & Micro Computers : Evolution of Microprocessor, Internal Microprocessor, Architecture, Architecture of digital Computer

Memory : - Semiconductor memories (RAM, ROM, PROM, EPROM, Shift register).

Magnetic Memory: - Floppy disks, Hard disks, Optical Disks, Magnetic Bubble Memory.

Networking : Types of network, Design features of a communication network ,Examples, TYMNET, ARPANET, ISDN, LAN , LAN topology (Bus, Star, Ring) .

UNIT – II

Intel 8085 : ALU, Timing and Control Unit, Registers, Data and Address Bus, Pin Configuration.

Instruction Cycle : Op-code and Operands, Fetch Operation, Execute Operation, Machine Cycle, Instruction and Data flow.

Time Diagram : Opcode Fetch Cycle, Memory read, I/O Read, Memory write, I/O Write.

Addressing Modes : Direct Addressing, Register addressing, Register Indirect Addressing, Immediate Addressing, Implicit Addressing.

Instruction set of 8085 : Data transfer group, Arithmetic group, Logical group.

Assembly Language Programs: Addition of Two 8-bit number, Sum 8-bit , Addition of Two 8-bit number, sum 16-bit, 8-bit subtraction, Find the largest number in a data array, To arrange a series of numbers in Descending order, Find the smallest number in a data array, To arrange a data array in ascending order,.

UNIT – III

Digital Communications

Pulse modulation system: Sampling theorem- Low pass and Band pass signals, PAM, Channel BW for a PAM signal, Natural sampling. Flat top smapling. Signal recovery through Holding. Quantization of signals, Quantization, Differential PCM, Delta Modulation, Adaptive Delta Modulation, CVSD

Digital Modulation Techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK.

UNIT – IV

Optical Fibers: Introduction, Structure, Classification, Refraction and Snell's law, Total internal refraction, Light propagation through and optical fiber, Acceptance angle for incident ray, Numerical Aperture, number of modes and cut-off parameter, single mode propagation, comparison of step and graded index fiber. **Types of Optical Fiber** : HPSUU, HPSIR, Halide fiber

Optical fiber cables : Multifibre cable, Splicing and connectors. Advantage and Disadvantage of optical fiber.

Text and Reference Books :

Fundamental of microprocessor and microcomputer – B. Ram, Dhanpat Rai Publication , New Delhi
Microprocessor Architecture, programming and application with 8085/8086- Ramesh S. Gaonkar Wiley Eastern Ltd. 1987.
Optical Fibres and Fibre Optic Communication Systems – Subir Kumar Sarkar (S.Chand & company Ltd.)
Optical Fiber Communications (Principle and Practice) John M. Senior Prentice Hall of India Pvt. Ltd.
Principle of communication system , Taub and Schilling. TMH

Signatures :

HOD : ----------

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6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)

SEMESTER - IV (JAN. – JUN. 2021)

Lab. Course
Electronics IV

Time : 5 Hrs. **Total Marks – 100**

1.	Experiment	60
2.	Viva Voce	20
3.	Sessional	20

List of Practical

1. Study of RAM circuit.
2. Study of ROM circuit.
3. Study of ALU.
4. Programming of microprocessor 8085.
5. Study of shift Register.
6. Study of fiber optic analog link
7. Study of fiber optic digital link
8. Study of Delta Modulation/Demodulation.
9. Study of Adaptive Modulation/Demodulation.
10. Intensity Modulation System using analog input system.
11. Measurement of Numerical Aperture.
12. To understand synchronization and control signal.
13. Study of signal sampling and reconstruction Techniques .
14. Comparison of frequency response of 2^{nd} order and 4^{th} order .
15. Butterworth Low pass filter.

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------

M. Sc. (PHYSICS)

SEMESTER - IV (JAN. – JUN. 2021)

Project Work

Time : III Semester to IV semester **Total Marks – 200**

The project work should be related to the field of Physics . The project report should include declaration by the candidate, certificate by the supervisor, acknowledgement, title and introduction along with the following points:

- Introduction
- Review of Literature
- Materials and Methods
- Results & Discussions
- Summary
- Bibliography

Last date of submission of project report: As per M. Sc. Ordinance

Evaluation of Project: Evaluation of the project work of semester system of all the candidates of colleges will be held at GOVT. NAGARJUNA PG COLLEGE OF SCIENCE, RAIPUR (C.G.)

Signatures :

HOD : ----------

External subject Experts: 1- ----------2----------3----------

Departmental Members : 1----------2----------3----------4----------5----------

6----------7----------8----------9----------

Student Members: 1----------2----------3----------