Syllabus & Scheme of Examination for M.Sc. (Final) Physics
(Annual Pattern)
Master of Science Examination as per Provisions of Ordinance No.39

In **M.Sc. (Final) Physics**, there shall be 04 Theory Papers, 01 LAB Courses & 01 Project work, each of 100 Marks with minimum 36% passing marks in each theory & practical papers separately.

04 Theory Papers shall be as follows:-

PAPER-I (COMPULSORY)

1. CONDENSED MATTER PHYSICS & NUCLEAR PHYSICS

PAPER – II (OPTIONAL – CHOOSE ANY ONE)

A. NUMERICAL METHODS AND PROGRAMMING
B. NUMERICAL METHODS AND PHYSICS OF LASERS AND LASER APPLICATION
C. NUMERICAL METHODS AND PHYSICS OF ELECTRONIC DEVICE
D. NUMERICAL METHODS AND PLASMA PHYSICS

PAPER-III (COMPULSORY) SPECIAL (A)

1. ELECTRONICS - I

PAPER-IV (COMPULSORY) SPECIAL (B)

1. ELECTRONICS - II

01 LAB COURSE shall be of 100 Marks & 01 PROJECT shall be of 100 Marks.

PAPER- I

CONDENSED MATTER PHYSICS & NUCLEAR PHYSICS

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION: A

Crystalline solids, unit cells and direct lattice, two and three dimensional Bravia's lattice, closed packed structure, interaction of X-ray with matter, absorption of X-ray elastic scattering from a perfect lattice, the reciprocal lattice and its application to diffraction techniques, The Laue powder and rotating crystal method, crystal structure factor and intensity of diffraction maxima, extinctions due to lattice centering, point defects, line defects, and planer (stacking) faults, the role of dislocation in plastic deformation and crystal growth the observation of imperfection in crystals, X-ray and electron microscopic techniques.

Electrons in periodic lattice, band theory, classification of solids, effective mass, tight binding, cellular and pseudo potential methods, De Hass Van Alfen effect, cyclotron resonance, magneto resistance quantum Hall effect, super conductivity, critical temperature, persistent current, meissner effect weiss theory of ferromagnetism, Heisenberg model and molecular field theory, curie- weiss law of susceptibility.

SECTION: B

Nucleaon-Nucleon interaction, exchange forces and tensor for meson theory of nuclear forces, nucleon-nucleon scattering, effective range theory, spin dependence of nuclear forces, charge independence and charge symmetry of nuclear forces, iso-spin formation , Yukawa interaction, direct and compound nuclear reactionmechanism, cross section in terms of partial wave amplitudes, compound nucleus, scattering matrix, reciprocity theorem, Breit- Wigner one level formula resonance scattering, liquid drop model, Bohr-Wheeler theory of fission experimental evidence for shell effects shell model, spin orbit coupling magic numbers, angular moment and parities of nuclear ground states, qualitative siscussion and estimates of transition rates magnetic moments Schmidtness – Collective model of Bohr and Mottelson.

Beta decay: Fermi theory of beta decay, shape of beta spectrum total decay rate, angular momentum and parity selection rules, comparative half life, allowed and forbidden transition selection rules, parity violation, two component theory of neutrino decay, detection and properties of neutrino, Gamma decay, multipole transition in nuclei angular momentum and parity selection rules internal conversion, nuclear iomerism.

Types of interaction between elementary particles, hadrons and leptons, symmetry and conservation law, elementary idea of CP & CPT invariance, classification of Hardons, Lie-

algebra SU(2) –SU(3) multi-plates, Quark model Gell- Mann-Ikubo mass formula for octet and lacuplet hadrons charm bottom and top quarks.

TEXT AND REFERENCE BOOKS:

1. Cystallography for solid state physics: Verma & Shrivastawa.
2. Solid state Physics: Omar
3. Solid State Physics: Aschroff & Mermin
4. Solid State Physics: Kittel
5. Introduction to solids: Azaroff
6. Principle of condense matter Physics: Chaikin & Lubensky
7. Introduction to Nuclear Physics: Kenneth & Kiane
8. Nuclear structure: Bohr & Mttelson
9. Nuclear Physics: Keplan
10. Concepts of Nuclear Physics: B.L. Cohen.
11. Introductory Nuclear Physics: Y.R. Waghmre.
12. Atomic & Nuclear Physics: Ghosal
13. Introduction to High energy Physics: Perkins.

PAPER- II
OPTIONAL (A)
NUMERICAL METHODS AND PROGRAMMING

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION-A

Solution of non linear and transcendental equations, bisection method, false position and Newton – Raphson method, Gaussian elimination method, pivoting method, eigen values and eigen vectors of matrices, power and Jacobi method, finite differences, interpolation with equally spaced points, curve fitting, polynomial least squares and cubic spline fitting, numerial differentiation and integration, Newton- Cotes formulate, error estimate, Gauss method, Trapezoidal formula, simpson 1/3 Formula, numerical solution of ordinary difference equation, Euler and Runge method, predictor and corrector methods, elementary idea of solution of partial differential equation.

SECTION: B

C programming structure, data types, constants, variables assignment declaration and expression, symbolic constants, different types of operator, integers, floating point in 'C' data input and output control , printf, and scanf function, putchanr getchar, control statement and decision making in 'C' if, if-else statement, nesting of if in statement, while loop, do-while loop, for loop, newton-Raphson integration method as an example of 'C' program, user defined function, function and structured programming, local and global variables, declaration of function, Array declaration, initialization and processing of array satatement.

TEXT AND REFERENCE BOOKS:

1. Introductory methods of numerical analysis: Sastry
2. Numerical analysis: Raja Raman
3. Let us "C": Kanitkar
4. Numerical Recipes: Vetterming, Teukolsky, Press and Flannery.

PAPER- II
OPTIONAL (B)
NUMERICAL METHODS AND PHYSICS OF LASERS AND LASER APPLICATION

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION-A

Solution of non linear and transcendental equations, bisection method, false position and Newton – Raphson method, Gaussian elimination method, pivoting method, eigen values and eigen vectors of matrices, power and Jacobi method, finite differences, interpolation with equally spaced points, curve fitting, polynomial least squares and cubic spline fitting, numerial differentiation and integration, Newton- Cotes formulate, error estimate, Gauss method, Trapezoidal formula, simpson 1/3 Formula, numerical solution of ordinary difference equation, Euler and Runge method, predictor and corrector methods, elementary idea of solution of partial differential equation.

SECTION: B

Gaussian beam and its properties, stale Two- mirror Optical resonators, Longitudinal and Transverse models of Laser cavity, Mode selection, Gain in a Regenerative Laser Cavity, Threshold For 3 and 4 level Laser system, Mode Locking, pulse shortening – Picosecond & femtosecond Operation, Spectral Narrowing and Stabilisation.

Ruby Laser, Nd- YAG Laser, Semi Conductor Lasers, Diode - Pumped Solid State Lasers, Nitrogen Laser, Carbon- Dioxide Laser Excimer Laser, Dye Laser, High Power Laser Systems.

Laser Fluorescene and Raman Scattering and their use in pollution studies Non- Linear interaction of light with matter, Laser induced multi - photon processes and their applications, Ultra high resolution Spectroscopy with lasers and its applications, propagation of light in a medium with variable refractive index, Optical fibres, Light, wave Communication, Qualitative treatment of medical and engineering application of lasers.

TEXT AND REFERENCE BOOKS:

1. Introductory methods of numerical analysis: Sastry
2. Numerical analysis: Raja Raman
3. Numerical Recipes: Vetterming, Teukolsky, Press and Flannery.
4. Lasers: Svelt
5. Laser spectroscopy :Demtroder
6. Non-Linear Laser Spectroscopy: Leteklov
7. Optical Electronics: Yariv.

PAPER- II
OPTIONAL (C)
NUMERICAL METHODS AND PHYSICS OF ELECTRONIC DEVICE

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION-A

Solution of non linear and transcendental equations, bisection method, false position and Newton – Raphson method, Gaussian elimination method, pivoting method, eigen values and eigen vectors of matrices, power and Jacobi method, finite differences, interpolation with equally spaced points, curve fitting, polynomial least squares and cubic spline fitting, numerial differentiation and integration, Newton- Cotes formulate, error estimate, Gauss method, Trapezoidal formula, simpson 1/3 Formula, numerical solution of ordinary difference equation, Euler and Runge method, predictor and corrector methods, elementary idea of solution of partial differential equation.

SECTION: B

Energy bands, intrinsic carrier concentration, donors and acceptors direct and indirect band semiconductors, degenerate and compensated semiconductors, elemental (Si) and compound semiconductors (GaAs), replacement of group III element and group V elements to get temary alloys and quaternary alloys and their important properties, doping of group III (n) and group V (p) compounds and GaAs (group II (p), IV (n-p)) and VI (n compunds), thermal diffusion, constant surface concentration, Constant total dopant diffusiotion, implantation.

Carrier drift under low and high field in (Si and GaAs), saturation of dirft velocity, high field effects in two valley semiconductors, carrier diffusion, carrier injection, generation, Direct and indirect band gap semiconductors, minority carrier, life time, drift and diffusion of minority carriers (Hayness – Shockley experiment), determination of conductivity four probe, Van der Paw techniques, Hall coefficient minority carrier life time p –n junction, metal- semiconductor (Schottky junction) and metaloxide semiconductor (MOS) diodes, junctions and their applications.

Transistors – BJT, JFET, MOSFET and MESFET Structure working derivation of the equations for I-V characteristics under different conditions high frequency limits.

Microwave devices – Tunnel diode, transfer electron devices (Gunn diode) avalanche transit time devices: read, impatt diodes and parametric device.
Photonic devices – radiative and non – radiative transitions, optical absorption, bulk and thin film photo – conductive devices (LDR), diode photodetectors solar cell, LED, diode lasers.

TEXT AND REFERENCE BOOKS:

1. Introductory methods of numerical analysis: Sastry
2. Numerical analysis: Raja Raman
3. Numerical Recipes: Vetterming, Teukolsky, Press and Flannery.
4. The physics of semiconductor devices D.A. Eraser.
5. Semiconductor devices – Physics and Technology : SM Size
6. Introduction to semiconductor devices: M.S. Tyagi.

PAPER- II
OPTIONAL (D)
NUMERICAL METHODS AND PLASMA PHYSICS

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION-A

Solution of non linear and transcendental equations, bisection method, false position and Newton – Raphson method, Gaussian elimination method, pivoting method, eigen values and eigen vectors of matrices, power and Jacobi method, finite differences, interpolation with equally spaced points, curve fitting, polynomial least squares and cubic spline fitting, numerial differentiation and integration, Newton- Cotes formulate, error estimate, Gauss method, Trapezoidal formula, simpson 1/3 Formula, numerical solution of ordinary difference equation, Euler and Runge method, predictor and corrector methods, elementary idea of solution of partial differential equation.

SECTION: B

Introduction to the Plasma state, elementary concepts and definition temperature and other plasma parameters, occurrence and important of plasma for various application, production of plasma in the labor physics of glow discharge, electron emission, ionization, breakdo gases, Paschen's Laws and different regimes of E/p in a discharge Townsend discharge and the evoluation of a discharge.

Plasma diagnostics; Probes energy analyzers, magnetic probes and optical diagnostics, preliminary concepts.

Single particle orbit theory; Drifts of charged particles under the effect of different combinations of electric and magnetic fields, crossed electric and magnetic fields, homogenous electric and magnetic fields spatially varying electric and magnetic fields, particle motion in large amplitude waves.

Fluid description of plasmas; distribution function and Liouville's equation macroscopic parameters of plasma, two and one fluid equ and simplified one fluid equation for plasma, MHD approximations commonly used in one fluid equations and simplified onf fluid and MHD Equations.

Waves in fluid Plasma; Dielectric constant of field free plasma, plasma oscillations, space charge waves of warm plasma, dielectric constant of a cold magnetized plasmation – acoustic, Alfven waves, magneto – sonic waves.

Stability of fluid Plasma; The equilibrium of plasma, plasma instabilities, stability analysis, two stream instability, instability of Alfven waves, Plasma supported against gravity by magnetic field, energy principle.

Kinetic description of plasma; Microscopic equation for many body systems, statistical equations for a many body system. Vlasov equation and its properties. Drift kinetic equation and its properties.

Waves in Vlasov plasma; Vlasov equation and its linearization, solutions of linearised Vlasov equation, theories of Langumuir waves. Landau damping, ion acoustic waves, drift waves in magnetized plasmas.

Non Linear plasma theories; Non Linear electrostatic waves, solitons, shocks non linear Landau damping.

Thermonuclear fusion: Status, Problems and technological requirements Applications of cold low pressure and thermal plasmas.

TEXT AND REFERENCE BOOKS:

1. Introductory methods of numerical analysis: Sastry
2. Numerical analysis: Raja Raman
3. Numerical Recipes: Vetterming, Teukolsky, Press and Flannery.
4. Plasma Physics: By Bitten Court
5. Plasma Physics: By F. Chen
6. Plasma Physics: By S.N. Sen.

PAPER- III
SPECIAL PAPER (A)
ELECTRONICS - I

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION-A

Noise: Thermal noise, shot noise, Partition noise, Partition noise, Low frequency or flicker noise, Burst noise, Avalanche noise, Bipolar Transistor Noise, Field – effect Transistor noise, Equivalent noise generators and comparison of BJT's and FET's singalto noise ratios, S/N ratio of a tandem connection, noise factor, amplifier input noise in terms of F, noise factor of amplifier in cascade, noise factor and equivalent input noise generators, noise factor of a loosy network, noise temperature measurement of noise temperature and noise factor, Narrowband Band Pass noise.

Signal analysis: Trigonometric and complex exponential Fourier series, negative frequency, complex Fourier spectrum, time domain and frequency domain representation of signal, sampling function and sine function Fourier transforms, continuous spectrum. FT involving impulse function, singularity function, sampling square function, shifting of delta function, convolution, Laws of convolution theorems, sampling theorem, signal recovery from sample.

Linear systems: Classification of systems, the system function, energy signals and power signals, Parseval's theorem for energy signals, energy spectral density, Parseval's Power theorem, power density spectrum. Frequency shifting theorem for power density spectrum.

Fundamentals of Modulation: Amplitude modulation, Frequency spectrum in amplitude modulation, power in AM wave, the SSB system, balance modulator, frequency modulation, frequency spectrum in FM wave, phase modulation.

Pulse modulation systems:PAM, natural sampling, Flat top sampling, PAM modulator circuit, demodulation of PAM signal using equalizer and holding circuit, PTM, generation of PTM signals, PWM and PPM circuits, PWM and PPM demodulation circuits, PCM, PCM systems, inter signal interference, eye patterns, bandwidth of PCM systems.

Data transmission: Amplitude shift keying, frequency shift keying, phase shift keying, differential phase shift keying, baseband signal receiver, probability error, the optimum filter, matched filter, corelator probability error in ASK, probability error in FSK, Probability of PSK and probability of DPSK.

TEXT AND REFERENCE BOOKS:

1. Communication systems digital and analog: By R.P. Singh and Sapre.
2. Electronic Communication: By Kesr.
3. Principle of Communication systems: By Taub and Sehilling
4. Communication System: By Simon Haykin
5. Electronic Communications: Dennis Roddy John Coolen.

PAPER- IV
SPECIAL PAPER (B)
ELECTRONICS - II

M.M. 100

- *Total no. of questions to be asked – 05 (with internal choice in each question)*
- *Total no. of questions to be attempted – 05*
- *Students are required to solve minimum 02 questions from each Section.*

SECTION-A

Introduction to Microprocessor and Microcomputer: Evolution and overview of microprocessor CPU, memory, basic concept of high level and assembly languages, assembler and compiler, recent trends in microprocessor and microcontrollers.

Microprocessor architecture: Introduction to internal architecture of 8085, ALU timing and control unit, registers data and address bus, pin configurations timing and control signals, fetch and execute operations, instruction and data flow, timing diagram.

Instruction set of INTEL 8085: Introduction, Instruction and data format, addressing modes, direct addressing, register addressing, indirect addressing, overview of instruction set data transfer group, arithmetic group, logical group, branch group, stack, I/O machine control group.

Programming techniques: Program design methodology, flow charts, looping, counting and indexing.

Assembly language programming of 8085: Additional data transfer and 16 bit arithmetic instruction arithmetic operations related to memory, logic operations.

Counter and time delays: Ikkustrative programs, debugging counter and time – delay program.
Microprocessor Based Information system, Analog to Digital Converter ADC 800, Digital to Analog Converter DAC 808.

Microprocessor Applications: 7 – Segment LED display, Measurement of frequency, Phase angle and Power factor, measurement of voltage, temperature, strain, speed of motor, water level, control of lift, microprocessor based traffic control.

TEXT AND REFERENCE BOOKS:

1. Digital principle and applications: By Navneet and Kale
2. Digital principle and applications: By Malvino and Leach
3. Microprocessor: By B. Ram
4. Microprocessors architecture programming and applications with 8085/8086: By Ramesh S. Gaonkar.

PAPER- V

LAB COURSE

M.M. 100

There shall be one Laboratory Course of 100 marks

List of Experiments:-

1. Study of Amplitude Modulation and Pulse Width Modulation.
2. Study of Frequency Modulation and Pulse Position Modulation.
3. To find out the Bending Loss and Numerical Aperture of an optical fiber.
4. To set the Optical Link and find out the Attenuation Constant.
5. To write the programme for addition and Multiplication for microprocessor and demonstrate its execution.
6. To write the programme for A to D Conversion for microprocessor & demonstrate its execution.
7. To study the R – C transmission line.
8. To study Up counter. Down counter and Shift Register.
9. To study Multiplexing and De-Multiplexing.
10. To study A to D to A conversion.

PAPER- VI

PROJECT

M.M. 100

There shall be one Project of 100 marks