Table - **3** : Common Course Structure for **P.G. Degree Programme in Science – M.Sc. (General)** #

(with effect from the academic year 2017-2018 onwards)

M.SC. PHYSICS

Sem. (1)	Sub. No. (2)	Subject Status (3)	Subject Title (4)	Contact Hrs./ Week (5)	Credits (6)
I	1	Core - 1	Classical Mechanics	6	4
	2	Core - 2	Mathematical Physics I	6	4
	3	Core - 3	Integrated Electronics	5	4
	4	Core - 4	Non Linear Dynamics	5	4
	5	Core - 5 Practical - 1	General Physics Experiments I	4	2
	6	Core - 6 Practical – 2	Electronics Experiments I	4	2
			Subtotal	**30**	**20**
II	7	Core - 7	Mathematical Physics II	5	4
	8	Core - 8	Condensed Matter Physics	5	4
	9	Core - 9	Microprocessor & Microcontroller	4	4
	10	Core - 10	Numerical Methods & C++ Programming	4	4
	11	Core - 11	Field Work	4+2	3
	12	Core - 12 Practical - 3	General Physics Experiments Ii	4	2
	13	Core - 13 Practical - 4	Electronics Experiments II	4	2
			Subtotal	**30**	**23**

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1.) Bio-Chemistry	2.) Biotechnology
3.) Botany	4.) Dietics and Food Management
5.) Electronics	6.) Electronics & Communication
7.) Geology	
8.) Hotel Management and Catering Science and Applied Nutrition	
9.) Nutrition and Dietics	10.) Physics
11.) Zoology	

Sem. (1)	Sub. No. (2)	Subject Status (3)	Subject Title (4)	Contact Hrs./ Week (5)	Credits (6)
III	14	Core - 14	Quantum Mechanics I	6	4
	15	Core - 15	Electromagnetic Theory	6	4
	16	Core - 16	Statistical Mechanics	5	4
	17	Core - 17	Research Methodology	5	4
	18	Core - 18 Practical - 5	Advanced Physics Experiments I	4	2
	19	Core - 19 Practical - 6	Microprocessor Experiments	4	2
			Subtotal	**30**	**20**
IV	20	Core - 20	Quantum Mechanics II	4	4
	21	Core - 21	Spectroscopy	4	4
	22	Core - 22	Nuclear and Particle Physics	4	4
	23	Core - 23 Practical - 7	Advanced Physics Experiments II	4	2
	24	Core - 24 Practical - 8	C++ Programming	4	2
	25	Elective - 1	Elective / Field Work / Study Tour	3+3	3
	26	Core - 25	Project	7+9	8
			Subtotal	**30**	**27**
			Total	**120**	**90**

+ Extra hours for the Field Work/Study Tour/Project

For the Project, **f**lexible credits are b/w 5 – 8 & Hours per week are b/w 10 - 16.

Total number of credits ≥ 90 : 90
Total number of Core Courses : 25 (15 T + 8 P + 1 Prj. + 1 FW.)
Total number of Elective Courses / F.W. / S.T.: 1
Total hours : 120

Core - 1 Classical Mechanics

Unit I Fundamental Principles and Lagrangian Formulation

Mechanics of a particle and a system of particles - Conservation laws - Constraints - Generalised Co-ordinates - Principle of Virtual work - D'Alembert's principle and Lagranges equations - Applications of Lagrange's equations - Hamilton's principle - Lagrange's equation from D'Alembert's principle.

Unit II : Motion Under a Central force : Two body problem

Equivalent one body problem - General features of Central force motion - Equivalent one dimensional problem - General features of the orbits - Motion under inverse square law - Kepler problem - Virial theorem - Unbound motion Rutherford scattering.

Unit III : Rigid Body Dynamics

Mechanics of a rigid body - Displacement of a rigid body - Orthogonal transformation - Eulerian angles - Infinitisinal rotation - Coriolis effect - Kinematics of a rigid body moments and products of inertia - K.E.of a rigid body - Euler's equation of motion - Torque free motion.

Unit IV : Hamilton's Formulation

Hanilton's equation from variational principle - Principle of least action – Applications- Legendre transformation - Canonical transformations - Lagrange and Poisson brackets - Equation of motion and conservation theorems in Poisson's brackets - Hamilton Jacobi method - Application to Harmonic osciallator - Hamilton's characteristic function - Separation of variable - Action angle variables - Kepler problem in action angle variables.

Unit V : Mechanics of Small Oscillations

Stable and unstable equillibrium - Formulation of the problem - Lagrange's equation of motion for small oscillations - Properties of T,V and w - Normal Co-ordinates and normal frequencies of vibration - Double pendulum - Free vibrations of linear triatomic molecule.

Books for Study :

1. Helbert Goldstein, Charles P.Poole John Safco, Classical Mechanics, Pearson, Chennai.
2. Gupta Kumar, Sharma, Classical Mechanics, Prakati Prakasham, Meerut.

Core 2 Mathematical Physics I

Unit I Vector Analysis

Gauss drivergence theorem - Deductions from Gauss divergence theorem - Green's theorem - Green's theorem in a plane - Classification of vector fields.

Unit II Matrices

Eigen values; Eigen Vectors - Characteristic equation of matrix - Cayley Hamilton theorem - Some important theorems of eigen values and eigen vectors - diagonalisation of matrices - Differentiation and integration of matrices - Power of matrics - Exponential of a matrix - Matrices in Physics.

Unit III : Special Functions :

Bessel differential equation and Bessels' function of I Kind - Generating function - Recurrence relations - Laguarre's differential equation and Laguerie polynomial - Generating function - Recurrence relations.

Unit IV : Fourier's Integral Transforms

Introduction - Fourier's transform (FT) - Properties of FT - FT of a derivative - Fourier sin and cosine transforms of derivatives - FT of functions of two or three variables - Finite FT - Simple applications of FT.

Unit V : Laplace Integral Transforms

Laplace Transform (LT) - Properties of LT - LT of derivation of a function - LT of periodic functions - Properties of inverse LT - Convolution theorem - Evaluation of inverse LT by convolution theorem - Application of LT.

Book for Study :

1. Sathya Prakash, Mathematical Physics, Sultan chand & sons, New Delhi.

Books for Reference :

1. Applied mathematics for Engineer and Physics,. Louis A.Pipes Lawrence R.Harvill, Mc Graw Hill Ltd., 1970.

2. Eugune Buthov, Mathematical Physics, Addision Weslay 1968.

Core 3 Integrated Electronics

Unit I Devices, Applications and Integrated Circuits

FET-Types of FET-Characteristics and applications of FET, MOSFET- SCR, DIAC,TRIAC-High frequency device-Inegrated Circuits-IC Fabrication Technology - Steps in Fabrication - Integrated Resistors and Capacitors-VLSI Technology.

Unit II Digital Electronics

Logic Families - DTL, RTL,TTL, ECL, I^2L,CMOS,NMOS and PMOS - DTL type AND, OR, NAND and NOR gates - RTL and TTL type NAND - CMOS NOR and CMOS NAND - Flip Flops: RS-RST-D- JK- JK Master/Slave- Asynchronous Counters and Synchronous Counters - Registers.

Unit III OP AMP and Applications

Characteristics and Parameters -DC Analysis of IC OP AMP- Applications of OP AMP - Instrumentation amplifier -Sample and Hold System- Analog Multiplexer -Integrator - Differentiator- Design of Analog circuits for the solution of Simultaneous and Differential Equations- Filters: First and Second order LOW,HIGH and BAND pass filters.

Unit IV Timer, VCO, PLL, and Applications

Timer-555 Timer IC-Internal Architecture and Working-Modes of Operation: Monostable and Astable operation- Applications-Voltage Control Oscillator - IC 566-PLL Concept-PLL IC 565 - Application- Frequency multiplexer - FSK Modulation and Demodulation.

Unit V Electronic Measurement and Control

Sensors and Transducers - Measurement and Control - Signal Conditioning and Recovery -Impedance Matching - Amplification (OP Amp based Feedback Amp, Instrumentation Amp) - Noise and Noise Sources -Filtering and Noise Reduction -Shielding and Grounding - Fourier Transform - Lock- in Detector/Amplifier - Box-Car Integrator or Averager - Modulation Techniques.

Books for Study:

1. Integrated Electronics Analog and Digital Circuits and Systems, Second Edition, Jacob Millman, Christos C Halkias, Chetan Parikh, Tata McGraw Hill Education Private Limited, NewDelhi.
3. Analog and Digital Electronics, U.A. Bakshi, A.P.Godse, Technical Publications, Pune.

Books for Reference :

1. Introduction to Semiconductor Devices M.S.Tyagi, John Wiley and Sons.
2. Electronic instrumentation, P.P.L. Regtien, VSSD Publications, 2005

Core 4 Nonlinear Dynamics

UNIT I Nonlinearity, linear and nonlinear oscillators

Dynamical systems-linear and nonlinear forces-Mathematical implications of nonlinearlty- Working definition of nonlinearity-Effects of nonlinearity-Linear oscillators and predictability- Damped and driven nonlinear oscillators.

UNIT II Equilibrium points, bifurcations and chaos

Equilibrium points-General criteria for stability-Classification-Some simple bifurcations - Saddle node, pitch fork, transcritical and Hopf bifurcations-Discrete dynamical systems-Logistic map-Equilibrium points and their stability-period doubling phenomenon-chaos.

UNIT III Chaos in nonlinear electronic circuits

Linear and nonlinear circuit elements-nonlinear circuits-Chua's diode-Autonomous case-Bifurcations and chaos-Chaotic dynamics of MLC circuit-Analogue circuit simulation-Some other useful nonlinear circuit - Colpitt's oscillator.

UNIT IV Fractals

Self similarity-Properties and examples of fractals-Fractal dimension-Construction and properties of some fractals-Middle one third cantor set-Koch curve-Sierpinski triangle-Julia set-Mandelbrot set-Applications of fractals.

UNIT V Solitons

Linear waves-Linear non dispersive wave propagation-Linear dispersive wave propagation-Nonlinear dispersive systems-Korteweg de vries equation- solitary and cnoidal waves-Numerical experiments of Zabusky and Kruskal-birth of solitons—Properties of solitons-applications of solitons.

Book For Study:

1. Nonlinear dynamics, Integr ability, Chaos, Patterns, M. Lakshmanan and S.Rajasekar, Springer, Berlin, 2003.

Books for Reference:

1. Chaos in nonlinear oscillator, controlling and synchronization, M.Lakshmanan and K.Murali.(World Scientific, Singapor,1997.)
2. Deterministic chaos, H.G.Schuster,(Verlag,Weinheim,1998.)

Core 5 Practical 1

General Physics Experiments I

Any 5 Experiments

1. ***Susceptibility***
   a. Determination of susceptibility of the given paramagnetic solution by Quinke's Method for various normalities,
   b. Determination of Magnetic Moment and Bohr Magnetron from graph and by calculation for various normalities.
2. ***Cauchy's Constant***
   a. Determination of Cauchy's Constant by spectrometer.
   b. Verification of the experimental result with graphically obtained value.
3. ***Michelson's Interferometer***

   Determination of wavelength of a source and thickness of a thin transparent medium by forming interference pattern,
4. ***Anderson's Bridge***

   Determination of self inductance of the given coil - (different turns/coil).
5. ***Force Constants***

   Calculation of force constants of a molecule from the vibrational spectral data
   - At least 3 spectrum
6. ***Solar Absorption Spectrum***

   Importance of Solar Absorption spectrum and Fraunhofer lines Determination of wavelength of various absorptions.
7. ***Thickness of a thin material/ diameter of a thread.***

   Determination of thickness of a very thin material or diameter of a thread using LASER diffraction and also by Airwedge method. Comparison of the results. Variation in thickness/diameter with Load.

Core 6 Practical 2

Electronics Experiments - I

Any 5 Experiments

1. ***Series Voltage Regulator***

   Construction of a series voltage regulator using transistor (as an error amplifier) - study the regulation factors (line regulation, load regulation) - to find out the percentage of regulation.

2. ***Schmitt Trigger***

   Designing of a Schmitt trigger circuit using transistors - Trace the input and output waveforms - Draw Hysteresis curve and calculate hysteresis voltage both theoretically and experimentally.

3. ***Wave Form Generators***

   Construction of a triangular and a ramp wave generator using OP Amp and construction of 5555 timer based square wave generator.Theoretical calculation of the frequency of the output wave for various

   R and C values with experimental verification.

4. ***Counters and Decoders***

   Construction and study of Modulus countrs (2 to 9) using IC 7490 or any equivalent IC. Use a 7 segment decoder and a 7 segment display to show output.

5. ***Analog to Digital Conversion***

   Construction of ADC converter using Comparator and an Encoder ICs - Measurement of the digital outputs for various input voltages - Resolution measurement.

6. ***Construction of Constant Current Source***

   Construction of a constant current source using OP Amp and transistor/ FET(floating and grounded load). IR chareteristics.

7. ***FET Characteristics and Amplifier***

   Drain and Transfer characteristics of FET - FET parameters from the characteristics. Designing of a voltage amplifier using FET - Frequency response and bandwidth of the amplifier.

Core 7 Mathematical Physics II

Unit I Complex analysis

Functions of complex variable - Analytic functions - Cauchy -Riemann differential equation - Harmonic functions - Cauchy's integral theorem - Cauchy's integral formula - Derivatives of analytic functions - Residues and their evaluations - Cauchy's residue theorem.

Unit II Group theory

Concept of a group - Abelian group - Cyclic group - Subgroup - Coset - Classes - Conjugate subgroups - Isomorphism and homomorphism - Reducible and irreducible representations - Some important theorems on representations - Orthogonality theorem.

Unit III Special functions II .

Introduction - Legendre differential equation and Legendre polynomial - Generating functions - Recurrence relations - Hermite differential equation and Hermite polynomial - Generating function - Recurrence relations.

Unit IV Partial Differential Equations

Solution of heat flow equation (Method of separation of vriables) – Linear flow in semi infinite solid : Temperature on one face given as sinusoidal function of time – Variable linear flow in an infinite bar – two dimentional heat flow - three dimentional heat flow – Heat flow in circular plate (use of cylindrical co ordinates) – Equation of motion for the vibrating string – Vibrations of a rectangular membrane - Vibrations of a circular membrane

Unit V Tensor analysis

Introduction - Scalar, contravarient and covarient vectors - Tensor of higher ranks - Algebraic operations of tensors - Symmetric and anti symmetric tensor - Fundamental tensor - Tensors in dynamic of a particle - Tensors in elasticity - Moment of inertia tensor.

Book for Study:

1. Mathematical Physics, Sathyapakash, Sultan Chand &Sons, New Delhi.

Books for Reference:

1. Applied Mathematics for Engineers and Physicsts, Louis A.Pipes, Lawrence R, Harvill, McGraw-Hill Ltd, 1970
2. Matrices and Tensors in^{1} Physics- A.W.Joshi, 3rd edition, New Age International Publishers, New Delhi, 1995.

Core 8 Condensed Matter Physics

Unit I Crystallography and crystal binding

Classification of crystals - Two dimensional Brava's - Brava's lattices in 3 dimensional - crystals of inert gases-ionic crystals-covalent crystals-metals-hydrogen bonds-atomic radii-analysis of elastic strains-elastic compliance and stiffness constants-elastic wave in cubic crystals.

Unit II Lattice vibrations

Lattice waves - properties of Lattice waves - vibratimal modes of a finite one - dimensional lattice of identical atoms - diatomic linear lattice - quantizaion of lattice vibrations – phonons momontum - Inelastic scattering by phonons, by long wave length phonons- X rays by phonons- neutrons by phonons

Unit III Free electron theory, Energy bands and Semiconductor crystals

Energy levels in one dimension-free electron gas in three dimensions-heat capacity of the electron gas-Electrical conductivity and Ohm's law-Hall effect-thermal conductivity of metals-Bloch functions-Kronig-Forder-magnons - antiferro magnetic order - Ferromagnetic domains - Origin of domains.

Unit IV Dia, Para, Ferro and Anti ferro magnetism

Langevin diamagnetism equation - quantum theory of diamagnetism -quantum theory of paramagnetism - Hund rules - Paramagnetic susceptibility of conduction electrons-ferromagnetic order-magnons - antiferro magnetic order - ferromagnetic domains - origin of domains.

Unit V Dielectrics, Ferroelectrics and Super conductivity

Macroscopic electric field - Local field at an atom - Dielectric constant and polarizability - Structural phase transitions - Ferroelectric crystals -Ferroelectric domains - Piezoelectricity - occurrence of supcrconductivity -Meissner effect - thermodynamics of superconducting transition - London equation - coherence length - BCS theory of superconductivity - single particle tunneling - DC Josepson and AC Josepson effects.

Book for study :

1. Introduction to Solid State Physics,Charles Kittel, Seventh Edition Wiley-India sixth reprint 2007.

Books for reference

l. Solid State Physics -R J Singh,Pearson First impression 2012

2. Solid Stale Physics-S 0 Pillai New age international Publishers

Core 9 Microprocessor 8085 and Microcontroller 8051

Unit I Introduction to 8085 Microprocessor

Pin diagram and description - Bus System, Control Signals, Status Signals- Clock System - Latching of Address Bus - Interrupt System - Direct Memory Access- Internal architecture - ALU- Registers organization - Special purpose Registers and Counters - Flags - Program Status Word.

Unit II Programming 8085

Assembly Language Programming - Assembler - Instruction Format of 8085-Instruction Set - Addressing Modes - Instruction Cycle, Machine Cycle and T-Slates - Timing Diagram of Read, Write machine Cycles and some basic Instructions - 8 bit and 16 bit addition and subtraction- Loops and Branching - Multiplication and Division in 8085-Searching and Sorting - Finding smallest/biggest number in an array - Time delay calculation- Stack and Subroutines - Software Interrupts and ISR- Data Transfer Schemes.

Unit III Interfacing and peripheral devices

Address Space of 8085- Address space partition- Memory Interfacing - Memory map and Address decoding- Interfacing of RAM (2K x 8 & 4K x 8) and ROM (2R x 8 & 4K x 8) - I/O mapped I/O and Memory Mapped I/O interfacing Schemes - Ports- Interfacing chips: Nonprogrammable Port 8212 - Programmable Peripheral Interface (PPI) 8255 architecture, Control Signals and operating Modes - Programmable Interval Timer (PIT) 8253 .

Unit IV Micro Controller 8051

Introduction - Comparison of Microcontroller & Microprocessor - Pin Diagram and description - Block Diagram of 8051 and Internal Architecture - Clocks - Registers- Flags- Internal Memory, SFR and I/O Ports - External Memory and decoding- Instruction Set and Addressing Modes of 8051- Features available in 8051: Timer and Counters, Timer Modes - Serial Port and Serial Data Transfer.

Unit V Micro Processor based system design and a Applications

Design considerations - Sensors and Transducers - Sample and Hold Circuits- - Interfacing Keyboard and multiplexed seven segment displays - DAC and ADC interfacing - Square, Rectangular and Ramp Wave Generation - Temperature measurement and control - Digital Clock - Stepper Motor Control.

Books for Study:

1. Fundamentals of Microprocessor and Microcontrollers by B. Ram- Dhanpat Rai Publications, 5th Edition
2. Microprocessor and microcontroller system (First Edition) by Godse and Godse , Technical Publication Pune
3. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2nd Ed. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, Pearson India.

Books for Reference:

1. Microprocessor Architecture, Programming and Applications with the 8085, Ramesh S. Gaonkar-4th Ed. Penram International.
2. The 8051 Microcontroller Architecture, Programming and Applications - Kenneth J. Ayala - Penram International Publishing.

Core 10 Numerical Methods and Programming in C++

Unit I Roots of equations and eigen-value problems

Newton-Raphson method. Secant Method. Muller's Method - Lin -Bairstow's Method. Linear Algebraic Equations: Gauss elimination - Gauss-Jordan - Gauss-Jacobi - Inverse of a matrix by Gauss Jordan elimination method.

Unit II Curve Fitting / Interpolation

Curve fitting: Linear Least square fitting - Nonlinear Fit- Fitting a Polynomial Function, Exponential function - Cubic spline fitting – Interpolation: Fundamental theorem of finite difference, Finite difference interpolation with equally spaced: Newton's forward and backward difference formulae - Unequally spaced: Lagrangian interpolation formula.

Unit III Numerical differentiation and integration

Numerical Differentiation : Methods based on interpolation: non uniform & uniform nodal points - Methods based on finite differences: forward & backward difference formulae. Numerical Integration: Trapezoidal Rule, Simpson Rule - Monte-Carlo evaluation of integration. Methods based on undetermined coefficients: Gauss-Legendre, Gauss - Lagurre, Gauss - Hermite integration methods.

Unit IV Solution to ordinary and partial differential equations

Ordinary Differential Equations- Taylor's Series Method- Euler's Method-Euler's modified method - Runge -Kutta 2nd and 4th Order Methods-Predictor- Corrector Methods-Solution to partial differential equations

Unit: V C++ Programming applications

Programme structure: header files, local, global and static variables, input and output statements; Euler's Method: Charging and discharging of a condenser; Runge-Kutta methods: Radioactive Decay; Newton-Raphson method: Solution van der Waals equation; Gauss elimination method: Currents in Wheatstone's bridge; Linear fitting. - least square method : Cauchy's constant; Simpson's and Monte-Carlo methods : Evaluation of (integral) area under the curve;Eigenvalues and eigenvectors of symmetry matrices; Numerical differentiation: Newton's Law of cooling.

Books for Study:

1. M.K.Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering computation, 3r edition, New age international (P) Ltd, Chennai (1998).
2. E.Balgurusamy, Object Oriented Programming with C++, Tata McGraw Hill, New Delhi (2000).

Books for Reference :

1. M.K. Venketraman, Numerical Methods in Science and Engineering 2nd Ed., National Publishing Co., Chennai(2010).
2. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods, Macmillan India Ltd, New Delhi (2000).

Core 11 Field work

Core 12 Practical 3

General Physics Experiments II

Any 5 Experiments

1. ***Hyperbolic fringes***

   Determination of Young's modulus, Bulk modulus, Rigidity modulus, poisson's ratio and compressibility of the given material by forming Hyperbolic fringes.

2. Ultrasonic Interferometer

Determination of velocity of ultrasonic sound in the given liquid and compressibility of the liquid.

3. Young's Double Slit

Determination of .wave length of the light source or width of the double slit using Laser source for a) standard kit b) lab/custom made double slit

4. Mutual Inductance

Determination of mutual inductance between a pair of coils. Study of variation of mutual inductance for various distances and angles between the coils and determination of coefficient of coupling in each case. Graphical determination of break in coupling for distance and angle.

5. XRD - Crystallographic Parameters

a) Braggs' Law of Diffraction - derivation,

b) Definition of Cry stallo graphic Parameters - d-Spacing and lattice parameters.

c) Crystal systems and d-spacing in different crystal systems.

d) Content of ICDD file (formerly known as JCPDS)

e) Determination of unit cell dimensions

f) Crystal parameter for the given XRD spectrums,

6. Optical Fibre Characteristics

Determination of

a. Numerical aperture and acceptance angle

b. Attenuation in the fibre and c. Loss due to air gaps and coupling.

Core 13 Practical 4

Electronics Experiments - II

Any 5 Experiments

1. Filters

Design and construction of II order Active Filters (Low pass, High Pass and band pass) using 1C 741 for a particular frequency - Draw frequency response curve for each case.

2. UJT Characteristics and Relaxation Oscillator

Characteristics study of UJT - construction of a relaxation Oscillator. using

UJT to produce the saw tooth wave. Frequency response of the output for various R and C values.

3. Phase Shift and Phase Shift Circuit

Design a Phase shifter circuit using Op-Amp - Measurement of the Phase shift of the input wave for various R and C combinations - Comparison of the experimental output with theoretical values.

4. Digital to Analog Conversion

Construction of Weighted Resistor and R-2R Ladder Network D/A converters using IC 741- Graphing input and output voltages - Resolution Measurement.

5. SCR Characteristics and power control

Characteristics study of SCR - Construction of a power controller device using SCR.

6.*Code Converters*

Construction of Code converters using ICs - Tabulate input and output for various decimal numbers

a. BCD to Excess-3 b. BCD to Gray

c. Excess-3 to BCD d. Gray to Excess-3

7. Analog Computation.

Solve the given 2 variable simultaneous equations by constructing the Analog computers using Op-Amps.

Sample Eqns. a) X+2Y =4 ; 2X+Y = 5 b) 3P + 2Q = 18 ; P + Q =7.