Indira Gandhi National Tribal University, Amarkantak (M.P.)-484 887

(A Central University Established by an Act of Parliament)

SYLLABUS

(Choice Based Credit System)

Faculty of Science

Department of Physics

M.Sc. in Physics

(Effective from 2017-2018)

M.Sc. in PHYSICS

DEPARTMENT OF PHYSICS

(4 semesters based on CBCS pattern)

Introduction:-

The Department of Physics began functioning at the Indira Gandhi National Tribal University, Amarkantak (MP) during the academic session 2016-17. M.Sc. program at the Department is running with an intake of 20 students in each session. The department plans to introduce Ph.D. program in coming session.

The details of the faculties at the Department of Physics are as follows:

S. No.	Name of the Faculty	Name of the Designation	Fill up	Vacant	Remarks
01	In process	Professor	Nil	01	Advertised
02	In process	Associate Professor	Nil	01	Advertised
03	Mr. Rajesh Kumar	Assistant Professor	Yes	Nil	Joined on 03/03/2016
04	Dr. Ishwar Prasad Sahu	Assistant Professor	Yes	Nil	Joined on 18/05/2017
05	Dr. Suman Ghosh	Assistant Professor	Yes	Nil	Joined on 19/05/2017
06	Dr. Arvind Kumar	Assistant Professor	Yes	Nil	Joined on 22/05/2017
The total sanctioned post for the Department of Physics = 06 (Fill up post 04 + Vacant post 02)					

Objective:-

The objective of the M. Sc. (Physics) program is twofold.

CSIR- UGC NET (JRF/ LS) Orientated

The syllabus of M.Sc. Physics Program is based on the syllabus of CSIR – UGC NET for Physical Sciences and National Institution like IITs, NITs, IISERs, IISc, TIFR and leading Central Universities. Therefore, the students gain the necessary training to qualify in the national level examinations for research and teaching such as NET, GATE, JEST, etc.

Research Orientated

The second objective of the program is to prepare the students for research and developments activities which will open job opportunities in the Industries as well. Hence, the M.Sc. Physics IVth semester is reserved for research projects. These projects may be carried out at the department of physics or any other department of the University or National/State level research institutions across India/abroad.

COURSE STRUCTURES

M.Sc. PHYSICS

(Choice Based Credit System)

(Effective from the academic Year 2017-2018)

Course Code	Title of the Courses	Types of Courses	Credit
SEMESTER-I			
MPHYT-C101	Mathematical Physics	Theory	4
MPHYT-C102	Classical Mechanics	Theory	4
MPHYT-C103	Quantum Mechanics-I	Theory	4
MPHYT-C104	Fundamental Electronics & Applications	Theory	4
MPHYL-C105	General Physics Practicals	Practical	2
MPHYL-C106	Electronics Practicals	Practical	2
Gen. Elective	Adopt from other disciplines	Generic Elective	3
		Total	**23**
SEMESTER-II			
MPHYT-C201	Quantum Mechanics – II	Theory	4
MPHYT-C202	Atomic and Molecular Spectroscopy	Theory	4
MPHYT-C203	Classical Electrodynamics	Theory	4
MPHYT-C204	Advanced Optics	Theory	4
MPHYL-C205	Optics Practicals	Practical	2
MPHYL-C206	Atomic and Molecular Physics Practicals	Practical	2
Gen. Elective	Adopt from other disciplines	Generic Elective	3
		Total	**23**
SEMESTER - III			
MPHYT-C301	Condensed Matter Physics –I	Theory	4
MPHYT-C302	Statistical Mechanics	Theory	4
MPHYT-C303	Nuclear and Particles Physics	Theory	4
MPHYL-C304	Condensed Matter Physics Practicals	Practical	2
MPHYL-C305	Nuclear Physics Practicals	Practical	2
ELECTIVES (Any one paper from Discipline Specific Elective below)			
MPHYT-D306	(a) Materials science - I: Physics of materials	Discipline Specific Elective	3
	(b) Advanced Electronics I	Discipline Specific Elective	
	(c) Gravitation and Cosmology -I: General Relativity	Discipline Specific Elective	
		Total	**19**
SEMESTER - IV			
MPHYT-C401	Condensed Matter Physics – II	Theory	4
MPHYT-C402	Numerical techniques and Computer applications	Theory	4
MPHYL-C403	Advanced practicals/simulations	Practical	2
ELECTIVES (Any one paper from Discipline Specific Elective below)			
MPHYT-D404	(a) Materials science -II: Physics of nanosystems	Discipline Specific Elective	3
	(b) Advanced Electronics II	Discipline Specific Elective	
	(c) Gravitation and Cosmology -II: Introduction to cosmology	Discipline Specific Elective	
MPHYD-D405	Master Dissertation	Project Work	6
		Total	**19**
Total number of credit in the M. Sc. (Physics) program = 84 credits			
Total marks of the M.Sc. (Physics) program = 2200 marks			

Internal Assessment Scheme for Semester I, II, III & IV.

Internal Assessment Exam to be held any time after 8 week of regular classes.

Marking Scheme for Internal Assessment Exams (theory):

(a) First Internal Assessment Exam (Written):	10 Marks
(b) Second Internal Assessment Exam (Written):	10 Marks
(c) Attendance (10) + Assignment (5) + Seminar (5):	20 Marks
Total :	**40 Marks**

Duration of Examination: One Hour

Pattern of Question Paper for Internal Assessment Exams:

Five Objective Type Questions, each carrying one mark and one Short Answer Type Question of five marks.

Distributions of marks awarded for regularity in theory and practical classes

Regularity in the theory Class: -Maximum Marks (for theory): 10 Marks

Award of marks for regularity:

Attendance	Award Marks
95 % and above	10
85 to 94.9 %	07
75 to 84.9 %	05

Regularity in Lab (05) and evaluation of individual experiments/ File/Record (10): -Maximum Marks: 15 Marks

Award of marks for regularity:

Attendance	Award Marks
95 % and above	05
85 to 94.9 %	04
75 to 84.9 %	03

Note: Minimum 75% attendance in the engaged theory classes and laboratory is compulsory for appearing in the end semester examinations.

Pattern of End Semester Examination for theory and Practicals

Maximum Marks: 60 (Theory)

Maximum Marks: 50 (Practical)

Duration of Examination: Three Hours (Theory)

Four Hours (Practical)

Pattern of the Question Paper (theory):

Five (5) Questions with internal choice (equal weightage for all units), each question shall carry 12 marks.

Total marks for End Semester Examination (Theory): **5 ×12 = 60 marks**

Pattern of M.Sc. Physics Practical Examinations:

Name of the functions	**Marks**
Practical performance (Written Practical Exam)	25
Evaluation of individual experiments/ File/Record	10
Viva-voce	10
Attendance	05
Total	**50**

Guidelines for Master Dissertation – MPHYD-D405

1. Students would be required to carry out an experimental/theory project in the 4th semester.

2. Project work may be assigned to the students by the end of the 3rd semester.

3. The project work may be carried out at the department or any other department of university or national/state level research institutions in India/abroad for not more than 15 days.

4. All students will be required to submit the monthly report through his/her supervisor.

5. Supervisor will be required to submit evaluation report of the concerned student based on continuous assessment of work of the student.

6. Co-supervisor may be allowed based on the requirement of the project works.

7. Two copies of dissertation will be submitted to the department.

8. The evaluation of the project and presentation will be done collectively by all faculty members of the department. Average marks of the collective evaluation will be submitted to the university.

9. The project presentation and viva-voce examination will be held at the department.

The details of the End Semester Examinations

The details of Exam are as follows:

Title of the papers	Credit	Lectures /Lab per Week	Max. Marks	Internal assessment exam marks	Attendance+ Assignment/ Seminar	End Semester Examination Max. Marks	Min. Passing Marks in End Sem. Exam*
Semester- I							
MPHYT-C101	4	4 Hrs.	100	20	20	60	24
MPHYT-C102	4	4 Hrs.	100	20	20	60	24
MPHYT-C103	4	4 Hrs.	100	20	20	60	24
MPHYT-C104	4	4 Hrs.	100	20	20	60	24
MPHYL-C105	2	4 Hrs.	50	-	-	50	20
MPHYL-C106	2	4 Hrs.	50	-	-	50	20
Generic Elective	3	3 Hrs.	100	40	-	60	24
Total	**23**	**-**	**600**	**-**	**-**	**-**	**-**
Semester-II							
MPHYT-C201	4	4 Hrs.	100	20	20	60	24
MPHYT-C202	4	4 Hrs.	100	20	20	60	24
MPHYT-C203	4	4 Hrs.	100	20	20	60	24
MPHYT-C204	4	4 Hrs.	100	20	20	60	24
MPHYL-C205	2	4 Hrs.	50	-	-	50	20
MPHYL-C206	2	4 Hrs.	50	-	-	50	20
Generic Elective	3	3 Hrs.	100	40	-	60	24
Total	**23**	**-**	**600**	**-**	**-**	**-**	**-**
Semester- III							
MPHYT-C301	4	4 Hrs.	100	20	20	60	24
MPHYT-C302	4	4 Hrs.	100	20	20	60	24
MPHYT-C303	4	4 Hrs.	100	20	20	60	24
MPHYL-C304	2	4 Hrs.	50	-	-	50	20
MPHYL-C305	2	4 Hrs.	50	-	-	50	20
MPHYT-D306	3	3 Hrs.	100	20	20	60	24
Total	**19**	**-**	**500**	**-**	**-**	**-**	**-**
Semester-IV							
MPHYT-C401	4	4 Hrs.	100	20	20	60	24
MPHYT-C402	4	4 Hrs.	100	20	20	60	24
MPHYL-C403	2	4 Hrs.	50	-	-	50	20
MPHYT-D404	3	3 Hrs.	100	20	20	60	24
MPHYT-D405	6	4 Hrs.	150	-	-	150	60
Total	**19**	**-**	**500**	**-**	**-**	**-**	**-**

*Passing Criterion for Internal Assessment and End Semester Examinations

The details of the Passing Criterion adopted by the University are as follows:

1. A student has to score a minimum of 40 marks out of 100 from internal (40 marks) and end semester (60) marks put together. However, s/he has to score a minimum of 24 marks in theory (semester end exam) to pass a paper which will be called a course from now onwards. If not, then s/he has to reappear for semester end exam when such exams will be conducted. But s/he cannot reappear for internals to improve the same.

2. A student has to secure an aggregate of minimum 40 % marks taking together all the courses in theory examination including internal test, assessment/project, seminar, presentation wherever applicable and practical exam separately till the end of the semester, i.e. up to the end of the IV semester in case of PG programs, then s/he shall be awarded the degree in which the students has been admitted.

3. A student who is not allowed to write semester end exam for a course for of attendance has to attend classes in that course to become eligible to write the exam. If s/he is not allowed to write all the courses in a semester for the same reason, he has to repeat the semester next year i.e. even with even and odd with odd. However, a student cannot continue to pursue his program if s/he remains absent for more than a semester for any reason.

4. His/her name on the roll stand automatically deleted if s/he remains absent for more than a semester. In such a case the students has to seek fresh admission as per the norms of the University.

Examination details and Marks Distributions

Master Dissertation

Title of the events	Credits	Contact Hrs./Week	Max. Marks	Min. Pass Marks in End Semester Exam
Project Work/ Report	4	8	100	40
Viva-Voce	1	-	25	10
Continuous assessment by Project Supervisor	1	-	25	10
Total	**6**	**-**	**150**	**60**

Syllabus for M.Sc. (Physics) First Semester

Title of Paper: Mathematical Physics (MPHYT- C101)

(Core Course-1, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Complex analysis: Functions of a complex variable, analytic functions, Integration in the Complex plane, Eular's formula De Moivre's theorem, Cauchy's Riemann condition, Cauchy Integral theorem, Cauchy's integral formula, multivalued functions.

Unit- 2 **12 hours**

Residue theorem and applications: Singular Points and Branch Point and branch Cut, Evaluation of definite integrals, Integrals involving branch point singularity, Liouville's theorem, Morera's theorem.

Series and function: Taylor and Laurent series, Convergence of Beta function and Gamma function, Error function.

Unit – 3 **12 hours**

Fourier and Laplace transforms: Solution of ordinary and partial differential equations by transform methods, Ordinary and partial differential equations, Integral equations, Fredholm and volterra equations of the first and second kinds.

Unit – 4 **12 hours**

Tensor analysis: Coordinate transformations, Covariant and Contravariant tensors, Outer product, Inner product and Contraction, Symmetric and antisymmetric tensors, Quotient law, Metric tensor. Conjugate tensor. Associated tensors, Raising and lowering of indices, Christoffel symbols covariant derivative.

Unit- 5 **12 hours**

Group theory: Finite and infinite groups, Subgroup, Generators, Isomorphism and homomorphism, Permutation and alternating groups, Representations, reducible representations and irreducible representations, Schur's lemmas, Discrete and continuous groups, Topological and Lie groups, rotation group SO(2), Rotation group SO(3), Special Unitary groups SU(2) and SU(3).

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Mathematical Methods for Physicists	Arfken, Weber and Harris	2011	Elsvier
2	Mathematical Methods For Physics And Engineers	Riley, Hobson and Bence	2006	Cambridge University Press
3	Mathematical Methods In Physical Sciences	M. L. Boas	2006	Wily India Education
4	Mathematical Physics	B. D. Gupta	2009	Vikas Publication House
5	Mathematical Methods for Physicist	T. L. Chow	2000	Cambridge University Press

Syllabus for M.Sc. (Physics) First Semester

Title of Paper: Classical Mechanics (MPHYT- C102)

(Core Course-2, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Review of vector analysis, Newton's Laws of Motion, inertial frames, Non-Inertial Frames, Newtonian Mechanics: Single Particle, Many Particles, Central Forces, Gravity, Electromagnetism, Friction, Dimensional Analysis, Kepler Problem, Scattering.

Unit – 2 **12 hours**

Lagrangian Formalism, The Principle of Least Action, Euler-Lagrange equations, Constraints and Generalised Coordinates, Noether's Theorem and Symmetries, homogeneity and isotropy of space, applications, Small Oscillations and Stability.

Unit – 3 **12 hours**

The Motion of Rigid Bodies, The Inertia Tensor, Parallel Axis Theorem, Angular Momentum, Euler's Equations, Euler's Angles, Free Tops, The Heavy Symmetric Top, The Motion of Deformable Bodies.

Unit- 4 **12 hours**

The Hamiltonian Formalism, Hamilton's Equations, Some Conservation Laws, The Principle of Least Action, Poisson Brackets, Legendre Transformation, Canonical Transformations, Generating function, Jacobi's identity, Jacobi-Poisson theorem, Liouville's theorem.

Unit – 5 **12 hours**

Poisson bracket and angular momentum, The Hamilton-Jacobi Equation and link to quantum mechanics, Action and Angle Variables, Elements of non-linear dynamics, one and two dimensional flows, fixed points, limit cycles, bifurcation, attractors, chaos, simple examples, Butterfly effect.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Classical Mechanics	H. Goldstein	2001	Narosa Publishing House
2	Classical Mechanics	Takwale and Puranic	2007	Tata McGraw Hill
3	Mechanics	Landau and Lifshitz	1982	Butterworth-Heinemann
4	Classical Mechanics	Rana and Joag	2017	Tata McGraw Hill
5	Classical Mechanics with MATLAB Applications	J. E. Hasbun	2010	Jones and Bartlett
6	Classical Mechanics	J. C. Upadhyaya	20017	Himalaya Publishing House
7	Classical Mechanics	Gupta, Kumar, Sharma	2017	Pragati Publication

Syllabus for M.Sc. (Physics) First Semester

Title of Paper: Quantum Mechanics- I (MPHYT- C103)

(Core Course-3, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit 1 **15 hours**

Linear vector space, Dirac notation, Kets, Bras and Operators, Expectation Values, Superposition Principle, Orthogonality, Completeness, Expansion of State Vector, Non commutating Observables, Uncertainty Relations, Unitary operators, State function, Matrix Representation, Continuous Basis.

Unit 2 **15 hours**

Foundations of quantum mechanics, Schrödinger equation and its applications, Particle in one-dimensional potential well, Solutions of different one-dimensional barriers, three dimensional case, Free particle wave function Solution of the Linear Harmonic Oscillator with Operator Method. Orbital angular momentum and the eigen-functions; Energy states associated wave functions of Hydrogen atom; Expression of Bohr radius.

Unit 3 **15 hours**

Motion of a charged particle in a spherically symmetric field, Symmetries, Translational invariance, time reversal and parity, Rotational invariance and angular momentum operator and related eigenvalue problems, Hydrogen atom, Degeneracy of Hydrogen spectrum, Numerical estimates, Multielectron atom and periodic table.

Unit 4 **15 hours**

Quantum spin, Infinitesimal rotation, Generator of rotation, Commutation rules, Matrix representation of angular momentum operators, Pauli spin matrices, Rotation of spin states, Coupling of two angular momentum operators, Clebsch-Gordon coefficients, Symmetries, Space rotation, Irreducible spherical tensor operators, Wigner-Eckert theorem and its applications, Space inversion, Time reversal**.**

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Quantum Mechanics	L. I. Schiff	1968	McGraw-Hill
2	Principles of Quantum Mechanics	R. Shankar	1994	Springer
3	Quantum Mechanics: Theory and Applications	A. K. Ghatak and S. Lokanathan	2006	Narosa Publishing House
4	Introduction to Quantum Mechanics	D. J. Griffiths	1980	Tata McGraw Hill
5	Quantum Mechanics: Concepts and Applications	N. Zettili	2009	John Wiley and Sons

Syllabus for M.Sc. (Physics) First Semester

Title of Paper: Fundamentals of Electronics & Applications (MPHYT- C104)

(Core Course-4, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Semiconductors, Fabrication of p-n junctions, Junction properties: equilibrium conditions, contact potential, current flow at a junction, junction breakdown, capacitance of p-n junctions. Semiconductor devices: Bipolar Junction Transistor and their biasing. Field Effect Transistor, Metal Oxide Semiconductor Field Effect Transistor, Zener diode, Tunnel diode.

Unit – 2 **12 hours**

Transistor amplifiers, Basic design consideration; high frequency effects; video and pulse amplifier; resonance amplifier; feedback in amplifiers. Harmonic self-oscillators: Steady state operation of self-oscillator; nonlinear equation of self-oscillator; examples.

Unit – 3 **12 hours**

Differential amplifiers: Inverting and non-inverting inputs, Various modes of operation. Operational amplifiers characteristics and specifications, Inverting and non-inverting amplifiers; Summing, Scaling and Averaging, Integrators and differentiators. Op-Amp Circuits; Nonlinear amplifiers, log amplifier, anti-log amplifier, regenerative comparators.

Unit – 4 **12 hours**

Numbers System: Binary, Octal, Decimal, Hexadecimal Binary and their conversion etc. BCD Code, Gray Code, Excess – 3 code, ASCII Code, Conversion from Binary to Gray code and Gray code to Binary. Combinational Logic gates: Basic and Universal Gates, Boolean algebra- De-Morgans Laws. Flip Flops: RS, JK and MS-JK flip-flops.

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Unit – 5 **12 hours**

Digital Circuits: Logic functions; Logic simplification using Karnaugh maps; SOP and POS design of logic circuits. Multiplexers, Demultiplexer. Encoders, Decoders. Adder, subtractor. Digital Comprator, Parity Checker. A/D and D/A Converters. Registers, counters and their applications. Semiconductor Memories: RAM and ROM. Microprocessor and microcontroller basics.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Semiconductor Physics And Devices	Donald A. Neaman	2007	Tata McGraw Hill
2	Electronic Principles	A. Malvino, D.J. Bates	2008	Tata McGraw Hill
3	Electronic Principles and Applications	J. D. Ryder	1990	Prentice Hall of India
4	Principles of Digital Electronic	K. Meena	2013	PHI India
5	Handbook of Electronics	Gupta Kumar	2016	Pragati Prakashan
6	Principles of Electronics	V. K. Mehta, Rohit Mehta	2010	S. Chand & Company
7	Op – Amps and linear Integrated Circuits	Ramakant A. Gayakwad	2012	Prentice Hall of india

Maximum Marks: 50 **Teaching hours: 60 hours**

1. Velocity of sound in air by CRO method.
2. Velocity of sound in liquid – Ultrasonic Interferometer method.
3. Velocity of sound in solids - Pulse echo method.
4. Determination of Planck's constant using different coloured LEDs and a photoelectric cell.
5. Study of polarization of light – linear polarizers.
6. Propagation of EM wave in a transmission line – Lecher wire method.
8. Michelson-Morley Experiment.
9. To determine the deflection sensitivity of a Cathode Ray Oscilloscope (CRO).

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	A Text Book of Practical Physics	Dr. Samir Kumar Ghosh	2008	New Central Book Agency
2	Practical Physics	P. R. Sasi Kumar	2006	PHI Learning
3	Experimental Physics	K. Venkatraman, R. Raja, M. Sunderrajan	2014	Scintech Publication
4	Physics Laboratory Manual	P. K. Palanisamy	2002	Scintech Publication
5	An Advance Course in Practical Physics	D. Chattopadhyay, P. C. Rakshit	2011	New Central Book Agency

Maximum Marks: 50 **Teaching hours: 60 hours**

1. PN junction diode – clipping and clamping.
2. To study OP-AMP as inverting and non-inverting amplifier.
3. To Study and measure voltage gain, impedance etc. of emitter follower amplifier.
4. To study hybrid parameters of transistors.
5. To study R-2R ladder network (D/A converter).
6. Study of logic circuits TTL, NAND and NOR gates.
7. Zener Diode - Characteristics and voltage Regulation.
8. Solving Boolean Expressions.
9. Microprocessor – 8085 and 8086 and its applications.
10. Construct and test a full-wave rectifier DC Power Supply.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Electronics Circuits Lab Manual	C. R. Ramesh	2015	Scintech Publication
2	A Text Book of Practical Physics	Dr. Samir Kumar Ghosh	2008	New Central Book Agency
3	Physics Laboratory Manual	P. K. Palanisamy	2002	Scintech Publication
4	An Advance Course in Practical Physics	D. Chattopadhyay, P.C. Rakshit	2011	New Central Book Agency
5	Electronics Lab Manual	K. A. Navas	2015	PHI Learning Pvt. Ltd.

Syllabus for M.Sc. (Physics) Second Semester

Title of Paper: Quantum Mechanics - II (MPHYT-C201)

(Core Courses-7, Credit- Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit 1 **15 hours**

Approximation methods, Time-independent perturbation theory for non-degenerate and degenerate states, Application: anharmonic oscillator, Helium atom, Stark effect in hydrogen atom, Variational methods: Helium atom, WKB method; Connection formulae

Unit 2 **15 hours**

Time-dependent perturbation theory; First order perturbation, sudden and adiabatic perturbation, Harmonic perturbation; Fermi's golden rule, higher order perturbation. Examples.

Unit 3 **15 hours**

Scattering of a particle by a fixed centre of force, Scattering amplitude, differential and total cross sections, Method of partial waves, Phase shifts, Optical theorem, Scattering by a hard sphere and potential well, Integral equation for potential scattering, Green's function, Born approximation, Yukawa and Coulomb potential.

Unit 4 **15 hours**

The Klein Gordon equation. Covariant notations. Negative energy and negative probability density. The Dirac equation. The Dirac particle in an external electromagnetic field. The non-relativistic limit of the Dirac equation and the magnetic moment of the electron. The Gamma matrices and their properties Lorentz covariance. Boost, rotation, parity and time reversal operation on the Dirac wave function. Dirac's hole theory and charge conjugation. Feynman-Stuckelberg interpretation of antiparticles.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	A First Book on Quantum Field Theory	A. Lahiri and P. B. Pal	2007	Narosa
2	Relativistic Quantum Mechanics	J. D. Bjorken and S. D. Drell	1964	McGraw-Hill
3	Relativistic Quantum Mechanics and Quantum Fields	T. Y. Wu and W. Y. Pauchy Hwang	2009	Allied Publishers
4	Quantum Mechanics	L. I. Schiff	1968	McGraw-Hill
5	Principles of Quantum Mechanics	R. Shankar	1994	Springer

Syllabus for M.Sc. (Physics) Second Semester

Title of Paper: Atomic and Molecular Spectroscopy (MPHYT-C202)

(Core Course-8, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

General discussion of Hydrogen-like systems, Spectra of monovalent atoms, penetrating and non-penetrating orbits, spin-orbit interaction and fine structure, Zeeman and Paschen-Back effect, Spectra of divalent atoms: Singlet and triplet states of divalent atoms, L-S and j-j coupling, Breit's scheme, Pauli exclusion principle.

Unit – 2 **12 hours**

Origin of X-rays spectra, screening constants, X-ray levels, spin-relativity and screening doublet-laws, Lasers in Spectroscopy: Broadening of spectral lines, Doppler-free spectroscopy, excitation spectroscopy, ionization spectroscopy, Born-Oppenheimer approximation, Band structures of molecular spectra.

Unit – 3 **12 hours**

Microwave and far infrared spectroscopy : diatomic molecules, Spectral structure, Isotope effect. Rotational and vibrational spectra: Selection rules and spectral structures, Rotational – vibrational coupling, Parallel and perpendicular modes. Symmetry of molecular wave functions and nuclear spins.

Unit – 4 **12 hours**

Raman spectroscopy:Rotational-Vibrational Raman spectra, Stokes and anti-stokes Raman lines, Selection Rules, Spectral structures. Nuclear spin and its effect on Raman spectra. Vibrational spectra of poly atomic molecules, Selection rules for Raman and infrared spectra. Complementarity of Raman and infrared spectra. Normal modes of CO_2 molecule.

Unit – 5 **12 hours**

Electronic spectra of diatomic molecules: Vibrational band structure, Progressions and sequences, Isotope shifts, molecular bonding. Rotational structure of electronic spectra, P-, Q- and R- branches, vibrational structure of electronic spectra, Franck-Condon principle. Hund's coupling.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Physics of Atoms and Molecules	B. H. Bransden and C. J. Joachain.	2003	Pearson Education India
2	Molecular structure and spectroscopy	G. Aruldhas	2007	PHI learning Pvt. Ltd.
3	Atomic and Molecular Spectroscopy	S.K. Dogra	2015	Pearson Education India
4.	Introduction to Atomic and Nuclear Physics	H. E. White	1966	D. Van Nostrand Company

Syllabus for M.Sc. (Physics) Second Semester

Title of Paper:- Classical Electrodynamics (MPHYT- C203)

(Core Courses-9, Credit- Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Maxwell's equations in vacuum, Maxwell's equations inside matter, Solving static boundary value problems Uniqueness theorems, Poisson's equation, Time-dependent electromagnetic Relaxation to a stationary state, Propagating plane electromagnetic (EM) wave, Decaying plane EM wave. Energy in electric and magnetic fields.

Unit – 2 **12 hours**

EM waves with boundaries EM waves at dielectric boundaries: reflection, refraction, EM waves in conductors: inside and at the boundary. EM Rectangular waveguides, Circular waves in confined cylindrical waveguides, Coaxial cable, spaces Cavities. EM wave equations with sources, EM radiation: radiation components, Radiation energy loss, Radiation from antennas, Multipole expansion, Electric dipole, Magnetic dipole and electric quadrupole radiation.

Unit – 3 **12 hours**

From electrodynamics to Special Relativity: Faraday's law and Lorentz force, Motivations for Special Relativity, Lorentz transformations. Lorentz Length, time, velocity, acceleration, EM transformations of wave, Covariant and contravariant 4-vectors,Lagrangian formulation of relativistic mechanics,Lagrangian formulation of relativistic electrodynamics.

Unit – 4 **12 hours**

Relativistic equations of motion, Particle Motion of charges in a uniform electric field and uniform magnetic field, EM potentials from a moving charge, Lienard-Wiechert potentials: without relativity and using relativity, EM fields from a uniformly moving charge E and B fields from Lienard-Wiechert potentials, E and B fields from Lorentz transformations, Force between two uniformly moving charges.

Unit – 5 **12 hours**

Intuitive understanding and applications, Cherenkov radiation: formal calculations, Radiation from accelerating charge From Lienard-Wiechert potentials to EM fields, Calculating relevant derivatives, Calculating E and B fields including their radiative components. Radiation from linear motion, Radiation from circular orbits: Synchrotron, Interactions of EM fields with electrons.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Introduction to Electrodynamics	D. J. Griffith	2000	Prentice Hall of India
2	Classical Electrodynamics	J. D. Jackson	2007	Willey -India
3	Classical Theory of Fields	L. D. Landau and E. M. Lifshitz	2013	Pergamon Press
	Principles of Electrodynamics	M.M. Schwartz	1987	Dover Publications

Syllabus for M.Sc. (Physics) Second Semester

Title of Paper: Advanced optics (MPHYT-C204)

(Core Courses-10, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **15 hours**

Applied Optics, Ray optics and matrix optics. Theory and practical examples of diffraction, interference, reflection and refraction of electromagnetic waves, wave propagation in anisotropic media, spatial frequency filtering, Fourier optics, spatial light modulators, charged coupled devices, speckle interferometry, polarized light, Jones matrices, crystal optics, electro-optics, acousto-optics, magneto optic.

Unit–2 **15 hours**

Historical background of laser, Einstein coefficients and stimulated light amplification: population inversion. Basic Laser Systems: Gas Laser: CO_2 laser, Solid State Laser: Host material and its characteristics, doped ions, Nd:YAG laser, Liquid laser: Dye laser, Semiconductor laser. Laser Beam Propagation: Laser beam propagation, properties of Gaussian beam, resonator, stability, various types of resonators, resonator for high gain and high energy lasers, Gaussian beam focusing.

Unit – 3 **15 hours**

Nonlinear Optics: Origin of nonlinearity, susceptibility tensor, phase matching, second harmonic generation, methods of enhancement, frequency mixing processes, nonlinear optical materials. Holography: Importance of coherence, Principle of holography and characteristics, Recording and reconstruction, classification of hologram and application, non-destructive testing, Transient effect: Principle of Q-switching, different methods of Q-switching, electro-optic Q-switching, Pockels cell.

Unit – 4 **15 hours**

Fibre optics: Dielectric slab waveguide, modes in the symmetric and asymmetric slab waveguide, TE and TM modes, coupling of the waveguide (edge, prism, grating), dispersion and distortion, integrated optics components (active, passive), optical fibre waveguides (step index, graded index, single mode), attenuation in fibre, couplers and connectors, LED, injection laser diode (double heterostructure, distributed feedback), Detection of optical radiation: Human eye, thermal detector (bolometer, pyro-electric), photon detector (photoconductive detector, photo voltaic detector and photoemissive detector), p-i-n photodiode, APD.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Fundamentals of Fiber Optics in Telecommunication and Sensor systems	B. P. Pal	2015	New Age International
2	Introduction to Fourier Optics	J. W. Goodman	2016	Tata McGraw Hill
3	Laser Fundamentals	W. T. Silfvast	1999	Cambridge University Press
4	Optical Electronics	A. Ghatak and K. Thyagrajan	1989	Cambridge University Press
5	Laser Physics	P. W. Milonni and J. H. Eberly	2010	John Wiley & Sons

Syllabus for M. Sc. (Physics) Second Semester

Title of Paper: Optics Practicals [MPHYL- P205]

(Core Course-11, Credit- 2)

Maximum Marks: 50 **Teaching hours: 60 hours**

1. To find the wavelength of Laser by diffraction grating.
2. Determination of numerical aperture of a fibre by measuring the diameter of laser beam.
3. To study the Faraday effect and Verdert constant of a given material.
4. To determine the distance between the grooves of a compact disk.
5. To find the wavelength of an unknown light source using compact disk.
6. Determination of the particle size of a material (supplied).
7. Measurement of Brewster angle of a substance and hence determine the refractive index.
8. To verify the Malus law. Optical interference and diffraction.
9. Electro-optic modulation.
10. Magneto-optic modulation.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Practical Physics	P. R. Sasi Kumar	2006	PHI Learning
2	Experimental Physics	K. Venkatraman, R. Raja, M. Sunderrajan	2014	Scintech Publication

Maximum Marks: 50 **Teaching hours: 60 hours**

1. Raman scattering using a laser source.
2. Band spectrum in liquids
3. e/m or hyperfine structure using Febry Perot's interferometer
4. Holography
5. Constant deviation spectrometer- fine structure of Hg spectral lines.
6. Zeeman Effect
7. To determine the wavelength of laser using grating.
8. To study the spectra of Hydrogen and deuterium
9. Study of laser as monochromatic coherence source

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Practical Physics	P. R. Sasi Kumar	2006	PHI Learning
2	Experimental Physics	K. Venkatraman, R. Raja, M. Sunderrajan	2014	Scintech Publication
3	Physics Laboratory Manual	P. K. Palanisamy	2002	Scintech Publication
4	An Advance Course in Practical Physics	D. Chattopadhyay, P.C. Rakshit	2011	New Central Book Agency

Syllabus for M.Sc. (Physics) Third Semester

Title of Paper: Condensed Matter Physics -I (MPHYT-C301)

(Core Courses-13, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Background of solid state physics, crystalline and amorphous state, fundamental types of lattices, Bravais lattices Packing Fraction, Miller indices, Symmetry operations, point groups, space group, and important crystal structure: NaCl, CsCl, Diamond and ZnS.

Unit – 2 **12 hours**

X-rays, X-ray diffraction, Bragg's law, Reciprocal lattice, Bragg's law in reciprocal lattice, Atomic scattering factor, Structure factor, Laue's equation, The Laue, Powder and Rotating crystal methods, Properties of reciprocal lattice, Brillion zones, determination of crystal structure using XRD spectra.

Unit-3 **12 hours**

Bonding in solids: Ionic, Covalent, Metallic, Vander waals, Hydrogen; Madelung constant, Range, Defects: Point defects, line defects and planer (stacking) faults, the role of dislocations in plastic deformation and crystal growth, the observation of imperfections in crystals, electron microscopic techniques.

Unit – 4 **12 hours**

Crystal vibrations: Vibrations of monoatomic and diatomic linear lattices, acoustical and optical phonons, dispersion relation for three dimension crystals, specific heat of solids, Einstein and Debye theory of specific heat, anharmonic crystal interactions.

Unit-5 **12 hours**

Drude model of electrical and thermal conductivity, Free electron theory and electronic specific heat, density of states, Band Theory of solids: Bloch theorem, The Kronig-Penney model, derivation of dispersion relation, concepts of effective mass, reduced zone scheme, Tight binding approximation.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Solid State Physics	Adrianus J Dekker	2000	Macmillan India Limited
2	Crystallography for Solid State Physics	A. R. Verma, & O. N. Srivastava	2001	New Age International
3	Introduction to Solid State Physics	C. Kittel	2001	John Wiley and Sons
4	Solid State Physics	S. O. Pallai	2016	New Age International publisher
5	Solid State Physics: Structure and Properties of Materials	M. A. Wahab	2005	Alpha Science International

Syllabus for M.Sc. (Physics) Third Semester

Title of Paper: Statistical Mechanics (MPHYT-C302)

(Core Course-14, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Scope and aim of statistical mechanics. phase space, phase points, Ensemble, Liouville's equation and Liouville's theorem. Micro canonical, canonical and grand canonical ensembles. Partition function, Equilibrium properties of ideal systems: ideal gas, Harmonic oscillators, rigid rotators. Para magnetism, negative temperature.

Unit – 2 **12 hours**

Density matrix. Pure and Mixed states, stationary ensembles. Application to a free particle in a box, an electron in a magnetic field. Density matrix for spin 1⁄2 particles, polarization vector. Distribution functions. Bose-Einstein and Fermi-Dirac statistics. General equations of state for ideal quantum systems.

Unit – 3 **12 hours**

Bose gas: Bose-Einstein condensation, liquid He, Superfluidity, Photon gas: Planck's radiation law. Phonon gas: Debye's theory of specific heat of solids. ideal Fermi gas, thermal and electrical properties of an ideal electron gas. Landau levels, Landau diamagnetism. White dwarf and Neutron stars.

Unit – 4 **12 hours**

Strongly interacting systems, Ising model. Idea of exchange interaction and Heisenberg Hamiltonian. Ising Hamiltonian as a truncated Heisenberg Hamiltonian, Exact solution of one-dimensional Ising system (Matrix methods). Bragg-William's approximation (Mean field theory) and the Bethe-Peierls approximation.

Unit – 4 **12 hours**

Phase transition, Phase transition and critical phenomena. Critical indices, Landau's order parameter theory of phase transition, Fluctuations. Thermodynamic fluctuations. Spatial correlations in a fluid. Brownian motion: Einstein-Smoluchowski's theory.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Fundamentals of Statistical and Thermal Physics	F. Reif	2009	Waveland Press
2	Statistical Mechanics	K. Huang	1991	Wiley Eastern Ltd.
3	Statistical Mechanics	R.K. Patharia, Paul D. Beale	1996	Butterworth - Heinemann
4	Fundamentals Of Statistical Mechanics	B. B. Laud	2007	New Age International Publishers
5	Statistical Physics	L. D. Landau and L. M. Lifshitz	1980	Butterworth - Heinemann

Syllabus for M.Sc. (Physics) Third Semester

Title of Paper: Nuclear and Particle Physics (MPHYT- C303)

(Core Course-15, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

General properties of nuclei: Basic concept, parity and isospin of nuclei,electron scattering, charge form factor, Magnetic dipole moment, electric quadrupole moment and nuclear shape, Two-nucleon problem and nuclear forces: Deuteron ground state, excited states, two-nucleon scattering, scattering length, p-p scattering, charge symmetry and charge independence of nuclear forces. Exchange nature of nuclear forces, elementary discussion on Yukawa's theory.

Unit – 2 **12 hours**

Nuclear models: Need for nuclear models, Fermi gas model, Spherical shell model. Nuclear reactions : Direct and compound nuclear-reactions, experimental verification of Bohr's independence-hypothesis, resonance reactions, Breit-Wigner one-level formula.

Unit – 3 **12 hours**

Particle accelerators: Tandem principle, Pelletron, Synchrotron and synchrosyclotron, colliding beams, threshold energy for particle production, Beta and Gamma decay, Fermi's theory of beta decay, allowed and forbidden transitions, selection rules, non-conservation of parity in beta decay, evidence for the neutrino.

Unit – 4 **12 hours**

Energy loss of charged particles and gamma rays: Mechanism, Ionization formula, Stopping power and range, radiation detectors proportional counter, scintillation counter and Cerenkov detector. Reactor Physics: Slowing down of neutrons in a moderator, average log decrement of energy per collision, slowing down power, moderating ratio,Fermi age equations, four-factor formula.

Unit – 5 **12 hours**

High energy physics: Types of interaction in nature-typical strengths and time-scales, conservation laws, charge-conjugation, Parity and Time reversal, CPT theorem, Gell-Mann-Nishijima formula, intrinsic parity of pions, resonances, symmetry classification of elementary particles, quark hypothesis.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Nuclear Physics: Theory and Experiment	R. R. Roy & B. P. Nigam	1967	Wiley
2	Introduction to High Energy Physics	Donald H. Parkins	2000	Cambridge University Press
3	Introduction to Nuclear Physics	H. A. Enge	1978	Addison Wesley
4	Concepts of Nuclear Physics	Bernard Leonard Cohen	1971	Tata McGraw Hill

Syllabus for M. Sc. Third Semester

Title of Paper: Condensed Matter Physics Practicals [MPHYL- C304]

(Core Course-16, Credit- 2)

Maximum Marks: 50 **Teaching hours: 60 hours**

1. To determine the band gap of a semiconductor.
2. To study the B- H Loop /curve for different iron materials.
3. Measurement of hall coefficient-determination of carrier concentrations.
4. Four probe – resistivity measurements.
5. Measurement of minority carriers' life time in semiconductors- Hyne-Shockely experiment.
6. Determination of transition temperature in high T_c superconductors.
7. Measurement of lattice parameter and indexing of powder photograph
8. Identification of unknown sample using powder diffraction method.
9. Determine the relaxation time (EPR) for a given sample and find the value of 'g'.
10. To determine magneto-resistance of a Bismuth crystal as a function of magnetic field.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Experimental Physics	K. Venkatraman, R. Raja, M. Sunderrajan	2014	Scintech Publication
2	Physics Laboratory Manual	P. K. Palanisamy	2002	Scintech Publication
3	An Advance Course in Practical Physics	D. Chattopadhyay, P.C. Rakshit	2011	New Central Book Agency

Syllabus for M. Sc. Third Semester

Title of Paper: Nuclear Physics Practicals [MPHYL-C305]

(Core Courese-17, Credit- 2)

Maximum Marks: 50 **Teaching hours: 60 hours**

1. G. M. counter – counting statistics and absorption cross-section.
2. Solid state detector – surface barrier detector, its characteristics and applications.
3. Spark counter – characteristics and range of x-particles in air.
4. Scintillation detector- energy calibration, resolution and determination of gamma ray energy.
5. Gamma ray absorption- half thickness in lead for ^{60}Co gamma rays.
6. Beta ray absorption – end point energy of beta particles.
7. Life time of a short lived radioactive source.
8. Study of pi-mu-e decay in nuclear emulsions.
9. Study of high energy interactions in nuclear emulsions.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	A Text Book of Practical Physics	Dr. Samir Kumar Ghosh	2008	New Central Book Agency
2	Practical Physics	P. R. Sasi Kumar	2006	PHI Learning
3	Experimental Physics	K. Venkatraman, R. Raja, M. Sunderrajan	2014	Scintech Publication
4	Physics Laboratory Manual	P. K. Palanisamy	2002	Scintech Publication

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Syllabus for M.Sc. (Physics) Third Semester

Title of Paper:- Materials science - I: Physics of materials [MPHYT-D306 (a)]

(Discipline Specific Elective, Credit- 3)

Maximum Marks: 100 **Teaching hours: 45 hours**

Unit – 1 **9 hours**

Historical perspective, Classification of materials. Advanced Materials, Future materials and modern materials. Crystallography: Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and noncrystalline materials. Miller indices. Xray crystallography techniques. polymers. ceramics. Imperfections Crystal Imperfections and their Classifications, Point Defects, Line Defects, Edge & Screw Dislocations, Surface Defects, Volume Defects.

Unit – 2 **9 hours**

Solid Solutions and Phase Diagram: Types of Solid Solutions, Solubility Limit, Phases, Microstructure, Phase Equilibria, Unary Phase Diagrams, Gibbs' Phase Rule, Binary Phase Diagrams, Binary Isomorphous Systems, Binary Eutectic Systems, Tie Line Rule, Lever Rule, Eutectic and Eutectoid Reactions, Peritectic and Peritectoid Reactions.

Unit – 3 **9 hours**

Electrical Properties Electrical conduction. Semi conductivity. Super conductivity. Electrical conduction in ionic ceramics and in polymers. Dielectric behavior. Ferroelectricity. Piezoelectricity. Thermal Properties: Heat capacity. Thermal expansion. Thermal conductivity. Thermal stresses. Magnetic Properties: Concept of magnetism - Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. Optical Properties: Basic concepts. metals. nonmetals. Application of optical phenomena.

Unit – 4 **9 hours**

Ceramics : Structure types and properties and applications of ceramics. Mechanical / Electrical behavior and processing of Ceramics; Other materials: optical and thermal materials, Composite Materials and its uses. Introduction to Smart materials & Nano-materials and their potential applications.

Unit – 5 **9 hours**

Microstructural Exam: Microscope principle and methods, Preparation of samples, Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys.

S. No.	Title of the book	Authors	Year	Publishers
1	Material Science and Engineering - An Introduction	W. D. Callister	2013	John Wiley and Sons
2	Elements of Material Science and Engineering	VanVlack	1989	Wesley Pub.
3	Introduction to Engineering Materials	B. Agarwal	1988	McGraw Hill
4	Material Science & Engineering	V. Raghvan	1974	Prentice Hall of India
5	Engineering Materials	Kenneth G. Budinski	1979	Prentice Hall of India
6	Material Science	Narula, Narula and Gupta	1989	New Age Publishers

Syllabus for M.Sc. (Physics) Third Semester

Title of Paper:- Advanced Electronics I [MPHYT-D306 (b)]

(Discipline Specific Elective, Credit- 3)

Maximum Marks: 100 **Teaching hours: 45 hours**

Unit – 1 **11 hours**

Microwave Devices: Klystron, magnetrons, Travelling wave tubes, Gunn diode, Impatt diode, transistors, GaAs-InP FET, HEMT. Optical Devices: Laser and Laser resonator, LEDs, Photodiodes, APD, Photo conductor.

Unit – 2 **9 hours**

Microwave measurements (Frequency, power, impedance). Optical modulator: Electro optics modulation (amplitude and phase). Optical coupler: Coupling of light from one fiber to other with the use of evanescent wave.

Unit – 3 **9 hours**

Integrated optics: basic idea. Analysis of networks and systems: Sample data system. Z- transform, Fourier and Laplace transforms.

Unit – 4 **9 hours**

Wave Guide and transmission networks: Wave guides coaxial, rectangular and cylindrical; resonators; filters; couplers; branching networks. Antennas-dipole, array; reflectors, steering strip, microstrip and coplanar structure.

Unit – 5 **7 hours**

Feed back control systems: Feed back system, stability, performance criteria, servo systems, automatic control principle.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Signal Analysis	A. Papoulis	2014	McGraw Hill
2	Semiconductor opto-electronics devices	P. Bhattacharya	2017	Pearson
3	Foundations of Microwave engineering	R. E. Collin	2007	Wiley
4	Networks, Lines and Field.	J. Ryder	2015	Pearson
5	Electronic and Radio Engineering	F. E. Terman	2005	McGraw Hil

Syllabus for M.Sc. (Physics) Third Semester

Title of Paper: Gravitation and Cosmology - I: General Relativity [MPHYT- D306 (c)]

(Discipline specific elective, Credit- 3)

Maximum Marks: 100 **Teaching hours: 45 hours**

Unit-1 **9 hours**

Geometric Viewpoint on Physics in Flat Spacetime: Vectors and Dual Vectors, Tensors, Special Relativity, Energy and Momentum, Conserved Currents, Stress Energy Tensor, Transformation Law for Tensors.

Unit- 2 **9 hours**

Metric in a Curved Space, Orthonormal and Coordinate Bases; Derivatives, Tensor Densities, Differential Forms and Integration, Gauge/Coordinate Transformations, Connection and Curvature, Geodesics, Geodesic Deviation, Bianchi Identity, Killing Vectors and Symmetries.

Unit- 3 **9 hours**

Einstein's Equation and Gravitation, Cosmological Constant, Hilbert Action, Weak Field/Linearized General Relativity, Gauge Invariant Characterization of Gravitational Degrees of Freedom, Spacetime of an Isolated Weakly Gravitating Body.

Unit- 4 **9 hours**

Gravitational Waves, Gravitational Lensing, Schwarzschild Solution, Birkhoff's Theorem, Metric of a Spherical "Star", Black Holes, Collapse to Black Hole; Orbits of a Black Hole, Kerr and Reissner-Nordstrom Solutions.

Unit- 5 **9 hours**

Cosmology, Friedmann-Robertson-Walker Solution, Distance Measures and Redshift, Our Universe, Advanced Topics and Current Research in General Relativity.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	An Introduction to General Relativity: Spacetime and Geometry	Sean M. Carroll	2004	Addison Wesley
2	Gravitation	C. W. Misner, K. S. Thorne and J. A. Wheeler	1973	W.H. freeman
3	A First Course in General Relativity	Bernard Schutz	2009	Cambridge University Press
4	Gravity: An introduction to Einstein's general relativity	J. B. Hartle	2003	Pearson Education India
5	Gravitation and Cosmology	Steven Weinberg	2008	Wiley India Pvt. Ltd.
6	General relativity	Robert M. Wald	2010	University of Chicago Press

Syllabus for M.Sc. (Physics) Fourth Semester

Title of Paper: **Condensed Matter Physics – II (MPHYT-C401)**

(Core Courses-18, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit-1 **12 hours**

SEMICONDUCTORS: Band theory of solids, Classification of solids on the basis of band theory, Types of semiconductors, Introduction to the concept of electrical conductivity, conductivity of conductors and semiconductors. Hall effect and Hall coefficient, Fermi-Dirac probability distribution function, Position of Fermi level in intrinsic semiconductors and in extrinsic semiconductors, Drift velocity, Mobility, Thermoelectric Effects, Semimetals, Hall effect and Hall coefficient, Superlattices**.**

Unit- 2 **12 hours**

Dielectric and Ferroelectric Properties- Macroscopic electric field, Local field at an atom, Clausius-Mosotti equation, Dielectric constant and polarisability, Electronic Polarisability, Classical theory of electronic polarisability, Structural phase transition, Soft modes, Anti-ferroelectricity, Ferroelectric domains, Piezoelectricity.

Unit- 3 **12 hours**

Electronic and optical properties- The upper filled band and the conduction band in ionic crystals, Excitons, Qualitative discussion of lattice defects and their influence on electronic levels, Colour centers, Luminescence, thallium activated alkali halides.

Unit- 4 **12 hours**

Superconductivity: Basic properties of superconductivity, Persistent currents, Perfect diamagnetism, Meissner effect, Application of basic thermodynamics to the superconducting transition, Discontinuity in the heat capacity, London equations. Penetration depth, Ginzburg-Landau theory, Type I and type II superconductors, The vortex lattice, Josephson effect, SQUID, BCS theory, High-temperature superconductors.

Unit- 5 **12 hours**

Emerging materials and technology: Graphene, Molybdenum disulfide (MoS_2), Tungsten disulfide (WS_2) and other two dimensional materials; High-k gate dielectrics, Hafnium oxide (HfO_2), Thin film transistors, CMOS technology.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Solid State Physics	A. J Dekker	2000	Macmillan India
2	Crystallography for Solid State Physics	A. R. Verma and O. N. Srivastava	2001	New Age International
3	Introduction to Solid State Physics	C. Kittel	2001	John Wiley and Sons
4	Solid State Physics	N. W. Ashcroft and N. D. Mermin	2001	Harcourt Asia
5	Solid State Physics	M. A. Wahab	2005	Alpha Science International

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Syllabus for M.Sc. (Physics) Fourth Semester

Title of Paper: Numerical Techniques and Computer Applications (MPHYT-C402)

(Core Courses-19, Credit- 4)

Maximum Marks: 100 **Teaching hours: 60 hours**

Unit – 1 **12 hours**

Functional units-CPU, Memory, I/O units; Information representation- integral and real number representation; Character representation: Alphanumeric codes; BCD, Gray, ASCII codes; Error detection and error correcting codes; Hamming codes; CRC codes, System software and application software; Translator programs; Loaders and linkers.

Unit – 2 **12 hours**

Computer Software and Operating Systems: Translator programs; Loaders and linkers; Operating systems- classification; Elements of DOS and Windows- basic commands. Elements of C Programming language:; Algorithms and flowchart; Features of C language; constants and variables; expressions; Input and output statements; conditional statements and loop statements; arrays; functions; character strings; structures; pointer data type; list and trees

Unit – 3 **12 hours**

CPU- programmers model; instruction set and addressing modes of a generic CPU; RISC and SISC; Storage System- primary and secondary memory; semiconductor, magnetic and optical memory; cache memory; virtual memory; memory management. IO Units – keyboard, mouse, VDU, printers; (principles only). Computer Networks- motivation, classification, topology, technology; Internet- structure, TCP/IP protocol, internet services; Introduction to WWW.

Unit – 4 **12 hours**

Representation of integers and real numbers; Accuracy, range, overflow and underflow of number representation; error propagation and instability. Solution of polynomial equations- bisection, Newton-Raphson algorithm, Solution of system of simultaneous equations- Gauss elimination, Gauss-Seidel, LU decomposition algorithms.

Unit – 5 **12 hours**

Interpolation- Newton interpolation formula. Numerical integration – trapezoidal formula, Simpson's formula, Romberg formula. Numerical solution of differential equations- Euler, Runge-Kutta formula. Numerical solution of partial differential equations- description of algorithms only. Monte Carlo technique of numerical integration.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Introductory Methods of numerical analysis	S. S. Sastry	2012	PHI Learning Pvt. Ltd.
2	Operating system	Tanenbaum,		Prentice Hall
3	Numerical Methods in Engineering and Science	B. S. Grewal	2005	Khanna publications
4	Let us C	Y. Kanitkar	2008	Infinity Science Press
5	Programming in ANSI C	E. Balaguruswamy	2012	Tata McGraw – Hill
6	Advance Engineering Mathematics	E. Kreyszig	2015	John Willey

Syllabus for M. Sc. Fourth Semester

Title of Paper: Advanced practicals/simulations [MPHYL-C403]

(Core Course-20, Credit- 2)

Maximum Marks: 50 **Teaching hours: 60 hours**

(a) Material science

1. Synthesis of nanoparticles by solution route.
2. Deposition of thin films by sol-gel method.
3. Optical characterization of thin films.
4. Fabrication of Metal-Oxide-Semiconductor-(MOS) capacitor
5. Electrical characteristics of MOS capacitor.

(b) Advanced Electronics

1. To design the arduino based pulse generator
2. Design and study of Wien-Bridge oscillator.
3. Studies on LED and LED based circuits.
4. Problems on assembly language programming using 8085 microprocessor.
5. Experiments on Microprocessor interfacing

(c) Gravitation and Cosmology

1. Solving geodesic equation using Mathemetica.
2. Solving geodesic deviation equation using Mathemetica.
3. Solving Raychoudhuri equation using Mathemetica.
4. Solving Einstein equation using Mathemetica.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	A Text Book of Practical Physics	Dr. Samir Kumar Ghosh	2008	New Central Book Agency
2	Practical Physics	P. R. Sasi Kumar	2006	PHI Learning
3	Experimental Physics	K. Venkatraman, R. Raja, M. Sunderrajan	2014	Scintech Publication
4	Physics Laboratory Manual	P. K. Palanisamy	2002	Scintech Publication
5	An Advance Course in Practical Physics	D. Chattopadhyay, P. C. Rakshit	2011	New Central Book Agency
6	Gravity	J. Hartle	2014	Pearson

Title of Paper:- Materials science -II: Physics of nanosystems [MPHYT-D404 (a)]

(Discipline specific elective, Credit- 3)

Maximum Marks: 100 **Teaching hours: 45 hours**

Unit-1 **9 hours**

Introduction to different nanosystems and their realization, method/technique to prepare low dimensional material and device: sol-gel, ALD, MOCVD, MBE.

Unit-2 **9 hours**

Electronic properties of quantum confined systems: quantum wells, wires, nanotubes and dots.

Unit-3 **9 hours**

Optical properties of Nano systems: exactions and Plasmon's; photoluminescence, absorption spectra, vibrational and thermal properties of Nano systems.

Unit-4 **9 hours**

Characterization Technique: Electrical (IV, CV), Optical (SEM, RAMAN, UV), Material characterization (XPS, XRD)

Unit-5 **9 hours**

Recent advancement: Thin film transistor, 2-D materials, high permittivity materials for device applications, memory devices.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience	E. L. Wolf	2015	John Wiley and Sons
2	Nanophysics of Solar and Renewable Energy	E. L. Wolf	2012	John Wiley and Sons
3	Understanding the Nanotechnology Revolution	E. L. Wolf	2012	John Wiley and Sons
4	Textbook of Nanoscience and Nanotechnology	B. S. Murty, B. Raj, J. Murday and P. Shankar	2013	Springer
5	Nano: The Essentials	T. Pradeep	2008	McGraw Hill

Syllabus for M.Sc. (Physics) Fourth Semester

Title of Paper:- Advanced Electronics II [MPHYT-D 404 (b)]

(Discipline Specific Elective, Credit- 3)

Maximum Marks: 100 **Teaching hours: 45 hours**

Unit-1 **9 hours**

Review of CW Modulation Technique: Linear modulation DSB, SSB, VSB, QAM techniques, Exponential modulation FM and PM; AM and FM modulators and demodulators. Pulse Modulation and Demodulation Techniques : Sampling the rein PAM, PWM, PPM, Pulse code modulation – coding technique modulation and demodulation.

Unit-2 **9 hours**

Digital Modulation Techniques : ASK, FSK, PSK, DPSK, QPSK, MSK, Principle, modulators and demodulators. Effect of Noise on Communication System: Characteristics of additive noise; Performance of AM, FM and PCM receivers in the face of noise; Multi-path effect.

Unit-3 **9 hours**

Elements of Information Theory: Information, average information, information rate, Effect of coding on average information per bit; Shanon's theorem; Channel capaity, an optimum modulation system. TV Systems: Color TV standards – NTSC, PAL, SECAM; Transmission format of intensity and color signal; Transmitter and receiver systems of broadcast TV; Advanced TV; Cable TV.

Unit-4 **9 hours**

RADAR System: Basic pulsed radar system – modulators, duplexer indicators, radar antenna CW radar; MTI radar FM radar; chirped pulse radar. Optical Communication: Fibre optic communication systems; Power budget equation; Multiplexing; Quantum limit; Incoherent reception; signal-to-noise ratio calculation; Coherent techniques in FOC.

Unit-5 **9 hours**

Satellite Communication: Orbits, Station keeping; Satellite attitude; Path loss calculation; Link calculation; Multiple access techniques; Transponders; Effects of nonlinearity of transponders. Specialised Communication Systems: Mobile Communication; Pagers. Computer communication – Types of networks; Circuit message and packet switched networks; Features of network, design and examples of ARPANET, LAN, ISDN, Medium access techniques – TDMA, FDMA, ALOHA, Slotted ALOHA, CSMA/CD; Basics of protocol.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Communication Systems	A. B. Carlson	2017	McGraw Hill
2	Electronic Communications	D. Roddy and J. Coolen	2008	Pearson
3	Optical Communication Systems	Franz and Jain	2000	Narosa
4	Television and Video Engineering	A. M. Dhake	2017	McGraw Hill
5	Electronic Communication Systems	Kennedy and Davis	2011	McGraw Hill

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Syllabus for M.Sc. (Physics) Fourth Semester

Title of Paper: Gravitation and Cosmology -II: Introduction to cosmology [MPHYT-D404 (c)]

(Discipline Specific Elective, Credit- 3)

Maximum Marks: 100 **Teaching hours: 45 hours**

Unit- 1 **9 hours**

The Cosmological Principle, Particles in the Universe, Elementary Properties of Radiation, Olbers Paradox, Doppler effect, Homogeneity and Isotropy, Expanding Universe, Gravitational redshift.

Unit- 2 **9 hours**

Friedmann equation, Density Parameter, Fluid Equation, Solving Friedmann equations, Fate of the Universe, Acceleration equation and Initial Singularity, Deceleration Parameter, Problems with the Big Bang, Cosmological Constant, The Preposterous Universe.

Unit- 3 **9 hours**

A Quick Primer to Non-Euclidean Geometries, Differential geometry, General relativity, Curved space-time, Einstein's Field Equations, Metric, Equations of Motion, Redshift, Measuring cosmological parameters: Age of the Universe, Distances, Time-Varying Redshift.

Unit- 4 **9 hours**

Cosmic microwave background radiation, Photon to Baryon Ratio, Origin of the CMB, Physics of Recombination, Radiation Drag Horizon Problem Relic Neutrinos, Origins of Light Elements, Nucleosynthesis.

Unit- 5 **9 hours**

Inflationary Solution, The Physics of Inflation, Alternative cosmologies, Modified theories of gravity, Extra dimensions, Braneworld cosmologies.

Recommended Books:

S. No.	Title of the book	Authors	Year	Publishers
1	Introduction to Modern Cosmology	A. Liddle	2015	John Wiley and Sons
2	Introduction to Cosmology	B. Ryden	2016	Cambridge University Press
3	Modern Cosmology	S. Dodelson	2003	Academic Press
4	Physical Foundations of Cosmology	V. Mukhanov	2005	Cambridge University Press
5	Cosmology	S. Weinberg	2008	OUP Oxford
6	Gravitation: Foundations and Frontiers	T. Padmanabhan	2010	Cambridge University Press

Minutes of the BOS meeting

The meeting of the board of Studies (PG) was convened during 3 pm to 6 pm on 30th July 2017 and 8 am to 11 am on 31st July, 2017 at the Meeting Hall of Agariya Saraya, IGNTU, Amarkantak, M.P. to discuss the following agenda.

1. Consideration and approval of Choice Based Credit Systems (PG) Physics program.
2. To prepare and approval of the guideline, scheme of examinations, distribution of marks for project work during the M.Sc. Physics (III and IV semester).
3. Consideration and approval of M.Sc. Physics (I and II semester) syllabus, if modification required.
4. Consideration and approval of M.Sc. (Generic Elective course- This course adopt by other department students) Physics (I and II semester) syllabus, scheme of examinations, distribution of marks, pattern of question papers etc.
5. Consideration and approval of B.Sc. (Generic Elective course- This course adopt by others departments students) Physics (I, II, III and IV semester) syllabus, scheme of examinations, distribution of marks, pattern of question papers etc.
6. To prepare a panel of teachers for I, II, III and IV semester exams of M.Sc. Physics/B.Sc. (Generic Elective) program and examination related work.
7. To prepare and approve the guidelines for admission, student's intake, specialization and COE related matters for M.Sc. Physics program.
8. Consideration and approval of the syllabus of Ph.D. course work in the department of Physics Ph.D. course work.
9. Any other issue, if required.

Resolutions:

1. Regarding agenda points numbered 1, 2, 3, 4, 5 and 9 the Board has discussed in detail and approved the syllabi of MSc Physics program (I to IV semesters) with corrections and modifications wherever needed, according to UGC guidelines.
2. Regarding agenda point 6, the board has suggested updating the panel of teachers list as per the availability of teachers in the nearby universities.
3. Regarding agenda point 7, the intake shall remain the same at least for coming academic session.

4. Regarding agenda point 9, the board approved the Ph.D. course work framed as per University/UGC guidelines.

The meeting is concluded with thanks by the chairman to all the members of the Board of Studies and the Dean (faculty of science) for their co-operation.

-Sd-

Prof. B. G. Mulimani
(Member, Special Invitee)

-Sd-

Prof. U. S. Raikar
(Member, External Expert)

-Sd-
Prof. K. Sreenivas
(Member, External Expert)

-Sd-
Mr. Rajesh Kumar
(Member)

-Sd-
Dr. Ishwar Prasad Sahu
(Member)

-Sd-
Dr. Suman Ghosh
(Member)

-Sd-
Dr. Arvind Kumar
(Member)

-Sd-
Prof. Naveen K. Sharma
(Dean, faculty of science)

-Sd-
Dr. Shameem Ahmad
(Member)

-Sd-
Prof. K. S. Adhav
(Chairman and convener, BOS)

Note: Prof. Bhuminath Tripathi could not attend the meeting due to preoccupation**.**