UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
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NOTIFICATION
(25/July/Adp./20)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Physics** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Physics	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

One Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Physics	Semester-I	December 2026, 2027 and 2028
	Semester-II	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

Anjna Bhasin
DEAN ACADEMIC AFFAIRS

Dbroca 28/7/25 | 28/7/25 | 28/7/25

No. F. Acd/II/25/4971-92
Dated: 30/7/25
Copy for information and necessary action to:

1. Dean, Faculty of Science
2. Director/Convener, Board of Studies in **Physics**
3. Director, Centre for IT Enabled services and Management, University of Jammu for information and for uploading on University Website.
4. All members of the Board of Studies
5. Joint Registrar (Evaluation/P.G. Exam.)
6. Programmer, Computer Section, Examination Wing

Annexure-II

UNIVERSITY OF JAMMU

LIST OF COURSES OF PHYSICS FOR ONE-YEAR POST-GRADUATE PROGRAMME AS PER NEP-2020 W.E.F. ACADEMIC SESSION 2025 ONWARDS

PG Syllabi 2025 (1-Year)															
S. No.	Course No.	Course Title	No. of Credits			Course Type	Marks		Nature of Course				SAWAM/ MOOC	Vocational Course	Research Project / Summer Internship/ Dissertation
				Credit Level	Credit Points	Core/Elective/ Any other	Theory	Practical	Global	National	Regional	Skill			
1	P1PHTC101	Condensed Matter Physics	04	6.5	26	Core	100		Global						
2	P1PHTC102	Nuclear & Particle Physics	04	6.5	26	Core	100		Global						
3	P1PHTE103	Physics of Materials (Elective)	04	6.5	26	Elective	100		Global						
4	P1PHTE104	Advanced Nuclear Structure (Elective)	04	6.5	26	Elective	100		Global						
5	P1PHTE105	Condensed Matter Physics (Special -I) (Elective)	04	6.5	26	Elective	100		Global						
6	P1PHTE106	High Energy Nuclear & Particle Physics(Special-I) (Elective)	04	6.5	26	Elective	100		Global						
7	P1PHTE107	Nuclear Theory(Special-I) (Elective)	04	6.5	26	Elective	100		Global						
8	P1PHTE108	Electronics (Special-I) (Elective)	04	6.5	26	Elective	100		Global						
9	P1PHPE109	Practicals in Condensed Matter Physics	08	6.5	26	Elective		200	Global						
10	P1PHPE110	Practicals in Nuclear & Particle Physics	08	6.5	26	Elective		200	Global						

11	P1PHPE111	Practicals in Nuclear Theory	08	6.5	26	Elective		200	Global						
12	P1PHPE112	Practical in Electronics	08	6.5	26	Elective		200	Global						
13	P1PHTE201	Condensed Matter Physics (Elective)	04	6.5	26	Elective	100		Global						
14	P1PHTE202	Nuclear & Particle Physics (Elective)	04	6.5	26	Elective	100		Global						
15	P1PHTE203	Quantum Electrodynamics (Elective)	04	6.5	26	Elective	100		Global						
16	P1PHTE204	Physics of Photonic Devices (Elective)	04	6.5	26	Elective	100		Global						
17	P1PHTE205	Condensed Matter Physics (Special-II) (Elective)	04	6.5	26	Elective	100		Global						
18	P1PHTE206	High Energy Nuclear & Particle Physics (Special-II) (Elective)	04	6.5	26	Elective	100		Global						
19	P1PHTE207	Nuclear Theory (Special-II) (Elective)	04	6.5	26	Elective	100		Global						
20	P1PHTE208	Electronics (Special-II) (Elective)	04	6.5	26	Elective	100		Global						
21	P1PHRE209	Project work in Condensed Matter Physics	16	6.5	26	Elective		400	Global						Dissertation
22	P1PHRE210	Project work in Nuclear & Particle Physics	16	6.5	26	Elective		400	Global						Dissertation
23	P1PHRE211	Projects in Nuclear Theory	16	6.5	26	Elective		400	Global						Dissertation
24	P1PHRE212	Project work in Electronics	16	6.5	26	Elective		400	Global						Dissertation

UNIVERSITY OF JAMMU

SYLLABI OF PHYSICS FOR ONE YEAR POST GRADUATE PROGRAMME AS PER NEP-2020 W.E.F. ACADEMIC SESSION 2026

List of Core and Elective Courses in Physics for 1st and 2nd Semester as per NEP-2020

SEMESTER-I

S. No.	Course Type	Course No.	Course Title	Credits	Marks					Total Marks
					Theory			Practical		
					Test I	Test II	Major	Internal Exam	External Exam	
1.	Core	P1PHTC101	Condensed Matter Physics	4	20	20	60	---	---	100
2.	Core	P1PHTC102	Nuclear & Particle Physics	4	20	20	60	---	---	100
3.	Elective	P1PHTE103	Physics of Materials	4	20	20	60	---	---	100
4.	Elective	P1PHTE104	Advanced Nuclear Structure	4	20	20	60	---	---	100
5.	Elective	P1PHTE105	Condensed Matter Physics (Special-I)	4	20	20	60	---	---	100
6.	Elective	P1PHTE106	High Energy Nuclear & Particle Physics (Special-I)	4	20	20	60	---	---	100
7.	Elective	P1PHTE107	Nuclear Theory (Special-I)	4	20	20	60	---	---	100
8.	Elective	P1PHTE108	Electronics (Special-I)	4	20	20	60	---	---	100
9.	Elective	P1PHPE109	Practicals in Condensed Matter Physics	8	---	---	---	100	100	200
10.	Elective	P1PHPE110	Practicals in Nuclear & Particle Physics	8	---	---	---	100	100	200
11.	Elective	P1PHPE111	Practicals in Nuclear Theory	8	---	---	---	100	100	200
12.	Elective	P1PHPE112	Practicals in Electronics	8	---	---	---	100	100	200

Note: Four specializations are offered to one year PG students in 1st and 2nd semester.

Following are the details of courses to be opted by students in 1st semester:

(i) Condensed Matter Physics	(ii) Electronics	(iii) Nuclear & Particle Physics	(iv) Nuclear Theory
P1PHTC101	P1PHTC101	P1PHTC101	P1PHTC101
P1PHTC102	P1PHTC102	P1PHTC102	P1PHTC102
P1PHTE103	P1PHTE103	P1PHTE104	P1PHTE104
P1PHTE105	P1PHTE108	P1PHTE106	P1PHTE107
P1PHPE109	P1PHPE112	P1PHPE110	P1PHPE111
24 Credits	**24 Credits**	**24 Credits**	**24 Credits**

SEMESTER-II

o.	Course Type	Course No.	Course Title	Credits	Marks					Total Marks
					Theory			Practical		
					Test I	Test II	Major	Internal Exam	External Exam	
.	Elective	P1PHTE201	Condensed Matter Physics	4	20	20	60	---	---	100
.	Elective	P1PHTE202	Nuclear & Particle Physics	4	20	20	60	---	---	100
.	Elective	P1PHTE203	Quantum Electrodynamics	4	20	20	60	---	---	100
.	Elective	P1PHTE204	Physics of Photonic Devices	4	20	20	60	---	---	100
.	Elective	P1PHTE205	Condensed Matter Physics (Special-II)	4	20	20	60	---	---	100
.	Elective	P1PHTE206	Nuclear & Particle Physics (Special-II)	4	20	20	60	---	---	100
.	Elective	P1PHTE207	Nuclear Theory (Special-II)	4	20	20	60	---	---	100
.	Elective	P1PHTE208	Electronics (Special-II)	4	20	20	60	---	---	100
.	Elective	P1PHRE209	Project work in Condensed Matter Physics	16	---	---	---	100	300	400
0.	Elective	P1PHRE210	Project work in Nuclear & Particle Physics	16	---	---	---	100	300	400
1.	Elective	P1PHRE211	Project work in Nuclear Theory	16	---	---	---	100	300	400
2.	Elective	P1PHRE212	Project work in Electronics	16	---	---	---	100	300	400

Note: Following are the details of courses to be opted by students in 2nd Semester:

(i) Condensed Matter Physics	(ii) Electronics	(iii) Nuclear & Particle Physics	(iv) Nuclear Theory
P1PHTE201	P1PHTE204	P1PHTE202	P1PHTE203
P1PHTE205	P1PHTE208	P1PHTE206	P1PHTE207
P1PHRE209	P1PHRE212	P1PHRE210	P1PHRE211
24 Credits	24 Credits	24 Credits	24 Credits

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC101**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (I[st] Semester-one year programme)

Course No. **P1PHTC102**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Nuclear & Particle Physics**
Minor Tests (I & II): **40**

Syllabus for the examinations to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives:

This course aims to provide a comprehensive understanding of nuclear structure, forces, and reactions, as well as the fundamentals of particle physics. It prepares students to apply theoretical models and experimental principles to analyze nuclear and subatomic phenomena.

Course Outcomes:

Upon successful completion of this course, students will be able to explain nuclear properties and forces, analyze nucleon interactions, and apply theoretical models like the shell and collective models to describe nuclear structure. They will understand nuclear reaction mechanisms and compute key parameters such as Q-values and cross sections. Foundational knowledge of cosmic rays and elementary particles, including the Standard Model and symmetry principles is also gained.

UNIT I: Atomic Nucleus

Historical development of nuclear physics: from the discovery of radioactivity and the nucleus (Becquerel, Rutherford) to major 20th-century milestones. Overview of nuclear properties; discovery of the neutron; nuclear composition: proton-electron and proton-neutron models.

Mass defect, packing fraction, binding energy curve; semi-empirical mass formula and nuclear stability. Nuclear potentials: square well, harmonic oscillator, and Woods-Saxon; nucleon energy levels and decay of nuclear states. *(10)*

UNIT-II Nuclear forces and two body problem

Meson exchange theory of nuclear forces; mass of exchange particles; exchange and tensor potentials. Charge independence and charge symmetry of nuclear forces; concept of isospin.

Ground state of the two-nucleon system (deuteron); low-energy nucleon-nucleon scattering (<10 MeV); scattering length and effective range theory.

Spin dependence of nuclear forces; scattering of neutrons by ortho and para hydrogen molecules. *(10)*

UNIT-III: Nuclear Models

Fermi gas model; nuclear shell model including experimental evidence for shell effects and magic numbers, square well and harmonic oscillator potentials, spin–orbit coupling; Schmidt model predictions for magnetic dipole moments and ground state angular momentum and parity; collective model covering vibrational and rotational spectra; Nilsson's unified model for deformed nuclei.

UNIT IV: Nuclear Reactions

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC101**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The objective of this course is to apprise and equip the students with the deeper insights into the field of Crystallography and magnetic properties of materials. The course prepares students for further study in advanced crystallography techniques. By studying magnetic properties of materials, students can better understand their behavior for use in various technologies.

Course Outcomes: By the end of the course, students will have a strong foundation in crystallographic principles, including the structure, symmetry, and properties of crystals. Students will be able to explain the basic principles of magnetism, including the different types of magnetic materials.

UNIT-I: Basic Crystallography

Introduction, anisotropy, the significance of order, crystal symmetry, coupling of symmetry elements, combination of symmetry elements, lattice directions and planes, indexing of planes, directions and positions of atoms, atom sizes and coordination, crystal shape, twinned crystals, quasi-crystals. (10)

UNIT-II: Point Groups and Space Groups

Derivation of 14 Bravais lattices, non- translational symmetry elements, derivation of 32 point groups, translational symmetry elements, space groups, derivation of space groups (triclinic, monoclinic and orthorhombic systems). (10)

UNIT-III: Diffraction

Interaction of electromagnetic radiation with matter, diffraction and information, X-ray diffraction, the mathematics of diffraction, diffraction and Fourier transforms, The significance of the Fourier transform, Fourier transforms and phase, Fourier transforms and the wave equation, Fourier transforms and information, The inverse transform. (10)

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC101**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

UNIT-IV: X-ray Diffraction by a three dimensional lattice

The diffraction pattern of a crystal, Bragg's law, The Laue equations, Equivalence of Bragg and Laue equations, Bragg's law in Ewald construction, Reciprocal Space, X-ray diffraction in direct and reciprocal space, Diffraction by liquids and amorphous bodies, Electron diffraction, Neutron diffraction, Electron, Neutron and X-ray diffraction : comparison and perspectives.

(10)

UNIT-V: Magnetic Properties of materials

Classification of magnetic materials, Atomic theory of magnetism, the origin of permanent magnetic moments, ferromagnetism, Weiss classical theory of ferromagnetism, Quantum theory of ferromagnetism, temperature dependence of spontaneous magnetization, ferromagnetic domains. Hysteresis curve of ferromagnetic materials, Bloch-Wall energy, antiferromagnetism -the two-sublattice model, ferrimagnetism, spin waves and magnons.

(10)

Text & Reference Books:

1. Applied Solid State Physics by Rajnikant
2. Introduction to Solids by Azaroff.
3. Crystallography Applied to Solid State Physics by Verma and Srivastava
4. Solid State Physics by M.A.Wahab
5. Elementary Solid State Physics by Omar

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC102**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Nuclear & Particle Physics**
Minor Tests (I & II): **40**

Syllabus for the examinations to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC102**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Nuclear & Particle Physics**
Minor Tests (I & II): **40**

Syllabus for the examinations to be held in Dec 2026, Dec 2027, Dec 2028.

Kinematics of nuclear reactions in lab and center-of-mass frames; Q-value, threshold energy, and cross sections (scattering and reaction) with partial wave analysis.
General features of nuclear reactions: energy spectra, angular distributions, and cross sections. Elastic scattering and nuclear size via electron scattering and the optical model.
Classification of nuclear reactions; stages of nuclear processes (pre-equilibrium, equilibrium, post-equilibrium); direct and compound reaction mechanisms, including scattering and transfer reactions; Bohr's theory of the compound nucleus.
Concept of Nuclear fission (spontaneous and induced) and nuclear fusion. (10)

UNIT-V Cosmic rays and Elementary Particles

Cosmic rays: Discovery, origin, primary and secondary components, and geomagnetic effects (latitude, altitude, east–west asymmetry).

Elementary particles: Overview of the Standard Model, particle types (leptons, baryons, bosons), quark model and color charge, conservation laws, and fundamental interactions (strong, weak, and electromagnetic), unification of fundamental forces. Symmetry principles including parity (Wu's experiment), isospin, hypercharge, Gell-Mann–Nishijima scheme, CP and CPT violations.

Text & Reference Books: -

1. Nuclear Physics: Principles and Applicatios, John Lilley Wiley student edition.
2. Nuclear Physics, Dr. S.N. Ghoshal, S.Chand
3. Particles and Nuclei: An introduction to the Physical Concepts, Povh, Rith, Scholz, Zetsche, Springer
4. Nuclear Physics : R. R. Roy and B. P Nigam
5. Nuclear Physics : D. Halliday
6. Nuclear Physics : I. Kaplan
7. Concepts of Nuclear Physics : B. L. Cohen
8. Introductory Nuclear Physics By K. S. Krane

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC103**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Physics of Materials (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC104**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Advanced Nuclear Structure (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The main objective of this course is to impart students the knowledge about nuclear properties, deformations and nuclear models to understand the complex world of atomic nucleus and its interactions.
Course outcomes: After completion of this course the students shall have detailed knowledge of nuclear excitations and how they relate to fundamental properties of nuclei such as nuclear shape and shell structure. They shall also have a good understanding of fundamental nuclear structure models, nuclear structure phenomena and can interpret experimental observables and spectroscopic information with the help of nuclear structure models. Besides, they would acquire knowledge of current research topics in nuclear structure physics.

Unit I: Nuclear global properties

Concepts, nuclear extension: densities and radii, proton and neutron charge distributions, angular momentum in the nucleus, nuclear moments, dipole magnetic moments, electric moments - electric quadrupole moment, one particle quadrupole moments, Nucleon-nucleon interaction, introduction, methods of approach, general aspects of the two-body interactions

Unit II: Collective Models

Introduction, semi empirical Mass Formula, Nuclear Surface Deformations, General parameterization, Types of Multipole deformations, Quadrupole deformations, Symmetries in Collective space, rotational motion of deformed shapes, the Bohr Hamiltonian, the axially symmetric case, the asymmetric rotor

Unit III: Phenomenological Single Particle Models

The Shell Model, introduction and general considerations, experimental evidence for shell effects, the average potential of the nucleus, spin orbit coupling, the shell model approach to the many body problem, ground state spin of nuclei, electromagnetic moments and transitions, the deformed Shell Model, experimental evidence, General deformed potential, the Anisotropic Harmonic Oscillator, Nilsson Hamiltonian, Quantum Numbers of the ground state in odd nuclei

Unit IV: Nuclear Physics at the extremes of stability

Introduction, nuclear structure at the extremes of stability, Theoretical concepts and extrapolations: changing mean fields, Dripline physics, nuclear halos, neutron skins, proton rich nuclei and other exotica

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC103**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Physics of Materials (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The objective of this course is to apprise the students with basic knowledge of materials science, so that they would be able to understand and distinguish between variety of materials based on their structure and properties.

Course Outcomes: Students will acquire the knowledge needed to understand, analyze, and manipulate materials for diverse technological applications. This course will prepares them for careers in research, industry, and academia while fostering an appreciation for the role of materials in modern society.

UNIT-I: Classification of Materials

Introduction, Classification of Materials, Engineering requirements, metals and alloys, metallic glasses – preparation and properties, ceramics, polymeric materials, composite materials, electronic materials, biomaterials, smart materials, materials with nano-dimension, aerospace materials, material structure, selection of materials, mechanical properties, electrical properties, thermal properties and their relations with structure of materials. (10)

UNIT-II: Ceramics, polymers and composites

Ceramics- Synthesis and processing of ceramic powders, sintered ceramics and its characteristics, inorganic glasses, glass ceramics, processing and applications of clay products, refractories, applications.
Polymers – classification, addition and condensation polymerization, degree of polymerization, thermoplastics, mechanical properties of thermoplastics, elastomers, adhesives
Composite materials – dispersion strengthened, particulate, fiber-reinforced, laminar and sandwich structures, insulating materials. (10)

UNIT-III: Nanomaterials

History and scope, effect of nano-dimensions on materials behavior, synthesis routes for nanostructured materials : bottom-up and top-down approaches, tools to characterize nanomaterials, quantum dots and its applications.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC103**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Physics of Materials (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

The world of carbon – Introduction, graphite related materials, Fullerenes, carbon nanotubes, applications of carbon nanotubes. (10)

UNIT-IV: Calamitic and polymer Liquid Crystals

Introduction, classification of liquid crystals, thermotropic liquid crystals (rod like molecules), chirality in liquid crystals, nematic, cholesteric and smectic mesophases, the blue phases, polymer liquid crystals, main chain liquid crystal polymers, side chain liquid crystal polymers, combined liquid crystal polymers, applications of polymer liquid crystals. (10)

UNIT-V: Discotic, Lyotropic Liquid Crystals and Liquid Crystal Technology

Discotic liquid crystals, discotic mesophase structures-the columnar liquid crystal, the discotic nematic phase. Lyotropic liquid crystals, constituents of lyotropic liquid crystals, structures of lyotropic liquid crystal phases, liquid crystal displays, the twisted nematic liquid crystal displays, applications of liquid crystals. (10)

Text & Reference Books:

1. Essentials of materials science and engineering by D.R.Askeland and P.P.Fulay
2. Material science by S.L.Kakani and Amit Kakani
3. Introduction to nanotechnology by C.P.Poole,Jr. and F.J.Owens
4. Carbon-the future material for advanced technology applications by G.Messina and S.Santangelo.
5. Supercarbon- Synthesis,properties and applications by S.Yoshimura and R.P.H.Chang
6. Liquid Crystals by S.Chandrasekhar
7. Introduction to Liquid Crystals: Chemistry and Physics by Peter J.Coolings and Michael Hird

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC104**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Advanced Nuclear Structure (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Unit-V: Relativistic mean field models

Relativistic quantum mechanics: Klein-Gordon and Dirac equations and their solutions, Gamma matrices, non-relativistic limit of Dirac equation; Parity inversion and time reversal, Introduction to relativistic mean field models, Formulation of the Models and applications

Text and Reference books:

1. Basic ideas and concepts in Nuclear Physics by K. Heyde
2. Theory of Nuclear structure by M.K Pal
3. Shapes and Shells in Nuclear Structure by S.G. Nilsson and I. Ragnarsson
4. Nuclear Models by W. Greiner and J.A. Maruhn
5. The Nuclear Many Body Problem by Peter Ring and Schuck
6. Nuclear structure by A. Bohr and B.R. Mottelson (Volume I)
7. Mean Field Description of Nuclei by Y.K. Gambhir
8. Introductory Nuclear Physics by Y.R. Waghmare
9. Concepts of Nuclear Physics by B.L. Cohen
10. Nuclear data, a primer, D.G. Jenkins and J.L. Wood

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC104**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Advanced Nuclear Structure (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC105**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Special-I) (Elective)**
Minor Tests (I & II): **40**

Maximum Marks : **100**
Major Test : **60**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The main objective of this course is to introduce towards the theoretical and experimental part of the condensed matter physics.

Course Outcomes: The students will get information about concept of phonon, its interaction with electron, experimental solid state physics with understanding of the low temperature phenomenon like superconductivity, Mossbauer effect of the solids and optical phenomenon.

UNIT-I: Lattice Dynamics and thermal properties of solids

Lattice waves, Vibrations of one- dimensional monatomic lattice (chain), Linear diatomic lattice, Measurement of dispersion relation, Quantization of lattice vibrations - concept of phonon, Characteristics of phonons, Classical and quantum model for thermal properties of solids, Debye's quantum model, Anharmonic crystal interactions, Thermal expansion, Thermal conductivity, Mean-free path of phonons.

(10)

UNIT-II: Electron – Phonon Interaction

Introduction, Hartree-Fock Approximation, Correlation energy, Plasmons, Plasma optics, Transverse optical modes in Plasma, Longitudinal Plasma oscillations, Polaritons, Long wavelength optical phonon in isotropic crystal (Lyddans, Sachs and Teller relation), Electron-phonon interaction in polar solids- polarons, Electron- phonon interaction in metals.

(10)

UNIT-III: Superconductivity

Introduction, Zero resistance state, Magnetic field effects, Meissner effect, Theoretical aspects-London's theory, Thermodynamics of superconducting transitions, Type I and type-II superconductors, BCS theory of Superconductivity, Copper pairing due to phonons, Josephson's tunneling effect (a.c & d.c), Elementary idea of high temperature superconductivity, Some applications of superconductivity.

(10)

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC105**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Special-I) (Elective)**

Maximum Marks : **100**
Major Test : **60**

Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

UNIT-IV: Mossbauer Effect

Resonant absorption, Mechanism of Mossbauer effect- recoil energy, natural line width, thermal line width: Doppler's broadening, Experimental description, Classical theory, Debye-Waller factor, Quantum theory, Mossbauer effect and lattice dynamics, Mossbauer effect and magnetism, Applications of Mossbauer effect.

(10)

UNIT-V: Optical Properties

Optical properties of metals and nonmetals, application of optical phenomenon, Model of luminescence in Sulphide Phosphorous, Thalium activated alkali halides, Electro-luminescence, Photoconductivity, Electronic transitions in photoconductors, Model of photoconductivity, Influence of traps, Excitons, Trapping and its effect.

(10)

Text & Reference Books:

1. Introduction to Solid State Physics – Charles Kittel
2. Elementary Solid State Physics - M. A. Omar
3. Applied Solid State Physics - Rajnikant
4. Quantum Theory of Solid State - Joseph Callaway
5. Introduction to Solid State Theory – Otfried Madelung
6. Solid State Physics - R. K. Singhal

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC105**
Credits: **4 (4-0-0)**

Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Special-I) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC106**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **High Energy Nuclear & Particle Physics (Elective)**

Maximum Marks : **100**
Major Test : **60**

Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The objective of this course is to apprise and equip the students with the knowledge of about various Resonances and also get understanding and usage of Feynman Diagrams and TOY theory and Bhabha Scattering.

Course Outcomes: The students will know about Symmetries. They get understanding of SU(2) Symmetry breaking , SU(3) generators, Quark model in detail. They also get concepts of Heavy Meson spectroscopy, Zweig rule, Isospin, Parity etc.

UNIT-I: Symmetries

Introduction to particles and their classifications, Standard Model, Isospin : SU(2) Symmetry, its mathematical formulation and breaking.SU(3), generators of SU(3), I-U-V spins, Casimir operator, Young's tableaux for irreducible representation, Gell-Mann Okubo mass formulae, magnetic moment of baryon, the mixing and mass formula.

(10)

UNIT-II: Static Quark Model of Hadrons

The Baryon Decouplet, Quark spin and color, Baryon Octet, Quark-Antiquark combinations :- The pseudoscalar mesons, the vector mesons, leptonic decay of vector mesons, Baryon Magnetic Movements, Heavy-meson spectroscopy and the quark model. J/ψ and upsilon states; Zweig Rule,

Quark confinement and search for free quarks.

(10)

UNIT-III: Applications of symmetries and invariance principles

Isospin of two nucleon systems and Pion- nucleon system. Parity, Intrinsic Parity, Parity due to angular momentum, parity of Particle and Antiparticle, Parity Conservation and Non-Conservation, Charge conservation, G-Parity, Gauge invariance and photons. Charge conjugation invariance, Eigen States of the charge conjugation operator, Positronium decay, K_0 decay, CP violation in K_0 decay, K^0 - K_L^0 system oscillations, K0 regeneration, Time Reversal,

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC106**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **High Energy Nuclear & Particle Physics (Elective)**

Maximum Marks : **100**
Major Test : **60**

Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

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invariance, CPT theorem and its consequences, Wave optical discussion of hadron scattering.

(10)

UNIT-IV: Relativistic kinematics and Scattering-Resonances

Resonances (ρ, η, $\acute{\omega}$, φ, Δ) and their Quantum numbers – Production and formation experiments. Relativistic kinematics and Invariants – Mandelstam variables, phase space, decay of one particles into three particle – Dalitz plot.

(10)

UNIT-V: Feynman Calculus and Quantum Electrodynamics

The Feynman Rules for a TOY theory, Feynman diagrams, Feynman Higher order diagrams.

Electromagnetic Interactions : Elastic scattering of spinless Electrons by Nuclei, Four Momentum transfer, scattering of Electrons by spinless nuclei, Electron scattering by nucleons. The process $e^+e^- \rightarrow \mu^+\mu^-$, Bhabha scattering: $e^+e^- \rightarrow e^+e^-$.

(10)

Text & Reference Books:

1. Introduction to High Energy Physics by Donald H. Perkins.
2. Nuclear and Particle Physics by E Burcham.
3. Elementary Particles by I. S. Hughes.
4. Quarks, Leptons and Gauge Fields by Kerson Huang.
5. Introduction to Particle Physics by M. P. Khanna.
6. Particle Physics by B. R. Martin and G. Shah.
7. The big and small by G. Venkataraman.
8. Elementary Particles and their Interactions concepts and phenomena by Quang Ho-Kim, Pham Xuan Yam.
9. Introduction to Elementary Particle Physics by David Griffith.
10. Elementary particles and symmetries by Lewis Ryder

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC106**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **High Energy Nuclear & Particle Physics (Elective)**

Maximum Marks : **100**
Major Test : **60**

Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC107**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Nuclear Theory (Special-I)(Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: It is an essential course for the students of M.Sc. Physics with Nuclear Theory specialization. The main objective of the course is to equip the students with the ability to understand and utilize group theory concepts to analyze symmetries in physical systems.

Learning outcomes: After completion of this course, the students will be able to apply group theory to solve problems in different areas of theoretical physics.

Unit–I: Abstract Group Theory

Group postulates, Finite and Infinite groups, Order of a group, subgroup, permutation group, group table, Isomorphism and Homomorphism, Cayley's theorem and its application for finding the group structures of groups of order 3,4,5 and 6. Cosets, Lagrange's theorem and its application for determining the group structures of groups of order 4,5 and 6. Conjugate elements and classes, Invariant subgroup, Factor or Quotient groups, self-conjugate sub-groups.

Unit–II: Theory of Group Representations

Matrix representation, Equivalent representation, Unitary representation, Reducible and irreducible representations, characters of irreducible representation, Schur's Lemmas, Orthogonality theorem for irreducible representation of a group- statement and proof, interpretation of Orthogonality theorem, orthogonality of characters, Continuous groups, Lie Groups- general properties and examples of Lie groups.

Unit–III: Group theory in Quantum mechanics-I

General concept of symmetries, Space and time displacements, Symmetry of Hamiltonian, Time-reversal symmetry, Time-reversal operator for spinless particles, Time-reversal operator for particles with spin, Kramers' theorem, Space-inversion symmetry, The axial rotation group SO(2), Generators of SO(2), 3-dimensional rotation group SO(3), its generators and irreducible representation.

Unit-IV: Group theory in Quantum mechanics-II

O(4) and SO(4) groups, SO(4) as a direct product of two SO(3) groups, Special unitary group SU(2) and its irreducible representations, Homomorphism of SU(2) on SO(3), Generators of U(n) and SU(n), Generators of SU(2), physical applications of SU(2).

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC107**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Nuclear Theory (Special-I)(Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Unit-V: Applications of Group theory

Special unitary group SU(3), physical applications of SU(3), Gell-Mann's representation of SU(3) and quarks, Detailed study of Lorentz group, application of group theory to Isotropic Harmonic Oscillator and Hydrogen atom.

Text and Reference Books

1. Quantum Mechanics/Symmetries (2nd edition) by W. Greiner and B. Muller.
2. Group Theory and its application to physical problems by M. Hamermesh.
3. Group theory and Quantum Mechanics by M. Tinkham.
4. Introduction to Group theory by A.W. Joshi.
5. Applied group theory by G.G. Hall.
6. Introduction to Group theory, European Mathematical Society by O. Bogopalski.
7. Problems and solutions in group theory for physicists, World Scientific by Zhang-Qi Ma and Xiao-Yan Gu.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC107**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Nuclear Theory (Special-I)(Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC108**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Electronics (Special-I)(Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: This course deals with some important modern applications in the electronic communication systems. The topics include microwaves, transmission lines, optical fibers, computer networking, RADAR and Satellites. The successful completion of the course would help the students to work in the communication industry as well as taking up research in some frontlines in the field of communication electronics.

Course outcomes: Upon successful completion of this course, students will be able to understand and apply key concepts in modern communication systems, including microwaves, transmission lines, optical fibers, computer networks, RADAR, and satellites, preparing them for careers in the communication industry or research in communication electronics.

Unit - I Signal Analysis

Sinusoidal signals (Frequency and time Domain), Fourier series expansion of periodic sequence of impulses, Sampling function, Normalized power, Power Spectral density (of Digital data, sequence of random pulses), Effect of Transfer function on power spectral density, Fourier transform (example v(t) = cos wt), Convolution, Parseval's Theorem, Power and Energy Transfer through a network. Correlation between waveforms and Autocorrelation, (10)

Unit-II Noise Analysis

Various Sources of Noise, Frequency-domain representation of noise, Spectral components of noise, Effect of Filter on the Power spectral density of Noise, Mixing of Noise, Linear Filtering, Quadrature components of noise $n_c(t)$, $n_s(t)$, (Power spectral Density) (10)

Unit-III Electronic Communication and Modulation

Types of electronics communication Systems, (Simplex, Duplex, Analog, Digital, Base band and modulated signals)

Modulation Systems: Need of Modulation, Amplitude Modulation, Frequency (Spectrum of an Amplitude Modulated signal, Low- level AM Modulator), Power relations, Single Sideband (SSB) Modulation, Generation of SSB signal (Filter and Phase Method), Vestigial-Sideband (VSB) Modulation, Demodulation of AM Waves (Square-law Detectors, Diode Detector)

Frequency Modulation, FM generation (Direct, Indirect method), FM Demodulation (Slope Detector and ratio detector) (10)

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC108**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Electronics (Special-I)(Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Unit –IV Communication Channels

Fundamentals of Transmission Lines, Losses in Transmission lines, Standing Waves and SWR, Slotted Lines.

Waveguides, Dominant Modes of Operation in rectangular waveguides, Advantages of waveguides over transmission lines, Cavity resonator, Strip line and Basic SAW resonator.

Introduction to optical fibres, Structures of Optical Fibres, types of optical fibers (Step and graded Index Fibe,Single mode and multimode Fibres, Acceptance angle and cone, Numerical aperture, mode of propagation, comparison of conventional transmission cables with optical fibres, Propagation in fibers using Ray's model, Bandwidth requirements in optical fibres, optical fiber splices and connectors, signal degradation; signal attenuation and dispersion.

(10)

Unit -V Microwave Devices and Circuits

Introduction to EM spectrum, Basic principle of operation of a Klystron (Multicavity and Reflex Klystron), Principle of operation of Cavity Magnetron, Helix Traveling Wave Tube, Velocity Modulation, Wave Modes and Microwave Antennas,

Transferred Electron Devices, New live Gunn Effect, Gunn Diode, IMPATT Diode and TRAPATT Diode, BARITT Diode, Schottky Barrier Diode, thermal equilibrium condition, Schottky–Mott Theory

Basic Concepts of Terahertz Electronics

(10)

Text and Reference Books:

1. **Principles of Communication Systems** by H. Taub and D.L. Schilling, 2e. Tata McGra- Hill Edition
2. **Electronic Communication Systems** by G. Kennedy and B. Davis, 4e, Tata McGra-Hill Edition
3. **Electronic Communication Systems Fundamentals through Advanced** by Wayne Tomasi, 3e, Pearson Education
4. **Communication Electronics, Principles and Applications** by Louis E. Frenzel, 3e Tata McGra-Hill Edition.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHTC108**
Credits: **4 (4-0-0)**
Maximum Marks : **100**
Major Test : **60**

Duration of Examination: **3 hours**
Title: **Electronics (Special-I)(Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

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POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE109**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practicals in Condensed Matter Physics**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The practicals have been designed so as to provide hands-on exposure to students in various experimental aspects of the physics of crystals. The students shall have to perform a variety of experiments to validate theoretical predictions.

Course outcomes: Students will gain experience in using experimental techniques and instruments commonly used in condensed matter physics and develop skills to analyze and interpret experimental data to extract meaningful physical parameters.

List of practicals

1. Indexing of a Zero layer Weissenberg Photograph and Cell Parameter elucidation.
2. Indexing of planes of a Laue pattern by using spot intensity of diffracted peaks.
3. Rotation X-ray method for the elucidation of cell parameters.
4. To find the frequency of ultrasonic waves in water Toluene and Benzene.
5. To find the dislocation etchant of a given crystal and to find the etch pit density.
6. Dielectric constant of a given material and to find its Curie temperature.
7. Magnetic permeability of a given magnetic material.
8. Polarization versus electrical field (PE) loop
9. Seebeck Co-efficient measurement system and dc resistivity measurement system.

Note:
Addition and deletion in the list of practicals may be made from time to time by the department.
Minimum of 06 practicals have to be performed in a given semester.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE109**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practicals in Condensed Matter Physics**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	4 hours	50% (100 Marks)
External Examination	100%	4 hours	50% (100 Marks)
Total			200 Marks

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE110**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practicals in Nuclear & Particle Physics**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The HEP Experiments have been designed so as to provide exposure to students in various experimental aspects of High Energy Physics Experiments. The dept. is part of International Collaborations like ALICE experiment at CERN, Geneva and NOVA experiment at Fermilab, USA . The HEP Experiments will give the students a training to get good grasp of Experimental techniques, so that they are ready for working in environment of huge High Energy Physics Experiments like ALICE etc.

List of experiments

1. To find the total cross section of K^+d interaction at 110 Gev using Big European Bubble chamber.
2. To find the total cross-section of pp^- interactions at 700 Mev
3. To study some of the basic techniques used for measuring γ rays with a Na(I) detector interfaced to a MCA whose settings and the data acquisition are connected to a computer to study the characteristics of GM counter and calculate operating voltage of the tube
4. To verify inverse square law for the gamma-radiations
5. To find the resolving time of GM counter hence find the dead time correction factor and also to study Inverse square law of GM counter.
6. To study the effect of quenching and characteristics curve of GM counter and finding Operating voltage.
7. To study the statistical behaviour of radioactive process to evaluate the behaviour of counter statistically by means of chi-square root test
8. To study measurement of muon life time using cosmic rays
9. Working of multiwire propotional chamber
10. Measure Photo current as a fun of irradiance at constant voltage.
11. Current Vs voltage characteristics of cds photo-resistor at constant irradiance

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE110**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practicals in Nuclear & Particle Physics**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

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12. Detecting Gamma radiation with scint. Counter, Detecting Energy resolution, Multichannel scaling and half life, Recording and calibrating Gamma Spectrum
13. Investigate the deflection of an electron beam by a magnetic field.
14. Plotting G.Plateau characteristic curve
15. Observe Zeeman splitting of green mercury line
16. Simple Alpha Spectrum & Energy Calibration with a Pulser

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	4 hours	50% (100 Marks)
External Examination	100%	4 hours	50% (100 Marks)
Total			200 Marks

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE111**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practicals in Nuclear Theory**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: This is a Lab oriented course explicitly for the students of Nuclear theory specialization. This course introduces the basic concepts of numerical methods for solving algebraic, transcendental and system of linear, non-linear equations and to understand the methods used for numerical differentiation and integration. The main emphasis would be on the development and understanding of computer codes for solving problems in physics that are not analytically soluble.

Course outcomes: After completion of this course the students would be able to write and understand computer codes for solving many body problems in Nuclear theory.

List of practicals

1. To write a computer code for finding the solution of a non-linear equation by using Secant Method.
2. To write a computer code for finding the solution of bi-quadratic (cubic) equation by using Bisection Method.
3. To write a computer code for evaluating a definite integral by using Trapezoidal Rule.
4. To write a computer code for finding the solution of given transcendental equation by using successive approximation method.
5. To write a computer code for evaluating a definite integral by using Simpson's 1/3rd rule.
6. To write a computer code for finding the wave functions of linear Harmonic Oscillator.
7. To write a computer code for evaluating the Clebsch-Gordan (C.G.) Coefficients.
8. To calculate the quadrupole and triaxial deformation parameters of even-even nuclei by using self-consistent mean field codes.
9. To calculate the average binding energies, mass defect and two neutron separation energies of even-even nuclei by using self-consistent mean field codes.
10. To calculate the root mean square neutron (proton) radii and charge radii of even –even nuclei by using computer codes.
11. To calculate the energy spectra of rotational bands of axially deformed nuclei by using computer code.
12. To find the structure of degenerate bands of triaxially deformed nuclei by using computer code.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE111**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practicals in Nuclear Theory**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

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13. Gamma-Ray spectroscopy by using thallium-activated sodium iodide NaI(Tl) detector.
14. Alpha Spectroscopy with Surface Barrier detectors.
15. Determination of the range and energy of alpha particles by using Spark Counter.

Note: Addition or deletion of experiments in the list of practicals may be made from time to time by the department. Minimum of six (06) practicals have to be performed by the students in a given semester.

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Internal Examination	100%	4 hours	50% (100 Marks)
External Examination	100%	4 hours	50% (100 Marks)
Total			200 Marks

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE112**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practical in Electronics**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Objectives: The objective of the course has been to get basic training on the experiments of the various topics such as operational amplifiers and familiarization with the communication systems which the students have studied in the theory. The purpose is to train the students to do the things experimentally.

List of Practicals:

1. To study the process of amplitude modulation and demodulation
2. To study R-2R digital to analog convertor (DAC)
3. To study the process of pulse amplitude modulation and demodulation
4. To study the process of pulse position modulation and demodulation
5. To study the operational amplifier as Schmitt trigger.
6. (a).To study the working of a 741 IC operational amplifier with inverting and non inverting configuration.
   (b).To study the working of operational amplifier 741IC as a summing scales and average Amplifier.
   (c).To study operational amplifier as differentiator. (d).To study operational amplifier as integerator.
   (e).To study operational amplifier as voltage follower and differential amplifier.
7. To study the process of Satellite communication
8. To study the process of Antenna Training System
9. To study the process of Transmission Line
10. To study the working of Radio detection and ranging.
11. To study the working of Wave and Propagation
12. To study the working of Optical Fiber Communication
13. To study the working of Connection splice
14. To study the working of Mode characterization in fiber optics
15. To study the working of Wireless digital comm.
16. To study the working of Frequency modulation
17. To study synthesis method for formation of nanoparticles.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist Semester-one year programme)

Course No. **P1PHPE112**
Credits: **08 (0-0-8)**
Maximum Marks: **200**
External: **100**

Duration of Examination: **4 hours**
Title: **Practical in Electronics**
Internal: **100**

Syllabus for the examination to be held in Dec 2026, Dec 2027, Dec 2028.

Note: Addition or deletion of experiments in the list of practicals may be made from time to time by the department. Minimum of six (06) practicals have to be performed by the students in a given semester.

Scheme of Examination:

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Internal Examination	100%	4 hours	50% (100 Marks)
External Examination	100%	4 hours	50% (100 Marks)
Total			200 Marks

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE201**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The main objective of this course is to introduce to students towards various facets of condensed matter physics which include the preparation and properties of a given solid.

Course Outcomes: This course gives strong concepts regarding preparation of materials in the form of a solid as crystals, atomic diffusion mechanism in solids, color centers, materials in the form of alloys and polymers, dielectric ferroelectric properties of the solids.

Unit-I: Preparation of Materials – Crystal Growth

Theoretical concept of crystal growth (supercooling and nucleation), Homogeneous and Heterogeneous Nucleation, Crystal Growth Techniques- Solution growth: Water solution, Gel, Flux method, Hydrothermal growth; Melt technique: Czochralski pulling, Bridgeman Stockbarger, Zone melting, Verneuil flame fusion. (10)

Unit-II: Materials: Alloys and Polymers

Alloys: Binary alloys, Solid solution, Families of Engineering alloys, Hume – Rothery's rule, Phase diagram, Gibb's Phase rule, , Concept of Eutectic, Order –disorder transformation, Elementary theory of order, Magnetic Alloys and Kondo effect.
Polymer: Introduction, Types, Effect of temperature, Properties: Mechanical and electrical
(10)

Unit-III: Atomic Diffusion and Colour Centres

Atomic diffusion, Ficks 1st and 2nd law of diffusion, Diffusion through plane, cylindrical & spherical under steady state condition, Diffusion under non steady state condition, Random-Walk treatment of diffusion, The Kirkendall effect, Diffusion in alkali halide, Ionic conductivity in alkali halide,
Colour centers, Types of colour centers, Generation of colour centers.

(10)

Unit-IV: Dielectric and Ferroelectric Properties

The Dielectric constant and polarizability, Induced polarization, Measurement of dielectric constant, Clausius - Mossotti relation, Polarization Polar and Non polar molecules, Characteristics of polarizability, Dipolar polarization in solids, Ionic polarazibility, Electronic polarazibility, Dielectric breakdown, Ferroelectricity, Ferroelectric domains, Applications of ferroelectrics. (10)

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE201**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Unit-V: Electrons in Solids

Introduction, An overview of classical models, Conductivity in metals, The Matthiesen's Rule, The Drude's Model for electrical properties of solids, Degenerate electron gas, Fermi-Dirac statistics of electron gas (Quantized free electron theory), Thermal conduction in solids, The Wiedemann - Franz Ratio, General properties of metals. (10)

Text and Reference Books

1. Introduction to Solid State Theory – Otfried Madelung
2. Solid State Physics – Charles Kittel
3. Applied solid state physics - Rajnikant
4. Solid State Physics (structure and properties of materials) - M. A. Wahab
5. Art and science of growing crystals - J. J. Gilman
6. Elementary Solid State Physics – M. A. Omar

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE201**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE202**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Nuclear & Particle Physics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Course Aim

The course aims to provide a thorough introduction to nuclear physics concepts and their real-world applications. This course aims to equip students with a foundational understanding of nuclear processes, including beta decay, fission, and fusion. It covers reactor operations, nuclear applications in various fields, principles of nuclear astrophysics. radiation-based technologies. Emphasis is also placed on safety practices and the detection methods used in nuclear and particle physics.

Course Outcomes

By the end of this course, students will be able to:

- Explain the mechanisms of nuclear decay, fission, and fusion.
- Describe the principles, components, and types of nuclear reactors, including their control mechanisms and safety features.
- Understand the role of nuclear reactions in astrophysical phenomena
- Describe peaceful nuclear applications
- Assess the effects of ionizing radiation and apply appropriate safety protocols.
- Identify and explain the working principles of common nuclear and particle detectors.

UNIT-I: Nuclear Beta Decay

Overview of beta decay and observed beta spectrum; discovery of continuous energy distribution. Neutrino hypothesis to explain the spectrum. Fermi's theory of beta decay: weak interaction model and transition probability. Derivation of total decay rate; comparative half-lives; Fermi-Kurie plots. Selection rules: Fermi and Gamow-Teller transitions. Neutrino properties (mass and helicity); neutrino-less beta decay; introduction to double beta decay. (10)

UNIT-II: Nuclear Fission & Nuclear Fusion

Discovery of Nuclear fission, energy released in fission, nature of the fission fragments and their energy distribution, emission of neutrons in the nuclear fission and energetics of fission process, Bohr-Wheeler theory of nuclear fission, Fissile and Fertile materials, Nuclear fission Chain reaction and four factor formula.

Nuclear Fusion, thermonuclear reaction, controlled fusion.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE202**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Nuclear & Particle Physics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

UNIT-III: Nuclear Power & Nuclear Astrophysics

Principles of nuclear reactors; neutron moderation and control; reactor components and operation. Types of reactors: thermal, fast, and breeder reactors. Reactor kinetics, safety systems, and emergency procedures. Peaceful use of fusion energy – prospects and challenges.

Evolution of Stars, Source of energy in stars, nucleosynthesis, Chandershekhar Limit and White Dwarfs, Neutron Star and Supernova. (10)

Unit IV: Hazards, Safety and Peaceful Applications

Physical and chemical effects of ionizing radiation.-Radiation hazards, effects of Nuclear weapon effect, safety protocols, shielding, waste management, and environmental impact.

Industrial: Material testing, food irradiation. Agricultural: Mutation breeding and pest control. Energy: nuclear batteries and space power systems for satellites and interplanetary missions, Environmental Applications: Water and waste water treatment using radiation technologies, Monitoring pollution and ecosystems with radiotracers. (10)

UNIT V: Particle Detectors

Detector properties: Sensitivity, energy and time resolution, response function, detection efficiency, and dead time. Role of detectors in nuclear and particle physics experiments.

Overview of nuclear emulsions, Cloud chamber, G.M. Counters, proportional counters TPC, Basic construction and working of Solid State Detectors detectors, Scintillation Counter (principle, PMT), Cerenkov counters, Calorimeters; introduction and types of calorimeters. (10)

Text & Reference Books:

1. Nuclear Physics: Principles and Applications *John Lilley,* Wiley Student Edition
2. Physics of Particle Detectors *Dan Green*
3. Nuclear Physics, *S.N. Ghoshal,* S. Chand
4. Fundamentals of Nuclear Physics, *Jahan Singh*, A Pragati oublication
5. Basics of Nuclear Physics, *B.N. Srivastava*
6. Introduction to Nuclear and Particle Physics, *V.K. Mittal, R.C. Verma, S.C. Gupta*

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE202**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Nuclear & Particle Physics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE203**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Quantum Electrodynamics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: It is an elective course for M.Sc. students to impart them the knowledge of second quantization and relativistic quantum mechanics for solving relevant physical problems.

Course outcomes: After completion of this course the students will be able to explain the relativistic quantum mechanical equations, describe second quantization and related concepts.

Unit–I: Second Quantization

Creation and annihilation operators for Bosonic and Fermionic states, Field operators, Commutation and anti-commutation relations of the Field operators, Second quantized operators (One-particle density operator and kinetic energy operator), Pair correlation function (Pauli's Exclusion Principle and Boson Condensation), Lagrangian densities for Schrodinger and electromagnetic fields, Second Quantization of Schrodinger field, Expression for Hamiltonian operator.

Unit-II: Klein- Gordon (K.G.) Equation

Klein- Gordon (K.G.) equation for a free particle, Charge and Current densities for K.G. equation and equation of continuity, Difficulties due to the existence of negative energy states, Correct expression for probability density, Plane wave solutions of K.G. equation, Klein-Gordon equation for a charged particle in an electromagnetic field and its solution for a particle with coulomb potential V_0 (Hydrogen atom problem), First order K.G. equations and its solution.

Unit-III: Dirac equation

Derivation of Dirac equation, α and β-matrices and their anti-commutation relations and their representations, Plane wave solutions of Dirac equation (Positive energy and Negative energy solutions), Projection operator for energy and spin. Physical interpretation of free particle solutions, Dirac equation with a central potential and Hydrogen atom problem.

Unit-IV: Covariance of Dirac Equation

Covariant form of Dirac equation (Feynman and Dirac Pauli covariant form), Dirac's gamma-

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE203**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Quantum Electrodynamics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

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matrices and their properties, γ_5-matrix and properties, Covariance of Dirac equation under Lorentz transformations and Rotations, Construction of Plane wave solutions of Dirac equation by Lorentz Boost of Particle at rest, Bilinear covariants.

Unit-V: Heisenberg Representation in Dirac Theory

Dirac operators in Heisenberg representation, Heisenberg equation of motion, constants of motion and existence of electron spin for a Dirac particle, Velocity in Dirac theory, Zitterbewegung, Negative energy states of an electron (theory of Positron), Hole theory and charge conjugation. Vacuum Polarization, Time Reversal and other symmetries.

Text and reference books

1. Lectures on Quantum Mechanics by Baum.
2. Modern Quantum Mechanics by J.J. Sakurai and J. Napolitano.
3. Quantum Mechanics (Third edition) by Eugyen Merzbacher.
4. Quantum Physics by L. I. Schiff.
5. Relativistic Quantum Mechanics by W. Greiner.
6. Relativistic Quantum Fields by J.D. Bjorken and S.D. Drell.
7. Quantum electrodynamics by Landau and Lifshitz.
8. The Quantum theory of fields by Steven Weinberg.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE203**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Quantum Electrodynamics (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE204**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Physics of Photonic Devices**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: This course aims to equip students with a strong foundation in the physical principles underlying the operation of photonic components such as lasers, LEDs, photodetectors, modulators, and waveguides. It emphasizes the interaction of light with matter, the behavior of light in dielectric and semiconductor media, and the design principles of optoelectronic and integrated photonic devices.

Course outcomes: By the end of the course, students will be able to analyze and design basic photonic systems, understand the role of semiconductor materials in light generation and detection, and explore advanced topics like nanophotonics, photonic crystals, and 3D printed optical devices. The course prepares students for applications in optical communication, sensing, and renewable energy systems, fostering the ability to engage with current and emerging technologies in photonics.

Unit 1: Fundamentals of Photonic Materials

Introduction to photonic materials; Energy bands and electronic states in semiconductors; Semiconductor materials for optoelectronics (Si, GaAs, InP); Direct vs. indirect bandgap materials; Spontaneous and stimulated emission, absorption processes; Excitons and their role in photonic devices; Quantum confinement in low-dimensional structures; Defects and impurities in photonic materials; Optical properties of III-V, II-VI, and organic semiconductors

Unit 2: Photodetectors and Solar Cells

Principles of photodetection and photoconductivity; p-n junction photodiodes: PIN, avalanche photodiodes; Schottky and MSM photodetectors; Quantum well and quantum dot photodetectors; Infrared detectors: HgCdTe, quantum cascade detectors; Fundamentals of solar cells and photovoltaic conversion; Silicon, perovskite, and organic solar cells; Tandem and multi-junction solar cells; Efficiency limits and loss mechanisms in solar cells

Unit 3: Light Emitting Devices and Lasers

Fundamentals of light-emitting diodes (LEDs); Semiconductor LEDs: Structure, efficiency, and color tuning; Organic LEDs (OLEDs) and quantum dot LEDs (QLEDs); Fundamentals of laser physics: Population inversion, gain; Semiconductor lasers: Fabry-Pérot, DFB, and VCSELs; Quantum well, dot, and cascade lasers; Mode locking, Q-switching, and tunable lasers; Nonlinear optics in laser applications; Optical feedback and laser beam shaping; Advanced laser systems: UV, mid-IR, and THz lasers

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE204**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Physics of Photonic Devices**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Unit 4: Light-Matter Interaction in Quantum Materials

Introduction to quantum materials (graphene, TMDs, perovskites, topological insulators); Optical absorption and emission in low-dimensional systems; Photocarrier generation and separation in 2D semiconductors; Light harvesting and charge transport in perovskite and quantum dot materials; Applications in solar cells, photodetectors, and quantum light sources

Unit 5: Emerging Photonic Devices and Applications

Introduction to Integrated Photonics; Basics of quantum dot and organic photonic devices; Nanoparticles, quantum dots, and their optical properties; Photonic crystals and plasmonic materials; Tunable and nonlinear optical materials; Microscale and Nanoscale Light Devices; Terahertz Technology; Brain-Inspired Light Devices; Flexible and Energy-Saving Light Devices; Next-Generation Optoelectronics

Text and reference books

1. Physics of Photonic Devices – Shun Lien Chuang
2. Principles of Optics – Max Born and Emil Wolf
3. Semiconductor Optoelectronic Devices – Pallab Bhattacharya
4. Fundamentals of Photonics – Bahaa E. A. Saleh and Malvin C. Teich
5. Optoelectronics and Photonics: Principles and Practices – S.O. Kasap
6. Photonics: Optical Electronics in Modern Communications – Amnon Yariv and Pochi Yeh
7. Photonic Devices – Jia-Ming Liu
8. Introduction to Solid State Physics – Charles Kittel
9. Photonic Crystals: Molding the Flow of Light – John D. Joannopoulos et al.
10. Advances in Photonic Crystals and Devices – Narendra Kumar and Bhuvneshwer Suthar
11. Solar Cells: Types and Applications – Sandeep Arya and Prerna Mahajan

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE204**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Physics of Photonic Devices**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE205**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Maximum Marks: **100**
Major Test: **60**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: This course is designed such that the students are exposed to the most basic Single Crystal / polycrystalline X-ray Diffraction techniques employed for molecular and crystal structure determination of materials.

Course Outcomes: Students will gain proficiency in using experimental methods to determine and analyze crystal structures. Students will develop a comprehensive understanding of how imperfections in materials influence their behavior, performance, and applications.

UNIT-I: Diffraction of X-rays by crystals

Basic properties of X-rays, interference of scattered waves, scattering by atomic electrons, scattering by atoms, scattering by a molecule, diffraction by a crystal, diffraction intensities, atomic scattering factor, structure factor, polarization factor, multiplicity factor, Lorentz factor, Absorption factor, temperature factor, general equation for the intensity. (10)

UNIT-II: Laue Technique

Introduction, Collimators, Specimens and specimen holders, Choice, mounting and alignment of a single crystal, The transmission Laue technique, Back reflection Laue technique, Laue spot shapes, indexing of Laue photographs, Interpretation of Laue patterns, The Reciprocal Lattice in the interpretation of Laue patterns, Applications of Laue method. (10)

UNIT-III: Powder Technique

Introduction, choice of radiation for powder technique, background radiation, crystal monochromators, Photographic technique: Debye Scherrer Camera, Specimen preparation indexing of powder photographs and lattice parameter determination, Powder diffractometer: Direct recording of the profiles, Applications of powder method. (10)

UNIT-IV: Rotating crystal and Weissenberg Techniques

Film methods for intensity measurement : The oscillation method, (single/double oscillation), Rotation method, Measurement of identity period, Interpretation of Rotation patterns, Limitations of rotation method, Weissenberg method, indexing of zero and higher layer

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE205**
Credits: **4 (4-0-0)**

Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Weissenberg photographs, determination of unit cell parameters and equi-inclination setting for obtaining higher layer Weissenberg photographs, Weissenberg uses,

Counter methods for intensity measurement: Single detector, Area detector. (10)

UNIT-V: Study of Imperfections

Introduction, X-ray topography: Direct investigation of Macro defects, Berg Barrett technique, Lang's Technique, X-ray diffraction topography camera, double crystal diffractrometry, Etching techniques, An overview of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM) for materials characterization. (10)

Text & Reference Books:

1. Applied Solid State Physics by Rajnikant.
2. Crystallography for Solid State Physics by A.R. Verma and O.N. Srivastava.
3. Solid State Physics by Kittle.
4. Crystal Structure Determination by G.H. Stout, L.H. Jensen.
5. Elementary Solid State Physics by Omar

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE205**
Credits: **4 (4-0-0)**

Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Condensed Matter Physics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II**. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE206**
Credits: **4 (4-0-0)**

Duration of Examination: **3 hours**
Title: **High Energy Nuclear & Particle Physics (Special-II) (Elective)**

Maximum Marks: **100**
Major Test: **60**

Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The objective of this course is to concepts of Quark Chromo Dynamics, which deals with quark-quark and quark-gluon Interactions. Finally they study most advanced concepts like Weinberg-Salam SU(2) x U(1) Model, spontaneous symmetry breaking, Higgs mechanism, Standard Model & Grand unification.

Course Outcomes: In this course, the students will know about Weak Interactions, Beta Decay and Fermi model. They get also understanding of Cabbibbo theory and GIM model and also Neutrino Oscillations in detail.

UNIT-I: Weak Interactions-I

Classification of weak interactions, Nuclear β decay-Fermi theory, inverse β decay, Parity non conservation in Neutrino, Helicity of the Neutrino, Helicity States, Dirac theory to β-decay, The V-A interaction, parity violation in weak decay, Pion and Muon decay.

(10)

UNIT-II: Weak Interactions-II

Weak Decays of Strange Particles-Cabibbo Theory, weak neutral currents, Absence of S=1 neutral currents, second order weak interactions. The GIM model and charm. Weak mixing angles with six quarks, Observation of $W^{\pm}$ and Z^0 Bosons, Neutrino masses and Neutrino oscillations.

(10)

UNIT-III: Quark Patron Model

Evidence for partons, Deep inelastic electron-nucleon scattering, Scale invariance and Partons (Bjorken scaling), Neutrino-nucleon inelastic scattering, Lepton-quark scattering: Parton spin, Parton charges, antiquark contents of the nucleon, gluon constituents, Electron-Positron annihilation to hadrons, Lepton pair production in hadron collisions-The Drell-Yan Process.

(10)

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE206**
Credits: **4 (4-0-0)**

Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **High Energy Nuclear & Particle Physics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

UNIT-IV: Quantum Chromodynamics

Quantum chromodynamics and Quark-Quark interactions, QCD potential at short distances, QCD potential at large distances (String model), Multijet events in e^+e^- annihilation, Effects of quark interactions in Deep-Inelastic lepton-Nucleon Scattering, Running Coupling constant: quantitative predictions of QCD, q^2 Evolution of Structure Functions, Comparison of Quark and Gluon Distribution.

(10)

UNIT-V: Unification of Interactions

Renormalizability in Quantum Electrodynamics, Divergence in weak interactions, Introduction of Neutral currents, Gauge Invariance in QED, Generalized Gauge Invariance. The Weinberg-Salam SU(2) x U(1) Model. Yang-Mils fields and SU(2) symmetry, spontaneous symmetry breaking. Neutral current coupling of Fermions, Higgs mechanism, The standard Model. Grand unification: - proton decay, the cosmic baryon asymmetry.

(10)

Text & Reference Books:

1. Introduction to High Energy Physics by Donald H. Perkins.
2. Nuclear and Particle Physics by E. Burcham.
3. Elementary Particles by I. S. Hughes.
4. Quarks, Leptons and Gauge Fields by Kerson Huang.
5. Introduction to Particle Physics by M. P. Khanna.
6. Particle Physics by B. R. Martin and G. Shaw.
7. The big and small by G. Venkataraman.
8. Modern particle physics by Mark Thomson
9. Elementary Particles and their Interactions concepts and phenomena Q. H. Kim, Pham Xuan Yam.
10. Introduction to Elementary Particle Physics by David Griffith.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE206**
Credits: **4 (4-0-0)**

Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **High Energy Nuclear & Particle Physics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE207**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Nuclear Theory (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: To impart knowledge of classical and quantum field theories for solving relevant physical problems.

Course outcomes: The students shall be able to apply the methods of advanced quantum theory to understand and solve many body problems in theoretical physics.

Unit-I: Classical Field Theory

Transition from a discrete to a continuous system, Lagrangian and Hamiltonian Formulations for continuous systems, Euler Lagrange equations and Hamilton's equations of motion, Applications of Lagrangian and Hamiltonian Formulations to Schrodinger and Electromagnetic fields, Derivation of Schrodinger and Maxwell's equations.

Unit-II: Second Quantization

Equations of motion, Schrodinger and Heisenberg pictures, Quantum equations for the field, Fields with more than one component, Complex field, Quantum equations, Occupation number representation, Creation and destruction operators (anticommutation), number operator, second quantization of Schrodinger and electromagnetic fields, Plane wave representation, quantized field energy and momentum, commutation relations for E and H.

Unit-III: Perturbation theory

The Brillouin-Wigner Perturbation series, Interaction representation, Time integral expansion series, Scattering (S) Matrix and its properties, S-matrix expansion, Chronological pairing of operators, Wick's theorem, diagrammatic representation, applications of Wick's theorem (Feynman diagrams), momentum representation.

Unit-IV: Many body Problems

Density matrix and operator, equation of motion of density operator, Thomas Fermi model, Hartree self-consistent field, The Hartree-Fock (HF) Method, Derivation of HF equations, Symmetries of HF Hamiltonian, Choice of expansion for the HF orbits, Single major shell HF-calculations.

Unit-V: Pairing Theory

General aspects, pair creation and annihilation operators, one body and two body potentials in second quantized formalism, pairing interaction in second quantized form. Pairing theory for

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE207**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Nuclear Theory (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

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degenerate configuration, commutation relations of pair creation operators with pairing

Hamiltonian and Number operators. Calculation of pairing matrix for two and four particles in J=5/2 shell, Generalization to non-degenerate configurations, The BCS formalism, Normalization of BCS wave function, Application of the BCS wave function to the pure j- shell. Derivation of expression for occupation probability and pairing gaps, Uniform model.

Books Recommended:

1. Classical Mechanics by H. Goldstein (for Unit I).
2. Quantum mechanics by L.I. Schiff (for Unit II)
3. Elements of Advanced Quantum Theory by J.M. Ziman (for Unit III)
4. Field Quantization by W. Greiner and J. Reinhardt.
5. The Quantum theory of fields by Steven Weinberg (Volume I)
6. Advances in Nuclear Physics Vol I edited by M. Baranger and E. Vogt (Unit IV)
   (Chapter on "The Hartree-Fock Theory of deformed Light nuclei by G. Ripka)
7. Shapes and Shells in nuclear structure by S.G Nilsson and I. Ragnarsson. (Unit V)
8. A first book of Quantum Field Theory by A. Lahiri and P.B. Pal

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE207**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Nuclear Theory (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of two sections, Section-A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). In section B students are required to attempt 01 question from each unit. **In major test there should not be a gap of more than two days in between two tests.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE208**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Electronics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The course provides a comprehensive understanding of pulse modulation systems, digital modulation techniques, radar systems, and semiconductor fabrication processes. It covers topics like sampling, quantization, PCM, DPCM, PSK, FSK, radar performance, satellite communication, and fabrication techniques such as crystal growth, photolithography, and metallization.

Course outcomes: By the end of the course, students will be able to analyze communication and radar systems, design semiconductor devices, and apply fabrication techniques to modern electronics and communication technologies.

Unit – I: Pulse Modulation Systems

The Sampling theorem (Low-pass Signals, Band-pass Signals), Pulse-Amplitude Modulation (PAM), Channel Bandwidth for a PAM signal, Natural sampling, Flat-top sampling, Signal recovery through Holding, Quantization of signals, Quantization Error

Pulse-Code Modulation (PCM), Electrical representation of Binary Digits, Differential Pulse-Code Modulation (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM)

(10)

Unit –II: Digital Modulation Techniques

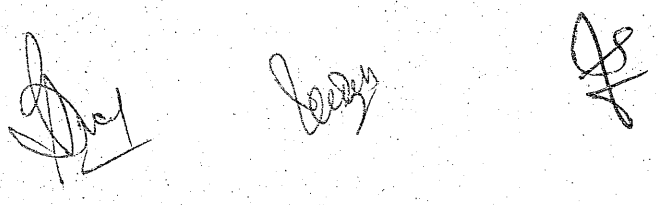
Binary Phase-Shift Keying (BPSK) (Reception, Spectrum, Geometrical Representation), Differential Phase-Shift Keying (DPSK), Differentially-Encoded PSK, Quadrature Phase-Shift Keying (transmitter, Receiver, signal space representation), M-ARY PSK. QASK. Binary Frequency-Shift Keying (Spectrum, Receiver), The Baseband Signal receiver, Optimum Filter, Matched Filter

(10)

Unit -III: Radar

Fundamentals of RADAR system: Block Diagram, Frequencies and Powers used in RADAR, RADAR performance Factors, Effects of Noise, Basic Pulse RADAR systems (Block Diagram and Description), Antenna and Scanning, Moving target Indication (Doppler Effect), Other RADAR systems (RADAR Beacons, Phased RADAR), RADAR applications.
Introduction to Satellite Communication
Frequency Division Multiple Access—(FDMA), Time Division Multiple Access (TDMA), Carrier Sense Multiple Access (CSMA), CDMA.

(10)



POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE208**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Electronics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Unit -IV: Semiconductor Growth Techniques

Basic Fabrication Steps, Crystal Growth: CZ Method, Float Zone Method, Thin Film deposition Techniques: Thermal and Sputtering, Epitaxy: Vapour Phase and Liquid phase epitaxy (MBE) Diffusion, ion implantation and Oxidation

(10)

Unit-V Fabrication of Semiconductor Devices

Photolithography and etching: Dry and Wet etching, metallization, IC Manufacturing and Processing

Basics of 2D and nanostructured Devices and Applications, Memory Devices using MOSFET Technology.

(10)

Text and Reference Books:

1. Principles of Communication Systems by H. Taub and D.L. Schilling, 2e. Tata McGraw-Hill Edition
2. Electronic Communication Systems by G. Kennedy and B. Davis, 4e, Tata McGraw-Hill Edition
3. Electronic Communication Systems Fundamentals through Advanced by Wayne Tomasi, 3e, Pearson Education
4. Communication Systems, Analog & Digital by R.P. Sing and S.D. Sapre 2e, Tata McGraw-Hill Edition
5. Fundamentals of Semiconductor Fabrication by Gary S. May and Simon M. Sze, Wiley Semiconductor Devices: Physics and Technology by S. M. Sze John Wiley international

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHTE208**
Credits: **4 (4-0-0)**
Maximum Marks: **100**
Major Test: **60**

Duration of Examination: **3 hours**
Title: **Electronics (Special-II) (Elective)**
Minor Tests (I & II): **40**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Scheme of Examination: (having five units)

The students shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
TEST I (after 30 days)	20%	1 hour	10 + 10
TEST II (after 60 days)	21 to 40%	1 hour	10 + 10
Theory	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

The Subjective Tests of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. **No preparatory holidays shall be provided for the Test I and Test II.** Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

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POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHRE209**
Credits: **16 (0-0-16)**

Duration of Examination: **4 hours**
Title: **Project work in Condensed Matter Physics**

Maximum Marks: **400**
External Exam: **300**

Internal Exam: **100**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The projects have been designed to characterize material properties of selected materials and analyze and interpret experimental data.

Course outcomes: Students will develop skills to compare experimental data with theoretical models and critically evaluate any discrepancies. Students will build a strong foundation for communicating scientific results effectively, through written reports, presentations, and discussions, using proper scientific language and visualization tools.

During this semester, the students will be assigned a mentor under whose guidance they have to complete a project based on the research work. In the end of the semester, the students have to submit a project report in the form of dissertation duly checked for plagiarism.

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	4 hours	25% (100 Marks)
External Examination	100%	4 hours	75% (300 Marks)
Total			100% (400 Marks)

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHRE210**
Credits: **16 (0-0-16)**

Duration of Examination: **4 hours**
Title: **Project work in Nuclear & Particle Physics**

Maximum Marks: **400**
External Exam: **300**

Internal Exam: **100**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The Projects have been designed so as to provide exposure to students in various experimental aspects of High Energy Physics Experiments. The dept. is part of International Collaborations like ALICE experiment at CERN, Geneva and NOVA experiment at Fermilab, USA. The projects will give the students a training to get good grasp of these International Experiments, so that they are ready for doing Research in High Energy Physics.

During this semester, the students will be assigned a mentor under whose guidance they have to complete a project based on the research work. In the end of the semester, the students have to submit a project report in the form of dissertation duly checked for plagiarism.

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	4 hours	25% (100 Marks)
External Examination	100%	4 hours	75% (300 Marks)
Total			100% (400 Marks)

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHRE211**
Credits: **16 (0-0-16)**
Maximum Marks: **400**
External Exam: **300**

Duration of Examination: **4 hours**
Title: **Projects in Nuclear Theory**
Internal Exam: **100**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The aim of the projects in nuclear theory is to deepen the understanding of the nucleus, its structure, and the forces governing it. These projects involve fundamental research, theoretical modeling and interpretation of experimental data by using nuclear models.

Course outcomes: The students will have a deep understanding of nuclear structure, stability, and interactions. Specifically, students would be able to explain different nuclear models, their limitations, and apply them to explain observed nuclear properties. They would also develop skills in analyzing nuclear data by using different nuclear models and communicating scientific findings through written reports, presentations and discussions.

During this semester, the students will be assigned a mentor under whose guidance they have to complete a project based on the research work. In the end of the semester, the students have to submit a project report in the form of a dissertation duly checked for plagiarism.

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	4 hours	25% (100 Marks)
External Examination	100%	4 hours	75% (300 Marks)
Total			100% (400 Marks)

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd Semester-one year programme)

Course No. **P1PHRE212**
Credits: **16 (0-0-16)**
Maximum Marks: **400**
External Exam: **300**

Duration of Examination: **4 hours**
Title: **Project work in Electronics**
Internal Exam: **100**

Syllabus for the examination to be held in May 2027, May 2028, May 2029.

Objectives: The objective of this course is to train the students of electronics specialization for successful implementation of the concepts into practical applications which have a direct bearing in the industry and R&D programmes.

During this semester, the students will be assigned a mentor under whose guidance they have to complete a project based on the research work. In the end of the semester, the students have to submit a project report in the form of dissertation duly checked for plagiarism.

Scheme of Examination:

Practical / Research (thesis/project/patent)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Internal Examination	100%	4 hours	25% (100 Marks)
External Examination	100%	4 hours	75% (300 Marks)
Total			100% (400 Marks)

External Practical/ Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one/two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance/ dissertation of the students.
