UNIVERSITY OF JAMMU
COURSE STRUCTURE FOR MASTERS DEGREE PROGRAMME IN PHYSICS

The following Courses of Study are prescribed for 1st to 4th Semester Masters Degree (PG) Programme under CBCS in the Subject of **Physics (Session 2018-19)**

Semester	Course Code	Course Title	Credits	Nature of Course
I	PSPHTC-101	Mathematical Physics	4	Core
	PSPHTC-102	Classical Mechanics	4	Core
	PSPHTC-103	Quantum Mechanics-I	4	Core
	PSPHTC-104	Integrated Electronics-I	4	Core
	PSPHPC-105	Lab Work (Practicals)	8	Core
II	PSPHTC-201	Quantum Mechanics-II	4	Core
	PSPHTC-202	Statistical Mechanics	4	Core
	PSPHTC-203	Integrated Electronics-II	4	Core
	PSPHTC-204	Electrodynamics and Plasma Physics	4	Core
	PSPHPC-205	Lab Work (Practicals)	8	Core
III	PSPHTC-301	Condensed Matter Physics(General)	4	Core
	PSPHTC-302	Nuclear & Particle Physics(General)	4	Core
	PSPHTE-303	Condensed Matter Physics (Special)	4	Elective
	PSPHTE-304	Nuclear & Particle Physics (Special)	4	Elective
	PSPHTE-305	Nuclear Theory (Special)	4	Elective
	PSPHTE-306	Electronics (Special)	4	Elective
	PSPHTO-307	Materials Physics (Open Course)	4	Open
	PSPHPE-308	Practicals in Condensed Matter Physics	8	Elective
	PSPHPE-309	Practicals in Nuclear & Particle Physics	8	Elective
	PSPHPE-310	Practicals in Nuclear Theory	8	Elective
	PSPHPE-311	Practicals in Electronics	8	Elective
IV	PSPHTE-401	Condensed Matter Physics(Special-I)	4	Elective
	PSPHTE-402	Nuclear and Particle Physics(Special-I)	4	Elective
	PSPHTE-403	Physics of Liquid Crystals (Elective)	4	Elective
	PSPHTE-404	Quantum Electrodynamics (Elective)	4	Elective
	PSPHTE-405	Condensed Matter Physics (Special-II)	4	Elective
	PSPHTE-406	Nuclear & Particle Physics (Special-II)	4	Elective
	PSPHTE-407	Nuclear Theory (Special-II)	4	Elective
	PSPHTE-408	Electronics (Special-II)	4	Elective
	PSPHTO-409	Modern Physics (Open)	4	Open
	PSPHDE-410	Projects in Condensed Matter Physics	8	Elective
	PSPHDE-411	Projects in Nuclear & Particle Physics	8	Elective
	PSPHDE-412	Projects in Nuclear Theory	8	Elective
	PSPHDE-413	Projects in Electronics	8	Elective

UNIVERSITY OF JAMMU

NOTIFICATION
(18/Feb./Adp/92)

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 **revised** Syllabi and Courses of Study in the subject of **Physics** of Master Degree Programme for Ist to IV Semesters under the **Choice Based Credit System (through regular mode)** in the main campus for the examinations to be held in the years as per the details given below:-

Subject	**Semester**	**for the examination to be held in the years**
Physics	Semester-I	December 2018, 2019 and 2020
	Semester-II	May 2019, 2020 and 2021
	Semester-III	December 2019, 2020 and 2021
	Semester-IV	May 2020, May 2021 and 2022

The Syllabi of the courses is available on the University website: www.jammuuniversity.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/18/ 17359-17380
Dated: 27-2-18

Copy for information and necessary action to:

1. Special Secretary to the Vice Chancellor, University of Jammu for the kind information of the Worthy Vice-Chancellor please
2. Sr. P.A. to the Dean Academic Affairs/ Dean Research Studies
3. Sr. P.A. to the Registrar/Controller of Examinations
4. Dean, Faculty of Science
5. HOD/Convener, Board of Studies in Physics
6. All members of the Board of Studies
7. C.A to the Controller of Examinations
8. I/c Director, Computer Centre, University of Jammu
9. Asst. Registrar (Conf. /Exams. PG/ Inf./Pub.)
10. Incharge, University Website for necessary action please.

Assistant Registrar(Academic)

<u>**POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU**</u>

Course No. PSPHTC101 **M.Sc.Physics (1st Semester)**
Credits 4 (3-1-0) **Title : Mathematical Physics**
Duration of examination: 3 Hours **Max. Marks: 100**

Detailed Syllabus for the examinations to be held in Dec. 2018, 2019 and 2020

Objectives : The main objectives of this course are:

- to introduce students to learn mathematical tools and techniques.
- to apply these techniques to solve problems in physical sciences.

Learning outcomes :

After completing this course the students will:

- have a good grasp of the basic elements of complex analysis, including the important integral theorems. They will be able to determine the residues of a complex function and use the residue theorem and contour integration to compute certain types of integrals.
- be able to determine eigen values and eigenvectors and solve eigenvalue problems.
- understand the concepts of tensor variables and usefulness of tensor analysis.
- identify different special mathematical functions; be able to apply special mathematical functions appropriately in solving problems in physics and model real situations using different differential equations.
- be able to learn how to expand function in a Fourier series, and under what conditions such an expansion is valid. They will learn the connection between Fourier series and integral transforms (Fourier and Laplace) and be able to use these integral transforms to solve mathematical problems relevant to the physical sciences.

Prerequisites :

Knowledge of calculus, complex numbers, matrix algebra, vector analysis, ordinary and partial differential equations.

Unit I

Complex Variables:

Functions of a complex variable, Cauchy Riemann equations, Cauchy Riemann equations in polar form, Multivalued functions and branch cuts, Analyticity and Singularities of complex functions, Harmonic functions, Complex integration Cauchy's integral theorem, Cauchy's integral formula, Power series in a complex variable, Taylor and Laurent series, Residue theorem, Methods of finding residues, Evaluation of definite integrals by use of residue theorem and contour integration. Simple problems on the above topics

Unit II

Linear Algebra and Tensor Analysis:

Linear Algebra: Special type of matrices: Orthogonal, Hermitian, anti-Hermitian and Unitary matrices, Matrices in Classical and Quantum mechanics: Rotation, Pauli spin and Dirac matrices, Similar matrices, Orthogonal, Unitary and Similarity transformations, Determination of eigenvalues and eigen vectors of matrices and their properties, Cayley-Hamilton theorem, Condition for diagonalizability, Diagonalization of matrices

Tensor Analysis: Space of N-dimensions, coordinate transformation, summation convention, contravariant and covariant vectors, Contravariant, covariant and mixed tensors, Kronecker delta, The fully antisymmetric tensor, Tensors of higher rank, scalars or invariants, symmetric and skew-symmetric tensors, fundamental operations with tensors (Addition, Subtraction, Outer multiplication, Contraction, Inner multiplication). Quotient law, metric tensor, Conjugate or reciprocal tensor, Associate tensors, Simple problems on the above topics

Unit III

Special functions and Differential Equations:

Beta and Gamma functions and their properties and inter relationships. Besselôs equation and its solutions, Besselôs functions of first and second kind, Spherical Bessel and Neumann functions, Recurrence formulae, Orthogonality of Bessel functions, Laguerreôs differential equation, Rodriguesô formula, Generating Function, Orthogonal properties, Power series solution of ordinary differential equations, Singular points: regular and irregular singular points; Frobenius method, Wronskian method

Unit IV

Fourier Series and Transforms:

Fourier series, Dirichlet conditions, determination of Fourier coefficients, F.S. for arbitrary period, discontinuous functions, half-wave expansions, applications of Fourier series (square, triangular, saw tooth waves and half wave and full wave rectifiers), Parsevalôs theorem, Complex form of Fourier series, Fourier integrals, Fourier and inverse Fourier transforms, Fourier integral theorem, Fourier sine and cosine transforms, Properties of Fourier transforms, Fourier Transform of Dirac Delta function, Convolution theorem, Parsevalôs identity, Fourier transform of derivatives, Simple problems on the above topics

Unit V

Laplace Transforms:

Laplace transform, Conditions for L.T., Properties of L.T., First and Second shifting theorems, L.T. of derivatives, L.T. of integrals, L.T. of periodic functions, Initial and final value theorems, Convolution Theorem, Relationship between Fourier and Laplace transforms, Inverse L.T. of derivatives, Inverse L.T. of Integrals, Inverse L.T. by Partial fractionôs method, Inverse L.T by Convolution, Solution of Differential equations by Laplace transforms, Simple problems on the above topics.

Text and Reference Books:

1. Mathematical Methods for Physicists by G.B. Arfken and H.J. Weber
2. Matrices and Tensors for Physicists by A.W. Joshi
3. Schaumôs Outlines Complex variables by Murray. R. Spiegel
4. Schaumôs Outline of Theory and problems of Laplace Transforms by Murray. R. Spiegel
5. Schaumôs Outline of Theory and problems of Fourier Analysis by Murray. R. Spiegel
6. Schaumôs Outline of Theory and problems of Tensor Analysis by Murray. R. Spiegel
7. Advanced Engineering Mathematics by E. Kreyszig
8. Special functions, by E.D. Rainvile
9. Special functions, by W.W. Bell
10. Mathematical Methods for Physics and Engineering, by K.F. Riley, M.P. Hobson and S.J. Bence
11. Mathematical Methods in the Physical Sciences by Mary L. Boas
12. Mathematical Physics by B.D. Gupta
13. Mathematical Physics by H.K. Dass
14. Mathematical Physics by B.S. Rajput
15. Mathematical Physics by Satya Prakash

Evaluation Scheme

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

Examination (Theory)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

DETAILED SYLLABUS

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

Course No. **PSPHTC102**

Title: Classical Mechanics

Duration of Examination : **3hours**

Credits : **4(4-0-0)**

Maximum Marks : **100**

a) Major Test : **60**

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

Syllabus for the examination to be held in Dec 2018, Dec 2019, Dec 2020.

Objectives : The objective of this course is to apprise and equip the students with the knowledge of Lagrangian, Hamiltonian Principles, Equations, canonical transformations so that students may apply these equations and principles in modern physics research. This course also gives strong theoretical foundation for advanced physics lies in Hamiltonian mechanics for Statistical and Quantum Mechanics Physics.

UNIT-I Constrained Motion and Lagrangianformulation

Revision of Constraints and their types, D Alembert's principle, Lagrange's equations, kinetic energy function and theorem on total energy, Lagrangian formulation for conservative theorems and in an electromagnetic field, Gauge transformations, Applications of Lagrange's equations.

(10)

UNIT-II Non-inertial frames of References ,Central force

Rotating frames of reference, inertial forces in rotating frames, Larmour precision, electromagnetic analogy of inertial effects of coriolis force,two body central force problem, stability of orbits, condition for closure, integrable power laws, orbits of artificial satellites, virial theorem and problems.

(10)

UNIT-III Variational principle and Hamilton's formulation

Variational principle, Euler's equation, Applications of variational principle, shortest distance problem, branchistrochrone, Geodesics of a sphere, Hamilton function and Hamilton's equation of motion, configuration space, phase space, state space, Lagrangian and Hamiltonian of relativistic particles, Applications of variational principle and Hamilton equations.

(10)

UNIT-IV Canonical transformation and Brackets

Legendre Transformation, Generating functions, condition for canonical transformation and problems, Definitions, identities, Poisson theorem, Relationship between angular momentum and Poisson brackets, Lagrange brackets, Relationship between Poisson and Lagrange Brackets, problems.

(10)

UNIT-V Hamilton- Jacobi Method

Hamilton-Jacobi equation, Hamilton's characteristic function, Hamilton- Jacobi equation for Hamilton's characteristic function (conservative system), Separation of variables in Hamilton Jacobi equation, Action and angle variables, Problem of Harmonic oscillator using action angle variables, Hamilton Jacobi equation-Geometrical optics and Wave Mechanics, problems

(10)

Text &Reference Books:

1. Classical Mechanics by H.Goldstein
2. Classical Mechanics of particles and system by Marion and Thomtron
3. Classical Mechanics by P.V. Panat
4. Classical Mechanics by N.C.Rana and P.S.Joag
5. Classical Mechanics by J.C.Upadhyaya
6. Classical Mechanics by SatyaPrakash
7. Introduction to classical Mechanics by R.G.Takawale and P.S.Puranik

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each).

Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get theminimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall beten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. Allquestions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (Ist -Semester)

Course No. **PSPHTC103** Title: **Quantum Mechanics-I**

Duration of Examination : **3hours** Maximum Marks : **100**

Credits : **4(4-0-0)** a) Major Test : **60**

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

Syllabus for the examination to be held in December 2018, December 2019 & December 2020

Objectives :

It is an essential core course for the students of M. Sc. Physics in 1st semester. The course covers the General formalism of Quantum Mechanics, Application of Schrodinger equation and Angular Momentum.

Unit-I

General Formalism :

Introduction about the state of a system , Hilbert space and Wave functions (the linear vector space and Hilbert space , Dimensions and Basis of a vector space, Square-Integrable wave functions), One- and three- dimensional wave packets, motion of wave pocket, Differential equation satisfied by wave packet, wave packets and uncertainty relations, Gaussian wave packet, wave packet in momentum space, Ehrenfestôs Theorem.

Unit -II

Applications of Schrodinger Equation:

One dimensional finite square well potential, particle in two and three dimensional box, exchange degeneracy, Accidental degeneracy, symmetric and anti-symmetric states, solution of free particle Schrodinger equation in spherical polar coordinates, solution of three dimensional harmonic oscillator Schrodinger equation in spherical polar coordinates, degeneracy of harmonic oscillator states.

Unit-III

Matrix Representation:

Basic postulates of quantum mechanics, expansion postulate, operator representation of dynamical variables, Commutation of operators, Adjoint and Hermition operators, Unitary operator, Eigen value problem for operators, properties of Eigen functions and Eigen values of Hermition operators, Simultaneous Eigen functions, Dirac Delta function and Box normalisation of free particle wave function. Uncertainty principle in operator approach, Ket & Bra notation, matrix representation of wave function & operators. Eigen spectrum of one-dimension Harmonic oscillator using matrix mechanics.

Unit-IV

Theory of Angular Momentum-I:

Definition of generalised angular momentum, operators for J_+, J_-, J_z commutation relation of angular momentum with r& p. Spectrum of Eigen values of J^2 and J_z, operators for orbital angular momentum L in spherical polar coordinates, Eigen values and Eigen function of L^2 and L_z. Spin angular Momentum, Eigen values and Eigen functions of S^2 & S_z.

Unit-V

Theory of Angular Momentum-II:

Matrix representation of J^2, J_z, J_+, J_-, J_x, J_y, for j=1/2 , 1 . Pauliês Spin matrices and their properties. Addition of two angular momenta, coupled & uncoupled representation, Clebsch Gorden co-efficients, Spectrum of Eigen values of total angular momentum. Calculation of C.G. Co-efficients for the cases (i) j_1=1/2 , j_2=1/2 , (ii) j_1= 1/2, j_2=1

Text and Reference Books:

1. L.I. Schiff , Quantum Mechanics (McGraw-Hill)
2. S.Gasiqrowicz, Quantum Physics (Wiley)
3. B.Craseman and J.D. Powell, Quantum Mechanics (Addison Wesley)
4. A.P. Messiah, Quantum Mechanics
5. J.S. Sakurai, Modern Quantum Mechanics
6. Mathews and Vankatesan, Quantum Mechanics

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts :

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each :

The candidates are required to attempt four questions from Section A and one question from Section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (Ist Semester)
Course No. PSPHTC104 Title : **Integrated Electronics – I**
Credits : 4 (4-0-0) Maximum Marks : 100
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in Dec 2018, Dec 2019, Dec 2020.

Objectives:
This course consists of two parts:
a) Semiconductor Physics (Unit I, II and III)
b) Digital Electronics (Unit IV and V)

The objectives of first three units are ï
1. To understand the basic fundamentals of semiconductor device physics
2. To understand the properties of semiconductors with application to the PN junction device and BJTῴs.

Good familiarity with Semiconductor physics can help the interested students to select such area to examine advanced semiconductor materials for device applications.
The objectives of next two units are
1. To familiarize students with
 Combinational logic circuits
 Sequential logic circuits
2. How digital logic gates are built using transistors
3. Design and build of digital logic systems

UNIT I
Semiconducting Materials, Carrier Concentration & transport

Introduction to semiconducting materials: elemental and compound semiconductors, the valence bond model of the semiconductors, the energy band model, the energy-Momentum diagram of intrinsic semiconductors, Fermi level and energy distribution of carriers inside intrinsic and doped semiconductors, Direct and indirect band gap semiconductors, non degenerate and degenerate semiconductors
Intrinsic carrier concentration, carrier drift in electric field: mobility, Resistivity and Conductivity, Hall effect.
Carrier diffusion phenomenon: Einsteinῴs relationship, constancy of Fermi Level across a junction, Generation and recombination processes: direct and indirect recombination, Auger recombination, continuity equation, Haynes-Shockley experiment

UNIT II
pn Junction

pn junction: building blocks of pn junction theory: thermal equilibrium condition, depletion region (abrupt and linearly graded junctions),
Depletion capacitance, Capacitance-Voltage characteristics;
Current-Voltage characteristics: Ideal characteristics, generation-recombination and high-injection effects, temperature effect.
Charge storage and transient behaviour: minority carrier storage, diffusion capacitance, transient behaviour, small signal model of the diode,
junction breakdown: tunneling effect and avalanche multiplication; semiconductor heterojunctions.

UNIT III

Diodes and BJT's

Emission in semiconductors, optical absorption, spontaneous and stimulated emission. Transferred electron effect (Gunn Diode), Tunnel diode, IMPATT Diode, Light Emitting Diodes and semiconductor LASERs, Photodiodes, Introduction to solar cells: Solar cell structure, solar cell parameters.
Bipolar junction Transistors: Principle of Operation, Transistor action: operation in active mode, current gain. Modes of operation of BJT, Current Voltage characteristics of common base and common emitter configuration, frequency response and switching in BJT.

UNIT IV

Combinational Logic Circuits

Introduction to Logic families, Characteristics of Digital ICs, Transistor as switch, TTL, binary number system, Decimal to binary and binary to decimal conversion, Logic Gates.

Review of Boolean Laws & Theorems,, Standard forms of Boolean expressions (SOP & POS form) and their implementation; simplification of SOP & POS Boolean expressions using K-maps (upto 5-variables) and Quine McClusky method (upto 5 variable).

Adders, subtractors, Encoder, De-coder, Comparator, Multiplexer, De-multiplexers, Parity generator and checker, Seven Segment decoder.

UNIT V

Sequential circuits

Clock waveform and its characteristics, One bit memories; RS, JK, JK-master slave, D and T Flip Flops (Unlocked, Locked and Edge triggered).
Counters: Modulus of Counter, ssynchronous 2-bit, Up/Down and decade counter, design of synchronous counter (Mod-8).
Resistors: Shift Resistors (SISO, SIPO, PISO and PIPO), applications of Shift Register.
Memory Systems: RAM, ROM, EPROM, EEROM.

Text and Reference Books:

1. Semiconductor Devices: Physics & Technology; S.M.Sze, John Wiley & Sons.
2. Introduction to semiconductor materials and devices, M.S. Tyagi.
3. Solid State Electronics Devices: Ben. G. Streetman; Prentice-Hall of India Ltd.
4. Modern Semiconductor devices for Integrated circuits by Chenming Calvin Hu, Pearson Publications
5. Digital Electronics, A Anand Kumar
6. Digital Electronics by G.K. Kharate (Oxford Higher Education)
7. Digital Electronics An Introduction to Theory and Practice by William H. Gothmann

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

List of experiments

Detailed Syllabus: **M.Sc.Physics (1st Semester)**
Course No. PSPHPC105 **Title: Credits: 8 (0-0-15)**
Maximum Marks: 200

Examination to be held in Dec 2018, Dec 2019, Dec 2020.

Objectives of the course:

The objective of this course is to get basic training on the experiments of various topics . The students get grasp of Dark room experiments such as Laser Experiment, Cauchy constants , Diffraction at St.edge etc. They get good concepts from the experiments like BH curve, ESR, Four probe . We are also trying to get new experiments like Planckôs constant with LED , PCB designing , studying various sensing devices , Measurement of Pankôs constant , which give the M.Sc students much clarity of the subject.

Existing practicals

1. Four Probe
2. ESR
3. Hall Effect
4. Laser
5. B_H Curve
6. Diffraction of St. Edge
7. Multivibrator
8. FET
9. Diode Characteristics
10. CRO
11. H-parameters
12. Solid State Power Supply
13. Michelson Interferrometer
14. Cauchy's Constant
15. UJT
16. Optoelectronics Devices
17. To study the operation and working principle of JK, D and T Flip Flop
18. To study the decoder for conversion of BCD to seven segment display.
19. To study logic gates and verify DeMorganôs law
20. To study RC coupled amplifier and plot a graph between gain and frequency
21. To study astable multivibrator using 555 timer.

22.To determine Planck constant using the stopping potential of different filters

Proposed list of the experiments for M.Sc. Physics (1st and 2nd) Semester course with existing infrastructure.

1. To design inverting and non-inverting op-amp and to study gain of each and observe the waveforms on CRO
2. To design and study the various electronic circuits (half wave rectifier, full wave rectifier, clipper, clamper etc) using Expeyes-17 and to study their input output wave forms.
3. Design and observe input output waveforms of various logic gates using Expeyes-17
4. Determination of the electronic charge by Milikanôs oil drop experiment

List of the experiments for M.Sc. Physics (1st and 2nd) Semester course.

S. No.	Name of Experiment	Pieces of Scientific equipment	Proposed for	Cost in INR
1	To determine Planckôs constant with LED	Educational Kit	1st sem	0.20 Lakh
2	To study divergence of Laser light	Experimental set up	2nd	0.25 lakh
3	To study various sensing devices	Sensor Lab kit	1st and 2nd	**0.80 Lakh**
4	To learn PCB designing	PCB Prototype Machine	2nd and 3rd	**4.22 Lakh**
5	Determination of the specific rotation of sugar solution using Half Shade Polarimeter Study of variation of angle of rotation of sugar solution with its concentration	Half Shade Polarimeter	1st and 2nd	**Rs .18 Lakh**
6	Plankôs Constant Å Measurement of Pankôs constant	SN627	1st and 2nd	**Rs. 33,500/-**

Total =Rs.5.985 Lakhs (Excluding GST) and coustoms duty (if any)

Evaluation Scheme

Practical examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

Note:

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

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (2nd -Semester)

Course No. **PSPHTC201** Title: **Quantum Mechanics-II**

Duration of Examination : **3hours** Maximum Marks : **100**

Credits : **4(4-0-0)** a) Major Test : **60**

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

Syllabus for the examination to be held in June 2019, 2020 and 2021.

Objectives :

It is an essential core course for the students of M. Sc. Physics in 2nd semester. The course covers the detailed contents about the Perturbation Theory and Scattering Theory.

Unit-I

Perturbation Theory

Time-independent non-degenerate perturbation theory up to second order, Application to perturbed harmonic oscillator, Time-independent degenerate perturbation theory up to first order, Application of degenerate perturbation theory to Stark effect and Zeeman effect. Time-dependent Perturbation theory, calculation of first order transition amplitude, transition probability and derivation of Fermiós Golden rule.

Unit-II

Semi classical theory of radiation, Einsteinós co-efficients of emission and absorption. Adiabatic and Sudden approximations, expression for transition probabilities. Transition rates for absorption and emission of radiation, Transition rates with the Dipole approximation, Transition rates from the first excited states to the ground state for an isotropic (3-dimensional) harmonic oscillator of charge q.

Unit-III

Variational technique, its application to ground state of Helium atom. W.K.B-approximation, classical turning points, connection formulae, application of W.K.B to bound state problem and tunnelling, α - decay derivation, Geiger Nuttal Law.

Unit-IV

Scattering theory-1

Differential and total scattering cross-sections, scattering amplitude, relation between differential scattering cross-section and scattering amplitude, Laboratory and Centre of mass reference frames, relation of scattering angles and cross-sections in Laboratory and Centre of mass systems, Partial wave analysis, expression for scattering amplitude and total scattering cross-section in terms of phase shifts, scattering by a perfectly rigid sphere and by square well potential, deduction of optical theorem from scattering cross-section.

Unit-V

Scattering theory-II

Free particle Greenǿs function, Greenǿs function method for scattering, derivation of scattering amplitude and Born approximation, validity of Born approximation, application of Born approximation to square well, Yukawa and screen coulomb potential, Scattering of identical particles.

Text and Reference books:

1. N. Zettili, Quantum Mechanics concepts and application (Wiley)
2. J.J. Sakurai, Modern Quantum Mechanics.
3. L.I. Schiff, Quantum Mechanics (Mcgraw-Hill).
4. S. Gasiorowicz, Quantum Mechanics (Wiley)
5. Mathews and Venkatesan, Quantum Mechanics.
6. B. Craseman and J D Powell, Quantum Mechanics (Addison Wesley)

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts :

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt Four questions from section A and One question from section B. All questions shall carry equal marks.

M.Sc PHYSICS SEMESTER-II

M.Sc. Physics (2nd -Semester)

Course No. **PSPHTC202** Title:**Statistical Mechanics**
Duration of Examination : **3hours** Maximum Marks : **100**
Credits : **4(4-0-0)** a) Major Test : **60**
b) Minor Tests (I & II): **40**

Syllabus for the examination to be held in June 2019, 2020 and 2021.

Objective of the course: The *objective* of this course is to introduce the student to today's understanding of *statistical physics* and *statistical mechanics*. This course develops concepts in classical laws of thermodynamics and their application, postulates of statistical mechanics, statistical interpretation of thermodynamics, microcanonical, canonical and grant canonical ensembles; the methods of statistical mechanics are used to develop the statistics for Bose-Einstein, Fermi-Dirac and photon gases; selected topics from low temperature physics and electrical and thermal properties of matter are discussed. The last portion of the course will be principally concerned with phase transitions, specifically first order phase transitions, phase separation, continuous phase transitions, and the Landau theory of phase transitions

UNIT I: Statistical Thermodynamics

Foundations of statistical mechanics, specification of states of a system-the microstate and the macrostate, phase space, Liouvilleõs Theorem, Statistical concept of Temperature and entropy Maxwell-Boltzmann distribution, determination of undetermined multipliers б and □α, equipartition of energy, free energy. Entropy of mixing and Gibbõs paradox, the semi-classical perfect gas.

UNIT II: Classical Statistical Mechanics

Ensembles, microcanonical ensemble, canonical ensemble thermodynamic properties of the canonical ensemble, evaluation of the total partition function, partition function in the presence of interactions, fluctuation of the assembly energy in a canonical ensemble, grand canonical ensemble, the grand partition function and its evaluation, fluctuations in the number of systems, the chemical potentials in the equilibrium state.

UNIT III: Quantum Statistics of ideal gases

Bose-Einstein statistics, the Bose-Einstein gas, Einstein diffusion equation, Bose-Einstein condensation, the photon gas, Fermi-Dirac statistics, the Fermi-Dirac gas, the electron gas, the thermodynamics of gases (evaluation of Boltzmann partition function and classical partition function), classical ideal gas.

UNIT IV: Phase Transition and Critical phenomena

Phase Transition: first order and continuous, Critical exponent and scaling relation, order parameters, Calculation of exponents from Mean field theory and Landauǒs theory, . Ising Model, partition function for one-dimensional case, equivalence of the Ising model to other models, chemical equilibrium and Saha ionization formula, the Bragg-williams approximation, the Bethe-Peierls approximation

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UNIT V: Fluctuations

Correlation of space-time dependent fluctuations, Fluctuations and transport phenomena, fluctuation-dissipation theorem, the Fokker-Planck equation, Brownian motion, Langevin Theory of Brownian motion

Reference Books:

1. Fundamentals of Statistical and Thermal Physics by F. Reif.
2. Fundamentals of Statistical mechanics by B.B Laud
3. Statistical Mechanics by K. Huang.
4. Statistical Mechanics by R.K. Pathria
5. Statistical Mechanics by R. Kubo
6. Statistical Physics by Landau and Lifshitz.
7. Statistical Mechanics : Satya Prakash, Kedar Nath Ram Nath Publication

Evaluation Scheme

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Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

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Major Test

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Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc. Physics (II Semester)
Course No. **PSPHTC203** Title : **Integrated Electronics – II**
Credits : 4 (4-0-0) Maximum Marks : 100
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in June 2019, 2020 & 2021.

Objectives : This course covers four major aspects of Electronics

a) Operational Amplifiers- Operational amplifier is one fundamental building block of analog circuits. When used properly in negative feedback configurations, the overall closed loop transfer characteristic can be precisely set by stable passive components such as resistors, capacitors, and diodes, regardless of the potential variation of open loop parameters. Negative feedback amplifier with op amp operating at its core provides key to highly reliable and stable analog functions.
The objective under this section is to encourage the students to learn and understand the OP Amps and its applications, so that they can theoretically realize such analog circuits using Op Amps.

b) Analog and Digital Circuits
The objective of this section to understand some special ICs that is used to design different electronic timers, generators and oscillators.

c) Radio waves
Familiarization of Radio waves is important to understand the electronic communication. Thus this portion covers the objectives regarding learning of electromagnetic waves. How antenna is important to receive and radiate radio waves. Students should know the essential parts of basic TV transmitters and receivers with their working. Basic understanding of Superheterodyne receivers is also important.

d) Microprocessor
Microprocessor is the course used to provide an understanding of microprocessor hardware and software. Technicians completing this course will work with microprocessor based equipment, and be capable of distinguishing hardware from software faults. The superior students will also be capable of participating in product development efforts, including support and development of assembly language code.

UNIT I

Operational Amplifier-I

Differential Amplifiers: Circuits Configurations, dual input, balanced output differential amplifier.
Introduction to Op-amps: Block diagram of a typical Op-amp, Circuit symbol and terminals, equivalent circuit and transfer characteristics, Ideal op-amp. Input, Output and supply voltages. Open loop configurations of Op-amps (the differential amplifier, inverting and non-inverting amplifiers) DC analysis (inverting and non-inverting), CMRR, constant current bias.
Op-amp with negative feedback: Voltage series feedback ï effect of feedback, bandwidth and output offset voltage, voltage follower.

UNIT II

Operational Amplifier-II

Practical Op-amp : input-offset Voltage , input bias current, input offset current, total output offset voltage, CMRR, frequency response.
DC and AC amplifier, summing, scaling and averaging amplifiers, instrumentation amplifier: integrator and differentiator. Oscillators : Principle, types, frequency stability, response. The phase shift oscillator and LC tunable oscillator. Multivibrators: Monostable and astable MV.

UNIT III

Analog and Digital Circuits

Analog computation, active filters, logarithmic and antilogarithmic amplifier, sample and hold amplifiers, square and triangular wave generators, 555 timer, Schmitt trigger, clipper and clamper.
Voltage Regulators: Zener diode as voltage regulator, Dual Polarity regulated power supplies using 78 XX and 79 XX series regulators (Basic ideas only).
Digital to analog converters (ladder and weighed resistor types), Analog to digital converters (Counter type, successive approximation and dual slope converters), Applications of DACs and ADCs.

UNIT IV

Radio Waves and Receivers

Introduction to the Electromagnetic waves and their optical properties, Various modes of radio wave propagation (space wave propagation, sky wave propagation and ground wave propagation), Basic antenna concept, Antenna parameters: patterns, beam area, radiation intensity, beam efficiency, directivity and gain.
Elements of TV System, Monochrome TV transmitter and receiver, composite video signal, Radio Receivers: Straight and Superheterodyne receiver, block diagram and working, Theory of Superheterodyne.

UNIT V

Memory Devices and Microprocessor (8085)

Introduction to Memories: SRAM, DRAM, CMOS and NMOS, magnetic memories (magnetic tape, hard disks, floppy disks), optical memories, CCD (Principle of operation and applications)

Intel 8085 Architecture and programming: Architecture of 8085, PIN layout and description of Signals, instruction set: types of instructions, addressing modes in instructions, instruction set. Instruction execution and timing diagrams: Opcode Fetch machine cycle, Memory Read Machine cycle, I/O Read, I/O write cycle, demultiplexing the address bus.
Assembly language programs based on simple arithmetic and logical operations.

Text and Reference Books

1. Op-Amp & Linear Integrated Circuits by R.A. Gayakwad
2. Operational Amplifiers and Linear ICs bi David A. Bell, Oxford University Press
3. Electronic Communication system by George Kennedy
4. Electronic devices & circuits theory By R.L. Boylestad, Louis Nashelsky ,Pearson education
5. R.R.Gulati, Monochrome & Colour Television
6. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with 8085, Penram India (1999).
7. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Sarvanan and S. Jeevananthan, Oxford University Press

Evaluation Scheme

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Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

<u>**POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU**</u>

<u>List of experiments</u>

Detailed Syllabus: **M.Sc.Physics (2nd Semester)**
Course No. PSPHPC205 **Title: Credits: 8 (0-0-15)**
Maximum Marks: 200

Examination to be held in June 2019, 2020 and 2021.

Objectives of the course:

The objective of this course is to get basic training on the experiments of various topics . The students get grasp of Dark room experiments such as Laser Experiment, Cauchy constants , Diffraction at St.edge etc. They get good concepts from the experiments like BH curve, ESR, Four probe . We are also trying to get new experiments like Planckôs constant with LED , PCB designing , studying various sensing devices , Measurement of Pankôs constant , which give the M.Sc students much clarity of the subject.

Existing practicals

1. Four Probe
2. ESR
3. Hall Effect
4. Laser
5. B_H Curve
6. Diffraction of St. Edge
7. Multivibrator
8. FET
9. Diode Characteristics
10. CRO
11. H-parameters
12. Solid State Power Supply
13. Michelson Interferrometer
14. Cauchy's Constant
15. UJT
16. Optoelectronics Devices
17. To study the operation and working principle of JK, D and T Flip Flop
18. To study the decoder for conversion of BCD to seven segment display.
19. To study logic gates and verify DeMorganôs law
20. To study RC coupled amplifier and plot a graph between gain and frequency
21. To study astable multivibrator using 555 timer.

22.To determine Planck constant using the stopping potential of different filters

Proposed list of the experiments for M.Sc. Physics (1st and 2nd) Semester course with existing infrastructure.

1. To design inverting and non-inverting op-amp and to study gain of each and observe the waveforms on CRO
2. To design and study the various electronic circuits (half wave rectifier, full wave rectifier, clipper, clamper etc) using Expeyes-17 and to study their input output wave forms.
3. Design and observe input output waveforms of various logic gates using Expeyes-17
4. Determination of the electronic charge by Milikanôs oil drop experiment

List of the experiments for M.Sc. Physics (1st and 2nd) Semester course.

S. No.	Name of Experiment	Pieces of Scientific equipment	Proposed for	Cost in INR
1	To determine Planckôs constant with LED	Educational Kit	1st sem	0.20 Lakh
2	To study divergence of Laser light	Experimental set up	2nd	0.25 lakh
3	To study various sensing devices	Sensor Lab kit	1st and 2nd	**0.80 Lakh**
4	To learn PCB designing	PCB Prototype Machine	2nd and 3rd	**4.22 Lakh**
5	Determination of the specific rotation of sugar solution using Half Shade Polarimeter Study of variation of angle of rotation of sugar solution with its concentration	Half Shade Polarimeter	1st and 2nd	**Rs .18 Lakh**
6	Plankôs Constant Å Measurement of Pankôs constant	SN627	1st and 2nd	**Rs. 33,500/-**

Total =Rs.5.985 Lakhs (Excluding GST) and coustoms duty (if any)

Evaluation Scheme

Practical examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

Note:

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

M.Sc PHYSICS

Detailed Syllabus: M.Sc Physics (2nd Semester)

Subject: Physics **Course No.: PSPHT206**

Title of the Paper:Electrodynamics and Plasma Physics **Max. Time: 3 hrs**

Max. Marks : 100 **Credits : 4 (4-0-0)**

Syllabus for the examination to be held in June 2019, June 2020, June 2021.

Objectives : Classical Electrodynamics and Plasma Physics is a course that covers electrostatics and magneto-statics as well the basics of plasma physics . Students are also made to understand the subject of plasma physics in detail. This course also covers the Maxwell equations their applications to the propagation of electromagnetic waves in metals, dielectrics and plasma field ; motions of relativistic and non relativistic charged particles in electrostatic magnetic fields.

UNIT-I

Electromagnetic waves, Application and Electric Multipole moment

Revision of Maxwell's equations, waves in different conducting mediums, Polarisation of Electromagnetic waves, rectangular wave guide, circular wave guides, resonant cavities , scattering and scattering parameters, polarisation of scattering light, coherence and incoherence of scattered light, Electric dipole and multipole moments of a system of charges, Multipole expansion of the scalar potential of an arbitrary charge distribution.

(10)

UNIT-II

Electrodynamics of a moving charge and radiating systems

Retarded potentials, Lienard-Wiechert potentials, Fields due to an arbitrarily moving point charge, special case of a charge moving with constant velocity, Radiations from an oscillating dipole, Power radiating by a point charges-Larmor Formula. Lienard's generalisation of Larmor formula.Energy loss in Bremsstrahlungand Linear Accelerators.Radiation reaction-Abraham-Lorentz formula.

(10)

UNIT-III

Relativistic Electrodynamics

Charge and Fields as observed in different frames. Covariant formulation of Electrodynamics-Electromagnetic field tensor, Transformation of fields, Field due to point charge in uniform motion, Lagrangian formulation of the motion of charged particle in an electromagnetic field, problems.

(10)

UNIT-IV

Plasma Physics

Kinetic Pressure in a partially ionised gas, Mean free path and collision cross-section, Mobility of charged particles, Effect of Magnetic field on the mobility of ions and electrons, Diffusion of electrons and ions, Ambipolar diffusion, Diffusion in Magnetic field, Thermal conductivity, Effect of magnetic field, Electron and ion temperature, Dielectric constant of Plasma, Quasi-neutrality of Plasma, Debye shielding distance, optical properties of Plasma, Magnetic susceptibility of Plasma.

(10)

UNIT-V

Motion of charged particles in Electric and Magnetic field

Particle description of Plasma, Motion of charged particle in an electrostatic field, Motion of charged particle in uniform magnetic field, Motion of Charged particle in electric and magnetic fields, Motion in a torroidal magnetic field, Motion of an electron in a time varying electric field, Motion in a crossed radio frequency and magnetic field, Magnetohydrodynamics, Decay of charge in conductors, Decay of current in conductors, Magneto hydrodynamic equations.

(10)

Text &Referrence Books:

1. Introduction to Electrodynamics by D.J.Griffiths
2. Classical Electrodynamics by J.D.Jackson
3. Electromagnetic by B.B.Laud
4. Plasma Physics by S.N.Sen
5. Principles of optics by M.Born and E.wolf

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get theminimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall beten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. Allquestions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (3^{rd} Semester)
Course No. PSPHTC301 Title : Condensed Matter Physics (General)
Credits : 4 (4-0-0) Maximum Marks : 100
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in Dec 2019, Dec 2020, Dec 2021.

Objectives : The M.Sc IIIrd n IVth semester Courses have been designed such that the students are exposed to the most basic as well as applied aspects of the Science of Solid state. The emphasis is on providing deeper insights into the fields of Crystallography which includes single crystal growth , Characterization and X-ray structure analysis of materials of applied nature.

Unit I : Basic Crystallography

Crystalline solids, Space Lattice, crystal systems, derivation of 14 Bravais lattices, Miller indices, non-translational symmetry elements, derivation of 32 point groups, translational symmetry elements, space groups, derivation of space groups (triclinic and monoclinic systems), Reciprocal lattice and its applications.

Unit II: X-rays and X-ray Sepctra

Production of X-rays, reflection and refraction of X-rays, Continuous X-ray spectrum, Characteristic emission spectrum, Characteristic absorption spectrum, Comparison of Optical and X-ray spectra, Moseleyôs law and its applications, monochromatization of X-rays, explanation of emission and absorption spectra, fine structure of X-ray levels, the fluorescence yield and Auger effect.

Unit III : X-ray diffraction in Crystals and X-ray diffraction Techniques

X-ray diffraction in Crystals, Braggôs law for X-ray diffraction, Braggôs law in reciprocal lattice-Ewald Construction, X-ray diffraction Techniques - Laueôs diffraction technique, indexing of Laue photographs, powder X-ray diffraction technique, indexing of powder photographs and lattice parameter determination, applications of Laue & powder methods

Unit IV : Disorder in Solids

Point defects (Frenkel & Schottky), line defects - (slip, plastic deformation, edge dislocation, screw dislocation, Burgerôs vector, concentration of line defects, estimation of dislocation density), Frank-Reid mechanism of dislocation multiplication (dislocation reaction), surface (planar) defects, grain boundaries and stacking faults.

Unit V: Magnetic Properties of solids

Classification and general properties of magnetic materials, Weiss and Heissenbergôs theory of ferromagnetism, temperature dependence of spontaneous magnetization, Theory of domain structure, observation of domains, ferromagnetic domains. Bloch-Wall energy, spin waves and magnons, quantization of spin waves, the Bloch $T^{3/2}$ law, Neel model of antiferromagnetism and ferrimagnetism. Hard and soft magnetic materials.

Text and reference Books :

1. Applied Solid State Physics ï Rajnikant
2. Introduction to Solids by Azaroff.
3. Crystallography Applied to Solid State Physics by Verma and Srivastava
4. Solid State Physics by Kittle
5. Solid State Physics by M.A.Wahab
6. Elementary Solid State Physics by Omar
7. X-ray Strucutre Determination by G.H. Stout, L.H. Jensen.

Evaluation Scheme

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Examination (Theory)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
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Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

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Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

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DETAILED SYLLABUS

M. Sc. Physics (THIRD SEMESTER)

Detailed Syllabus : M.Sc.Physics (3^{rd} Semester)
Course No. **PSPHTC302** Title: **Nuclear & Particle Physics (General)**
Credits: 4 (4-0-0) Maximum Marks: 100
Duration of Examination: 3 hrs.

Syllabus for the examinations to be held in Dec 2019, 2020 and 2021.

Objectives :- The course deals with the nature of nuclear forces, nuclear models and nuclear disintegration. It also covers Nuclear Fission , Nuclear Reactions . Finally student will come to know about classification of Elementary particles and CP violation and CPT theorems.

SYLLABUS

UNIT – I Properties of Nuclei & Nuclear Forces

Nuclear Mass, Nuclear Binding Energy Nuclear radius, Spin and magnetic moments of Nucleus and Nuclei, Parity, Angular Moment, Quadrupole Electric moments. Concept of meson theory of Nuclear forces, Exchange Force and Tensor Force. Pase shifts, Charge independence and Charge symmetry of nuclear forces. Isospin formalism.

(10)

UNIT – II Nuclear Interactions

Bound State of two nucleons, Theory of Ground State of two nucleons. Nucleon-nucleon scattering (n-p & p-p) at Low energies (<10MeV). Scattering Length. Effective range theory in n-p and p-p scattering, Spin dependence of nuclear forces.,Scattering of Neutrons by ortho and para hydrogen molecule , Polarisation and scattering parameters

(10)

UNIT – III Nuclear Reactions

Classification of nuclear reactions ï Direct and Compound nuclear reaction mechanisms, General features of nuclear reactions, Scattering and reaction cross sections by partial wave analysis. Bohrõs theory of compound nucleus. Resonance reactions and Briet-Wigner one-level formula. Different stages of nuclear reactions

Bohr-Wheeler theory of fission & Nuclear Reactors.

(10)

UNIT – IV **Nuclear Models**

Shell model ï Experimental evidence for shell effects and magic numbers, shell model ï spin orbit coupling., square well of infinite depth, harmonic oscillator potential, Schmidt,s lines and prediction of angular momentum and parity of nuclear ground states.

Collective model of Bohr and Mottelson - Rotational States and Vibrational levels, Nelson Model.

(10)

UNIT – V **Elementary Particles and their Classification**

Elementary particles and their classification, Conservation laws, Parity conservation and violation, Conservation of isotopic spin, GellMann Nishigima Scheme, Charge conjugation and Time reversal, CP violation and CPT theorem.

Strong, Weak and Electromagnetic interactions : coupling constants, decay life times and cross-sections, Resonances states, quarks.

(10)

Books Recommended :-

1. *Nuclear Physics : R. R. Roy and B. P Nigam*
2. *Nuclear Physics : D. Halliday*
3. *Introduction to Nuclear Physics : H. A. Enge*
4. *Nuclear Physics : E. Fermi*
5. *Nuclear Physics : I. Kaplan*
6. *Concepts of Nuclear Physics : B. L. Cohen*
7. *Nucleon-Nucleon Interaction : G. E. Brown & A. D. Jackson*
8. *Nuclear Interaction : S. de Benedetti*
9. *Nuclear Structure, Vol 1 and Vol 2 : A. Bohr and B. R. Mottelson*
10. *Experimental Nuclear Physics, Vol 1 and Vol 2 : K.N. Mukhin, Mir Publisher*

11. Atomic Nucleus : R. D. Evans

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Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

<u>**POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU**</u>

Detailed Syllabus : M.Sc.Physics (3rd Semester)
Course No. **PSPHTE303** Title: **Condensed Matter Physics (Special)**
Credits: 4 (4-0-0) Maximum Marks: 100
Duration of Examination: 3 hrs.

Syllabus for the examination to be held in Dec 2019, Dec 2020, Dec 2021.

OBJECTIVES : The course content of this paper is intended for the candidates who opt for condensed matter physics as their specialization during the 2nd year of their Post Graduate course in Physics, The main objective of this course is to introduce towards the theoretical and experimental part of the condensed matter physics. The course starts with introduction to the concept of phonon and moves forward with the interaction of electron with phonon. In the other part the syllabus, the students will get information about experimental solid state physics with understanding of the low temperature phenomenon like superconductivity and optical as well as Mossbauer Effect of the solids.

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-concepts of phonon, Characteristics of phonons, Classical and quantum model for thermal properties of solids, Debyeës quantum model, Anharmonic crystal interactions, Thermal expansion, Thermal conductivity, Mean-free path of phonons.

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.

Unit-III

Superconductivity

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

Unit – IV

Optical Properties

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

Unit-V

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.

Text and 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

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

M. Sc. Physics (IIIrd Semester)

Detailed Syllabus : **M.Sc.Physics (3rd Semester)**

Course No. PSPHTE304 **Title : Nuclear and Particle Physics (Special)**

Duration of Examination : **3hours** Maximum Marks : **100**

Credits : **4(4-0-0)** a) Major Test : **60**

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

Syllabus for the examination to be held in Dec 2019, Dec 2020, Dec 2021.

OBJECTIVES :

In this course 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. They study about various Resonances and also get understanding and usage of Feynman Diagrams and TOY theory and Bhabha Scattering.

UNIT – I **Symmetries**

Elementary Particles & Classification, Gellmann- Nishijima Scheme, Quark model.

Isospin : SU(2) Symmetry, its mathematical formulation and breaking.SU(3), generators of SU(3), I-U-V spins, Casmier operator, Quark model, 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 Decuplet, 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

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, 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_L^0 - K_S^0 system oscillations, K^0 regeneration. Time Reversal Invariance, CPT theorem and its consequences. Wave optical discussion of hadron scattering. The Briet-Wigner Resonance Formula.

(10)

UNIT – IV **Nuclear Scattering-Resonances**

Resonances (ρ,η,ι ,φ,ꝕ) 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 with spin by spinless nuclei, Electron scattering by nucneons. The process $e^+e^- \rightarrow \mu^+\mu^-$, Bhabha scattering: $e^+e^- \rightarrow e^+e^-$.

(10)

Books Recommended :-

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 Quang Ho-Kim, Pham Xuan Yam.
9. Introduction to Elementary Particle Physics by David Griffith.

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20

Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (3rd -Semester)

Course No. **PSPHTE305** Title: **Nuclear Theory (Special-I)**

Duration of Examination : **3hours** Maximum Marks : **100**

Credits : **4(4-0-0)** a) Major Test : **60**

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

Syllabus for the examinations to be held in **December 2019, 2020 & 2021.**

Objectives :

It is an essential course for the students of M. Sc. Physics with Nuclear Theory specialization in 3rd semester. The course covers the detailed information about the group theory and symmetries in physics.

Unit – I

Abstract group theory : Group postulates, Finite and Infinite groups, Order of a group, subgroup, permutation group, group table, Isomorphism and Homomorphism, Cayleyôs theorem and its application for finding the group structures of groups of order 3,4,5 and 6. Cosets, Lagrangeôs 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

Matrix representation, Equivalent representation, Unitary representation, Reducible and irreducible representations, characters of irreducible representation, Schurôs 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 – II

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, Effect of time-reversal on wave function of particle, 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

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 representation, Homomorphism of SU(2) on SO(3), Generators of U(n) and SU(n), Generators of SU(2), physical applications of SU(2).

Unit-V

Special unitary group SU(3), physical applications of SU(3), formation of SU(3) from elementary particles, Gell-Mannôs 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 (2^{nd} edition) by W. Greiner and B.Muller.
2. Group Theory by Hammer Mesh.
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. Group theory by N.Deo
7. Introduction to Group theory , European Mathematical Society , by O. Bogopalski
8. Problems and solutions in group theory for physicists, World Scientific, Zhang-Qi Ma and Xiao-Yan Gu.

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

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Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt Four questions from section A and One question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (3rd Semester)
Course No. **PSPHTE306** Title : **Electronics (Special-I**)
Credits : 4 (4-0-0) Maximum Marks : 100
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in Dec 2019, Dec 2020, Dec 2021.

Objectives of the course:

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.

Unit - I
Electronic Communication and Modulation :

Various types of classifications Electronic Communication System, Distinction between the error and Noise occurring in the transmission of signal, Importance of Communication, Introduction to Elements of communication systems and types of electronics communication (Simplex, Duplex, Analog, Digital, Base band and modulated signals)

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

Angle Modulation (Frequency and Phase Modulation), FM generation (Parameter Variation method), Frequency multiplication, FM Demodulation (Slope Detector) (10)

Unit -II
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, Schottkyï Mott Theory (10)

Unit -III
Communication Channels:

Optical Fibers: Introduction to optical fibers, Acceptance angle, Acceptance cone, Numerical aperture, mode of propagation, comparison of conventional transmission cables with optical fibers, types of optical fibers, Propagation in fibers using Rayǿs model, Bandwidth requirements in optical fibers, optical fiber splices and connectors, signal degradation; signal attenuation and dispersion.

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.

(10)

Unit -IV:
Radar and Satellite Systems

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.

Orbital Satellites, Geostationary Satellites, Look Angles (angle of elevation, Azimuth angle), Satellite system Link Model (UP Link Model, Transponder, Down-Link Model), MUF, Critical Frequency.

(10)

Unit -V:
Multiple Access methods and Networks

Frequency Division Multiple Accessing (FDMA), Time Division Multiple Accessing (TDMA), Carrier Sense Multiple Access (CSMA), ALOHA, CDMA.

Types of Networks (Circuit Switching, Message Switching, packet-Switched Network), Design Features of Computer Communication Networks, ISDN, LAN, WAN, OSI Protocol of network architecture, Introduction to Mobile Telephone Communication (The Cellular Concept)

(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.

Evaluation Scheme

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

Examination (Theory)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

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Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (3rd Semester)
Course No. **PSPHTO307** Title : Material Physics (Open)
Credits : 4 (4-0-0) Maximum Marks : 100
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in Dec 2019, Dec 2020, Dec 2021.

Objectives: The objectives of the proposed syllabus for students undergoing Masters Degree in subjects other than Physics and opted Material Physics as OPEN Course are to have basic understanding of the crystal physics and materials of technological importance.

Unit I : Crystal Physics and Atomic Bonding

Classification of solids, Properties of Crystalline and amorphous solids, crystal Lattice, basis, unit cell, crystal systems, 14 Bravais lattices, Miller indices, X-ray diffraction in Crystals, Braggôs law for X-ray diffraction, Ionic bonding, covalent bonding, metallic bonding, hydrogen bonding, van der Waals bonding.

Unit II : Semiconductors

Distinction between Metals, Insulators and Semiconductors,, characteristics of semiconductors, intrinsic and extrinsic semiconductors, compound semiconductors, direct and indirect band gap semiconductors, law of mass action, Hall Effect in Semiconductors, Applications of Hall Effect

Unit III : Superconductivity and Nanomaterials

Superconductivity - Experimental Results, Critical Temperature, Critical Magnetic Field, Meissner Effect, Type I and type ï II superconductors, Idea of BCS Theory, Cooper pair, Josephson Effect. Applications of superconductivity
Nanomaterials ï Introduction, Size Dependence of Properties of Solids, Applications of nanomaterials.

Unit IV : Liquid Crystals

Introduction, classification of liquid crystals, thermotropic liquid crystals (rod like molecules), nematic, cholesteric and smectic mesophases, polymer liquid crystals, Ferroelectreic liquid crystals, discotic liquid crystals, Lyotropic liquid crystals, liquid crystal displays, twisted nematic liquid crystal displays, applications of liquid crystals.

Unit V : Magnetic properties of Solids

Classification of Magnetic Materials, Origin of magnetic moment, Diamagnetism, Paramagnetism, Ferromagnetism, Domain theory of Ferromagnetism, Hysteresis, Hard and Soft magnetic materials, Antiferromagnetism, Ferrimagnetism, Ferrites and their applications.

Text and reference Books :

1. Liquid Crystals by S.Chandrasekhar
2. Thermotropic Liquid Crystals by Vertogen and Jeu
3. Applied Solid State Physics ï Rajnikant
4. Introduction to Solids by Azaroff.
5. Crystallography Applied to Solid State Physics by Verma and Srivastava
6. Solid State Physics by Kittle
7. Solid State Physics by M.A.Wahab
8. Elementary Solid State Physics by Omar

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and

Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

<u>**POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU**</u>

List of experiments

Detailed Syllabus: **M.Sc.Physics (3rd Semester)**
Course No. PSPHPE308 **Title: Practicals in Condensed Matter Physics**
Credits: 8 (0-0-15) **Maximum Marks: 200**

Examination to be held in Dec 2019, Dec 2020, Dec 2021.

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 dept. has a variety of experiments which the students shall have to perform to develop a good technical hand.

Existing 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 using Kappa geometry for the elucidation of cell parameters and indexing of planes.
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. To find the micro-hardness of a given material and to plot the curve for hardness versus load.

Proposed list of the experiments for M.Sc. Physics (3rd) Semester course with existing infrastructure.

7. Dielectric constant of a given material and to find its Curie temperature.
8. Meissner Effect in a superconducting material.
9. Magnetic permeability of a given magnetic material.

List of the experiments for M.Sc. Physics (3rd & 4th) Semester course.

Most of the experiments are based as per the existing syllabus.

S. No.	Name of Experiment	Pieces of Scientific equipment	Proposed for	Cost in INR
10.	Selection, mounting and Alignment of a single crystal on Kappa goniometer through manual and automated mode	(i)Mo K alpha X-ray source(Tube)	3rd	Apprx. Cost Rs. 12.00 lacs
		(ii)Chiller for HT Tube/Source	3rd	Apprx. Cost Rs. 16.00 lacs

11	Determination of orientation matrix for the unit cell in a restricted Bragg angular range at room and cryogenic temperature.	(iii)CCD power supply. (iv)Chiller for CCD Camera	3^{rd} 3rd	Apprx. Cost Rs. 10.00 lacs Apprx. Cost Rs. 16.00 lacs
12 13. 14.	Elucidation of the mosaicity component of a single crystal using CCD camera Indexing of plane of an unknown crystal by using photographic Laueös method Six Months Dissertation-Based Project Work for CMP M.Sc IV th Semester students	(v)High tension Cable as an Interface between the X-ray source and the X-ray generator. (vi) Mother Board(Electronic Pad) for XóCalibur Oxford Diffraction 50KV/30mA Radiation Source Generator	3^{rd} 3rd 4th Sem	Apprx. Cost Rs. 11.00 lacs Apprx. Rs. 52.00 Lacs
15	Polarization versus electrical field (PE) loop	PE loop traces System	3^{rd}	Rs. 6.00 Lacs
16	PE fatigue measurement at variable temperature and variable frequencies	Same as above	3^{rd}	--
17	Fatigue measurement at different temperatures	Same as above	3^{rd}	--
18	Seebeck coefficient (known as thermopower, thermoelectric power, and thermoelectric sensitivity) of a material is a measure of the magnitude of an induced thermoelectric voltage in response to a temperature difference across that material, as induced by the Seebeck effect	Seebeck Co-efficient measurement system and dc resistivity measurement system.	3^{rd} & 4^{th}	Rs. 16.00 Lacs
19	Bragg reflection:	Table top X-ray scattering	3^{rd} & 4^{th}	Rs. 25.00 Lacs

	determination the lattice constant of monocrystal	instrument		
20	Laue diagrams: investigating the lattice structure of monocrystal	Same as above		--
21	Debye-Scherrer photography; determining the lattice plane spacing of polycrystalline sample	Same as above		--
22	Digitial Laue diagram: investigating the lattice structure of monocrystal	Same as above		--

Total =Rs. 164.00 lacs EXCLUDING GST and customs duty (if any)

Evaluation Scheme

Practical examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

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

Major Existing Research facilities in the Department for CMP Practicals/Research:

1. **DST-XRD National Facility on CCD-Based Single Crystal X-ray Diffractometer created under an Individual-Centric Research Project by Prof. Rajni Kant since 2007.**
2. **Powder XRD under PURSE Programe of DST as a Common Facility for the Department**
3. **UV-Vis-IR Spectrophotometer as a common facility under DST-PURSE Project**
4. **Three Radon House X-ray Generators with multiple types of X-rasy Diffraction Cameras and Techniques**
5. **Polarizing Microscope for Online analysis of Morhology of single crystals.**
6. **14 Computer and 04 Printers**
7. **Cambridge Structure Database on-line Licensed Access on anual basis.**

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

List of experiments

Detailed Syllabus: **M.Sc.Physics (3rd Semester)**
Course No. PSPHPE309 **Title: Practicals in Nuclear & Particle Physics**
Credits: 8 (0-0-15) **Maximum Marks: 200**

Examination to be held in Dec 2019, Dec 2020, Dec 2021.

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.

Existing practicals

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 ɔ 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

Proposed list of the experiments for M.Sc. Physics (3rd) Semester course with existing infrastructure.

List of the experiments for M.Sc. Physics (3rd& 4th) Semester course.
(4th Semester is project based)

S. No.	Name of Experiment	Pieces of Scientific equipment	Proposed for	Cost in INR
2	To study measurement of muon life time using cosmic rays	Scintillator paddles, photomultiplier tubes, multi channel analyzer, high voltage power supply Digital oscilloscope(4 channel)	3rd& 4thsemester	Rs. 20 lakhs
3	Working of multiwire propotional chamber	Pre-amplifier, amplifier, high voltage module, gas flow chamber, DSO(4 channel), Radio active sources	3rd& 4thsemester	**Rs. 15 lakhs**
4	• Measure Photo current as a fun of irradiance at constant voltage. • Current Vs voltage characteristics of cds photo-resistor at constant irradiance	Photoconductivity apparatus . SN627	3rd& 4thsemester	**Rs. 30,938/-**
5	Å Detecting Gamma radiation with scint. Counter Å Detecting Energy resolution	Gamma Spectroscopy & Compton Effect	3rd& 4thsemester	**Rs. 6.44 Lakhs**

	Å Multichannel scaling and half life Å Pair production and annihilation Å Recording and calibrating Gamma Spectrum	SN1038		
6	Å Investigate the deflection of an electron beam by a magnetic field. Å Estimate specific charge of electron Å Investigate deflection of an electron beam by an electric field.	SN1031	3^{rd}& 4^{th}semester	**Rs. 2.12 Lakhs**
	Å Plotting G.Plateau characteristic curve Å Calculate statistics of counting Å Study background radiation Å Measure the revolving time Å Study of absorption ϐ-particles Å Study Back scatting & Calculate ϐ-decay energy	SN 615	3^{rd}& 4^{th}semester	**Rs. 3.30 Lakhs**
	Å Observe Zeeman splitting of green mercury line Å Polarization state of the triplet components in transverse conf. Å Polarization state of doublet components in longitudinal configuration	Zeeman Effect SK 075	3^{rd}& 4^{th}semester	**Rs. 3.30 Lakhs**
	Å Simple Alpha Spectrum & Energy Calibration with a Pulser Å Energy Determination of an Unknown Source. Å Energy Calibration with Two Alpha Sources Å Alsolute Activity of an Alpha Source Å Spectrum Expansion with a Biased Amplifier Å Decay Ratios for ^{241}Am	Alpha Spectrometer EG &G ORTEC SOURCE KIT SK -1A Surface Barrier Detector and accessories	3^{rd}& 4^{th}semester	**Rs 60.0 lakhs**
		TOTAL AMOUNT		**Rs.110.46938**

Total =Rs. 110.46938 lakhs EXCLUDING GST and custom duty (if any)

Evaluation Scheme

Practical examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

Note:

Addition and deletion in the list of practicalös may be made from time to time by the department.

Minimum of 06 practicalös have to be performed in a given semester.

<u>**POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU**</u>

List of practicals for Nuclear Theory

Detailed Syllabus: **M.Sc.Physics (3rd Semester)**
Course No. PSPHPE310 **Title: Practicals in Nuclear Theory**
Credits: 8 (0-0-15) **Maximum Marks: 200**

Examination to be held in Dec 2019, Dec 2020, Dec 2021.

Objectives:

This is a practical oriented course opted by the students of Nuclear Theory Specialization in 3rd Semester. This course lays emphasis on the developing of computer programs on the Numerical methods.

(a) List of Existing practicals :

1) To write a program to find the solution of a non-linear equation by using Secant Method.
2) To find the solution of bi-quadratic (cubic) equation by using Bisection Method.
3) To write a program to evaluate a definite integral by using Trapezoidal Rule.
4) To find the solution of given transcendental equation by using successive approximation method.
5) To write a program to evaluate a definite integral by using Simpson's 1/3rd rule.
6) To write a program to find the wave functions of linear Harmonic Oscillator.

(b) Proposed list of the practicals to be added with the existing ones for M.Sc. Physics (3rd) Semester course

Most of the practicals/experiments are based as per the existing syllabus.

S. No.	Name of Experiment	Pieces of Scientific equipment	Proposed for	Cost in INR
7.	To calculate the energy of high spin states of rotational bands of triaxially deformed nuclei by using computer program.	(i) TWO SERVERS (High Performance Computing system) with 64 GB RAM **(ii)** TWP On-line UPSes with atleast 4Hrs back-up	3rd	**9.0 Lacs**
8.	To evaluate the C.G. Coefficients by using computer program.	-do-	3rd	--
9.	To calculate the energy	-do	3rd	--

	of high spin states of rotational bands of axially deformed nuclei by using computer program.			
10.	To find the internal structure of degenerate bands of axially deformed nuclei by using computer program.	-do-	3rd	--
11.	To find the internal structure of degenerate bands of triaxially deformed nuclei by using computer program.	-do-	3rd	--
12.	To calculate the amount of deformation in nuclei by using computer program.	-do-	3rd	--
13.	Gamma-Ray spectroscopy using Na (Tl) detector.	2 Kits of Na (Tl) Detector	3rd	**1.5 Lac**
14.	Alpha Spectroscopy with Surface Barrier detector.	2 Kits of Surface Barrier Detector	3rd	**1.5 Lac**
15.	Determination of the range and energy of alpha particles using Spark Counter.	2 Kits of Spark Counter	3rd	**2.00 Lac**

Total Amount required for performing new practicals : 14.00 Lacs

<u>Evaluation Scheme</u>

Practical examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

Note 1: Minimum of 06 practicals to be performed in a given semester.

Note2 : Addition and deletion in the list of practicals may be made from time to time by the

Department.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (3rd Semester)
Course No. PSPHPE311 **Title : Practical in Electronics**
Credits : 8 (0-0-16) **Maximum Marks : 200**
Duration of Examination : 3 hrs.

Examination to be held in Dec 2019, Dec 2020, Dec 2021.

Objectives of the course:

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.

Existing 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 integrator.
   (e).To study operational amplifier as voltage follower and differential amplifier.

List of the experiments for M.Sc. Physics (3^{rd} & 4^{th}) Semester course.

Most of the experiments are based as per the existing syllabus.

S.No.	Name of the Experiment	Pieces of Scientific equipment/ Model & Make	Proposed For	Cost In INR
3.	Satellite communication plat form	Module	3^{rd}	Approx. Rs. 20.00 Lacs
4.	Antenna Training System	Module	3^{rd}	
5.	Transmission Line Trainer	Module	3^{rd}	

6.	Radar Trainer	Module	3rd	
7.	Wave and Propagation Trainer	Module	3rd	
8.	Optical Fiber Communication	Module	3rd	
9.	Connection splice kit	Module	3rd	
10.	Mode characterization in fiber optics	Module	3rd	
11.	Wireless digital comm. Trainer	Module	3rd	
12.	Frequency modulation setup	Module	3rd	
	• Can be utilized for several combinations of particles • Dry process does not require drying • It is possible to process in inert gas such as argon and nitrogen • Material temperature can be controlled with the help of cooling jacket • Production of composed particles, high degree of mixing • Broad range of capacities are offered	**Nanoparticle Production System**	3rd	Approx. Rs. 20.00 Lacs

Total =Rs. 40.00 lacs EXCLUDING GST and customs duty (if any)

<u>Evaluation Scheme</u>

Practical examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

Note 1: Minimum of 06 practicals to be performed in a given semester.

Note2 : Addition and deletion in the list of practicals may be made from time to time by the Department.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4^{th} Semester)
Course No. **PSPHTE401** Title: **Condensed Matter Physics (Special - I)**
Credits: 4 (4-0-0) Maximum Marks: 100
Duration of Examination: 3 hrs.

Syllabus for the examination to be held in May 2020, 2021, 2022.

OBJECTIVES : The course content of this paper is intended for the candidates who have opted for condensed matter physics and electronics as their specialization during the 2^{nd} year of their Post Graduate course in Physics, 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. The course starts with preparation of materials in the form of a solid as crystals, then defects in the solid and the concept of atomic diffusion. Electric properties of a solid like dielectric and ferroelectric will be introduced to the students which will then be followed by studying electrons in 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.

Unit-II

Disorder in Solids

Point defects (Frenkel & Schottky); line defects ï (slip, plastic deformation, edge dislocation, screw dislocation, Burgerês vector, concentration of line defects, estimation of dislocation density); Frank-Reid mechanism of dislocation multiplication (dislocation reaction), surface (planar) defects, grain boundaries and stacking faults.

Unit-III

Atomic Diffusion and Colour Centres

Atomic diffusion, Ficks 1^{st} and 2^{nd} 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.

Unit-IV

Dilectric and Ferrroelectric Properties

The Dielectric constant and susceptibility, Induced polarization, Clausius-Mossotti relation, Measurement of dielectric constant, Dipolar polarization in solids, Ionic polarazibility, Electronic polarazibility, Dielectric breakdown, Ferroelectricity, Ferroelectric domains, Applications of ferroelectrics.

Unit-V

Electrons in Solids
Introduction, An overview of classical models, Conductivity in metals, The Matthiesenôs Rule, The Drudeôs 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.

Text and Reference Books

1. Introduction to Solid State Theory- Otfried Madelung
2. Quantum Theory of Solids- 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. Crystal growth- Brian R Pamplin

Evaluation Scheme

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

Examination (Theory)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests
The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test
There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

DETAILED SYLLABUS

M. Sc. Physics (FOURTH SEMESTER)

Detailed Syllabus : M.Sc.Physics (4^{th} Semester)
Course No. **PSPHTE402** Title: **Nuclear and Particle Physics (Special-I)**
Credits: 4 (4-0-0) Maximum Marks: 100
Duration of Examination: 3 hrs.

Syllabus for the examination to be held in May 2020, 2021,2022.

OBJECTIVES : The course deals with Radiation through matter , where they understand Bethe-Bloch Formula , Range-Energy Correlations, Bremsstrahlung and Cerenkov Radiation etc. Also the course is designed for the students to understand both Linear and Orbital Accelerators and finally understanding of Colliders. As Particle Detectors are the main tools of HEP Experiments, this course gives clarity of various detectors like Emulsions , Gaseous Detectors, and advanced detectors like MWPC, TPC . And finally most important Energy measurement detectors like Calorimeters.

SYLLABUS

UNIT – I **Nuclear Decay**

Energies of β-decay, neutrino hypothesis, Fermi theory of β-decay. Shape of beta spectrum, Total decay Rate, Comparative life times, Fermi-Kurie plots, Selection rules for Beta decay transitions (Fermi & Gammow Teller transitions), Mass & Helicity of Neutrino. Small note on Neutrino less Beta decay.

(10)

UNIT – II **Radiation through Matter**

Energy loss of charged particles through matter. Bethe block ionisation formula. Range-Energy relation. Multiple coulomb scattering -pβ measurements, Bremsstrahlung and Cerenkov radiations. Interaction of gamma radiation with Matter (Compton scattering, photoelectric effect and pair production).

(10)

UNIT – III **Accelerating Machines and General Characteristics of the Detector**

Linear accelerators, Principle of orbital accelerators, Cyclotron, synchro-cyclotron, modification with reference to magnetic field and frequency, Beam Collider.

Detector properties :- Sensitivity, Detector response, Energy resolution Response function and time, Detector efficiency and Dead time.

(10)

UNIT – IV **Nuclear Detectors(A)**

Nuclear Emulsion, Gaseous Ionization Detectors :- Ionization and Transport Phenomena in Gases, Transport of electrons and Ions in Gases. Avalanche Multiplication, Proportional counters, Multiwire proportional counters, Time Projection Chamber (TPC) ï Introduction & Working of TPC .

(10)

UNIT – V **Nuclear Detectors-(B)**

Semiconductor Detectors : Basic Semiconductor Properties : Energy band structure, Charge carriers, Intrinsic charge carrier concentration, Mobility, Recombination and trapping ï surface Barrier Detectors.
Scintillation Detectors :- General Characteristics, Organic & Inorganic scintillators .Introduction to Calorimetry. & Different types of calorimeters. Construction & Features of EM Calorimeters . Energy loss in EM Calorimeters & Energy Resolution of EM Calorimeters.

Books Recommended :-

1. *Nuclear Physics : D. Halliday*
2. *Introduction to Nuclear Physics : H. A. Enge*
3. *Concepts of Nuclear Physics : B. L. Cohen*
4. *Physics of Nuclei and Particles, Vol I & II : P Marmier and E. Sheldon*
5. *Accelerator Physics, S. Y. Lee*
6. *Principles of Particle Accelerators, Enrico Persico, Ezio Ferrari, Sergio e. Sergre*

7. Physics of Particle Detectors : Dan Green
8. Introduction to Elementary Particles, D. Griffiths
9. Introduction to High Energy Physics, P. H. Perkins
10. Nuclear and Particle Physics, E. Burcham
11. Elementary Particles : L. H. Ryder

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests
The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test
There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4th Semester)
Course No. **PSPHTE403** Title : **Physics of Liquid Crystals (Elective)**
Credits : 4 (4-0-0) Maximum Marks : 100
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in May 2020, May 2021, May 2022.

Objectives: The objectives of the proposed syllabus for students undergoing Masters Degree in Physics is to have proper understanding of the phase behavior, optical properties, behaviour of confined liquid crystals under the influence of external electric or magnetic field and liquid crystal technology.

Unit I : Classification of Liquid Crystals

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

Unit II : Phase transitions in Liquid Crystals

Melting of molecular crystals, distribution functions and order parameters, measurement of order parameters by X-ray diffraction. Nature of phase transitions and critical phenomena in liquid crystals, Reentrant phenomena in liquid crystals, optical properties of cholesteric liquid crystals, the blue phases, pressure induced mesomorphism.

Unit III : Liquid Crystals in Electric and Magnetic Fields

Liquid crystals in electric and magnetic fields, magnetic coherence length, Freederick transitions, Helix unwinding transition, Effect of solid boundaries on liquid crystals, convective instabilities.

Unit IV : Ferroelectric, Discotic and Lyotropic Liquid Crystals

Ferroelectreic liquid crystals, applications of ferroelectric liquid crystals, 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, biological membranes.

Unit V : Identification of Liquid Crystal Phases and Liquid Crystal Technology

Identification of nematic, smectic and chiral liquid crystal phases by optical polarizing microscopy (Visual appearance and texture), Phase identification with Differential Scanning Calorimetry, liquid crystal displays, the twisted nematic liquid crystal displays, nematic liquid crystal displays, liquis crystal displays using polymers, applications of liquid crystals.

Text and reference Books :

1. Liquid Crystals by S.Chandrasekhar
2. Thermotropic Liquid Crystals by Vertogen and Jeu
3. The Physics of Liquid Crystals by de Geenes and Prost
4. Ferroelectric Liquid Crystals by Goodby et al.
5. Introduction to Liquid Crystals Chemistry and Physics by Peter J.Coolings and Michael Hird

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

DETAILED SYLLABUS

M.Sc. Physics (IV-Semester)

Course No. **PSPHTE404** Title: **Quantum Electrodynamics (Elective)**
Duration of Examination : **3 hours** Maximum Marks : **100**
Credits **: 4(4-0-0)**
a) Major Test : **60**
b) Minor Tests (I & II) : **40**

Syllabus for the examination to be held in May 2020, May 2021 & May 2022

Objectives : It is an elective course opted by the students of M. Sc. Physics with specialization in High Energy Physics and Nuclear Theory. The course covers the formalism of second quantization and relativistic quantum mechanics.

Second Quantization :

Unit – I:

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 (Pauliĉs Exclusion Principle and Boson Condensation), Langrangian densities for Schrodinger and electromagnetic fields, Second Quantization of Schrodinger field, Expression for Hamiltonian operator.

Relativistic Quantum Mechanics :

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_o (Hydrogen atom problem), First order K.G. equations and its solution.

Unit-III: Dirac equation :

Derivation of Dirac equation, Ŭ and ɓ-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), Diracĉs gamma-matrices and their properties, ɔ$_5$-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.

Books Recommended

1. Quantum Mechanics by Baym.
2. Relative Quantum Mechanics by J.J.Sakurai.
3. Quantum Mechanics(Third edition) by Eugyen Merzbacher.
4. Quantum Mechanics by L. I. Schiff.
5. Quantum Mechanics by G. Aruldhas.
6. Relative Quantum Mechanics by W. Greiner.
7. Relative Quantum Fields by J.D. Bjorken and S.D. Drell.
8. Classical Mechanics by Goldstein

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts :

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each :

The candidates are required to attempt Four questions from Section A and One question from Section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : **M.Sc.Physics (4th Semester)**
Course No. PSPHTE405 **Title : Condensed Matter Physics (Special-II)**
Credits : 4 (4-0-0) **Maximum Marks : 100**
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in May 2020, May 2021, May 2022.

Objectives : The M.Sc IIIrd n IVth semester Courses have been designed such that the students are exposed to the most basic as well as applied aspects of the Science of Solid state. The emphasis is on providing deeper insights into the fields of Crystallography which includes single crystal growth , Characterization and X-ray structure analysis of materials of applied nature.

UNIT I: Experimental Techniques for Single Crystal Data Collection

An overview of X-ray diffractions, Principle, construction and working of rotating crystal X-ray diffraction methods (single/double oscillation, rotation), Measurement of identity period, basic principle and geometry of Weissenberg technique, visual estimation technique for intensity data collection, indexing of zero and higher Weissenberg photographs, determination of unit cell parameters and equi-inclination setting for obtaining higher layer Weissenberg photographs.

UNIT II: Experimental Methods of Observing Dislocations

X-ray photographic technique, basic principle, Berg Barrett technique, Lang Technique, X-ray diffraction topography camera, double crystal diffractrometry, Etching Methods of etching, An overview of Scanning Electron Microscope and Transmission Electron Microscope for materials characterization.

UNIT III: Surface and Interface Physics

Elementary concept of surface crystallography,, surface electronic structure, work function, thermionic emission, heterostructures, semiconductor lasers, light emitting diode.

UNIT IV: Thin Films

Liquid phase epitaxy (Experimental set up), preparation of thin films by vacuum vapour deposition, film thickness measurement and study of surface topography by multiple beam interferometry, electrical conductivity of thin films, Boltzmann transport equation for thin film.

UNIT V: Introduction to the Science of Nano

Introduction to nanotechnology , Historical development, nanomaterials and applications, New forms of carbon- fullerenes, nanowires and nanotubes , types of nanotubes, applications of nanowires and nanotubes.

Text and 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. Multiple beam interferrometry by Tolansky.
5. Physics of Thin Flms by Chopra.
6. Crystal Structure Determination by G.H. Stout, L.H. Jensen.
7. Handbook of Nanotechnology by Bharat Bhushan.

Evaluation Scheme

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

Examination (Theory)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests : The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test : There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

Nuclear and Particle Physics(Special II)

M. Sc. Physics (IVth Semester)

Detailed Syllabus : **M.Sc.Physics (4^{th} Semester)**
Course No. PSPHTE406 **Title: Nuclear and Particle Physics (Special-II)**
Credits: 4 (4-0-0) **Maximum Marks: 100**
Duration of Examination: 3 hrs.

Syllabus for the examination to be held in May 2020, 2021,2022.

OBJECTIVES :

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. They also get 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.

UNIT – I

Weak Interactions-I

Classification of weak interactions, Nuclear β decay ï 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 decay, Pion and Muon decay.

(10)

UNIT – II

Weak Interactions-II

Weak Decays of Strange Particles ï Cabibbo Theory, weak neutral currents, Absence of S=1 neutral currents. The GIM model and charm. Weak mixing angles with six quarks. Observation of $W^{\pm}$ and Z^{0} Bosons. Lepton families, 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 ï Positron annihilation to hadrons, Lepton pair production in hadron collissions ï The Drell-Yan Process.

(10)

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)

Books Recommended :-

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 Quang Ho-Kim, Pham Xuan Yam.
9. Introduction to Elementary Particle Physics by David Griffith.

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests
The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test
There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each
Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

DETAILED SYLLABUS

M.Sc. Physics (4^{th} -Semester)

Course No. **PSPHTE407** Title: **Nuclear Theory (Special-II)**

Duration of Examination : **3hours** Maximum Marks : **100**

Credits : **4(4-0-0)** (a) Major Test : **60**

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

Syllabus for the examination to be held in May 2020, May 2021 & May 2022.

Objectives : It is a theory course opted by the students of M. Sc. Physics with Nuclear Theory specialization in the 4^{th} Semester. The course covers the formalism of Quantum Field theory and its application to various problems.

Unit-I

Transition from discrete to continuous vibrating system, Lagrangian and Hamiltonian Formulations for continuous systems, Euler Lagrange equations and Hamiltonös equations of motion, Applications of Lagrangian and Hamiltonian Formulations to Schrodinger and Electromagnetic fields, Derivation of Schrodinger and Maxwellös equations.

Unit-II

Second Quantization, second quantization of electromagnetic field and Schrodinger field, quantized field energy and momentum, commutation relation between E and H, Number representation of operators for fermions.

Unit-III

Brillowin-Wigner Perturbation series, Schrodinger, Heisenberg and Interaction representations, Theory of Scattering Matrix (S-Matrix) and its properties, Optical theorem, Symmetries of S-Matrix (Lorentz Invariance and Time reversal). Wickös theorem and its applications (Feynman diagrams).

Unit-IV

Density Operator and its equation of motion, Fermi gas and Thomas Fermi model, Importance of Hartree-Fock (HF) Method, Derivation of HF equation, Symmetries of HF Hamiltonian, Choice of expansion for the orbits, Single major shell HF-calculations.

Unit-V

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 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 wavefunction, Application of the BCS wave function to the pure j-shell. Derivation of expression for occupation probability and pairing gaps, Unified model.

Books Recommended:

1. Classical Mechanics by Goldstein.
2. Classical Mechanics by W. Greiner.
3. Classical Mechanics by T.W.B Kibble and F. H. Berkshire.
4. Elements of Advanced Quantum Mechanics by J.M. Zimen.
5. Field Quantization by W. Greiner and J. Reinhardt.
6. Shapes and Shells in nuclear structure by S.G Nilsson and I. Ragnarsson.
7. An introduction to Relativistic Quantum Field Theory by Silvan S. Schweber.
8. Relativistic Quantum Mechanics and introduction to Quantum Field Theory by Anton Z. Capri.
9. Relativistic Quantum Fields by Bjorken and Drell.

Evaluation Scheme

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

Examination (Theory)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts :

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt Four questions from section A and One question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4th Semester)
Course No. PSPHTE408 **Title : Electronics (Special-II)**
Credits : 4 (4-0-0) **Maximum Marks : 100**
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in May 2020, May 2021 & May 2022

Objectives of the course:

This deals with the modern applications in the signal analysis and electronic communication. The successful completion of the course would help the students to work in the industry as well as taking up research in some frontline areas of signal analysis, digital communication systems.

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, Parsevalõs Theorem, Power and Energy Transfer through a network. Correlation between waveforms, Autocorrelation, Autocorrelation of periodic waveforms.

(10)

Unit -II
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 -III
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) (10)

Unit -IV
Noise:

Various Sources of Noise, Frequency-domain representation of noise, Effect of filtering on the probability density of Gaussian noise, Spectral components of noise, Effect of Filter on the Power spetral density of Noise, Mixing (Noise with sinusoid, noise-noise mixing), Linear Filtering, Quadrature components of noise $n_c(t)$, $n_s(t)$, (Power spectral Density, probability density and their time derivatives) (10)

Unit -V
Data Transmission and Noise Calculation:

The Baseband Signal receiver, Optimum Filter, Matched Filter, Coherent Reception: Correlation, Phase-Shift Keying (PSK), Frequency-Shift Keying (FSK), Differential PSK, DPSK, Calculation of Error Probability for BPSK and BFSK

Calculation of Quantization noise, output-signal power and output-to-noise ratio in PCM and Delta Modulation (DM) transmission. (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

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20
Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

The minor test would consist of two sections (A & B). Section A would consist of three short answer type questions (05 marks each) and section B would consist of two long answer type questions (10 marks each). Students are required to answer two questions from section A and one question from section B. No preparatory holidays shall be provided for the minor tests. Those candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Minor Tests only once.

Major Test

There shall be ten questions in the Major Test out of which 08 questions (as Section A) would be set out of the 50% of the Syllabus not covered in the Minor Test 1 and Minor Test 2. The remaining 02 questions (as Section B) would be set across the units of the 50% of the Syllabus covered in the Minor Test 1 and Minor Test 2. Each question shall comprise of two parts

Part (a) objective/ short answer type of 03 marks each

Part (b) long answer type of 09 marks each

The candidates are required to attempt four questions from section A and one question from section B. All questions shall carry equal marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Syllabus for the examination to be held in May 2020, May 2021 & May 2022.

M.Sc.Physics (4th Semester) Course No. **PSPHTO409**
Credits : 4 (4-0-0) Title : **Modern Physics (Open)**
Maximum Marks : 100 Duration of Examination : **3 hrs.**

Course Objectives and Learning outcome

This course which is an open course to be studied by the PG students of other department will give the flavour of basic concepts of Modern Physics. It will provide an introduction to the Basic concepts of Relativity, quantum mechanics, atomic and nuclear physics. In addition to these topics one unit is on the X-rays, an important discovery both for the development of sciences and medical science and cosmic rays. After going through this course a student who is not pursuing PG in Physics will learn about some of the basic concepts of the Modern Physicsð Physics concepts which were developed during the 20th century and set the ground of modern day technology, applications and basic research in Physics

Unit I
Basics of Relativity

Some Historical background, Frames of Reference, postulates of special theory of relativity, The Lorentz transformations, Lorentz-Fitzgerald contraction, Time dilation and Length contraction,Simultaneity and relativity, variation of mass with velocity, mass-energy equivalence, relation between momentum and energy

Unit II
Quantum Mechanics

Photoelectric effect, Compton effect, wave nature of matter, de-Broglie's concept of matter waves, Davisson and Germer experiment, Electron microscope, Heisenberg's uncertainty principle, wave-packet, Wave function and its properties, Postulates of wave mechanics, Schrödinger wave equation and its application for particle in a box.

Unit III
Atomic Physics

Structure of atom, Rutherford nuclear atom model, Hydrogen spectrum, Bohr's theory of Atomic structure, Bohr's theory of the Hydrogen atom, Bohr's Correspondence Principle, Alkali spectra, Franck and Hertz experiment, Types of

Spectra, Emission and Absorption Line spectra, vector atom model and quantum numbers

Unit IV

Nuclear and particle Physics

Basic properties of the nucleus: constituents of the nucleus. Nuclear charge, binding energy, nuclear stability, nuclear forces, Radioactive decays: Alpha decay, beta decay-the neutrino hypothesis, Gamma decay, Radioactive dating, biological effects of radiation exposure, Elementary particles: their classification, elementary idea about quarks, Fundamental interactions-strengths and ranges, unification of forces of nature, standard model and grand unified theory (concept only)

Unit V

X-rays and Cosmic rays

Discovery of X-rays, production of X-rays, properties of X-rays, Practical applications of X-rays, Continuous X-ray spectrum and characteristic X-radiation spectrum, Moseley's law

Discovery of cosmic rays, Experimental methods of study of cosmic rays, General characteristics of cosmic rays, composition of cosmic rays, discovery of positron, secondary cosmic rays, cosmic shower, Mesons: muons and pions, discovery of muons. Decay of muon: its mean life.

Text and reference Books:

1. Principles of Modern Physics, A.K. Saxena, Narosa
2. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, McGraw Hill Education
3. Modern Physics, Jeremy Bernstein, Paul M. Fishbane, Stephen Gosiorowiz
4. Atomic and Nuclear Physics, A.B. Gupta and Dipak Ghosh
5. Modern Physics, S.L. Kakani and Shubhra Kakani

Evaluation Scheme

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

Examination (Theory)	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor Test I (after 30 days)	Up to 25 %	1 and half hour	20

Minor Test II (after 60 days)	Up to 50 %	1 and half hour	20
Major Test I (after 90 days)	Up to 100 %	03 hours	60

Minor Tests

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POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4th Semester)
Course No. PSPHPE410 **Title : Project work in Condensed Matter Physics.**
Credits : 8 (0-0-16) **Maximum Marks : 200**
Duration of Examination : 3 hrs.

Examination to be held in May 2020, 2021,2022.

Objectives : The Projects have been designed so as to provide hands-on exposure to students in various experimental aspects of the physics of crystals. The dept. has a variety of experiments which the students shall have to perform to develop a good technical hand.

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.

Evaluation Scheme

Practical/Project examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4th Semester)
Course No. PSPHPE411 **Title : Project work in Nuclear & Particle Physics.**
Credits : 8 (0-0-16) **Maximum Marks : 200**
Duration of Examination : 3 hrs.

Examination to be held in May 2020, 2021,2022.

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.

Evaluation Scheme

Practical/Project examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4th Semester)
Course No. PSPHPE412 **Title : Project work in Nuclear Theory**
Credits : 8 (0-0-16) **Maximum Marks : 200**
Duration of Examination : 3 hrs.

Examination to be held in May 2020, 2021,2022

Objectives:

During the 4th semester , the students will be assigned a mentor under whose guidance they have to complete a project based on the preliminary research work being carried out in Nuclear Theory Specialization. In the end of the semester, the students have to submit a project report in the form of a dissertation.

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.

Evaluation Scheme

Practical/Project examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

POST GRADUATE DEPARTMENT OF PHYSICS, UNIVERSITY OF JAMMU

Detailed Syllabus : M.Sc.Physics (4th Semester)
Course No. PSPHPE413 **Title : Project work in Electronics**
Credits : 8 (0-0-16) **Maximum Marks : 200**
Duration of Examination : 3 hrs.

Syllabus for the examination to be held in May 2020, 2021, 2022.

Objectives of the course:

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.

List of the requirements for M.Sc. Physics 4th Semester Project Work.

S.No.	Name of the Experiment	Pieces of Scientific equipment/ Model & Make	Proposed For	Cost In INR
1.	Fabrication of semiconductor layered structure devices for their use as photovoltaic and optoelectronic applications	Atomic Layer Deposition (ALD) setup.	M.Sc. Project Work	Approx. Rs. 60.00 Lacs
2.	The preparation of compound semiconductor thin films for photovoltaic & optoelectronic applications and calculation of their parameters	1. Furnance Temperature upto 1500^0C & Accessories	M.Sc. Project Work	Approx. Rs. 4.50 Lacs
		2. Cu K alpha X-ray source(Tube) & Accessories		Approx. Rs. 6.00 Lacs
3.	Synthesis of basic nanostructures	Hot plate, spin coater, Muffle furnace & Accessories	M.Sc. Project Work	Approx. Rs. 3.00 Lacs

Total =Rs. 73.50 lacs EXCLUDING GST and customs duty (if any)

<u>Evaluation Scheme</u>

Practical/Project examination consists of two parts ï Internal and External. Internal part is 50% of the total marks and external is 50% of the total marks.

Note:

Addition and deletion in the list of practicalôs may be made from time to time by the department.
Minimum of 06 practicalôs have to be performed in case of practical course in semester-III.