FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. (HS) PHYSICS (CBEGS)
(Semester : III-VI)
(FOR OLD STUDENTS)

Examinations: 2019-20

GURU NANAK DEV UNIVERSITY
AMRITSAR

**(ii) Subject to change in the syllabi at any time.
Please visit the University website time to time**

B.Sc. (HS) Physics (Semester System)
(Credit Based Evaluation & Grading System)

Semester III

Course No.	**C/E/I**	**Course Title**	**Hrs/Week**	**LTP**
*ESL-220	C	Environmental Studies (Compulsory)	3	4-0-0
PHL-202	C	Electricity & Magnetism-II	4	3-1-0
PHL-203	C	Optics	4	3-1-0
MTL-231	C	Mathematics-III	4	3-1-0
CYL-291	C	Physical Chemistry	4	3-1-0
I-1	I		4	4-0-0
PHP-223	C	Modern Physics Experiment and Workshop	6	0-0-3
CYP-292	C	Physical Chemistry Lab.	6	0-0-3

Total Credits : 30

***Note : Credits will not be included in the total.**

Semester IV

Course No.	**C/E/I**	**Course Title**	**Hrs/Week**	**LTP**
PHL-251	C	Electronics	4	3-1-0
PHL-253	C	Theory of Relativity	4	3-1-0
PHL-255	C	Quantum Mechanics-I	4	3-1-0
MTL-232	C	Mathematics-IV	4	3-1-0
I-2	I		4	4-0-0
PHP-271	C	Optics Lab	6	0-0-3
PHP-272	C	Electronics Lab	6	0-0-3

Total Credits : 26

Note : 1. PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory ID Paper). Students can opt. this paper in any semester except the 1st Semester. This ID Paper is one of the total ID Papers of this course.
2. Marks will not be included in the total marks.

B.Sc. (HS) Physics (Semester System)
(Credit Based Evaluation & Grading System)

Semester V

Course No.	**C/E/I**	**Course Title**	**Hrs/Week**	**LTP**
PHL-301	C	Solid State Physics	4	3-1-0
PHL-302	C	Classical Mechanics	4	3-1-0
PHL-305	C	Spectroscopy	4	3-1-0
PHL-306	C	Mathematical Physics -I	4	3-1-0
I-3	*I		4	4-0-0
PHP-321	C	Spectroscopy Lab	6	0-0-3
PHP-322	C	Solid State Physics Lab	6	0-0-3

Total Credits : 26

Semester VI

Course No.	**C/E/I**	**Course Title**	**Hrs/Week**	**LTP**
PHL-352	C	Nuclear and Particle Physics	4	3-1-0
PHL-353	C	Statistical Mechanics	4	3-1-0
PHL-356	C	Quantum Mechanics-II	4	3-1-0
PHL-357	C	Mathematical Physics -II	4	3-1-0
I-4	I		4	4-0-0
PHP-371	C	Nuclear Physics Lab	6	0-0-3
PHP-373	C	Computer Lab	6	0-0-3

Total Credits : 26

B.Sc. (HS) Physics (Semester-III)
(Credit Based Evaluation & Grading System)

ESL-220 : ENVIRONMENTAL STUDIES (COMPULSORY)

Credits: 4-0-0

Teaching Methodologies

The Core Module Syllabus for Environmental Studies includes class room teaching and field work. The syllabus is divided into 8 Units [Unit-1 to Unit-VII] covering 45 lectures + 5 hours for field work [Unit-VIII]. The first 7 Units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit-VIII comprises of 5 hours field work to be submitted by each candidate to the Teacher in-charge for evaluation latest by 15 December, 2019.

Exam Pattern: **End Semester Examination- 75 marks**
Project Report/Field Study- 25 marks [based on submitted report]
Total Marks- 100

The structure of the question paper being:

Part-A, Short answer pattern with inbuilt choice – **25 marks**
Attempt any five questions out of seven distributed equally from Unit-1 to Unit-VII.
Each question carries 5 marks. Answer to each question should not exceed 2 pages.

Part-B, Essay type with inbuilt choice – **50 marks**
Attempt any five questions out of eight distributed equally from Unit-1 to Unit-VII. Each question carries 10 marks. Answer to each question should not exceed 5 pages.

Project Report / Internal Assessment:

Part-C, Field work – **25 marks [Field work equal to 5 lecture hours]**
The candidate will submit a hand written field work report showing photographs, sketches, observations, perspective of any topic related to Environment or Ecosystem. The exhaustive list for project report/area of study are given just for reference:

1. Visit to a local area to document environmental assets: River / Forest/ Grassland / Hill / Mountain / Water body / Pond / Lake / Solid Waste Disposal / Water Treatment Plant / Wastewater Treatment Facility etc.
2. Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
3. Study of common plants, insects, birds
4. Study of tree in your areas with their botanical names and soil types
5. Study of birds and their nesting habits
6. Study of local pond in terms of wastewater inflow and water quality
7. Study of industrial units in your area. Name of industry, type of industry, Size (Large, Medium or small scale)
8. Study of common disease in the village and basic data from community health centre
9. Adopt any five young plants and photograph its growth
10. Analyze the Total dissolved solids of ground water samples in your area.
11. Study of Particulate Matter ($PM_{2.5}$ or PM_{10}) data from Sameer website. Download from Play store.
12. Perspective on any field on Environmental Studies with secondary data taken from Central Pollution Control Board, State Pollution Control Board, State Science & Technology Council etc.

Unit-I

The multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness

(2 lectures)

Unit-II

Natural Resources: Renewable and non-renewable resources:

Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

(8 Lectures)

Unit-III

Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

(6 Lectures)

Unit-IV

Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

(8 Lectures)

Unit-V

Environmental Pollution

Definition

- Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

(8 Lectures)

Unit-VI

Social Issues and the Environment

- From unsustainable to sustainable development
- Urban problems and related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environmental Protection Act, 1986
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention and control of Pollution) Act, 1974
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

(7 Lectures)

Unit-VII

Human Population and the Environment

- Population growth, variation among nations
- Population explosion – Family Welfare Programmes
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and Human Health
- Case Studies

(6 Lectures)

Unit-VIII

Field Work

- Visit to a local area to document environmental assets river/forest/grassland/hill/mountain
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems-pond, river, hill slopes, etc

(Field work equal to 5 lecture hours)

References:

1. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
2. Down to Earth, Centre for Science and Environment, New Delhi.
3. Heywood, V.H. & Waston, R.T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
4. Joseph, K. & Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
5. Kaushik, A. & Kaushik, C.P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
6. Rajagopalan, R. 2011. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
7. Sharma, J. P., Sharma. N.K. & Yadav, N.S. 2005. Comprehensive Environmental Studies, Laxmi Publications, New Delhi.
8. Sharma, P. D. 2009. Ecology and Environment, Rastogi Publications, Meerut.
9. State of India’s Environment 2018 by Centre for Sciences and Environment, New Delhi
10. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.

B.Sc. (HS) Physics (Semester-III)
(Credit Based Evaluation & Grading System)

ELECTRICITY & MAGNETISM-II

Course No. **LTP**
PHL-202 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Faraday's law: Faraday's law of electromagnetic induction, a stationery circuit in a time varying field, a moving conductor in a static magnetic field, a moving circuit in a time varying magnetic field, Mutual inductance, reciprocity theorem, self inductance, a circuit containing self inductance, energy stored in magnetic field, displacement current.

15 Lectures

SECTION-B

Maxwell's Equations, Integral form of Maxwell's equations. Potential functions, electromagnetic boundary conditions, Inter-face between two loss-less linear media, Interface between a dielectric and perfect conductor. Wave equations and their solutions. Time harmonic electromagnetics, source free fields in simple media.

15 Lectures

SECTION-C

Plane Electromagnetic Waves: Plane waves in lossless media, transverse electromagnetic waves, polarisation of plane waves, plane waves in conducting media, Low-loss dielectric, good conductor, group velocity. Flow of electromagnetic power and the poynting vector. Instantaneous and average power density.

15 Lectures

SECTION-D

Normal and oblique incidence at a plane conducting boundary, Perpendicular and parallel polarisation, normal incidence at a plane dielectric boundary and at multiple dielectric interfaces, wave impedance of total field, impedance transformation with multiple dielectrics, oblique incidence at a plane dielectric boundary, total reflection, perpendicular and parallel polarisation.

15 Lectures

Reference Books:

1. Field & wave Electromagnetics by David & Cheng, Addison Wesley Publishing co, 1996.
2. Introduction to Electrodynamics by David J. Griffiths, Prentice Hall of India, 2012.

B.Sc. (HS) Physics (Semester-III)
(Credit Based Evaluation & Grading System)

OPTICS

Course No. **LTP**
PHL-203 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Overview of models of light; Examples of diffraction, Simple harmonic motion and addition of waves, Propagating waves, Complex representation of waves, Plane waves, sign convention, propagation directions, Spherical waves, Converging waves, Diverging waves, Paraxial approximation.

15 Lectures

SECTION-B

Superposition of Waves, Addition of propagating waves, Introductory interferometry, Two Beam Interference, Division of Wavefront Interferometers (Young's Experiment and variants), Division of Amplitude Interferometers (Michelson Interferometer), Multiple Beam Interference, Division of Wavefront Interferometers (Multiple coherent oscillators), Division of Amplitude Interferometers (Fabry-Perot interferometer).

15 Lectures

SECTION-C

Diffraction theory, Huygen's principle, Fresnel Formulation of Huygen's Principle, Rayleigh-Sommerfeld diffraction, Paraxial Approximation, Fresnel diffraction, Fraunhofer diffraction Diffraction from Apertures, Fraunhofer and Fresnel Diffraction from rectangular apertures, Fraunhofer diffraction from circular apertures, Fresnel diffraction from straight edges;

15 Lectures

SECTION-D

Fourier series and integrals: Dirac delta function, Fourier theorems,Wave model of lenses and imaging, Diffraction using a transform lens, Coherent Optical Fourier Processor Amplitude Impulse Response, Coherent Transfer Function, Introduction to Holography, Incoherent Imaging Intensity Impulse Response, Resolution, Incoherent Transfer Function

15 Lectures

Reference Books:
1. Introduction to Modern Optics (2nd ed.), G.R. Fowles, Dover, ISBN 0-486-65957-7, 2012.
2. Fundamentals of Optics, F.A. Jenkins & H.E. White, McGraw-Hill, 2011.
3. Schaum's Outline of Theory and Problems of Optics, E. Hecht, McGraw-Hill, ISBN 0-07-027730-3,1998.

B.Sc. (HS) Physics (Semester-III)
(Credit Based Evaluation & Grading System)

MATHEMATICS-III

Course No. **LTP**
MTL-231 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Determinants & Matrices: Definition and expansion properties of determinants. Product of determinants of order three. Algebra of matrices. Inverse of matrices, singular and non – singular matrices. Special types of matrices. (unitary, Hermitian and orthogonal). Statement of Cayley - Hamilton theorem, Rank of a matrix, Condition of Consistency of a system of linear equations.

15 Lectures

SECTION-B

Co-ordinate Geometry: Polar and Cartesian co-ordinates. Distance formula. Section formula of a line in different forms. Angle between two lines. Intersection of two lines. Standard equation of ellipse, parabola and hyperbola.

15 Lectures

SECTION-C

Vector Calculus: Definition and graphical representation. Addition and subtraction of vectors. Scalar and vector products. Scalar and Vector triple products. Differentiation of a vector function. Gradient, Divergence and Curl operators and their expressions in cylindrical and spherical co-ordinates. Statement of Gauss, Green & Stokes theorems and their applications.

15 Lectures

SECTION-D

Tensors: Cartesian tensors of different orders, vectors and moments of inertia as tensor quantities, addition, multiplication, contraction and Quotient rule of tensors, introduction to general tensors, covariant, contravarient and mixed tensors, Differentiation of tensors, covariant derivative of a tensor.

15 Lectures

References Books:-

1. Mathematics Hand book : M. Vygodsky, Mir, Moscow, 1975.
2. Higher Engineering Mathematics : B.S. Grewal, Delhi, Khanna, 1995.
3. Applied Mathematics for Engineers and Physicists : Pipes & Harvill, London, McGraw Hill, 1970.
4. Mathematics of Physics and Modern Engineering : Sokolnikoff & Recheffer,1984.
5. Mathematical Methods for Physicists : George Arfken, New York, Academic Press, 1970.

B.Sc. (HS) Physics (Semester-III)
(Credit Based Evaluation & Grading System)

PHYSICAL CHEMISTRY

Course No. **LTP**
CYL-291 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Chemical Thermodynamics: System and surroundings properties and variables of a system, laws of thermodynamics, Enthalpy of a system, heat capacity, Isothermal & adiabatic processes in ideal gases, Joule-Thomos effect, Carnot cycle, thermodynamic efficiency. Thermo-Chemistry: heat of reaction at constant volume and pressure thermochemical equations, calculations of E from H & vice versa, Hess's law of heat summation, heat of formation, heats of combustion, heat of solution, heat of neutralization of acids & bases, heat of formations of ions, heat of reaction from bond enthalpies, dependence of H & E for a reaction (Kirchoff's equation). II & III law of thermodynamics: Entropy, dependence of entropy on variables of a system, Entropy change in ideal gases, entropy of mixing for ideal gases, entropy change in physical transformations, Entropy change in chemical reactions, absolute Entropies, residual entropy, thermodynamics of III Law.

15 Lectures

SECTION-B

Spontaneity and Equilibrium : General conditions for Equilibrium and Spontaneity under constraints, Helmholtz free energy (A) for reactions, Gibbs free energy.

Chemical Equilibrium: Chemical potential, Gibbs free energy and entropy of mixing of ideal gases. The Equilibrium constants Kp and Kc of real gases Temperature dependence of Equilibrium constant. The Lechatelier principle.

10 Lectures

SECTION-C

Phase Rule: Gibbs Phase rule, derivation of phase rule, one component system, the water system, the sulphur system, two components system-simple eutectic diagram, formation of compound with congruent M. pt. Chemical Kinetics: Measurement of reaction rate, order, molecularity of reaction, first order reactions, second order reactions, third order reactions. Methods of determination of order, effect of temperature, activation energy, catalysis, Homogeneous catalysis in gases, homogenous catalysis in solutions.

20 Lectures

SECTION-D

Electro Chemistry: Conductance & Ionic Equilibrium: Faraday's law of electrolysis, transference numbers determination of transference numbers, electrolytic conductance, variation of conductance with concentration, equivalent conductance at infinite dilution, intrinsic attraction theory of conductance, Absoute velocities of ions, degree of ionization & conductance activity & activity coefficients of strong electrolytes, determination of activity coefficients, Debye-Huckel Theory of activity coefficients, Ionization constants of weak acids, & weak bases. Ionic product of water, pH & pOH Buffer solution, hydrolysis, calculation of hydrolytic constants, solubility product, salt effect & solubility. Electrochemical Cells: Reversible & Irreversible cells, standard cells, cell reaction & EMP, single electrode potential & its calculation, thermodynamic & EMF, standard potential & equilibrium constants, Classification of electrodes, chemical & concentration cells, Junction potential, solubility product & EMF.

15 Lectures

Reference Books:

1 Physical Chemistry by Samuel H, Carl P. Prutton Americ Inc. Co.
2 Physical chemistry by Glassstone, The Macmillian Press Ltd.
3 Kinectic and Mechanism by frost A and Pearson R.G, Wiley Eastern Pvt. Ltd.
4 Chemical Kinectic by K.J. Laidler, Harper and Row.
5 Physical chemistry by Glberg W. Castellian Addison- Wesley publishing Comp

B.Sc. (HS) Physics (Semester-IV)
(Credit Based Evaluation & Grading System)

ELECTRONICS

Course No. **LTP**
PHL-251 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

P.N. Junction: Intrinsic/Extrinsic semiconductor, Fermi level, charge carriers in semiconductors, pn-junctions, current components in pn-junction, characteristic of pn junction diode, pn junction as rectifier, efficiency, ripple factor, qualitative ideas of filter circuits,characteristics and applications of Zener diode, tunnel diode.

15 Lectures

SECTION-B

Electronic Devices: Bipolar junction transistor, current components in transistors, CB, CE, CC configurations, transistor biasing, h-parameters, transistor as an amplifier, Construction and Working of FET, MOSFET.

15 Lectures

SECTION-C

Transistor Circuits: Feedback amplifiers and oscillators; Feed-back concept, negative feed-back,sinusoidal oscillations; phase shift oscillator, basic idea about AM modulation and demodulations.

15 Lectures

SECTION-D

Digital Principles: Number system, decimal, binary, octal, hexadecimal, Boolean algebra, logic gates: AND, OR, NOT, NAND, NOR, XOR and XNOR.

15 Lectures

Reference Books:

1. Electronic Devices & Circuits–J.Millman and C.C.Halkias (Tata McGraw Hill, 2009).
2. Electronic Devices and Circuit Theory – Robert L. Boylestad, Louis Nashelsky.
3. Digital Principles & Applications–P.Malvino& Leach (Tata McGraw Hill,1993)

B.Sc. (HS) Physics (Semester-IV)
(Credit Based Evaluation & Grading System)

THEORY OF RELATIVITY

Course No. **LTP**
PHL-253 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

General Relativity: Linearized general relativity, Gange invariant characterization of gravitational degrees of freedom, space time of an isolated weakly gravitational waves, gravitational lensing, cosmology, froedmann-robertson-walker solution, distance measures and redshift, our universe.

10 Lectures

SECTION-B

The Lorentz Transformation: Newtonian relativity. Instances of its failure in electromagnetism, attempts to locate the absolute frame of reference, aberration of star light, ether-drag hypothesis and Fizeau's experiment. Michelson-Morley experiment, Lorentz-Fttzgerald contraction, Einstein's basic postulates of relativity and geometric derivation of Lorentz transformation, Invariance of Maxwell's equations, length contraction, relativity of simultaneity, synchronization and time dilation. Einstein's velocity addition rule, transformation of acceleration. Aberration and Doppler effect of relativity, Twin paradox and its resolution.

20 Lectures

SECTION-C

Relativistic Dynamics: Variation of mass with velocity, mass energy equivalence, relativistic formulae for momentum and energy, transformation of momentum, energy and force. Transformation of electromagnetic fields, Magnetism as a relativistic phenomenon

10 Lectures

SECTION-D

Structure of Spacetime and Principle of Equivalence: Concept of Minkowski space, geometrical interpretation of Lorentz transformations of space & time; simultaneity; contraction and dilation. Space-like, time like and light-like intervals, four vectors, concept of world lines, Principle of Equivalence, gravitational and inertial mass, gravitational mass of photons, gravitational red shift, Precession of the perihelion of Mercury.

20 Lectures

Reference Books:

1. Mechanics : Berkeley Physics Course Vol-I, C. Kittel, W.D. Knight, M.A. Ruderman, C.A. Helmholtz and B.J. Moyer- Tata McGraw Hill Publishing Company Ltd., New Delhi, 2011.
2. The Special Theory of Relativity, S. Banerji & A. Banerji (Prentice Hall India),2012.
3. Introduction of to Special Relativity: R. Resnick Wiley Eastern India Pvt. Ltd, 2007.
4. The Feymann Lectures Physics: R.P. Feymann, R.B. Leighton and M. Sands, Vol. I & II- Narosa Publishing House, New Delhi, 1963.
5. "Special Relativity" A.P. French, N.W. Norton and Company Inc. , New York, 1968.

B.Sc. (HS) Physics (Semester-IV)
(Credit Based Evaluation & Grading System)

QUANTUM MECHANICS-I

Course No. **LTP**
PHL-255 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Inadequacy of classical Physics: Spectral radiation – Planck's law. Photoelectric effect – Einstien's photoelectric equation. Compton's effect (quantitative) experimental verification. Stability of an atom – Bohr's atomic theory. Limitations of old quantum theory. Matter Waves: de Broglie's hypothesis – wavelength of matter waves, properties of matter waves. Davisson and Germer experiment. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits.

15 Lectures

SECTION-B

Uncertainty Principle: Heisenberg's uncertainty principle for position and momentum (x and px), Energy and time (E and t). Gamma ray microscope. Diffraction by a single slit. Position of electron in a Bohr orbit. Particle in a box. Complementary principle of Bohr.

15 Lectures

SECTION-C

Formalism of wave mechanics: Brief introduction to need and development of quantum mechanics, correspondence principle, Schrodinger equation-time dependent and steady state forms, expectation value, Normalization and probability interpretation of wave function, standard deviation, probability current and conservation of probability, eigen function and eigen values

15 Lectures

SECTION-D

Schrodinger Wave Equation: Infinite square well, free particle: wave packet, group velocity, phase velocity, delta potential, Schrodinger equation for hydrogen atom, separation of variables, quantum numbers.

15 Lectures

Reference Books:
1. Quantum Physics of Atoms Molecules Solids, Nuclei & Particles: R. Eisberg and R. Resnick, 1985.
2. Introduction to Quantum Mechanics by David J. Griffiths, Prentice Hall, Inc., 1995
3.Elementary Modern Physics: Atam P. Arya, 1971.
4.Concepts of modern physics: A. Beiser, 2003.
5. Introduction to Atomic and Nuclear Physics: H. Semat and J.R. Albright, 1978.
6. Introduction to Quantum Mechanics by David J. Griffiths, Prentice Hall, Inc., 1995

B.Sc. (HS) Physics (Semester-IV)
(Credit Based Evaluation & Grading System)

MATHEMATICS-IV

Course No. **LTP**
MTL-232 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Complex variables: Complex numbers and their geometrical representation, De-Moivre's theorem and its simple applications, analytic functions, statement of Cauchy's theorem, singularities, Cauchy's integral formula, statement of Taylor's and Laurant's theorem, Cauchy's residue theorem and its application to evaluation of definite integrals of simple types.

20 Lectures

SECTION-B

Group Theory: Sets, intersection, union, complement, mapping, binary operation, associative and commutative laws, identity existences, definition of a group and group operations, permutation groups, subgroups, isomorphic groups, Cayley's theorem, congruence group, of geometrical forms, rotation groups of triangle and square, group representation, reducible and irreducible representations.

20 Lectures

SECTION-C

Probability theory and distributions: Axiomatic theory of probability, probability density function, conditional probability, mathematical expectation, moments, moment generating function, characteristic function, central limit theorem, conditional and marginal distribution, special frequency distributions, Binomial, Poisson, Normal, Uniform, Gamma, Beta and Exponential distribution.

10 Lectures

SECTION-D

Curve fitting: Curve fitting by least square, fitting of polynomial, of n^{th} degree, power curve and exponential curve.

10 Lectures

References Books:-

1. Mathematics Hand book : M. Vygodsky, Mir, Moscow, 1975.
2. Higher Engineering Mathematics : B.S. Grewal, Delhi, Khanna, 1995.
3. Applied Mathematics for Engineers and Physicists : Pipes & Harvill, London, McGraw Hill, 1970.
4. Mathematics of Physics and Modern Engineering : Sokolnikoff & Recheffer, 1984.

B.Sc. (HS) Physics (Semester-V)
(Credit Based Continuous Evaluation Grading System)

SOLID STATE PHYSICS

Course No. **LTP**
PHL-301 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

SECTION-A

Crystal Structure: Lattice translation, vectors and lattices, symmetry operations, basis and crystal structure, Miller indices, unit cell, two dimensional lattice, three dimensional lattices, hexagonal close packed structure. FCC and BCC structure, simple crystal structure, diffraction of x-rays according to law of Bragg and diffraction conditions. Reciprocal lattice, Brillouin zone, Reciprocal lattice to SC, BCC and FCC lattice, Atomic form factor, geometrical structure factor, rules for identifying simple structures(SC, BCC and FCC) using x-rays diffraction.

15 Lectures

SECTION-B

Crystal Binding and lattice Vibrations: Various types of binding, crystals of inert gases, Vander Waals-London interactions. Lenard-Jones potential, Ionic crystals, Madelung constant, Bulk Modulus, calculation of repulsive exponent. Quantization of Lattice vibrations, phonon momentum, inelastic scattering by phonons (Normal and Umclampp processes). Wave motion on a lattice, one dimensional line of atoms, symmetry of dispersion relation, total number of normal modes (Bon Ker man boundary conditions) linear diatomic lattice, optical and acoustical branch.

15 Lectures

SECTION-C

Free Electron Theory: Drude-Lorentz theory, Sommerfeld model, the Fermi-Dirac distribution, Effect of temperature on f-d distribution, electronic specific heat, the electrical conductivity and Ohm's Law, the thermal conductivity of metals. Wiedemann-Frenz law, Hall effect.

15 Lectures

SECTION-D

Band Theory: Nearly free electron model, origin and magnitude of energy gap, Density of states, K-space, Bloch theorem, Kronig-Penney model of an infinite one dimensional crystal, classification of insulators, semiconductors and metals.

15 Lectures

Reference Books:

1. An introduction to Solid State Physics - C. Kittel, Wiley 2008.
2. Solid State Physics – A.J. Dekkar, Macruillan, 1967.
3. Principles of Solid State Physics – R.A. Levy, Academic Press, 20

CLASSICAL MECHANICS

Course No. **LTP**
PHL-302 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

SECTION-A

Constrained Motion: Constraints, Classification of Constraints, Principal of Virtual Work, D'Alembert's principal and its applications (Problems only), (One or Two Problems should be discussed with D'Alembert's, Lagrangian, Hamiltons from same set of problems).

10 Lectures

SECTION-B

Lagrangian formulation: Generalized coordinates, Langrange's equations of motion, properties of kinetic energy function, theorem on total energy, generalized momenta, cyclic-coordinates, integrals of motion, Jacobi integrals and energy conservation, Concept of symmetry, invariance under Galilean transformation, velocity dependent potential.

15 Lectures

SECTION-C

Hamilton's formulation: Hamilton's function and Hamilton's equation of motion, configuration space, phase space and state space, Lagrangian and Hamiltonian of relativistic particles and light rays. Variational Principle: Variational principle, Euler's equation, applications of variational principle, shortest distance problem, brachistrochrone, Geodesics of a Sphere.

15 Lectures

SECTION-D

Canonical Transformations: Generating function, Conditions for canonical transformation and problems. Definition, Identities, Poisson theorem, Jacobi-Poisson theorem, Jacobi identity, (statement only), invariance of PB under canonical transformation. Rotation Motion and Center force: Rotating frames of reference, inertial forces in rotating frames, Larmour precision, electromagnetic analogy of inertial forces, effectsof Coriolis force, Focoult's pendulum.Two body central force problem, stability of orbits, condition for closure, integrable power laws, Kepler's problems, orbits of artificialsatellites, Virial theorem.

20 Lectures

Reference Books :

1. Classical Mechanics by H.Goldstein, Narosa Publishing Home, New Delhi, 2002.
2. Classical Dynamics of Particles and Systems by Marion and Thomtron, Third Edition, Horoloma Book Jovanovich College Publisher, 2004.
3. Classical Mechanics by N.C.Rana and P.S.Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2001.

B.Sc. (HS) Physics (Semester-V)
(Credit Based Continuous Evaluation Grading System)

SPECTROSCOPY

Course No.	**LTP**
PHL-305	**3 1 0**
Time: 3 Hours	**Max. Marks: 100**
	Mid Semester Marks : 20
	End Semester Marks : 80

SECTION-A

Introduction to Atomic Spectra: Observation of spectra, Types of spectra, Light sources, Spectral analysis, Units in spectroscopy, Bohr's Theory and Hydrogen spectrum, Explanation of Spectral series, Representation of spectral lines by terms, Energy level Diagram, Ritz combination Rule, Continuum at series limit, Evidences in favour of Bohr's Theory, Experimental confirmation of Bohr's theory, Franck-Hertz Experiment**.**

15 Lectures

SECTION-B

Spectra of Alkali Atoms: Different series in Alkali Spectra, Term values. The effective quantum number and the quantum defect, The Spinning electron and the vector model, The normal order of fine structure doublets, Electron Spin orbit interaction, Spin orbit interaction for Non-penetrating orbits, Doublet structure in alkali Spectra (Fine Structure), Energy level diagram of Sodium Atom, Selection rules for doublets, Intensity rules for fine structure doublets.

15 Lectures

SECTION-C

Zeeman Effect and the Paschen-Bach effect: Early discoveries and developments, The vector model of one electron system in weak magnetic field. The magnetic moment of a bound electron, Magnetic interaction energy, Selection rules, Intensity rules, The Paschen-Bach effect, The Paschen-Bach effect of a Principal-series doublet, Selection rules for the Paschen-Bach effect, the Zeeman and Paschen-Bach effect of hydrogen.

15 Lectures

SECTION-D

X-rays Spectra: Production of X-rays, Origin of X-rays from electromagnetic theory, X-ray diffraction, Bragg's law, Laue Spots, Bragg's spectrometer, Reflection and refraction of X-rays, X-ray scattering, Continuous X-ray spectrum, Characteristics absorption and emission Spectra, comparison of optical and X-ray Spectra, Moseley's law, Applications of Moseley's law.

15 Lectures

Reference Books:

1. Introduction to Atomic Spectra by H. E. White-Aurkland Tata Mc-Graw Hill, 1934.
2. Atomic Spectra and Atomic structure by Gerhard Herzberg, NY, 1944.
3. Concepts of Modern Physics by Arthur Beiser, Tata Mc-Graw Hill 2003.

B.Sc. (HS) Physics (Semester-V)
(Credit Based Continuous Evaluation Grading System)

MATHEMATICAL PHYSICS-I

Course No. **LTP**
PHL-306 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

SECTION-A

Coordinate systems: Curvilinear coodinates, Differential vector operators in curvilinear coordinates, spherical and cylinderical systems, General coordinate transformation, Tensors: covariant, contravariant and mixed, algebraic operations on tensors, Illustative applications with reference to relativity and classical electrodynamics. Differential equations: Second order differential equations, Frobenius method, Wronskian and a second solution, the strum Liouville theorem.

15 Lectures

SECTION-B

Linear spaces and operators: Vector spaces and subspaces, Linear dependence and independence, Basis and Dimensions, linear operators, Inverses, Matrix representation, Similarity transformations, Eigenvaluesand eigenvectors, Inner product, Orthogonality, Introduction only to Gramm-Schmidt orthogonalization procedure, Self adjoint and Unitary transformations, Eigenvalues & eigenvectors of termitian & Unitary transformations, Diagonalization.

15 Lectures

SECTION-C

Special Functions: Legendre Hermite, Laguerre function – Generating function, Recurrence relations and their differential equations Orthogonality properties, Bessels's function of first kind , Spherical Bessel function, Associated Legendre function, Spherical harmonics.

15 Lectures

SECTION-D

Fourier Series and Integral transforms : Fourier Series : Definition, Dirichlet's condition, Convergence, Fourier Integral and Fourier transform, Convolution theorem, Parseral's identity, Applications to the solution of differential equations, Laplace transform and its properties, Applications to the solution of differential equations, Fourier transform & Laplace transform of Dirac Delta function.

15 Lectures

Reference Books :

1.Mathematical methods for Physicists – Arfken & Weber – 6th Edition-Academic Press- N.Y.1990
2. Mathematical Methods of Physics – Mathews & Walker – 2nd Edition- Pearson Edition 1968.

B.Sc. (HS) Physics (Semester-VI)
(Credit Based Continuous Evaluation Grading System)

NUCLEAR & PARTICLE PHYSICS

Course No. **LTP**
PHL-352 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

SECTION-A

Structure and Properties of the Nucleus: Structure of the nucleus: Discovery of the nucleus, composition, basic properties; charge, mass, size, spin, magnetic moment, electric quadrupole moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus, coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve, liquid drop model of the nucleus.

10 Lectures

SECTION-B

Radioactivity: The radioactive decay law, decay constant and half life; methods of measurement of half life, spectra of emitters. Alpha decay: Basic decay process, Geiger-Nuttal law, Gamow's explanation, angular momentum and parity in a decay, energy release in alpha decay. Beta decay: Fermi's theory, angular momentum and parity selection rules, neutrino and antineutrino, non conservation of parity in beta decay and its experimental verification. Gamma decay: Energetics of a decay, elementary theory of multiple transitions, angular momentum and parity selection rules, internal conversion, nuclear absorption and fluorescence, Mössbauer effect, energy levels.

20 Lectures

SECTION-C

Interaction of Radiation with Matter: Energy loss of particles in passage through matter, stopping power of matter for charged particles, energy range relationship and straggling. Interaction of gamma radiation with matter: photoelectric effect, Compton effect and pair production. Thomson scattering and Rayleigh scattering. Detectors and Accelerators: Detectors for charged particles: ion chamber, Geiger counter, cloud chamber, photographic emulsions, bubble chamber and Solid State Nuclear Track Detectors. Need for accelerators: Cockroft, Walton, Van de Graff, cyclic accelerators, cyclotron, synchrocyclotron, variable energy cyclotron, phase stability, superconducting magnets.

20 Lectures

SECTION-D

Cosmic Rays and Elementary Particles: Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life time determination for muon and pion. Primary Cosmic Rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories. Resonance Particles**:** Discovery and important properties, Strangeness, conservation of strangeness in particle interactions, quark hypothesis, high energy electron scattering from protons, basic interactions of quark and leptons, interrelation between particle physics and cosmology.

10 Lectures

Reference Books:

1. R.D. Evans: Atomic Nucleus, Krieger Publishing Co. 2003
2. K.S. Krane: Introductory Nuclear Physics, Wiley 2008.
3. P. Mermier and E. Sheldon: Physics of Nuclei and particles, Academic Press, 2013.

STATISTICAL MECHANICS

Course No. **LTP**
PHL-353 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

SECTION-A

Classical Stat. Mech. I : Foundations of statistical mechanics; specification of states in a system, contact between statistics and thermodynamics, the classical ideal state, the entropy of mixing and Gibbs paradox. The phase space of a classical system, Liouville's theorem and its consequences.

15 Lectures

SECTION-B

Classical Stat. Mech. II : The microcanonical ensemble with examples. The canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations in the canonical ensemble. A system of harmonic oscillators. The statistics of paramagnetism. The grand canononical ensemble, the physical significance of the statistical quantities, examples, fluctuation of energy and density. Cluster expansion of classical gas, the virial equation of state.

15 Lectures

SECTION-C

Quantum Stat. Mech.I : Quatum states and phase space, the density matrix, statistics of various ensembles. Example of electrons in a magnetic field, a free particle in a box and a linear harmonic oscillator. Significance of Boltzamann formula in classical and quantum statistical mechanics.

15 Lectures

SECTION-D

Quantum Stat. Mech. II : An ideal gas in quantum mechanical microcanonical ensemble. Statistics of occupation numbers, concepts and thermodynamical behaviour of an ideal gas. Bose Einstein condensation. Discussion of a gas of photons and phonons. Thermodynamical behaviour of an ideal fermi gas, electron gas in metals, Pauli's paramagnetism, statistical equilibrium of white dwarf stars.

15 Lectures

Reference Books:

1. Statistical Mechanics:R.K. Patharia Butterworth-Heineman, 1996
2. Statistical Mechanics: Kerson Huang-Wiley-1963.

B.Sc. (HS) Physics (Semester-VI)
(Credit Based Continuous Evaluation Grading System)

QUANTUM MECHANICS-II

Course No.	**LTP**
PHL-356	**3 1 0**
Time: 3 Hours	**Max. Marks: 100**
	Mid Semester Marks : 20
	End Semester Marks : 80

SECTION-A

Basic Formulation: *One Dimensional Systems:* Potential Step, potential barrier, potential well finite. Scattering vs. Bounds states. Simple harmonic oscillator, Stern-Gerlach experiment as a tool to introduce quantum ideas, analogy of two level quantum system with polarization states of light.

15 Lectures

SECTION-B

Quantum Kinematics: Linear vector space, ket vector, bra vector, linear operators, Hermitian conjugate, definition of representation, matrix representation of kets, bras and operators, change of representation, eigen values and eigen vectors of an operator, observables and commuting oservables, |r> and |p> representations

15 Lectures

SECTION-C

Quantum Dynamics: The equation of motion, Schrodinger picture, evolution of time development operator, Hamiltonian as generator of time evolution, Schrodingers equation of motion, Stationary states, Ehrenfest's theorm, Heisenberg picture, Heisenberg's equation of motion, interaction picture.

15 Lectures

SECTION-D

Angular Momentum algebra: Angular momentum commutation relations. Eigen vectors and eigen functions of J^2 and J_z. , Matrix elements of anular momentum operators, Addition of angular momentum and C.G. coefficients. Spherical tensors and Wigner Eckart theorem.

15 Lectures

Reference Books:

1. Quantum Mechanics, Volume 1 by Claude Cohen-Tannoudji , Bernard Diu , Frank Laloe
2. Modern Quantum Mechanics by J. J. Sakurai (Principal text)-Pearson Education Pvt. Ltd., New Delhi, 2002.
3. Introduction to Quantum Mechanics by David J. Griffiths, Prentice Hall, Inc., 1995
4. Quantum Mechanics by L I Schiff-Tokyo Mc Graw Hill, 1968.
5. Feynman lectures in Physics Vol. III-Addison Wesly, 1975.
6. Quantum Mechanics by Powel and Craseman-Narosa Publication, New Delhi, 1961
7. Quantum Mechanics by Merzbacher-John Wiley & Sons, New York, 1970.

MATHEMATICAL PHYSICS-II

Course No. **LTP**
PHL-357 **3 1 0**
Time: 3 Hours **Max. Marks: 100**
Mid Semester Marks : 20
End Semester Marks : 80

SECTION-A

Group Theory: What is a group? Multiplication table, conjugate elements and classes, subgroups, Isomorphism and Homomorphism, Definition of representation and its properties, Reducible and irreducible representations, Schur's lemmas (only statements), characters of a representation. Example of C4v, Topological groups and Lie groups, three dimensional rotation group, special unitary groups SU(2) and SU(3).

15 Lectures

SECTION-B

Tensors: Introduction, definitions, contraction, direct product, Quotient rule, Levi-Civita symbol, Noncartesian tensors, metric tensor, Covariant differentiation. Illustrative applications with reference to relativity and classical electrodynamics.

15 Lectures

SECTION-C

Programming using Python: Introduction to Python, basic concepts, Arithmetics, parentheses and rounding errors, variables and objects, fornatting text and numbers, arrays, plotting, input data, symbolic computations, functions, for loops, while loops, reading from and writting to files, modules: numpy, ipython, sympy, scipy

15 Lectures

SECTION-D

Numerical techniques using Python: Computing integrals, trapezoidal rules, mid point method, solving differential equation, euler method, finite difference method

15 Lectures

Reference Books:

1. Mathematical Methods for Physicists-Arfken and Weber-6th Edition-Academic Press-NY, 1990.
2. Mathematical Methods of Physics – Mathews & Walker – 2nd, Edition- Pearson Edition,1985
3. Python for Dummies by Stef Maruch and Aahz Maruch, John Wiley & Sons, 2006
4. Programming for Computations- A Gentle Introduction to Numerical Simulations with Python by Svein Linge and Hans Petter Langtangen
5. Programming for Computations- A Gentle Introduction to Numerical Simulations with Python by Svein Linge and Hans Petter Langtangen