FACULTY OF SCIENCES

SYLLABUS

FOR

B. Sc. (Hons. School) Physics

(Under Credit Based Continuous Evaluation Grading System)

(SEMESTER: I - VI)

Examinations: 2016-17

GURU NANAK DEV UNIVERSITY AMRITSAR

B.Sc. (Hons. School) Physics (Semester System)

Semester I

Course No.	C/E/I	Course Title	Hrs/Week	LTP
PHL-101	C	Mechanics	4	3-1-0
PHL-102	C	Thermal Physics	4	3-1-0
MTL-131	C	Mathematics-I	4	3-1-0
CYL-191	C	Organic Chemistry	4	3-1-0
ENL-101	C	Communicative English	2	2-0-0
PBL-121/		Punjabi (Compulsory)		
PBL-122	C	/ਮੁੱਢਲੀ ਪੰਜਾਬੀ	2	2-0-0
PHP-121	C	Mechanics Lab	6	0-0-3
CYP-193	C	Organic Chemistry Lab.	4	0-0-2
			Total Credit	**25**

Semester II

Course No.	C/E/I	Course Title	Hrs/Week	LTP
PHL-151	C	Electricity & Magnetism-I	4	3-1-0
PHL-152	C	Waves & Oscillations	4	3-1-0
MTL-132	C	Mathematics-II	4	3-1-0
CYL-192	C	Inorganic Chemistry	4	3-1-0
ENL-151	C	Communicative English	2	2-0-0
PBL-131/		Punjabi (Compulsory)		
PBL-132	C	/ਮੁੱਢਲੀ ਪੰਜਾਬੀ	2	2-0-0
PHP-171	C	Electricity & Magnetism Lab	6	0-0-3
CYP-194	C	Inorganic Chemistry Lab.	4	0-0-2
			Total Credit	**25**

B.Sc. (Hons. School) Physics (Semester System)

Semester III

Course No.	C/E/I	Course Title	Hrs/Week	LTP
PHL-202	C	Electricity & Magnetism-II	4	3-1-0
PHL-203	C	Optics	4	4-0-0
MTL-231	C	Mathematics-III	4	3-1-0
CYL-291	C	Physical Chemistry	4	3-1-0
ESL-220	C	Environmental Studies	3	3-0-0
I-1	I		3	3-0-0
PHP-222	C	Optics Lab	6	0-0-3
CYP-292	C	Physical Chemistry Lab.	4	0-0-2
			Total Credit	**27**

Semester IV

Course No.	C/E/I	Course Title	Hrs/Week	LTP
PHL-252	C	Quantum Physics	4	3-1-0
PHL-253	C	Theory of Relativity	4	3-1-0
PHL-254	C	Electronics	4	3-1-0
MTL-232	C	Mathematics-IV	4	3-1-0
I-2	I		3	3-0-0
PHP-273	C	Modern Physics Lab	6	0-0-3
PHP-274	C	Electronics Lab	6	0-0-3
			Total Credit	**25**

B.Sc. (Hons. School) Physics (Semester 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-304	C	Mathematical Physics	4	3-1-0
PHL-305	C	Spectroscopy	4	3-1-0
I-3	I		3	3-0-0
PHP-321	C	Spectroscopy Lab	6	0-0-3
PHP-322	C	Solid State Physics Lab	6	0-0-3
				____
			Total Credit	**25**

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-354	C	Electronics	4	3-1-0
PHL-355	C	Quantum Mechanics	4	3-1-0
I-4	I		3	3-0-0
PHP-371	C	Nuclear Physics Lab	6	0-0-3
PHP-372	C	Electronics Lab	6	0-0-3
				____
			Total Credit	**25**

B.Sc. (Hons. School) Physics (Semester-I)

MECHANICS

Course No.	**LTP**
PHL-101	**3 1 0**

Co-ordinate system and Motion of a Particle: Cartesian and Spherical polar co-ordinate systems; area, volume, displacement, velocity and acceleration in these systems. Solid angle. Newton's laws of motion.

Conservation of Momentum and Collisions: Internal forces and momentum conservation. Centre of mass. Elastic collisions in laboratory and center of mass systems; velocities, angles, energies in these systems and their relationships. Conservation of angular momentum and examples-shape of the galaxy, angular momentum of solar system. Torques due to internal forces, angular momentum about center of mass. Cross-section elastic scattering and impact parameter, Rutherford scattering.

Inverse-Square-Law Force: Forces in nature (qualitative). Central forces, Potential energy and force between a point mass and spherical shell, a point mass and solid sphere, gravitational and electrostatic self energy. Two body problem and concept of reduced mass. Motion of a body under central force, equation of orbit in inverse-square force field. Kepler's laws and their derivation.

Dynamics of Rigid Bodies: Equation of motion of a rigid body, rotational motion of a rigid body in general and that of plane lamina. Rotation of angular momentum vector about a fixed axis. Angular momentum and kinetic energy of a rigid body about principal axis, Euler's equations. Precession and elementary gyroscope, Spinning top.

Reference Books:

1. Mechanics-Berkeley Physics Course, Vol-I (second edition):C. Kittel, W. D. Knight, M. A. Ruderman, C. A. Helmholtz and R. J. Moyer-Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

2. Analytical Mechanics: Satish K. Gupta-Modern Publishers.

3. Fundamentals of Physics: D. Halliday, R. Resnick and J. Walker (sixth edition)-Wiley India Pvt. Ltd., New Delhi.

4. An introduction to Mechanics: D. Kleppner & R. Kolenkow. Tata Mc Graw Hill Publishing Compnay Ltd., New Delhi.

5. Mechanics: H.S. Hans & S.P Puri, Tata Mc Graw Hill Publishing Company Ltd. New Delhi.

6. Mechanics: A.K. Sikri. Pardep Pulications

7. Introduction to Classical Mechanics: R. G. Takwale & P.S. Puranik. Tata Mc Graw Hill Publishing Company Ltd., New Delhi

B.Sc. (Hons. School) Physics (Semester-I)

THERMAL PHYSICS

Course No.	**LTP**
PHL-102	**3 1 0**

Thermodynamics: Laws of Thermodynamics: The zeroth law; indicator diagrams, work done, the first law, internal energy, Carnot cycle, Carnot's theorem, the second law. Entropy as a thermodynamic variable; reversible and irreversible processes. Principle of increase of entropy. Unavailable energy, Thermodynamic scale of temperature; its identity with perfect gas scale, impossibility of attaining absolute zero.

Maxwell's equations; application to Clausius-Clapeyron equation and Joule-Thomson effect. Thermodynamic potentials, relation to thermodynamic variables; equilibrium in thermodynamic systems, simple applications, Thomson and adiabatic cooling, Joule-Thomson expansion; Thermoelectric refrigeration, Constancy of U+PV, cooling, liquefaction of gases. Low temperatures: Production and measurement of very low temperatures, adiabatic demagnetization, nuclear magnetism and cooling

Statistical Physics: The statistical basis of thermodynamics: Probability and thermodynamic probability; principle of equal a priori probabilities, probability distribution, its narrowing with increasing n, average properties, fluctuations, micro and macrostates, accessible and inaccessible states. Phase space, division of phase space into cells, thermal equilibrium between two systems, beta parameter and its identification with $(kT)^{-1}$, probability and entropy, Boltzmann's entropy relation, statistical interpretation of second law of thermodynamics. Maxwell-Boltzmann statistics, application of M-B statistics to monoatomic gas, principle of equipartition of energy, Calculation of specific heat for monoatomic, diatomic and polyatomic gases.

Bose-Einstein statistics, Deduction of Planck's radiation law, derivation of Wiens's displacement law and Stefan's law. Bose-Einstein condensation. Properties of liquid helium, Lambda point. Fermi-Dirac statistics, Application of FD statistics to free electron gas, comparison of three types of statistics.

Text and Reference Books:

1. Statistical Physics and Thermodynamics- V.S. Bhatia, Punjab University Press, Chandigarh, 1977

2. Heat and Thermodynamics- Mark W. Zemansky and Richard H. Dittman, Mc Graw-Hill International -7th edition , 1996

3. Treatise on Heat, M. N. Saha and B.N. Srivastava, Indian Academic Press (Publications), Allahabad, 1969.

4. Statistical Physics, F. Reif, Berkeley Physics Course Vol. 5, McGraw –Hill International, New York, 1970.

B.Sc. (Hons. School) Physics (Semester-I)

MATHEMATICS – I

Course No.	**LTP**
MTL-131	**3 1 0**

Functions and Derivatives: $\epsilon - \delta$ definition of limit of a map $f: R \to R$ at a point. Algebra of limits, Proofs of the basic theorems on limit and their use, Rigorous definition of continuity of a map $f: R \to R$ at a point, Continuity of composition of functions, Basic theorems on continuity, discontinuous functions, Statement of the extreme-value theorem for continuous functions. Differentiability. The algebra of derivatives, Continuity via differentiability, standard theorems on differentiability, the chain rule, proofs of Rolle's theorem, Lagrange mean value theorem, Cauchy theorem, and Taylor's theorem, Applications of mean value theorems, L'hospital rule, Leibniz theorem on higher order derivative of product of two smooth functions,

Several variable calculus: Functions of two and three variables, rigorous treatment of limit, continuity, and differentiability of functions of two variables, Directional derivative, partial derivatives, the chain rule, statements of the inverse function theorem and implicit function theorem and their applications.

Integral Calculus: Anti-derivatives, standard techniques and formulae for anti derivatives of elementary functions, Reduction formulae. Riemann integration, Statement of fundamental theorem of Calculus, and geometrical interpretation as an area bounded by a curve. Formal double and triple Riemann integrals and their applications in Physics

Text and Reference Books:

1. Earl Coddington, *Theory of ordinary differential equations*, 1984. (First 3 chapters)
2. Tom M. Apostol, *Calculus I & II*, John-Wiley, 1967. (Scope in Chapters 3,4,5,8 of Vol. I, Ch. 8 , 11 of Vol. 2)
3. Shanti Narayan, *Differential Calculus*, New Delhi, Shyam Lal, 1983.
4. Shanti Narayan, *Integral Calculus*, Delhi, S. Chand, 1968.

B.Sc. (Hons. School) Physics (Semester-I)

ORGANIC CHEMISTRY

Course No.	**LTP**
CYL-191	**3 1 0**

Stereochemistry: Molecular chirality, enantiomers/symmetry in achiaral structures, chiral centres in chiral molecules, properties of chiral molecules-optical activity, absolute and relative configuration, the Cahn-Ingold Perlog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemical reactions that produce stereoisomers, Resolution of enantiomers, chiral centres other than carbon.

Chemistry alkanes and alkenes: Conformations of alkanes and cycloalkanes: conformational analysis of ethane, butane, cyclohexane, monosubstituted and disubstituted cyclohexane, conformation of small, medium and large ring cycloalkanes and of polycyclic ring systems.Stereochemistry of alkenes, naming stereo isometric alkenes by the E-Z system, mechanism of hydrogenation of alkenes, stereochemistry of hydrogenation of cycloalkenes, Dehydration of alcohols and regioselectivity of these reactions. Acid catalysed dehydration of alcohols with complete mechanistic discussion, Mechanism of dehydrohalogenation of alkylhalides (E mechanism), stereoselective and antielimination in E reactions, the E Mechanism, electrophilic addition of hydrogen halides to alkenes its regioselectivity explained on the basis of mechanism, free radical addition of hydrogen bromide to alkenes, acid catalysed hydration of alkene with mechanism stereochemistry of halogen addition to alkenes and its mechanistic explanation. Hypohalous acid addition to alkenes, epoxidation of alkenes.

Alkynes: Acidity of acetylene and terminal alkenes, metal ammonia reduction of alkyne, addition of hydrogen halides and water to alkynes, with detailed discussion of mechanism of these reactions, the diels Alder reaction, orbital symmetry and the diels Adler reaction.

Nucleophilic substitution and addition reaction:

(a) Functional group transformation by nucleophilic substituion, the biomolecular(SN), mechanism of nucleophilic substitution, stereochemistry of SN reactions, how SN reactions occur, steric effect in SN reactions, nucleophiles and nucleophilicity, the unimolecular (SN) mechanism of nucleophilic substitution, carbocation stability and the rate of substitution, by the SN mechanism stereochemistry of SN reactions, carbocation real arrangements in SN reactions, solvent effects, substitution and elimination as competing reactions. The SN -SN.

(b) Principles of nucleophillic addition to carbonyl groups : Hydration acetal formation, cyanohydrin formation ; reactions with primary and secondary amines, Whittig reaction, steroselective addition to carbonyl groups mechanism of halogenation, acid and base catalysed cholization, haloform reaction, aldol condensation, conjugate nucleophillic addition to unsaturated carbonyl compounds

Spectroscopy: Principles of molecular spectroscopy, electromagnetic radiation, quantized energy states, NMR(H) Spectroscopy, nuclear shielding and Chemical shift measurements chemical shift and molecular structure, interpreting proton NMR spectra, spin- spin splitting in NMR spectroscopy, patterns of spin-spin splitting, proton NMR spectra of alcohols, NMR and conformations carbons- 13 nuclear magnetic resonance, the sensitivity problem, interpretation of spectra. Infrared spectroscopy, ultraviolet–visible (UV-VIS) spectroscopy and mass spectrometry.

Text and Reference Books:

1. R.T. Morison and R.N. Boyd, Organic Chemistry.
2. I.L. Finar, Organic Chemistry, Vol. I IV ed.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure by J. March.
4. Schaum's Outlines Series Theory and Problems of Organic Chemistry by Herbert Meislick and Jacob Sharefkin
5. Problems and their solution in Organic chemistry by I.L. Finar, Modern Organic Chemistry by J.D. Robbert and M.C. Caserio.
6. Organic Chemistry by D.J. Cram and G.S. Hammond.
7. J.E. Banks, Naming Organic Compounds – Programmed Introduction to Organic Chemistry.
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F.A. Carey, Organic Chemistry.

B.Sc. (Hons. School) Physics (Semester-I)

ENL-101: COMMUNICATIVE ENGLISH

Time: 3 Hrs **LTU**
2 0 0

Objective: To introduce students to the skills and strategies of reading and writing by identifying organizational patterns, spotting classification systems and understanding associations between ideas. This course will prepare students to read a variety of texts and also to communicate more effectively through writing. The course will also pay special attention to vocabulary building.

Prescribed Text books:

1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 1 and 2 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

2. Developing Vocabulary and using it in the Right Context:

The students will be required to master "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" in the book *The Written Word.*

3. Writing Skills

Students will be required to learn "Report Writing" and "Letter Writing" as in the book *The Written Word.*

Students will be required to write long essays based on the prescribed text book *Making Connections: A Strategic Approach to Academic Reading.*

Minor 1:

Syllabus to be covered:

1. Unit 1 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. Report Writing from *TheWritten Word.*

Suggested Paper Pattern:

1. Report Writing (8 marks)
2. Short answer type questions from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Minor 2:

Syllabus to be covered:

1. "Word List" from the Chapter "Vocabulary" in the book *The Written Word.*
2. Unit-2 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

Suggested Paper Pattern:

1. Word List from the Chapter "Vocabulary" in the book *The Written Word* (8 marks)
2. Short answer type questions from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Suggested Paper Pattern for Major Exam:

1. Letter Writing as prescribed in *The Written Word* /1 out of 2 (10 marks)
2. Short answer type questions from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* (14 marks)
3. "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" present in the book *The Written Word.* (10 marks)
4. Essay type question from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (8 marks)
5. Report Writing from *The Written Word* (8 marks)

PBL-121: ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)
p`T-km Eq p`T-psqk-

Credits: 2–0–0

(I) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :

(a) grmK isG ms`iPr : gt`r
(E) sj`n isG : pT`x dl Dl
(e) krq`r isG dgl : acl Efl v`ll grg`bl
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. grmKl ErQgr`Pl dl jgq, (plql; mh`rnl; ibdl, itpl q EDk); ivr`m icn, Sbd jV (SD-ESD)

(II) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :

(a) sqK isG Dlr : s-Jl kD
(E) klvq isG ivrk : aj`V
(e) mihdr isG srn` : jQd`r mkd isG
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. lK rcn` (jlvnl-prk, sm`jk Eq clq iviSE- aq):
10 lK ilKv`ax (kl`s ivc Eq Gr lel EiBE`s)

(III) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :

(a) pm pk`S : m`V` bd`
(E) glz`r isG sD : klCx
(e) mhn Bf`rl : Gtx`
(s) virE`m isG sD : dldl
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. pr` pV k pSn- d aqr dx`
(E`qm En`qm psqk d kh`xl B`g ivcl 15 pirE- d EiBE`s krv`ax)

B.Sc. (Hons. School) Physics (Semester-I)

PBL-122: ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Punjabi Compulsory)

Credits: 2-0-0

ਪਾਠ-ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ,
   ਗੁਰਮੁਖੀ ਲਿਪੀ
   ਗੁਰਮੁਖੀ ਲਿਪੀ : ਬਣਤਰ ਅਤੇ ਤਰਤੀਬ

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ
   ਸ੍ਵਰ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ
   ਵਿਅੰਜਨ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ

3. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ
   ਸਾਧਾਰਨ ਸ਼ਬਦ
   ਇਕ ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ : ਨਾਮਕਰਣ ਅਤੇ ਸੰਖੇਪ ਜਾਣ ਪਛਾਣ, ਗੁਰਮੁਖੀ ਲਿਪੀ : ਨਾਮਕਰਣ, ਗੁਰਮੁਖੀ ਵਰਣਮਾਲਾ; ਪੈਂਤੀ ਅੱਖਰੀ, ਅੱਖਰ ਕ੍ਰਮ, ਸ੍ਵਰ ਵਾਹਕ (ਓ ਅ ਏ), ਲਗਾਂ ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ।

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ ਅਤੇ ਉਚਾਰਨ; ਸ੍ਵਰਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ (ਲਘੂ-ਦੀਰਘ ਸ੍ਵਰ); ਸ੍ਵਰ ਅਤੇ ਲਗਾਂ ਮਾਤਰਾਂ; ਵਿਅੰਜਨਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣਾਂ (ਹ, ਰ, ਵ) ਦਾ ਉਚਾਰਨ ; ਲ ਅਤੇ ਲ਼ ਦਾ ਉਚਾਰਨ; ਭ, ਧ, ਢ, ਝ, ਘ ਦਾ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣਾਂ ਦਾ ਉਚਾਰਨ।

3. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸਾਧਾਰਨ ਸ਼ਬਦ; ਇਕੱਲਾ ਸ੍ਵਰ (ਜਿਵੇਂ ਆ); ਸ੍ਵਰ ਅਤੇ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਆਰ); ਵਿਅੰਜਨ ਅਤੇ ਸ੍ਵਰ (ਜਿਵੇਂ ਪਾ); ਵਿਅੰਜਨ ਸ੍ਵਰ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਪਾਰ); ਕੌਸ਼ਗਤ ਸ਼ਬਦ (ਜਿਵੇਂ ਘਰ, ਪੀ); ਵਿਆਕਰਣਕ ਸ਼ਬਦ (ਜਿਵੇਂ ਨੂੰ, ਨੇ); ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ-1; ਲਿੰਗ-ਪੁਲਿੰਗ, ਇਕ ਵਚਨ-ਬਹੁ ਵਚਨ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ-1: ਖਾਣ-ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ ਆਦਿ ਨਾਲ ਸੰਬੰਧਿਤ।

B.Sc. (Hons. School) Physics (Semester-II)

ELECTRICITY & MAGNETISM-I

Course No.	**LTP**
PHL-151	**3 1 0**

Calculus of Vectors : Introduction to gradient, divergence & curl; their physical significance. Rules for vector derivatives, useful relations involving gradient, divergence & curl. Fundamental theorem for gradients, Gauss's and Stoke's theorems.

Electrostatics and Electric Current: Electric charge and its properties, Coulomb's law. The electric field due to a point charge and continuous charge distributions, Field due to electric dipole, Field lines, flux, Gauss's law and its applications. Curl of electric field. Relation between potential and electric field. Poisson's and Laplace's equations. Electric potential due to different charge distribution: Wire, Ring, Disc, Spherical Shell, Sphere, dipole etc. The potential energy for a point and continuous charge distribution. Conductors in the electrostatic field, Capacitors, Current and current density, drift velocity, expression for current density vector, equation of continuity. Ohm's Law and expression for electrical conductivity, limitations of Ohm's law. Equipotential surface method of electrical images

Magnetostatics : Magnetic fields, magnetic forces, magnetic force on a current carrying wire. Torque on a current loop, Biot-Savart law . Magnetic Field due to infinite wire carrying steady current, field of rings and coils. Magnetic field due to a solenoid, Force on parallel current carrying wires. Ampere's circuital law and its applications to infinite hollow cylinder, solenoid and toroid. The divergence and curl of magnetic induction, Comparison of magnetostatics and electrostatics. Magnetic vector potential and its expression. Surface current density and Change in magnetic field at a current sheet. Hall Effect.

Field of Moving Charges:- Measurement of charge in motion, Transformation of electric and magnetic fields in different frames of references, Electric field due to moving charges, electric force in two inertial frames, Interaction between moving charges.

Text and Reference Books:

1. Introduction to Electrodynamics -D.J. Griffiths, Perason Prentice Hall of India, New Delhi, 2006
2. Electricity & Magnetism- E.M. Purcell, Berkeley Physics Course Vol. 2, Mc Graw Hill, New York, 2008.
3. Fundamental of Physics -D. Halliday, R. Resnick and J. Walker (6^{th} edition)-John Wiley India Pvt. Ltd., 2012.
4. Electricity and Magnetism- A.K. Sikri – Pardeep Publications.
5. Electricity and Magnetism-A. S. Mahajan & A. A. Rang wala, Tata –Mc Graw Hill Publications Company Pvt. Ltd.

B.Sc. (Hons. School) Physics (Semester-II)

WAVES & OSCILLATIONS

Course No.	**LTP**
PHL-152	**3 1 0**

Damped Oscillations: Superposition of two SHM by vector addition, superposition of two perpendicular SHM, Polarization, Lissajous figures–superposition of many SHMs, complex number notation and use of exponential series. Damped motion of mechanical and electrical oscillator, heavy damping, critical damping. Damped single harmonic oscillator, amplitude decay, logarithmic decrement, relaxation time, energy decay, Q value, rate of energy decay equal to work rate of damping force, problems.

Forced Oscillations: Transient and steady state behaviour of a forced oscillator, Variation of displacement and velocity with frequency of driving force, frequency dependence of phase angle between force and (a) displacement, (b) velocity, Vibration Insulation – Power supplied to oscillator, Q-value as a measure of power absorption bandwidth, Q-value as amplification factor of low frequency response, modes of vibration, inductance coupling of electrical oscillators, wave motion as the limit of coupled oscillations.

Wave Motion: The wave equation, transverse waves on a string , the string as a forced oscillator, characteristic impedance of a string, reflection and transmission of transverse waves at a boundary , impedance matching, insertion of quarter wave element, standing waves on a string of fixed length, normal modes and eigen frequencies. Energy in a normal mode of oscillation, wave groups, group velocity, dispersion, wave group of many components, bandwidth theorem, transverse waves in a periodic structure (crystal). Doppler effect, sound waves in gases, energy distribution in sound waves, intensity, specific acoustic impedance, longitudinal waves in a solid, Young's modulus, Poisson's ratio, longitudinal waves in a periodic structure, reflection and transmission of sound waves.

Wave Motion Continued: Harmonic analysis, modulation, pulses and wave groups, Fourier tansform, Anharmonic oscillations, free vibrations of finite amplitude pendulum, nonlinear restoring force, forced vibrations. Thermal expansion of a crystal, electrical 'relaxation' oscillator, nonlinear acoustic effects. Shock waves in a gas.

Reference Books:

1. The Physics of Vibrations and Waves- H.J. Pain, John Wiley, Chichester, 1999
2. Vibrations and Waves in Physics- I.G. Main-Cambridge University, Cambridge, 1993.
3. Berkeley Physics Course Vol. III (Waves)-Frank S Crawford Jr-Frank S. Crawfold Jr.

B.Sc. (Hons. School) Physics (Semester-II)

MATHEMATICS – II

Course No.	**LTP**
MTL-132	**3 1 0**

Ordinary Differential Equations(ODEs): Definition & formation of linear ODEs, First order Linear, Linear homogenous and non-homogeneous ODEs of second order, Complementary function and particular integral, Solutions of Linear differential equations with constant and variable coefficients, Solution by variation of parameters method. Linear dependence and independence, Existence and Uniqueness theorem on solution of Euler's equation, Abel's formula.

Partial Differential Equations(PDEs):
First order PDEs: Definition, origins of first order PDEs. Second order PDEs, Definition, origins of second order PDEs, Second order PDEs in Physics, Laplace, Wave, and diffusion equation in one and two dimensions, Solutions of second order PDEs by separation of variables.

Laplace Transforms: Exponentially bounded functions, Existence of Laplace transform, Laplace transforms of elementary functions, derivative formulae, Shifting properties, the Heaviside and Dirac-Delta functions and their Laplace transforms, Convolution, Convolution theorem, Inverse Laplace transforms and their properties, Applications of Laplace transforms in solving improper integrals, integral equations, initial value problems in ordinary differential equations, and system of ordinary differential equations.

Reference Books:

1. I. N. Sneddon, *Elements of Partial Differential Equations*, Dover, 2006.

   (Scope in Chapters **2-6**)
2. A. Pinkus and S. Zafrany, *Fourier Series and Integral Transforms*, Cambridge University Press, 1997. (Scope in **Chapter 4.**)
3. Applied Mathematics for Engineers and Physicists : Pipes & Harvill, London, McGraw Hill, 1970.
4. Mathematics of Physics and Modern Engineering : Sokolnikoff & Recheffer
5. Mathematical Methods for Physicists : George Arfken, New York, Academic Press, 1970.

B.Sc. (Hons. School) Physics (Semester-II)

INORGANIC CHEMISTRY

Course No.	**LTP**
CYL-192	**3 1 0**

Co-ordination Chemistry: Introduction, Werner's coordination theory, naming of co-ordinate complexes.Co-ordination numbers 1-12 and their stereo-chemistries.Factors affecting co-ordination numbers and stereo-chemistry

(a) Configurational Isomers

(b) Conformational isomerism, VSPER theory, molecular orbital theory applied to homoneuclear diatomic molecules and heteronuclear Diatomic molecules.

Bonding in metal complexes: Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, Electro-neutrality and back bonding, limitations of V.B. theory.

Stability of coordination compounds: Introduction, Stability constant, stepwise stability constant, overall stability constant. Factors affecting the stability of metal ion complexes with general ligands, HSAB principle.

Crystal field theory: Splitting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands. Calculation of C.F.S.E. in high spin and low spin octahedral and High spin tetrahedral complexes, factors affecting the 10 Dq Value. Structural effects of crystal field splitting (Jahn-Teller distortion, variation of Ionic radii with increase in atomic number). Thermodynamics effects of C.F. splitting, variation in lattice energies, Hydration energies, Dissociation energies, Formation constants of hexammines. Site selection in spinels, Paramagnetism, diamagnetism, ferro and anti ferromagnetism. Microstates and spectroscopic terms, a calculation of spectroscopic terms for d^1 - d^{10} electronic configurations, L S coupling, Hund's rule for finding the ground state terms, Electronic spectral properties of Ist transition series, Orgel Diagrams for d^1 - d^{10} systems, for weak field octahedral and tetrahedral complexes, limitations of C.F.T

Molecular Orbital Theory: Evidence for covalent character in Bonding, MOEL diagram for octahedral and tetrahedral complexes involving bonding, charge transfer transitions.

π Acid Ligands: Definition Carbon monoxide complexes, bonding in linear MCO groups, polynuclear metal carbonyls, vibrational spectra, Reactions, carbonyl hydrides and halides. Metal-metal bonding metal-metal multiple bonding , isolable analogies, Structure of high nuclearity carbonyl clusters, counting of electrons in carbonyl clusters.

Alkali metal and alkaline earth metal chelators: Macrocyclic ligands, macrocyclic effect, crown ethers and podands, coronands, cryptands, structure of 18 crown-6 complex with KNCS, ion cavity complex, effect of anion and cation type on complex structure, simultaneous complexation of metal ion and water or of two metal ions, sandwich formation, cryptands and their cation complexes, podands with aromatic donors and groups.

Text and Reference Books:

1. J.E. Huheey, Inorganic Chemistry, 3rd Ed.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry.
3. B.E. Douglas and D.H. McDaniel, Concepts and Models of Inorganic Chemistry.
4. R. Hilgenfeld and W. Saengar, Topics in current chemistry Vol-II.

B.Sc. (Hons. School) Physics (Semester-II)

ENL-151: COMMUNICATIVE ENGLISH

Time: 3 Hrs **LTU**
2 0 0

Objectives: To equip students with the skill of reading and writing dexterously. By the end of the course the students will be skilled in the art of expressing their ideas in short and long compositions, noting information effectively and summarizing and abstracting more efficiently.

Prescribed Text books:
1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 3 and 4 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

2. Writing Skills

Students will be required to learn Paragraph and Essay Writing and Note Making, Summarizing and Abstracting as in the book *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Minor 1:

Syllabus to be covered:
1. Unit 3 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. ABC of Good notes, Sub dividing your Notes and Summarizing and abstracting included in the Chapter "Note Making, Summarizing and Abstracting" from *The Written Word.*

Suggested Paper Pattern:
1. Theoretical questions based on ABC of Good notes, Sub dividing your Notes and Summarizing and abstracting included in the Chapter "Note Making, Summarizing and Abstracting" *The Written Word* (8 marks).
2. Short answer type questions from Unit 3 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks).
3. Essay type question from Unit 3 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks).

Minor 2:

Syllabus to be covered:

1. Abbreviations and Symbols and Note making in practice from the chapter "Note-Making, Summarizing and Abstracting in the book *The Written Word*

2. Unit-4 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

Suggested Paper Pattern:

1. A practical question on Note making in practice "Note-Making, Summarizing and Abstracting" from the chapter the book *The Written Word* (8 marks)

2. Short answer type questions from Unit 4 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Suggested Paper Pattern for Major Exam:

1. Practical Question on Paragraph and Essay Writing as prescribed in *The Written Word* /1 out of 2 (10 marks)
2. Short answer type questions from Unit 3,4 of *Making Connections: A Strategic Approach to Academic Reading* (16 marks)
3. Essay type question from Unit 3,4 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (10 marks)
4. Practical Question on Note Making from *The Written Word* (8 marks)
5. Theoretical Question(s) based on the two chapters from the book *The Written Word* (6 marks)

B.Sc. (Hons. School) Physics (Semester-II)

PBL-131: ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ)

p`T-km Eq p`T psqk-

Credits: 2-0-0

(I) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl,Eimqsr) ivcl hT- ilK kvl :

(a) B`el vlr isG
(E) p: prn isG
(e) p: mhn isG
(kivq`-s`r, ivS`–vsq, k`iv-kl`, kvl)

2. pj`bl Sbd bxqr: D`q/ml, vDqr (Egqr, ipCqr, ivalqpq Eq rp-qrl), sm`s |

(II) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kvl :

(a) Eimq` plqm
(E) f`. hrBjn isG
(e) iSv km`r bt`lvl
(kivq`-s`r, ivS`-vsq, k`iv-kl`, kvl)

2. pr` rcn` : kl`s ivc 10 iviSE- (siBE`c`rk, D`rimk Eq r`jnlqk) q pr` rcn` d EiBE`s krv`ax |

(III) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kvl :

(a) f`. jsvq isG nkl
(E) f`. jgq`r
(e) f`. srjlq p`qr
(s) p`S
(kivq`-s`r, ivS`-vsq, k`iv-kl`, kvl)

2. mh`vr q EK`x (EK`x q mh`vr` kS ivc) 200 mh`virE- Eq 100 EK`x- n v`k- ivc vrqx d EiBE`s krv`ax (kl`s ivc q Gr lel)|

PBL-132: ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Punjabi Compulsory)

Credits: 2-0-0

ਪਾਠ–ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ–ਬਣਤਰ
   ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ
   ਬਹੁ–ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

2. ਪੰਜਾਬੀ ਵਾਕ–ਬਣਤਰ
   ਸਾਧਾਰਨ–ਵਾਕ : ਕਿਸਮਾਂ
   ਸੰਯੁਕਤ–ਵਾਕ : ਕਿਸਮਾਂ
   ਮਿਸ਼ਰਤ–ਵਾਕ : ਕਿਸਮਾਂ

3. ਪ੍ਰਕਾਰਜੀ ਪੰਜਾਬੀ
   ਚਿੱਠੀ ਪੱਤਰ
   ਪੈਰ੍ਹਾ ਰਚਨਾ
   ਸੰਖੇਪ ਰਚਨਾ
   ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸੰਯੁਕਤ ਸ਼ਬਦ; ਸਮਾਸੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਲੋਕ ਸਭਾ); ਦੋਜਾਤੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਕਾਲਾ ਸਿਆਹ); ਦੋਹਰੇ ਸ਼ਬਦ/ਦੁਹਰੁਕਤੀ (ਜਿਵੇਂ ਧੂੜ੍ਹ ਧਾੜ੍ਹ/ਭਰ ਭਰ), ਮਿਸ਼ਰਤ ਸ਼ਬਦਾਂ ਦੀ ਬਣਤਰ/ਸਿਰਜਨਾ; ਅਗੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਉਪ ਭਾਸ਼ਾ), ਪਿਛੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਰੰਗਲਾ), ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ–2: ਪੜਨਾਵੀਂ ਰੂਪ, ਕਿਰਿਆ/ਸਹਾਇਕ ਕਿਰਿਆ ਦੇ ਰੂਪ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ–2: ਮਾਰਕੀਟ/ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਿਤ।

2. ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ : ਕਰਤਾ ਕਰਮ ਕਿਰਿਆ; ਸਾਧਾਰਨ ਵਾਕ, ਬਿਆਨੀਆ, ਪ੍ਰਸ਼ਨਵਾਚਕ, ਆਗਿਆਵਾਚਕ, ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ; ਸੁਤੰਤਰ ਅਤੇ ਅਧੀਨ ਉਪਵਾਕ; ਸਮਾਨ (ਤੇ/ਅਤੇ) ਅਤੇ ਅਧੀਨ (ਜੋ/ਕਿ) ਯੋਜਕਾਂ ਦੀ ਵਰਤੋਂ; ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਰਤੋਂ : ਵਿਭਿੰਨ ਸਮਾਜਕ/ਸਭਿਆਚਾਰਕ ਪ੍ਰਸਥਿਤੀਆਂ ਦੇ ਅੰਤਰਗਤ; ਘਰ ਵਿਚ, ਬਾਜ਼ਾਰ ਵਿਚ, ਮੇਲੇ ਵਿਚ, ਸ਼ੌਪਿੰਗ ਮਾਲ/ਸਿਨਮੇ ਵਿਚ, ਵਿਆਹ ਵਿਚ, ਧਾਰਮਿਕ ਸਥਾਨਾਂ ਵਿਚ, ਦੋਸਤਾਂ ਨਾਲ ਆਦਿ।

3. ਇਸ ਯੂਨਿਟ ਵਿਚ ਚਿੱਠੀ ਪੱਤਰ (ਨਿੱਜੀ/ਦਫ਼ਤਰੀ/ਵਪਾਰਕ), ਪੈਰਾ ਰਚਨਾਂ, ਸੰਖੇਪ ਰਚਨਾ ਅਤੇ ਅਖਾਣ ਮੁਹਾਵਰਿਆਂ ਦੀ ਵਰਤੋਂ ਰਾਹੀਂ ਵਿਦਿਆਰਥੀ ਦੀ ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਨੂੰ ਪਰਖਿਆ ਜਾਵੇਗਾ।

B.Sc. (Hons. School) Physics (Semester-III)

ELECTRICITY & MAGNETISM-II

Course No.	**LTP**
PHL-202	**3 1 0**

Faraday's law and Maxwell's equations: 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, Maxwell's Equations, Integral form of Maxwell's equations, Invariance of Maxwell equations under Lorentz transformations, Potential functions, electromagnetic boundary conditions, Inter-face between two loss-less linear media, Interface between a dielectric and perfect conductor.

Electric Fields in Matter: Moments of charge distribution, Potential and field of a diploe, torque and force on a dipole in an external electric field, polarizability tensor, Electric field caused by polarized matter, Electric field of Polarized Sphere, Dielectric sphere in a uniform electric field, Field of a charge in a dielectric medium, Electric susceptibility and atomic polarizability tensor, Polarization in alternating fields.

Magnetic Fields in Matter: Response of various substances in magnetic field, Field of a current loop, force on magnetic dipole in a an external field, Electric currents in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility, Magnetic field caused by magnetized matter, Field of a permanent magnet, field currents and field H.

Plane Electromagnetic Waves:
Plane waves in lossless media, transverse electromagnetic waves, polarization 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. Normal and oblique incidence at a plane conducting boundary, Perpendicular and parallel polarization, 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 polarization.

Text and Reference Books:

1. Introduction to Electrodynamics- David J. Griffiths, Pearson Prentice Hall of India, 2006.
2. Electricity & Magnetism, Berkeley Physics Course Vol. 2-E.M.Purcell, McGraw Hill, New York, 1970.
3. Physics of Waves and Vibrations- H. J. Pain, John Wiley and Sons Ltd. ,1981.

B.Sc. (Hons. School) Physics (Semester-III)

OPTICS

Course No.	**LTP**
PHL-203	**4 0 0**

Interference: Young's experiment, Coherent Source, Theory of interference fringes, Fresnel's biprism, thickness of thin transparent sheet, interference in thin film due to reflected and transmitted light, colour of thin film, Newtons rings and their application, Michelson & Febry-Perot Interferometer, Anti reflection coatings.

Fresnel Diffraction: Fresnel Half period Zones, Zone plate, Diffraction at a straight edge, Diffraction by a circular aperture, diffraction by circular disc

Franunhoffer diffraction: Diffraction at a single slit and at double slit, missing orders in a double slit, Diffraction of N slits, Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating.

Polarization: Transverse nature of light, Polarization by reflection and refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, production and detection of polarized light, Optical activity, specific rotation. Half shade polarimeter.

Laser: Spontaneous and stimulated emission, population inversion, resonator, Helium-Neon later

Reference Books:

1. Text book of Optics: N. Subramanayam, B. Lal and M. N. Avadhamulu
2. Fundamentals of Optics: Jenkins and White
3. Optics: Ajoy Ghatak

B.Sc. (Hons. School) Physics (Semester-III)

MATHEMATICS-III

Course No.	**LTP**
MTL-231	**3 1 0**

Complex numbers: Complex numbers and their geometrical representation, De-Moivre's theorem and its applications.

Complex Analysis: Basic topology of complex plane: open and closed sets, interior points, limit points, limit, continuity, and differentiability of a function of complex variable, Analytic function, statement of Cauchy's theorem, singularities, Cauchy's integral formula, Taylor's and Laurant's theorems, Cauchy's residue theorem and its application to evaluation of definite integrals.

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.

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.

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
5. Mathematical Methods for Physicists : George Arfken, New York, Academic Press, 1970.

B.Sc. (Hons. School) Physics (Semester-III)

PHYSICAL CHEMISTRY

Course No.	**LTP**
CYL-291	**3 1 0**

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.

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.

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.

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.

Books Recommended:

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. (Hons. School) Physics (Semester-III)

ESL 220 Environmental Studies (Compulsory Paper)

Credit 3-0-0

1. **The Multidisciplinary Nature of Environmental Studies:** Definition, scope & its importance, Need for public awareness.

2. **Natural Resources**: Natural resources and associated problems.
   - **a) Forest Resources**: Use of 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, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
   - **e) Energy Resources**: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
   - **f) Land Recourses**: Land as a resource, land degradation, soil erosion and desertification.
   - **g)** Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

3. **Ecosystem:**
   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 ecosystems:
   a. Forest ecosystem
   b. Grassland ecosystem
   c. Desert ecosystem
   d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

4. **Biodiversity and its Conservation:**
   Definition: Genetic, species and ecosystem diversity, Biogeographical classification of India.
   Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values.
   Biodiversity of global, National and local levels, India as mega-diversity nation "Hot-spots of biodiversity.
   Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts Endangered and endemic species of India.
   Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

5. **Environmental Pollution:**
   Definition, Causes, effects and control measures of:
   a) Air Pollution
   b) Water Pollution
   c) Soil Pollution
   d) Marine Pollution
   e) Noise Pollution
   f) Thermal Pollution
   g) Nuclear Hazards
   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

6. Social Issues and Environment:

* From unsustainable to sustainable development
* Urban problems 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 warning, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
* Wasteland reclamation
* Consumerism and waste products
* Environmental Protection Act
* Air (prevention and Control of Pollution) Act
* Water (prevention and Control of Pollution) Act
* Wildlife Protection Act
* Forest Conservation Act
* Issues involved in enforcement of environmental legislation
* Public awareness

7. Human Population and the Environment

* Population growth, variation among nations
* Population explosion-Family welfare programme
* 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

* **Road Safety Rules & Regulations:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs
* **Accident & First Aid:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance

8. National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS: Emblem, flag, motto, song, badge etc.; Organization structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.
- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self defense training.

9. 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. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Bharucha, E. 2004. The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.
4. Brunner, R. C. 1989. Hazardous Waste Incineration, McGraw Hill Inc. New York.
5. Clark, R. S. 2000. Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W. P., Cooper, T. H., Gorhani, E. & Hepworth, M. T. 2001. Environmental Encyclopedia, Jaico Publications House, Mumbai.
7. De, A. K. 1989. Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment, New Delhi.
9. Hawkins, R. E. 2000. Encyclopedia of Indian Natural History, Bombay Natural History Society.
10. Heywood, V. H & Waston, R. T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
11. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
12. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
13. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
14. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
15. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
16. Rajagopalan, R. 2005. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
17. Sharma, B. K. 2001. Environmental Chemistry. Geol Publishing House, Meerut.
18. Sharma, J. P. 2004. Comprehensive Environmental Studies, Laxmi Publications (P) Ltd, New Delhi.
19. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
20. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.
21. Survey of the Environment. 2005. The Hindu.
22. Tiwari, S. C. 2003. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehra Dun.
23. Townsend, C., Harper, J. and Michael, B. 2001. Essentials of Ecology, Blackwell Science.
24. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar

B.Sc. (Hons. School) Physics (Semester-IV)

QUANTUM PHYSICS

Course No.	**LTP**
PHL-252	**3 1 0**

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. Phase and group velocities. Davisson and Germer experiment. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits.

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.

Schrodinger Wave Equation: Schodinger equation -time dependent and steady state forms, expectation value, Particle in a box, Schrodinger equation for hydrogen atom, separation of variables, quantum numbers.

Many electron atoms: Electron spin, spin-spin coupling, identical particles, exclusion principle, total angular momentum, Spin–orbit interaction and fine structure, Magnetic dipole moment due to orbital, spin and total motion, Effect of an external magnetic field on atom, Normal and Anomalous Zeeman effect.

Reference Books:

1. Quantum Physics of Atoms Molecules Solids, Nuclei & Particles: R. Eisberg and R.Resnick.
2. Elementary Modern Physics: Atam P. Arya.
3. Concepts of modern physics: A. Beiser
4. Introduction to Atomic and Nuclear Physics: H. Semat and J.R. Albright.

B.Sc. (Hons. School) Physics (Semester-IV)

THEORY OF RELATIVITY

Course No.	**LTP**
PHL-253	**3 1 0**

Frames of References: Inertial frame of reference, Galilean transformation, Galilean Invariance of space & time intervals; Newton's laws of motion; law of conservation of linear momentum & energy. Inertial and non-inertial frames and fictitious forces. Effect of rotation of earth on 'g'. Effects of centrifugal and Coriolis forces produced as a result of earth's rotation. Foucault's pendulum and its equation of motion.

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.

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

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.

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.
2. The Special Theory of Relativity, S. Banerji & A. Banerji (Prentice Hall India).
3. Introduction of to Special Relativity: R. Resnick Wiley Eastern India Pvt. Ltd.
4. The Feymann Lectures Physics: R.P. Feymann, R.B. Leighton and M. Sands, Vol. I & II- Narosa Publishing House, New Delhi.
5. "Special Relativity" A.P. French, N.W. Norton and Company Inc. , New York.

B.Sc. (Hons. School) Physics (Semester-IV)

ELECTRONICS

Course No.	**LTP**
PHL-254	**3 1 0**

P.N. Junction : Intrinsic/Extrinsic semiconductor, Fermi level, Charge carries in semiconductors, PN junctions, depletion region, current components in pn junction, Characteristic of pn junction diode, pn junction as rectifier, characteristics and applications of Zener diode, Photodiode, LED and photocells.

Electronic Devices : Bipolar junction transistor, current components in transistors, CB, CE, CC configuration, h-parameters, transistor biasing, transistor as an amplifier, Emitter follower, characteristics and applications of FET, MOSFET.

Transistor Circuits : Feedback amplifiers; classification of amplifiers, feed-back concept, Sinusoidal oscillations; phase shift oscillators, Wien Bridge Oscillator, Crystal oscillator, Basic idea about AM modulation and demodulations, Oscilloscope.

Digital Principles : Number system, Decimal, binary, Octal, hexadecimal, logic gates, AND, OR, NOT, NAND, NOR, XOR, XNOR, Karnaugh map techniques.

Recommended Books:

1. Integrated Electronics: J.Millman and C.C.Halkias (Tata McGraw Hill).
2. Electronic Devices & Circuits – J.Millman and C.C.Halkias (Tata McGraw Hill).
3. Digital Principles & Applications – P.Malvine & Leach (Tata McGraw Hill).

B.Sc. (Hons. School) Physics (Semester-IV)

MATHEMATICS-IV

Course No.	**LTP**
MTL-232	**3 1 0**

Determinants & Matrices: Properties of matrices and determinants, Algebra of matrices, Eigen values and eigenvectors, bilinear forms, canonical forms, Unitary, Hermitian, and Orthogonal matrices and their properties, Cayley-Hamilton theorem, Rank of a matrix, Condition of Consistency of linear systems,

Introduction to vectors spaces, linear maps, basis and dimension, algebra of linear maps, change of basis formula.

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.

Curve fitting: Curve fitting by least square, fitting a polynomial of degree n, power curve and exponential curve.

References Books:-

1. Mathematics Hand book : M. Vygodsky, Mir, Moscow, 1975.
2. Applied Mathematics for Engineers and Physicists : Pipes & Harvill, London, McGraw Hill, 1970.
4. Mathematics of Physics and Modern Engineering : Sokolnikoff & Recheffer
5. Fundamentals of mathematical Statistics: S. C. Gupta, V. K. Kapoor.

B.Sc. (Hons. School) Physics (Semester-V)

SOLID STATE PHYSICS

Course No.	**LTP**
PHL-301	**3 1 0**

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, experiment methods of x-rays diffraction.

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. Born-Haber cycle, quantization of Lattice vibrations, phonon momentum, inelastic scattering by phonons. Wave motion on a lattice, one dimensional line of atoms, linear diatomic lattice, optical and acoustical branch.

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.

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. The tight-binding approximation in evaluating the energy levels for an electron in a solid. The Weigner-Seitg approximation and the cohesive energy of metals.

Text and Reference Books:

1. An introduction to Solid State Physics - C. Kittel.
2. Solid State Physics – A.J. Dekkar.
3. Principles of Solid State Physics – R.A. Levy.

B.Sc. (Hons. School) Physics (Semester-V)

CLASSICAL MECHANICS

Course No.	**LTP**
PHL-302	**3 1 0**

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).

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.

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.

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.

Reference Books :

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

B.Sc. (Hons. School) Physics (Semester-V)

MATHEMATICAL PHYSICS

Course No.	**LTP**
PHL-304	**3 1 0**

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.

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.

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.

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.

Reference Books :

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

B.Sc. (Hons. School) Physics (Semester-V)

SPECTROSCOPY

Course No.	**LTP**
PHL-305	**3 1 0**

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.

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.

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.

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.

Text and Reference Books:

1. Introduction to Atomic Spectra by H. E. White
2. Atomic Spectra and Atomic structure by Gerhard Herzberg
3. Concepts of Modern Physics by Arthur Beiser
4. Elements of Spectroscopy by Gupta, Kumar and Sharma

B.Sc. (Hons. School) Physics (Semester-VI)

NUCLEAR & PARTICLE PHYSICS

Course No.	**LTP**
PHL-352	**3 1 0**

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.

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.

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.

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.

Text and Reference Books:

1. R.D. Evans: Atomic Nucleus
2. K.S. Krane: Introductory Nuclear Physics
3. P. Mermier and E. Sheldon: Physics of Nuclei and particles

B.Sc. (Hons. School) Physics (Semester-VI)

STATISTICAL MECHANICS

Course No.	**LTP**
PHL-353	**3 1 0**

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.

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.

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.

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.

Reference Books:

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

B.Sc. (Hons. School) Physics (Semester-VI)

ELECTRONICS

Course No.	**LTP**
PHL-354	**3 1 0**

P.N. Junction : Intrinsic/Extrinsic semiconductor, Fermi level, Charge carries in semiconductors, PN junctions, depletion region, current components in pn junction, Characteristic of pn junction diode, pn junction as rectifier, characteristics and applications of Zener diode, Photodiode, LED and photocells.

Electronic Devices : Bipolar junction transistor, current components in transistors, CB, CE, CC configuration, h-parameters, transistor biasing, transistor as an amplifier, Emitter follower, characteristics and applications of FET, MOSFET.

Transistor Circuits : Feedback amplifiers; classification of amplifiers, feed-back concept, Sinusoidal oscillations; phase shift oscillators, Wien Bridge Oscillator, Crystal oscillator, Basic idea about AM modulation and demodulations, Oscilloscope.

Digital Principles : Number system, Decimal, binary, Octal, hexadecimal, logic gates, AND, OR, NOT, NAND, NOR, XOR, XNOR, Karnaugh map techniques.

Recommended Books:

1. Integrated Electronics: J.Millman and C.C.Halkias (Tata McGraw Hill).
2. Electronic Devices & Circuits – J.Millman and C.C.Halkias (Tata McGraw Hill).
3. Digital Principles & Applications – P.Malvine & Leach (Tata McGraw Hill).

B.Sc. (Hons. School) Physics (Semester-VI)

QUANTUM MECHANICS

Course No.	**LTP**
PHL-355	**3 1 0**

Quantum states, the space of states, inner products. Hilbert space, bases. Dirac notation: kets, the dual space, bras. Wave-functions in Dirac notation, inner product reconsidered. Operators in Dirac notation, Hermitian operators and measurement of observables, completeness, expansion in eigenstates.Unitary operators and change of basis. Postulates of quantum mechanics. Application to the operators p–constructing the operators, x and representations of states and operators in the basis of eigenstates x and of p. Infinite dimensional Hilbert space. Nondenumerable bases.Commuting operators. Compatible observables. Complete sets of commuting observables. Noncommuting operators. Incompatible observables. Uncertainty relations. Application of operator methods to the harmonic oscillator. Hamiltonian and raising and lowering operators, operator algebra. The ground state, the spectrum. Matrix representation of operators.

Quantum Dynamics: The time development of quantum systems from an operator point of view. Several different inquiries into the relation between classical and quantum dynamics. Paths in the space of states, unitary time evolution, the Hamiltonian as the generator of time evolution.The Schrodinger equation and the time dependence of states in the Schrodinger picture.Time dependence of operators, the Heisenberg picture, Ehrenfest's equation, and the correspondence to classical physics.The evolution of p and x in the harmonic oscillator. Coherent states of the harmonic oscillator and the classical limit. Construction of, properties of, and time evolution of coherent states. Expansion of coherent states in energy eigenstates.

Two-State Systems: The ammonia molecule. An example of dynamics in a two-state system with a time-independent Hamiltonian. The ammonia maser: dynamics in a two-state system with a time-dependent Hamiltonian. Spin precession and NMR. Spin-1/2 particle in a static magnetic field. Eigenstates of Sˆn revisited. Unitary time evolution as precession among these states. Realization that this is the most general two state system with a time independent Hamiltonian.Nuclear magnetic resonance: a time-dependent term in the Hamiltonian. Rotating frame. Resonance condition.

Neutrino Oscillations: Two different bases related by a unitary transformation: weak interactions produce either νe or νμ; eigen-states of the Hamiltonian are ν1 or ν2 .Computation of the probability that an electron neutrino will be found in an initially purely νμ beam, as a function of the distance traveled. Experiments that use neutrinos from accelerators, the sun, and cosmic rays.

Angular Momentum and Spin: Schrodinger equation in three dimensions with central forces. Reduced mass. Separation of variables. Angular momentum operators, commutators, raising and lowering operators. Matrix representation. Eigenvalues and eigenstates of angular momentum, wavefunctions, properties of spherical harmonics. Absence of half-integer orbital angular momentum.We revisit spin, now after having learned about angular momentum in more generality. Operator algebra of spin-1/2, Pauli matrices, rotation of spinors. Combining spin and spatial states.

References:

1. Modern Quantum Mechanics by J. J. Sakurai (Principal text) Pearson Education Pvt. Ltd
2. Quantum Mechanics by L.I. Schiff-Tokyo McGraw Hill