FACULTY OF SCIENCES

SYLLABUS

FOR

B. Sc. (Hons. School) Physics

(Under Credit Based Continuous Evaluation Grading System)

(SEMESTER: I to VI)

Examinations: 2014-15

GURU NANAK DEV UNIVERSITY AMRITSAR

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

SEMESTER I

SCHEME:-

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 - I	2	2-0-0
PBL-122	C	Punjabi/ਮੁੱਢਲੀ Punjabi	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-1	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 - II	2	2-0-0
PBL-132	C	Punjabi/ ਮੁੱਢਲੀ Punjabi	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**

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SEMESTER–III

SCHEME:-

Course No.	C/E/I	Course Title	Hrs/Week	LTP
ESL-220	C	Environmental Studies	3	3-0-0
PHL-202	C	Electricity & Magnetism–II	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		3	3-0-0
PHP-221	C	Modern Physics Lab-I	6	0-0-3
CYP-292	C	Physical Chemistry Lab.	4	0-0-2
			Total Credit	**23**

SEMESTER–IV

SCHEME:-

Course No.	C/E/I	Course Title	Hrs/Week	LTP
PHL-251	C	Optics	4	3-1-0
PHL-252	C	Quantum Physics	4	3-1-0
PHL-253	C	Theory of Relativity	4	3-1-0
MTL-232	C	Mathematics-IV	4	3-1-0
I-II	I		3	3-0-0
PHP-271	C	Optics Lab	6	0-0-3
PHP-272	C	Computer Lab	6	0-0-3
			Total Credit	**25**

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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-303	C	Quantum Physics	4	3-1-0
PHL-304	C	Mathematical Physics	4	3-1-0
I-2	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-351	C	Quantum Mechanics-I	4	3-1-0
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*
I-3	*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 Credits	**25**

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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.

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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. 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; Constancy of U+PV, cooling, liquefaction of gases. Low temperatures: Production and measurement of very low temperatures, adiabatic demagnetization.

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, Bose-Einstein statistics, deduction of Planck's radiation law, derivation of Wiens's displacement law and Stefan's law. Fermi-Dirac statistics, comparison of three types of statistics.

Text and Reference Books:

1. Statistical Physics and Thermodynamics- V.S. Bhatia, Punjab University, Chandigarh, 1977
2. Thermodynamics and Statistical Physics- Khandelwal and Loknathan, Shivlal Agnawala, Agna, 1979
3. Heat and Thermodynamics-Zemansky and Dittman, Mc Graw-Hill Science/Engineering/Math-7th edition (Nov,1, 1996)

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MATHEMATICS – I

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

Functions and Derivatives: Limits, continuity and derivative of function. Differentiation of standard functions, Successive differentiation. Geometrical significance of derivative. Maxima and Minima of a function of single variable. Partial differentiation. Chain rule of differentiation.

Differential Calculus: Statement of Rolle's theorem and Mean value theorem, Taylor's and Maclaurins theorems and their applications to formal expansion of functions. Tangents and normals. Asymptotes and graphs of simple curves in Cartesian co-ordinates.

Integral Calculus: Integration as inverse of differentiation. Indefinite integrals of standard forms. Method of substitution. Integration using partial fractions. Integration by parts. Reduction formulae. Definite integrals. Definite integral as limit of a sum and geometrical interpretation as an area. Formal double and triple integrals and their uses in the determination of C. G. and Moments of inertia.

Differential Equations: Definition & formation of differential equations. Linear differential equation of first order and first degree. Linear homogenous and inhomogeneous differential equation of second order. Linear differential equations with constant coefficients.

Text and Reference Books:

1. Differential Calculus: Shanti Narayan, New Delhi, Shyam Lal, 1983.

2. Integral Calculus: Shanti Narayan, Delhi, S. Chand, 1968.

3. Mathematical Hand Book: M. Vygodsky, Mir, Mascow, 1975.

4.. Higher Engineering Mathematics: B.S. Grewal, Delhi, Khanna, 1995.

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ORGANIC CHEMISTRY

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

1. 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.

2. 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.

3. 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.

4. 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.

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5. 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, Herbert Meislich, 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.

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ENL-101: Communicative English

Subject Code: ENL–101 Duration of Examination: 3 Hrs
Course Title: **Communicative English** Credits: 02 (L=2,T=0,U=0)

Objectives: To Introduce students in a graded manner to the communication skills of Reading and Writing in English. At the end of semester I, the students should be able to demonstrate adequate competence in comprehending the prescribed text and performing the given writing tasks.

Reading:

a) Developing Habits of Independent and Fast Reading.

Students will be required to read a prescribed prose anthology titled *Selections from Modern English Prose* (Ed. Haladhar Panda published by University Press, Hyderabad). The essays in the anthology will be read by students at home with the help of glossary given in the book. Progressing from one lesson to another, they should learn to read fast.

Students are supposed to keep a record of their reading in the form of notes, difficulties, summaries, outlines and reading time for each essay. Class teacher may use this record for award of internal assessment (if any).

b) Developing Comprehension Skills

Teacher will provide guided comprehension of the prescribed texts in the class and help students in answering the questions given at the end of each lesson. Teacher can construct more questions of factual and inferential nature to enhance the comprehension skills of the students. The teacher shall also guide students to do the grammar exercises given at the end of each lesson.

Writing:

a) Developing Skills in Personal Writing

Students will be required to learn short personal write–ups involving skills of description and narration. The types of composition task may include personal letter writing, telegram writing, notice writing, diary writing etc. Teacher shall instruct the students about the appropriate format and usual conventions followed in such writings. The teacher may also prescribe composition/writing book if so required.

b) Developing Writing Skills based on Guided Composition

The students will be required to write a longish composition on a question from the essays on *Selections from Modern English Prose*. The composition will require presentation of ideas beyond the prescribed essays. Sample composition topics are given at the end of each lesson.

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Question Paper: The following format is suggested for a 3–hour test.
(Appropriate choices may be given where possible)

1. Short–answer comprehension questions (at least 5) based on the lessons included in S*election from Modern English Prose* **App. weighting 30%**
2. Questions on grammar and vocabulary (words, phrases, proverbs) **App. weighting 20%**
3. Two short writing tasks of app. 100 words. One a personal letter involving narration of a personal experience or description of objects, persons, places of events. The second may be a telegram or public notice or a diary entry about a personal or family achievement, loss or celebration. **App. weighting 30%**
4. One long composition of about 300 words on one of the topics discussed in Selections from Modern English Prose. Due consideration be given to the organization of details and coherence in writing. **App. weighting 20%**

Internal Assessment: The teacher may consider the following for award of internal assessment, if any.
1. Evidence of independent reading as given above. Teacher may suggest some special tasks to suit the needs of their students.
2. Students may be asked to keep diary of their daily or specific routines.
3. Students may be asked to write a certain number of compositions on selected topics during the semester.

The division of the syllabus and the paper pattern for Minor and Major tests may be as follows:-

Minor-I

The syllabus to be covered; the essay from Sr. No. 1 to Sr. No. 6 from the prescribed book and personal letter.
Paper pattern: The following format is suggested for a test of 20 marks.
1. Personal letter (1 out of 2)
2. Short answer type question from the essay (2 out of 4).
3. Questions on Grammar and Vocabulary.

Minor-II

The syllabus to be covered; the essay from Sr. No. 7 to Sr. No. 13 from the prescribed book and personal letter.

Paper pattern: The following format is suggested for a test of 20 marks.

1. Personal letter (1 out of 2)
2. Short answer type question from the essay (2 out of 4).
3. Questions on Grammar and Vocabulary.

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Major Test

The syllabus to be covered; the essay from Sr. No. 14 to Sr. No. 20 from the prescribed book telegram and diary entry.

1. The format for 3 hour major test will be mentioned in the syllabus. This test will also include the syllabus covered in Minor-I and Minor-II.

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PBL-121: ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ – I (CBCEGS)

ਪਾਠ-ਕ੍ਰਮ ਅਤੇ ਪਾਠ-ਪੁਸਤਕਾਂ

Credits: 2–0–0

(I) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਹਾਣੀਕਾਰ:

(ੳ) ਗੁਰਮੁਖ ਸਿੰਘ ਮੁਸਾਫਿਰ : **ਗਟਾਰ**
(ਅ) ਸੁਜਾਨ ਸਿੰਘ : **ਪਠਾਣ ਦੀ ਧੀ**
(ੲ) ਕਰਤਾਰ ਸਿੰਘ ਦੁੱਗਲ : **ਉੱਚੀ ਅੱਡੀ ਵਾਲੀ ਗੁਰਗਾਬੀ**
(ਕਹਾਣੀ-ਸਾਰ, ਵਿਸ਼ਾ-ਵਸਤੂ, ਕਹਾਣੀ-ਕਲਾ, ਕਹਾਣੀਕਾਰ)

2. ਗੁਰਮੁਖੀ ਔਰਥੋਗਰਾਫੀ ਦੀ ਜੁਗਤ, (ਪੈਂਤੀ; ਮੁਹਾਰਨੀ; ਬਿੰਦੀ, ਟਿੱਪੀ ਤੇ ਅੱਧਕ); ਵਿਰਾਮ ਚਿੰਨ੍ਹ, ਸ਼ਬਦ ਜੋੜ (ਸ਼ੁਧ-ਅਸ਼ੁਧ)

(II) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਹਾਣੀਕਾਰ:

(ੳ) ਸੰਤੋਖ ਸਿੰਘ ਧੀਰ : **ਸਾਂਝੀ ਕੰਧ**
(ਅ) ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ : **ਉਜਾੜ**
(ੲ) ਮਹਿੰਦਰ ਸਿੰਘ ਸਰਨਾ : **ਜਥੇਦਾਰ ਮੁਕੰਦ ਸਿੰਘ**
(ਕਹਾਣੀ-ਸਾਰ, ਵਿਸ਼ਾ-ਵਸਤੂ, ਕਹਾਣੀ-ਕਲਾ, ਕਹਾਣੀਕਾਰ)

2. ਲੇਖ ਰਚਨਾ (ਜੀਵਨੀ-ਪਰਕ, ਸਮਾਜਕ ਅਤੇ ਚਲੰਤ ਵਿਸ਼ਿਆਂ ਉੱਤੇ):
10 ਲੇਖ ਲਿਖਵਾਉਣੇ (ਕਲਾਸ ਵਿੱਚ ਅਤੇ ਘਰ ਲਈ ਅਭਿਅਸ)

(III) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਹਾਣੀਕਾਰ:

(ੳ) ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼ : **ਮਾੜਾ ਬੰਦਾ**
(ਅ) ਗੁਲਜ਼ਾਰ ਸਿੰਘ ਸੰਧੂ : **ਕੁਲੱਛਣੇ**
(ੲ) ਮੋਹਨ ਭੰਡਾਰੀ : **ਘੋਟਣ**
(ਸ) ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ : **ਦਲਦਲ**
(ਕਹਾਣੀ-ਸਾਰ, ਵਿਸ਼ਾ-ਵਸਤੂ, ਕਹਾਣੀ-ਕਲਾ, ਕਹਾਣੀਕਾਰ)

2. ਪੈਰਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾ ਦੇ ਉੱਤਰ ਦੇਣਾ
(**ਆਤਮ ਅਨਾਤਮ** ਪੁਸਤਕ ਦੇ ਕਹਾਣੀ ਭਾਗ ਵਿੱਚੋਂ 15 ਪੈਰ੍ਹਿਆਂ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ)

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PBL-122: ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Punjabi Compulsory)
(Credit Based Continuous Evaluation Grading System)

2–0–0

ਪਾਠ–ਕ੍ਰਮ

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

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ
   ਸੁਰ 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, ਸੁਰ ਵਾਹਕ (ਓ ਅ ਏ), ਲਗਾਂ ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ।

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ ਅਤੇ ਉਚਾਰਨ; ਸੁਰਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ (ਲਘੂ–ਦੀਰਘ ਸੁਰ); ਸੁਰ 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 ਸੁਰ (ਜਿਵੇਂ ਆ); ਸੁਰ ਅਤੇ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਆਰ); ਵਿਅੰਜਨ ਅਤੇ ਸੁਰ (ਜਿਵੇਂ ਪਾ); ਵਿਅੰਜਨ ਸੁਰ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਪਾਰ); ਕੋਸ਼ਗਤ 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. (HS) Physics (Semester-II)
(Under Credit Based Continuous Evaluation Grading System)

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 (Statements only)

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. Potential of a localized charge distribution. The 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.

Magnetostatics : Magnetic fields, magnetic forces, magnetic force on a current carrying wire. Torque on a current loop, Biot-Savart law . 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 **B**. 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.

Electromagnetic Induction and Maxwell's Equation: Faraday's laws of e4lectromagnetic induction, Amphere's law for varying currents. Displacement current, Maxwell's equations.

Reference Books:

1. Introduction to Electrodynamics -D.J. Griffiths, Pearson Prentice Hall, New Delhi, 2006.
2. Berkeley Physics Course Vol. II (Electricity & Magnetism)- E.M.Purcell, McGraw Hill, New York, 1970.
3. Electricity & Magnetism-A.K. Sikri
4. Fundamental of Physics -D. Halliday, R. Resnick and J. Walker (6^{th} edition)-John Wiley, India Pvt. Ltd., 2001.

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

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. (HS) Physics (Semester-II)
(Under Credit Based Continuous Evaluation Grading System)

MATHEMATICS – II

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

Second order Differential Equations: Linear differential equations with variable coefficients. Series Solution of Bessel, Legendre, Hermite, Laguerre and Hypergeometric differential equations by Frobenius method. Recurrence relations and orthogonality properties.

Partial Differential Equations: Definition and formation of first and second order partial differential equations, Laplace, Wave and diffusion equation in one and two dimensions, Solutions of these equations by separation of variables.

Laplace Transforms: Definition, elementary Laplace transforms, transforms of derivatives, integration of transforms, Laplace transform of periodic functions, solution of differential equations with constant coefficients using Laplace transforms.

Fourier series and Transforms: Periodic functions, Drichlet's conditions, Fourier coefficients, Sine and Cosine series, half range expansions, exponential series, differentiation and integration of Fourier transform, Fourier Sine and Cosine transforms, Inversion formulae, Fourier transforms of derivatives.

Reference 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. (HS) Physics (Semester-II)
(Under Credit Based Continuous Evaluation Grading System)

INORGANIC CHEMISTRY

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

1**. 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.

2. **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.

3**. 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.

4**. 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

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

6. II 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.

7. 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. (HS) Physics (Semester-II)
(Under Credit Based Continuous Evaluation Grading System)

ENL-151: Communicative English

Subject Code: ENL–151	Duration of Examination : 3 Hrs
Course Title: **Communicative English**	Credits : 02 (L=2,T=0,U=0)

Objectives: To Introduce students in a graded manner to the communication skills of Reading and Writing in English. At the end of Semester II, the students should be able to demonstrate adequate competence in comprehending an unseen passage and performing the prescribed communication/writing tasks.

Prescribed Book: Vandana R. Singh, The Written Word, Oxford University Press, New Delhi (Selected Chapters).

Reading:

a) Developing Comprehension Skills

Students will be required to read sample comprehension passage as given in Chapter *Critical Reading and Comprehension* of the prescribed book. The teacher will help students in handling text and answering questions given at the end of each passage.

Teacher can bring in more texts and construct questions of factual and inferential nature to enhance the comprehension skills of the students.

b) Developing Habits of Additional Reading

The students will be required to show evidence of additional independent reading. They will maintain a scrapbook consisting of such readings as clippings from newspapers and magazines, short articles, stories etc. The minimum quantum of such additional reading will be decided by the class teacher, who will also test students individually on their additional reading and appropriately award internal assessment, if required.

Writing:

a) Developing Vocabulary and using it in the Right Context

Students will be required to pay special attention to build up their vocabulary. They should master the contents of the chapter on *Vocabulary* in the prescribed book. Teacher will help the students learn the correct and appropriate use of the given set of words/phrases/expressions.

b) Developing Skills in Formal Writing

Students will be required to do write–ups involving skills of making formal complaints, requests, orders etc., reporting, note taking, summarizing and transcoding. The types of composition task may include business and public interest letters, news/features writing, speeches, minutes, instructions, summary reports etc. Teacher shall instruct the students about the appropriate format and usual conventions followed in such writings. The following chapters in the prescribed book may be consulted for exercise materials on these tasks:

1. Paragraph and essay writing
2. Report Writing
3. Letter Writig
4. Note Making and Summarizing
5. Transcoding

Recommended Books:

1. A Course in Grammar and Composition by Geeta Nagaraj, Foundation Book, 2006.

2. Oxford Guide to Effective Writing and Speaking by Jhon Seely.

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

PBL-131: ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ – II (CBCEGS)

ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ ਪੁਸਤਕਾਂ

Credits: 2-0-0

(I) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠਾਂ ਲਿਖੇ ਕਵੀ:

(ੳ) ਭਾਈ ਵੀਰ ਸਿੰਘ
(ਅ) ਪ੍ਰੋ: ਪੂਰਨ ਸਿੰਘ
(ੲ) ਪ੍ਰੋ: ਮੋਹਨ ਸਿੰਘ
(ਕਵਿਤਾ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਾਵਿ–ਕਲਾ, ਕਵੀ)

2. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ: ਧਾਤੂ/ਮੂਲ, ਵਧੇਤਰ (ਅਗੇਤਰ, ਪਿਛੇਤਰ, ਵਿਉਂਤਪਤ ਅਤੇ ਰੁਪਾਂਤਰੀ), ਸਮਾਸ।

(II) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਵੀ:

(ੳ) ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ
(ਅ) ਡਾ. ਹਰਭਜਨ ਸਿੰਘ
(ੲ) ਸ਼ਿਵ ਕੁਮਾਰ ਬਟਾਲਵੀ
(ਕਵਿਤਾ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਾਵਿ–ਕਲਾ, ਕਵੀ)

2. **ਪੈਰ੍ਹਾ ਰਚਨਾ:** ਕਲਾਸ ਵਿੱਚ 10 ਵਿਸ਼ਿਆਂ (ਸਭਿਆਚਾਰਕ, ਧਾਰਮਿਕ ਅਤੇ ਰਾਜਨੀਤਕ) ਤੇ ਪੈਰ੍ਹਾ ਰਚਨਾ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ।

(III) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਵੀ:

(ੳ) ਡਾ. ਜਸਵੰਤ ਸਿੰਘ ਨੇਕੀ
(ਅ) ਡਾ. ਜਗਤਾਰ
(ੲ) ਡਾ. ਸੁਰਜੀਤ ਪਾਤਰ
(ਸ) ਪਾਸ਼
(ਕਵਿਤਾ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਾਵਿ–ਕਲਾ, ਕਵੀ)

2. ਮੁਹਾਵਰੇ ਤੇ ਅਖਾਣ (ਅਖਾਣ ਤੇ ਮੁਹਾਵਰਾ ਕੋਸ਼ ਵਿੱਚ) 200 ਮੁਹਾਵਰਿਆਂ ਅਤੇ 100 ਅਖਾਣਾਂ ਨੂੰ ਵਾਕਾਂ ਵਿੱਚ ਵਰਤਣ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ (ਕਲਾਸ ਵਿੱਚ ਤੇ ਘਰ ਲਈ)।

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

PBL-132: ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Punjabi Compulsory)

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/ਦੁਹਰਰੁਕਤੀ (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. (HS) Physics (Semester-III)
(Under Credit Based Continuous Evaluation Grading System)

ESL 220 Environmental Studies (Compulsory Paper)
(Under Credit Based Continuous Evaluation Grading System)

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 o£. 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. 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. (HS) Physics (Semester-III)
(Under Credit Based Continuous Evaluation Grading System)

ELECTROMAGNETISM

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. 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,

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. 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.

Text and Reference Books:

1. Field & wave Electromagnetics by David & Cheng, Addison Wesley Publishing co.

2. Introduction to Electrodynamics by David J. Griffiths, Prentice Hall of India.

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

MATHEMATICS-III

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

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.

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.

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.

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. (HS) Physics (Semester-III)
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PHYSICAL CHEMISTRY

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

1. **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.

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

3. **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.

4. **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.

5. **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.

6. 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. (HS) Physics (Semester-IV)
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OPTICS

Course No.	**L T P**
PHL-251	**3 1 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. (HS) Physics (Semester-IV)
(Under Credit Based Continuous Evaluation Grading System)

QUANTUM PHYSICS

Course No.	**L**	**T**	**P**
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. (HS) Physics (Semester-IV)
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THEORY OF RELATIVITY

Course No.	**L**	**T**	**P**
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. (HS) Physics (Semester-IV)
(Under Credit Based Continuous Evaluation Grading System)

MATHEMATICS-IV

Course No.	**L**	**T**	**P**
MTL-232	**3**	**1**	**0**

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.

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.

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 of polynomial, of n^{th} degree, power curve and exponential curve.

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. Fundamentals of mathematical Statistics: S. C. Gupta, V. K. Kapoor.

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

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

CLASSICAL MECHANICS

Course No.	**L**	**T**	**P**
PHL-302	**3**	**1**	**0**

Lagrangian Mechanics: Newton's law of motion, mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange's equations of motion. Velocity; dependent potentials and dissipation function. Some applications of Lagrangian formulation, Hamilton's principle, derivation of Lagrange's equations from the Hamilton's principle. Conservation theorems and symmetry properties.

Central Force Problem: Two body central force problem, reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one dimensional problem, and classification of orbits. The differential equation for the orbit and integrable power-law potential. The Kepler problem. Scattering in a central force.

Rigid Body Dynamics: The independent co-ordinates of a rigid body, orthogonal transformation, the Euler's angles. Euler's theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energy about a point for a rigid body, the inertia tensor and moment of inertia, the eigen values of the inertia tensor and the principal axis transformation. Euler's equations of motion, torque free motion of a rigid body.

Canonical Transformations: Legendre transformation and Hamilton's equations of motion, cyclic co-ordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action. The equation of canonical transformation, examples of canonical transformations. Poission brackets. Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poission bracket formulation.

Text and Reference Books:

1 Classical Mechanics: Herbert Goldstein-Narosa Pub. House, 1970.

2 Mechanics: Landau & Lifshitz-Pergamon Press-Oxford, 1982.

3 Classical Mechanics: Rana and Joag-Tata Mc Graw Hill, New Delhi, 1995.

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

SEMESTER–V
QUANTUM PHYSICS

Course No.	L	T	P
PHL-303	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. (HS) Physics (Semester-V)
(Under Credit Based Continuous Evaluation Grading System)

MATHEMATICAL PHYSICS

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

Coordinate systems:

Curvillinear coordinates, Differential vector operators in curvillinear coordinates, spherical and cylindrical systems, General coordinate transformation, Tensors: covariant, contravariant and Mixed , Algebraic operations on tensors, Illustrative applications.

Differential equations.

Second order differential equations, Frobenions method, wronskian and a second solution, the Strum Liouville theorem, one dimensional Green's function.

Special Functions.

Gamma functions. The exponential integral and related functions, Bessel functions of the first and second kind, Legendre polynomials , associated Legendre polynomials and spherical harmonics, Generating functions for Bessel, Legendre and associated Legendre functions, Hermite Function.

Complex analysis

The Cauchy –Riemann conditions, Cauchy integral theorem, Cauchy integral formula, Taylor and Laurent series, singularities and residues, Cauchy residue theorem, calculations of real integrals.

Fourier Transform.

Fourier decomposition, Fourier series and convolution theorem, Fourier transforms and its applications to wave theory.

Reference Books:

1. Mathematical Methods for Physicists: George Arfken-New York Academy, 1970.
2. Mathematical Physics : P.K. Chattopadhyay
3. Applied Mathematics for Engineers and Physicists: Pipes and Harvil-Tokyo Mc Graw Hill, 1970.
4. Advanced Mathematical methods for Engg. & Science students: George S. and Radmose P.M-Cambridge University Press, 1990.

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

QUANTUM MECHANICS-I

Course No.	**LTP**
PHL-351	**3 1 0**

Basic Formulation and Quantum Kinematics: Stern- Gerlach experiment as a tool to introduce quantum ideas, analogy of two level quantum system with polarization states of light. Complex linear vector spaces, ket space bra space and inner product, operators and properties of operators. Eigenkets of an observable, eigen kets as base kets, matrix representations Measurements of observable, compatible vs. incompatible observable, commutator and uncertainty relations. Change of basis and unitary transformations. Diagonalisation of operators. Position, momentum and translation, momentum as a generator of translations, canonical commutation relations. Wave functions as position representation of ket vectors. Momentum operator in position representation, momentum space wave function.

Quantum Dynamics: Time evolution operator and Schrödinger equation, special role of the Hamiltonian operator, energy eigen kets, time dependence of expectation values, spin precession. Schrödinger vs. Heisenberg picture, unitary operators, state kets and observable in Schrödinger and Heisenberg pictures, Heisenberg equations of motion, Ehrenfest's theorem.

One Dimensional Systems: Potential Step, potential barrier, potential well. Scattering vs. Bounds states. Simple harmonic oscillator, energy eigen states, wave functions and coherent states.

Spherical Symmetric Systems and Angular Momentum: Schrödinger equation for a spherically symmetric potential. Orbital angular momentum commutation relations. Eigen value problem for L^2, spherical harmonics. Three dim harmonic oscillator, three dim potential well and the hydrogen atom. Angular momentum algebra, commutation relations. Introduction to the concept of representation of the commutation relations in different dimensions. Eigen vectors and eigen functions of J^2 and J_z. Addition of angular momentum and C.G. coefficients.

Text and Reference Books:

1. Modern Quantum Mechanics by J. J. Sakurai (Principal text)-Pearson Education Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics by L I Schiff-Tokyo Mc Graw Hill, 1968.
3. Feynman lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics by Powel and Craseman-Narosa Publication, New Delhi, 1961
5. Quantum Mechanics by Merzbacher-John Wiley & Sons, New York, 1970.

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

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

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

ELECTRONICS

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

Unit - I

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.

Unit - II

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.

Unit - III

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.

Unit - IV

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).