RAMAKRISHNA MISSION VIDYAMANDIRA

BELURMATH, HOWRAH, WEST BENGAL

DEPARTMENT OF PHYSCS

PROGRAMME OFFERED : B.Sc. PHYSICS HONOURS

PROGRAMME CODE : PHSA

DURATION : 6 SEMESTERS

TOTAL CREDIT : 148

FULL SYLLABUS WITH COURSE OUTCOME

VALID & ONGOING AS ON 30TH JUNE, 2019

Following is the credit distribution for B.Sc. Physics Hons. Programme:

	CR SEM 1	CR SEM 2	CR SEM 3	CR SEM 4	CR SEM 5	CR SEM 6	Total Credit
Core Course / Hons.	14	14	14	14	26	26	**108**
Generic Elective	6	6	6	6	--	--	**24**
AECC-Lang.	2	2	2	2	--	--	**4**
AECC-ENVS	--	--	--	--	--	--	**4**
SEC- ICSH	1	1	1	1	2	2	**8**
	23	**23**	**23**	**23**	**28**	**28**	**148**

Following is the Grade Point distribution:

% of Marks	Descriptor	Grade	Grade Point
85 - 100	OUTSTANDING	**O**	**10**
70 - 84.99	EXCELLENT	**A+**	**9**
60 - 69.99	VERY GOOD	**A**	**8**
55 - 59.99	GOOD	**B+**	**7**
50 - 54.99	ABOVE AVERAGE	**B**	**6**
40 - 49.99	AVERAGE	**C**	**5**
35 - 39.99	PASS (HONOURS)	**P**	**4**
30 - 34.99	PASS (OTHERS)	**P**	**4**
LESS THAN 35	FAILED (HONOURS)	**F**	**0**
LESS THAN 30	FAILED (OTHERS)	**F**	**0**

Physics Hons	108	Total Credit : 24 Guidelines to make Choice : While Generic Elective subject Course 'a' is to be taken by all students, any one from Generic Elective subject Course 'b' may be chosen by the students a) Mathematics & b) Chemistry / Computer Science

B.Sc. Physics Hons. Programme has introduced Discipline Specific Elective Course (DSE) and/or Project in 5h and/or 6th semester:

Sl. No.	Name of the Programme	Discipline Specific Elective / Project
1	Physics Hons	Project

Students of B.Sc. Physics Hons. Programme must take following courses :

- Ability Enhancement Compulsory Courses (AECC):
  - Environmental Science : 4 Credit
  - English Language and MIL (Bengali Language/ Alternative English) : 4 Credit
- Value-Oriented Course (Indian Cultural and Spiritual Heritage) : 8 Credit

Total Credit to be earned by a student to complete B.Sc. Physics Hons. Programme: 148 Credit
Mark sheet after each semester will be given both with SGPA and detailed marks obtained by the examinee.
Similarly Mark sheet after the final semester will be given with CGPA and detailed marks obtained by the examinee.

Calculation of SGPA = (Total Credit X Total Grade Point = Total Credit Point);
Total Credit Points / Total Credits
Calculation of CGPA = (Total SGPA X Total Credits in each Sem.) / Total Credits earned in all the Semesters

B.Sc. Physics Honours
6 Semester Course
List of Courses

Sl No	Name of the Course	Semester	Course Code	Credit	Marks in the Course	Course outcome
1	Mathematical Methods-I Mechanics – I Vibration Geometrical Optics	1	**PHSA-P1-T**	**14**	100	In mathematical methods, basic understanding of Vector analysis, ordinary and partial differential equations, Fourier series are learnt. In mechanics, Newtonian, mechanics related physics is learnt. In vibration & waves, SHM, damped and forced oscillations, general properties of waves (acoustics and stationary) are learnt.
2	Mathematical Methods-II Mechanics – II General Properties of Matter Waves and Physical Optics	2	**PHSA-P2-T**	**10**	100	In mathematical methods, basic understandings of Linear vector space, Matrix-Tensor and some special functions, partial differential equations are learnt. In mechanics, many particles problem, rotational and rigid body motions are learnt. General Properties of matter (GPM) where the basic principles of elasticity, viscosity and surface tension are learnt. In optics, geometrical and physical optics including interference, diffraction and polarization are learnt.
3	General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics	2	**PHSA-P2-p**	**4**	50	Different experimental skills related to mechanics, general properties of mater, basic electronics and optics are developed.
4	Electrostatics Current Electricity & Magnetism Thermal Physics – I	3	PHSA-P3-T	**14**	100	In Electrostatics and Current Electricity & Magnetism part, the basic knowledge of electrostatics, current electricity, magneto statics, and preliminary electromagnetic theory are learnt. In heat and thermodynamics the basic laws of kinetic theory, thermodynamics and radiation are learnt.

5	Alternating Current & Electronics Thermal Physics – II	4	**PHSA-P4-T**	**10**	100	In Electronics part, analog and digital electronics and basic communication electronics are learnt. In Thermal Physics, thermodynamics related topics are learnt.
6	General Properties of Matter, Heat, Magnetism Physical Optics, Electricity & Electronics. Computer programing & Numerical Analysis	4	**PHSA-P4-P**	**4**	100	General practical skills are developed in this course. The skill of construction of amplifier, oscillator, power supply etc. in electronics are developed. Also the measurement of conductivity of bad conductor is done. The computer practical build the programming skills of students.
7	Mechanics – III Special Theory of Relativity Quantum Mechanics Atomic Physics & Laser	5	**PHSA-P5-T**	**16**	100	In mechanics, many particles problem, rotational and rigid body motions are learnt. In Special Theory of Relativity, basic knowledge of relativity, space-time and light cone are learnt. Quantum Mechanics is introduced up to hydrogen atom problem. In Atomic Physics and Laser, the spectroscopic behaviour of atomic transitions are learnt.
8	Electromagnetic Theory	5	**PHSA-P6-T**	**10**	50	The advance level theory of electromagnetic phenomena is learnt.
9	Nuclear Physics & Particle Physics, Statistical Physics Project	6	**PHSA-P7-T**	**9 (8+1)**	100	In Nuclear and Particle Physics, the properties of nucleus and its energetics, different nuclear models and the detectors & accelerators, interaction of nuclear radiation with matter and particles itself are learnt. In Statistical Physics, classical and quantum statistics are learnt. In project part, students get flavour of research in physics.
10	Solid State Physics	6	**PHSA-P8-T**	**4**	50	Different theoretical development and calculations are introduced to study the behaviour of solids.
11	Non-electronics, Electronics	6	**PHSA-P9-P**	**9**	100	Important physical constants/quantities like e/m, hall coefficient, bandgap energy of a solid, hysteresis loss etc. are measured. Also, the skill of design and fabrication of advance electronics circuits are developed.
12	Optics	6	**PHSA-P10-P**	**4**	50	The use of advance optical instruments is learnt.

B.Sc. Physics Honours
6 Semester Course
Mapping of Employability etc

Sl No	Name of the Course	Semester	Course Code	Employability/Skill enhancement / Enterpreneurship development
1	Mathematical Methods-I Mechanics – I Vibration Geometrical Optics	1	**PHSA-P1-T**	The course focuses to develop the basic knowledge in physics. The basic knowledge and conception is essential to understand the higher level physics and engineering. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students. To enhance the knowledge we conduct regular class test and assignment. Also we encourage students for questions related to topic and interact with teachers beyond class hours.
2	Mathematical Methods-II Mechanics – II General Properties of Matter Waves and Physical Optics	2	**PHSA-P2-T**	The course focuses to develop the basic knowledge in mathematics, mechanics, GPM and physical optics. The basic knowledge and conception about those topics are essential to understand the higher level physics and engineering. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students. To enhance the knowledge we conduct regular class test and assignment. Also we encourage students for questions related to topic and oral presentation of selected topic.
3	General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics	2	**PHSA-P2-p**	Very basic instruments handling capabilities are developed. That knowledge is essential for the experiments in higher physics. We conduct regular assessment and viva on experiment performed by the student.

4	Electrostatics Current Electricity & Magnetism Thermal Physics – I	3	PHSA-P3-T	Basic knowledge of electrostatics, electricity, magnetism is essential to realize the higher physics. The basic knowledge in thermal physics is the building block to understand the physics of material at higher level. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students. We conduct regular class test and assignment to enhance the understandings of the student. Also we encourage students to ask questions and involve in interaction in class so they gain interest and success in job oriented examinations.
5	Alternating Current & Electronics Thermal Physics – II	4	**PHSA-P4-T**	The advance knowledge in alternating current, analog electronics and digital electronics is essential and important to understand the modern day's development of devices and technology. The basic knowledge in thermal physics is the building block to understand the physics of material at higher level. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students. Students are encouraged to develop models on electronics as project work. We conduct regular class test and assignment to gain interest in problem solving and subject. Also we encourage students to conquer questions and involve in interaction to gain confidence to face competitive examinations.
6	General Properties of Matter, Heat, Magnetism Physical Optics, Electricity & Electronics. Computer programing & Numerical Analysis	4	**PHSA-P4-P**	The working experiences with the electrical and electronics circuits and optical instruments are essential for the higher level experiment in physics.The practical knowledge of circuit construction of basic building block of electronic devices is developed. We conduct regular assessment and viva on experiment performed by the student to enhance their knowledge and gain confidence to face competitive examinations.

7	Mechanics – III Special Theory of Relativity Quantum Mechanics Atomic Physics & Laser	5	**PHSA-P5-T**	The advance knowledge of theoretical physics is introduced here. The knowledge of those topics is essential for higher level studies and research. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.To enhance the knowledge we conduct regular class test and assignment. Also we encourage students for questions related to topic, class interaction with teachers and oral presentation of selected topic to develop their problem solving skills.
8	Electromagnetic Theory	5	**PHSA-P6-T**	The advance knowledge of Electromagnetic Theory is essential for higher level studies and research. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.
9	Nuclear Physics & Particle Physics, Statistical Physics Project	6	**PHSA-P7-T**	Development of knowledge of nuclear and particle physics which is future energy source and can fulfil the daily human energy requirements. The understanding of nuclear reactors and the stellar energy source with evolution of universe.The knowledge of statistical physics is very important to understand the physics of matter.Theoretical and practical skills related to research are developed through different project works. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students. Students are encouraged to develop research methodology as project work. We conduct regular assignment to gain interest in problem solving and subject. Also we encourage students to conquer questions and involve in interaction to motivate for competitive examinations.

10	Solid State Physics	6	**PHSA-P8-T**	The basic knowledge of Crystal Structure and properties of material is essential to study the higher level Physics and technologies . The content of course is also important to qualify the NET, SET and other job oriented examinations for UG and PG students. We encourage students for questions related to topic and oral presentation and group discussion on selected topic to motivate for competitive examinations.
11	Non-electronics, Electronics	6	**PHSA-P9-P**	Advance level instruments are used to measure the physical quantities. That gives a test of research work to the students. The development of skill to design and construct advance electronics circuits is helpful in future research work. We conduct regular assessment and viva on experiment performed by the student.
12	Optics	6	**PHSA-P10-P**	The development of skill to use advance and sophisticated optical instruments are helpful in future research work. We conduct regular assessment and viva on experiment performed by the student to enhance their knowledge and gain confidence to face competitive examinations.
16	General Properties of Matter Geometrical Optics Waves and Vibrations	1	**PHSG-P1-T**	The basic reason behind the different properties of matter and their applicability in daily life and industrial instruments are expected to learnt in GPM. The knowledge of geometrical optics is essential for the manufacturing or different optical instruments like microscope, telescope, camera, spectrometer, spectrophotometer etc. The study of wave motion is essential to understand the modern day's communication. The content of course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students. We encourage students for questions related to topic and interact with teachers within and beyond class hours.

17	Heat and Thermodynamics Vector and Electricity	2	**PHSG-P2-T**	The basic knowledge of heat and thermodynamics is the building block to understand the physics of material at higher level. The basic knowledge of electricity is essential for understanding modern day's electrical devices. The course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students.We encourage students for questions related to topic and interact with teachers within and beyond class hours.
18	General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics.	2	**PHSG-P2-P**	Different experimental skills related to electricity, heat and general properties of matter are developed.Very basic instruments handling capabilities are developed. Measurement of different physical quantities is useful in realizing the physics in daily life. We conduct regular assessment and viva on experiment performed by the student.
19	Mechanics Physical Optics	3	**PHSG-P3-T**	Development of knowledge and problem solving skills are developed in vector algebra and Newtonian Mechanics.The knowledge of motion of rigid body and related topics are essential for understanding the physical world of science and engineering. The knowledge of central force is necessary to understand the planetary motion of planets and satellites. The study of physical optics helps to know the nature of light. The course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students. We encourage students for questions related to topic and assignment to improve their knowledge.
20	Electronics Modern Physics	4	**PHSG-P4-T**	The basic knowledge of electronics is essential to understand the modern day electronic devices and communication. The basic concept of Modern Physics gives some ideas of some recent topics developed in physics. The course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students. We

				encourage students for questions related to topic and assignment to improve their knowledge.
21	General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics	4	**PHSG-P4-P**	Different experimental skills related to heat, electricity, magnestism, electronics and optics are developed. We conduct regular assessment and viva on experiment performed by the student.

RAMAKRISHNA MISSION VIDYAMANDIRA

3 Year B.Sc. Physics(Honours)

Syllabus Structure (Batch: 2014-2017, 2015-2018 & 2016-2019)

1st Semester Total Credit-14 Total marks-100

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
I Theory	14	100	Mathematical Methods-I	A: unit-I	30	30
			Mechanics – I	A: unit-II	30	30
PHSA-P1-T			Vibration	A: unit-III	10	10
			Geometrical Optics	B	30	30

2nd Semester Total Credit-14 Total marks-150

Paper / Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
II Theory	10	100	Mathematical Methods-II	A	20	20
PHSA-P2-T			Mechanics – II	B	20	20
			General Properties of Matter	C	20	20
			Waves and Physical Optics	D	40	40
II Lab.	4	50	General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics.		50	
PHSA-P2-p						

3rd Semester Total Credit-14 Total marks-100

Paper / Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
II Theory	14	100	Electrostatics	A	30	30
			Current Electricity & Magnetism	B	40	40
PHSA-P3-T			Thermal Physics – I	C	30	30

4th Semester Total Credit-14 Total marks-200

Paper / Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
III Theory	10	100	Alternating Current & Electronics	A	70	70
PHSA-P4-T			Thermal Physics – II	B	30	30

IV Lab. **PHSA-P4-P**	4	100	General Properties of Matter, Heat, Magnetism Physical Optics, Electricity & Electronics. Computer programing & Numerical Analysis	A B	75 25	

5th Semester Total Credit-26 Total marks-150

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
V Theory **PHSA-P5-T**	16	100	Mechanics – III Special Theory of Relativity Quantum Mechanics Atomic Physics & Laser	A B C D	30 20 30 20	30 20 30 20
VI Theory **PHSA-P6-T**	10	50	Electromagnetic Theory		50	50

6th Semester Total Credit-26 Total marks-300

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
VII Theory **PHSA-P7-T**	9 (8+1)	100	Nuclear Physics & Particle Physics, Statistical Physics Project	A B C	50 30 20	50 30
VIII Theory **PHSA-P8-T**	4	50	Solid State Physics		50	50
XI Lab. **PHSA-P9-P**	9	100	Non-electronics, Electronics		50 50	
XII Lab. **PHSA-P10-P**	4	50	Optics			50

B.Sc. Physics (General)

1st Semester Total Credit-3 Total marks-50

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
I Theory **PHSG-P1-T**	3	50	General Properties of Matter Geometrical Optics Waves and Vibrations	A B C	20 15 15	20 15 15

2nd Semester Total Credit-3 Total marks-100

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
II Theory **PHSG-P2-T**	2	50	Heat and Thermodynamics Vector and Electricity	A B	20 30	20 30
II Lab. **PHSG-P2-P**	1	50	General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics.		50	

3rd Semester Total Credit-3 Total marks-50

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
III Theory **PHSG-P3-T**	3	50	Mechanics Physical Optics	A B	30 20	30 20

4th Semester Total Credit-3 Total marks-100

Paper/ Course Code	Credits	Marks	Course Name	Group	Marks	No. of Lectures
IV Theory **PHSG-P4-T**	**2**	**50**	Electronics Modern Physics	A B	20 30	20 30
IV Lab. **PHSG-P4-P**	**1**	**50**	General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics.		50	

1st Semester

Paper- I; Course Code- PHSA-P1-t
Course Name - Mathematical Methods I, Mechanics I, Vibration, Geometrical Optics
Marks- 100; No. of Lectures- 100

Course Outcome: In mathematical methods, basic understanding of Vector analysis, ordinary and partial differential equations, Fourier series are learnt. In mechanics, Newtonian, mechanics related physics is learnt. In vibration & waves, SHM, damped and forced oscillations, general properties of waves (acoustics and stationary) are learnt.

Course Employability: The course focuses to develop the basic knowledge in physics. The basic knowledge and conception is essential to understand the higher level physics and engineering. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.

Course Contents:

Group A: Mathematical Methods I; Marks- 30; Lectures-30

Module – 1: Matrix Matrices of real no., equality of matrices, addition, multiplication, by a scalar, multiplication of matrices—associative properties, Transpose of a matrix—its properties, inverse of a non-singular matrix, symmetric and anti-symmetric matrices, scalar matrix, elementary operations on matrices, rank of a matrix, similarity transformation, diagonalisation of a matrix. 10L

Module – 2. a) Vectors and scalars :Vectors and scalars definition using transformation of coordinates : rotation of coordinate axes about the origin . components of a vector, distinction between polar and axial vectors in terms of rotation, Matrix notations . 3L
b). Vector algebra :Scalar and Vector products , various triple and multiple products. 3L
c) Vector function : Scalar and vector functions, continuity and differentiability ; derivatives of vector and scalar products of two vector functions .Parametric dependence of vectors and vector functions, Integration of a vector function . Definition of the arc length parameter ,s , ; space curve in terms of s . Tangent vector to a curve ,unit tangent vector , unit normal vector. 4L
d) Scalar and vector fields directional derivatives, gradient and its properties, divergence, curl of vector, line, surface and volume integrals, Gauss's, Green's and Stoke's theorems and its applications, the Laplacian and Δ-operator. 3L
e) Linear dependence of a set of vectors, complete set, reciprocal sets, basis vector, change of basis, orthogonal vectors, Gram-Schmidt orthogonalisation process. 3L

Module– 3. Orthogonal curvilinear coordinates: Jacobian of transformation,gradient, divergence, curl and Laplacian in rectangular, cylindrical and spherical polar coordinates . 4L

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
11. Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.

Group A: Mechanics I; Marks- 30; Lectures-30

Module–1: . **Kinetics: a)** Velocity and acceleration of a particle in (i) plane polar coordinates -- radial and cross-radial components (ii) spherical polar and (iii) cylindrical polar coordinate system, motion with uniform velocity and uniform acceleration, relative velocity, angular velocity and angular acceleration, linear , angular momentum and their components, work, energy and power. 8L

Module–2:. Frames of reference and Newton's laws of motion :Newton's laws of motion, law of gravitation, concept of inertial and gravitational mass, inertial frames, Galilean Transformation Inertial frames and Galilean principle of relativity, transformation of position vector, acceleration, linear momentum and energy. 6L

Module–3: Application of laws of motion and conservation principles :**a)** One dimensional motion of particles, time integral of force—impulse, work and energy, concept of potential, work-energy theorem, conservation linear momentum, variable mass problem- rocket motion, falling chains etc. **b)** Two and three dimensional motions--projectiles. **c)** Dissipative forces : non-conservation of mechanical energy, friction, dissipative forces proportional to velocity and square of velocity, motion in a viscous medium – terminal velocity. 7L

Module–4: System of particles : Centre of mass of a system of particles, momentum and kinetic energy of a system of particles in terms of the velocity of centre of mass; kinetic energy of two particles in terms of their relative coordinate and concept of reduced mass. Reduction of motion of two particles under external forces proportional to their masses to one body problem. Dynamics of a system of particles, concept of rigid bodies as a system of particles. Angular momentum of a system of particles and centre of mass; relation between torque and angular momentum, principle of conservation of angular momentum-examples. Conservation of mechanical energy of a system of particles subjected to external and internal conservation forces. Collisions of particles-elastic and inelastic scattering. Elastic Scattering: laboratory and centre of mass frame, relation between different quantities in the laboratory and centre of mass system. 9L

Reference Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
5. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
6. Sengupta Chaterjee

Group A: Vibration; Marks- 10; Lectures-10

Module –1: Ordinary Differential Equations : Introduction and recapitulation of the diff. equations. Solution of 2nd order diff equations with constant coefficients and variable coefficients (homogeneous and non- homogeneous). 4L

Module –2: Vibrations : Simple harmonic oscillator, properties, free and forced vibrations of a damped harmonic oscillator, amplitude and velocity resonance, sharpness of resonance and Q-factor. 6L

Reference Books:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.

3. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
4. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.

Group B: Geometrical Optics; **Marks- 30; Lectures-30**

Module –1: Fermat principle: Fermat principle, application to reflection and refraction at curved surfaces. 6L
Module –2: Cardinal points of an optical system: Paraxial approximation, introduction to matrix methods in paraxial optics – simple application. two thin lenses separated by a distance, equivalent lens, different types of magnification: Helmholtz- Lagrange magnification formula, 8L
Module –3. Dispersion : Dispersive power of optical systems, dispersive power of prism, chromatic aberration – methods of reduction, achromatic lens combination. 6L
Module–4. Seidel aberration : (only qualitative discussion) Nature and cause of different seidel aberrations, methods of reducing these. 6L
Module –5. Optical instruments : Field of view, entrance and exit pupil; microscope, Ramsden and Huygen eyepieces. 4L

References Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

2nd Semester

Paper- II; Course Code- PHSA-P2-t
Course Name - Mathematical Methods II, Mechanics II, General Properties of Matter, Waves and Physical Optics
Marks- 100; No. of Lectures- 100

Course Outcome: In mathematical methods, basic understandings of Linear vector space, Matrix-Tensor and some special functions, partial differential equations are learnt. In mechanics, many particles problem, rotational and rigid body motions are learnt. General Properties of matter (GPM) where the basic principles of elasticity, viscosity and surface tension are learnt. In optics, geometrical and physical optics including interference, diffraction and polarization are learnt.

Course Employability: The course focuses to develop the basic knowledge in mathematics, mechanics, GPM and optics. The basic knowledge and conception about those topics are essential to understand the higher level physics and engineering. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students

Course Contents:

Group – A: Mathematical Methods II; Marks - 20 ; Lectures – 20

Module –1. Fourier Series: Fourier expansion – statement of Dirichlet's condition, analysis of simple wave forms (sine, square, saw-thooth, half-wave) with Fourier series. Introduction to Fourier transforms; the Dirac-delta function and its Fourier transform; other simple examples (step, Gaussian etc.) 11L

Module –2. Partial Differential Equations: Solution by the method of separation of variables. Laplace's equation and its solution in Cartesian, spherical polar (axially symmetric problems), cylindrical polar (infinite cylinder problems), coordinate systems (with applications). Wave equation and its plane and spherical wave solutions. 9L

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning

8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
11. Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.

Group – B: Mechanics – II; **Marks – 20; Lectures – 20**

Module –1. Motion under central forces: a) General conservation laws.
b) Bound state: Attractive inverse-square law of forces ; nature of orbits ; effective potential energy ; orbit equation from the solution of radial equation of motion ; Kepler's laws of planetary motion. [Discuss Laplace-Lenz-Runge Vector --- not for exam]
c) Scattering, Rutherford's scattering ; repulsive inverse-square law of force. 9L

Module –2. Rotational Motion: a) Concept of angular velocity of a rotating frame : space-fixed and body-fixed axes.
b) Equation of motion in a rotating frame ; inertial forces : centrifugal, coriolis and transverse forces. The earth as a rotating frame ; simple examples : Free fall, river motion, Foucault pendulum ; Wind motion in northern hemisphere .
c) Moment of inertia, radius of gyration; Parallel and perpendicular axes theorems. Moment of inertia of a rigid body about an arbitrary axis; M.I of Rectangular and triangular lamina; thin rod, circular loop and disc, rectangular parallelepiped, sphere and hemisphere, cylinder and cone (solid and hollow) Kinetic energy and angular momentum of a rigid body, equation of motion of a rigid body. Products of inertia; inertia tensor; Ellipsoid of inertia ; Principal axes transformation, Finding principal axes for simple symmetric systems: symmetric and spherical top. 11L

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
8. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
9. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
10. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

Group – C: General Properties of Matter; **Marks – 20; Lectures – 20**

Module –1. Gravitation : Gravitational potential and intensity , Gauss' law , Laplace's equation, Poisson's equation and applications to calculate gravitational potential and intensity simple symmetric problems, Self- energy , Binary star. 5L
Module –2. Elasticity : Interrelations of elastic constants for an isotropic solid. Torsional rigidity; Bending moments and shearing forces, cantilever; Beam supported at both ends; strain energy. 5L
Module –3. Surface Tension :Surface energy and surface tension; Angle of contact; Excess pressure on a curved liquid surface; Capillary rise. Equilibrium vapour pressure over curved liquid. 3L
Module –4. Mechanics of Ideal Fluids and Viscosity :Newtonian & non-Newtonian fluids; Streamline and turbulent flows; Critical velocity; Reynold's number; Poiseuille's equation for incompressible fluids; Statement of Stokes' law - terminal velocity; Equation of motion of a body in a viscous liquid ; Equation of continuity; Euler's equation of motion; Bernoulli's equation and its applications. 7L

Group – D: Waves and Physical Optics; Marks – 30; lectures – 40

Module –1: General properties of waves : Physical and mathematical representation of wave, differential wave equation and its general solutions, Principle of superpogetion of waves, **a)** two slightly different frequency(beat)
b) two same frequency at right angle(Polarization), **c)** two different frequency (Polarization, Lissajous Fig.)
d)Standing wave, group velocity and phase velocity, wave packet, intensity, interference, diffraction. 6L
Module –2: Characteristics of acoustic wave: Acoustic waves, Velocity of acoustic waves in isotropic gas, solid (liquid for tutorial). Energy and Intensity of a plane progressive wave 6L

Module –3: Stationary wave: Transverse vibrations in stretched strings Wave equation in the linear approximation; eigen frequencies and eigen modes .(plucked and struck strings for tutorial); energy of transverse vibrations. 6L
Module–4: Dopplar effect : Various type of source and observer movement. 2L
Module–5. Wave theory of light : Introduction (History of optics). 1L
Module–6. Interference of light waves : Interference of light waves: Young's experiment;, idea of coherence; intensity distribution;. Fringe width, spatial and temporal coherence; intensity distribution; Fresnel's biprism, interference in thin film; fringes of equal inclination and equal thickness; Newton's ring. Michelson's interferometer, application in fine structure study. Multiple beam interference – reflected and transmitted pattern. Fabry-Perot interferometer and application to fine structure study 10L
Module –7. Diffraction of light waves :Fresnel and Fraunhofer class, Fresnel's half period zones; explanation of rectilinear propagation of light; zone plate. Fraunhofer diffraction due to a single slit, double slit and circular aperature (qualitative). Plane diffraction grating (transmission). Rayleigh criterion of resolution; resolving power of prism, telescope, microscope and transmission grating. 10L

References Books:

5. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
6. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
7. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
8. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

Paper – II(Lab.); Course Code- PHSA-P2-p
Course Name: General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics.
Marks- 50

Course Outcome: Different experimental skills related to mechanics, general properties of mater, basic electronics and optics are developed.

Course Employability: Basic instruments handling capabilities are developed. That knowledge is essential for the experiments in higher physics.

Course Contents:

1. Determination of the volume of a solid cylinder by slide calipers and find out the density of the material by measuring the mass of the cylinder.
2 .Determination of external diameter of a capillary tube by screw gauge and internal diameter by travelling microscope.
3. Determination of radius of curvature of a concave mirror by spherometer and check by coincidence method.
4. Determination of radii of curvature of both the surfaceof a concave/convex lens by spherometer and estimation of the focal length of the lens (*r.i.* is known).
5. Determination of the value of resistance of carbon resistor by colour code and checking their actual values with the help of digital meter. Estimation of the equivalent resistance of some combinations of carbon resistance on bread board.
6. Determination of the modulus of rigidity of the material of the given wire by dynamical method.
7. Determination of the moment of inertia of a rectangular body about an axis passing through its centre of gravity and perpendicular to its length. Using a cylinder as known body, compare the value of moment of inertia thus obtained with theoretical value calculated with the measured mass and dimensions of the rectangular body.
8. Determination of the coefficient of linear expansion of the material of the given metallic rod using an optical lever.
9. Study the variation of pressure with temperature [from room temp to 60^{o} C] of a given mass of air at constant volume. Draw the pressure temperature graph and hence calculate the pressure coefficient of air using two points from the graph within the observed region. Readings will be taken at intervals of 5 or 6^{0}C.
10. Determination of the refractive index of a liquid and that of the material of the convex lens supplied by using the lens and a plane mirror.
11. Determination of the focal length of the given concave lens by combination method. Focal length of the given convex lens and that of its combination with the given concave lens are to be measured by displacement method for

three distances between the object and the screen and each consecutive distance between the object and the screen should differ by 4 or 6 cm.
12. Determination of the focal length of the given concave lens by the auxiliary lens method.
13. Determination of the unknown frequency of a tuning fork with the help of a sonometer by drawing *n-l* curve. [The resonating length of the sonometer wire for tuning forks of at least five different frequencies are to be recorded].
14. a) Draw the current-voltage characteristics of an ordinary p-n junction diode in forward biased condition with experimentally obtained data. From the graph estimate the dynamic resistance of the diode for three different currents. Indicate the cut-in voltage of the diode.
b) Draw the reverse characteristics of a Zener diode and determine the break down voltage of the diode from graph.
15. Determination of the resistance per unit length of the bridge wire by Carey Foster's method. Then determine the resistance of an unknown resistor.
16. a) Draw the $\frac{R_t}{R_d}$ vs T calibration graph of a given torch bulb's filament using the given data.

T(K)	800	,1000	1200	1400	1600	1800	2000	2200	2400	2600	2800
R(t)/R(d)	1	1.23	1.63	1.97	2.33	2.69	3.08	3.48	3.89	4.31	4.76

b) Measure the resistance of the filament at the draper point and at eight other conditions by varying current (100 mA to 220 mA) and observing voltage across it. Now find the temperature from the calibration graph and corresponding power P radiated by the filament. c) Draw $log_{10} P \ vs \ log_{10} T$ graph, estimate the slope near the high temperature region and hence verify Stefan's law. Discuss the result obtained.

Reference Books:

1. Advanced Practical Physics (Vol 1, Vol 2), B. Ghosh.
2. An advanced course in Practical Physics, Chattopadhyay and Rakshit, New Central Book Agency.
3. A Text Book on Practical Physics , K. G. Mazumdar, B. Ghosh

3rd Semester

Paper- III; Course Code- PHSA-P3-t
Course Name – Electrostatics, Current Electricity & Magnetism, Thermal Physics-I
Marks- 100; No. of Lectures 100

Course Outcome: In Electrostatics and Current Electricity & Magnetism part, the basic knowledge of electrostatics, current electricity, magneto statics, and preliminary electromagnetic theory are learnt. In heat and thermodynamics the basic laws of kinetic theory, thermodynamics and radiation are learnt.

Course Employability: Basic knowledge of electricity, magnetism and thermal physics is essential to realize the higher physics. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.

Course Contents:

Group – A: Electrostatics; Marks – 30; Lectures - 30

Module-1 Mathematical Methods: Legendre function: Legendre's differential equation, Legendre functions for integer, properties of Legendre polynomials, mutual orthogonality, generating function.Bessel functions: Bassel's equation, Bessel functions for non-integer's, Bessel functions for integer's, properties of Bessel functions, mutual orthogonality, generating function. Unit and dimensions: CGS, Gaussion and SI units, conversion between Gaussion and SI unit. 6L

Module –2. Electrostatics: Coulomb's law of electrostatics, intensity and potential , Gauss' law its applications, Poisson and Laplace's equations, deduction from Gauss's law, uniqueness theorem, Superposition theorem (Statement only). Application of Laplace's equation to simple cases of symmetric spherical charge distribution. 5L

Module –3. Multipole expansion: Multipole expansion of scalar potential- monopole, dipole and quadrupole terms, potential and field due to a dipole, work done in deflecting a dipole, dipole -dipole interaction(for both electric and magnetic dipoles), force on dipole in a non-homogeneous field. 6L

Module – 4. Dielectric: Polarisation, electric displacement vector (D), Gauss's law in dielectric media, boundary condition, electric field energy, computation of capacitance in simple cases (parallel plates), spherical and cylindrical capacitance containing dielectric uniform and non-uniform. 6L

Module –5. Electric Image: Solution of field problems in case of a point charge near a ground conducting infinite plane. Boundary value problem: in uniform external field for (i) conducting spherical shell and (ii) dielectric sphere. 7L

Group – B: Current Electricity & Magnetism; **Marks – 40; lectures - 40**

Module –1. Electric Current associate Laws: Definition of electric current, current density; Ohm's law; resistance, registivity, conductance, conductivity; Differential form of Ohm's law(, relation between ; dielectric, conductor, semiconductor; Lorenz force basic idea. Kirchoff's Law, continuity relation ; concept of impedance; and Wheatstone bridge network; Thevenin and Norton Theorems. Maximum power transfer Superposition and reciprocity Theorems. 8L

Module –2. Static magnetic field and steady electric current: Force on current carrying wire in a magnetic field; Magnetic field of a current carrying element(Biot savart Law); Force between two parallel current carrying conductors; flux and flux density. torque in a loop, Magnetic flux over a closed surface (Gauss's law integral and differential form) . Ampere's law (integral and differential form) Vector potential; Multipole expression of the vector potential. 8L

Module –3. Magnetic materials in magnetic field: Magnetization, Concept of magnetic dipole moment per unit volume, Dia, Para, Fero magnetic material. Field of a magnetized object, Bound current, Physical interpretation. Amper's law in magnetized material, Linear material, Hysteresis. Boundary conditions, Magnetic potential, Magnetic sphere in uniform external field, Magnetic circuit. 10L

Module –4. Electromagnetic induction: Charged particle Moving in Static magnetic field, Faraday's Law by motional emf, Two ways of emf generation its problems, Faraday's Law general treatment, Self inductance, Mutual inductance, its problems, The Neumann Formula, Inductance in series and in parallel. Energy stored in an inductor. Loss of energy in ferromagnetic material. Energy stored in magnetic field. 8L

Module –5. Transient: Growth and decay of current/voltage in LR, CR, LCR, circuits. Time constant, Problems. 6L

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
4. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
5. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
6. Electricity and Magnetism, A.S. Mahajan & A. A. Rangawala
7. Electricity and Magnetism, Chattopadhay & Rakshit

Group – C: Thermal Physics-I Marks – 30; Lectures - 30

Module –1. Probability: Random variables and probabilities – statistical expectation value, variance; Binomial distribution, Gaussian distribution and Poisson distribution. 3L

Module –2. **Basic concepts of Thermal Physics**

Temperature, Heat, and Internal energy; Macroscopic & microscopic point of view: An example - Ideal Gas. (i) Phenomenological view of ideal gas: Boyle's law, Charle's law, Avogadro's law- mole & Avogadro's Number, Equation of state- Universal Gas constant and Boltzmann constant. (ii) Microscopic view of ideal gas: size of the gas molecule, intermolecular interaction - ideal gas approximation. Collisions of gas molecules-expression of pressure, kinetic interpretation of temperature. 4L

Module –3. Temperature and Canonical distribution

(i) Thermodynamical view: Thermal equilibrium, Zeroth law of thermodynamics - temperature as a thermodynamic parameter. (ii) Statistical view: macrostate and microstate; statistical definition of temperature. Canonical distribution, Boltzmann factor - partition function. 5L

Module –4. The Maxwell-Boltzmann distribution
The velocity distribution, the speed distribution-mean speed and r.m.s speed; most probable speed
Energy distribution- mean energy. Equipartition theorem: Degrees of freedom(f); expression of specific heats in terms of 'f'. 4L

Module –5. Idea of Mean free path and its applications
(i) Free path - Survival equation, The collision cross-section, Expression of mean free path.
(ii) Expression of pressure using free path concept. Dalton's law of partial pressure. 3L

Module –6. Molecular effusion: Graham's law, molecular flux, speed distribution of effusing gas and its mean kinetic energy. 2L

Module –7. Transport Phenomena in gases : Viscosity, thermal conduction and diffusion in gases 3L

Module –8. The thermal diffusion equation: Fourier's equation in one and three dimension and its solution. Periodic flow of heat. 2L

Module –9. Real gases: Isotherms of real gases -critical constants; Virial Coefficients, Boyle temperature; van der-Waal's equation of state- nature of isotherms, limitations of van der-Waal's equation of state. Other equations of state (mention only) of a gas, law of corresponding states – universality; 4L

Reference Books:

1. Thermal Physics, M. N. Saha and B. N. Srivastava, The Indian Press.
2. Thermal Physics, F. Rief.
3. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
4. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
5. Thermal Physics, A. B. Gupta and H. P. Roy.

4th Semester
Paper-IV; Course Code- PHSA-P4-t
Course Name - Alternating Current & Electronics, Thermal Physics- II
Marks- 100; No. of Lectures 100
Revision done vide BoS dated : 22.12.2014

Course Outcome: In Electronics part, analog and digital electronics and basic communication electronics are learnt. In Thermal Physics, thermodynamics related topics are learnt.

Course Employability: The advance knowledge in analog electronics and digital electronics is essential and important to understand the modern day's development of devices and technology. The basic knowledge in thermal physics is the building block to understand the physics of material at higher level. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.

Course Contents:

Group – A: Alternating Current & Electronics; Marks – 70; Lectures – 70

Module –1. Alternating current:

Basic idea and expression of rms, average, voltage and current, power, power factor in ac circuits. Imaginary operator in ac circuit, phase diagram. LR, CR, LCR circuit. Q factor, Resonance in series and parallel LCR circuits, basic theory of transformer, genarelised AC bridge and balanced condition. Anderson's bridge. 12L

Module –2.Rectification and filtering. Diode I-V characteristics of forward and reverse bias junction, Half and Full wave rectification, bridge rectifier, filters [C, L, π], ripple factor relations. Zener diode and its application (voltage regulation). 4L

Module –3. Electronic Devices and Circuits. BJT: PNP and NPN transistor, Input and output characteritics in CB and CE configuration, cutoff, saturation and active regions. Ebers-Moll representation of BJT, CB, CE and CC configuration, of a transistor and their relations. DC biasing of a transistor; load line and Q-point, stability factors. Fixed bias and self bias. Hybrid parameters, low frequency model, analysis of CE amplifier using hybrid model: current and voltage gain, input and output impedance, power gain. 8L

b) Field Effect Transistors (FET) : Classification of various types of FETs, construction of junction FET and MOSFET. principle of operation, pinch-off., operating region, drain transfer characteristics JFET. FET as an amplifier. biasing, small signal low frequency equivalent circuit – voltage gain. 4L

Module –4. Amplifier Circuit and System. **a)** Small-Signal Model of BJT: hybrid equivalent circuit for CE mode, low and high frequency model. BJT as a diode, Emitter coupled pair.
b) Basic Amplifier at Low Frequency: Biasing of single stage and multistage circuits. Low frequency response of various circuits.
c) Frequency Response of Amplifier: High frequency response of single and multistage circuits. Tuned amplifiers circuits. 8L
Module –5. Feed Back Amplifier: Voltage and Current feedback. Topologies. Ideal feedback Amplifier. Properties of Negative feedback amplifier. Sinusoidal oscillator: Barkhausen criterion. Wine Bridge, Colpitte, Heartily, Crystal oscillators. Multivibrators (astable, bistable, monostable). 8L

Module –6. OP Amp.: Architectures, Inverting, Non inverting, Adders, Subtractor, Integrator, Differentiator, Current to Voltage converter, Voltage to Current converter, AD and DA. 6L

Module –7. Digital algebra and logic gate. Binary, Decimal, hexadecimal number system and its conversion, 1's and 2's number system, addition and subtraction. AND, OR, NOT gates, NAND and NOR Gates, de Morgan's theorem, simplification of Boolian expressions. 5L

Module –8. Combination and Sequential Digital Circuits : Adder, Comparator, Decoder, Encoder, ROM and RAM, EPROM, EEPROM, FF, RS, JK, MS, Shift Register, Counter. 6L

Module –9. Power Amplifier Circuits. Regulated power circuit, Monolithic Regulator, Switching regulator, A, B, AB amplifiers. Class C Amplifier. 6L

Module –10. Communication : Modulation. Type of modulation, AM, frequency of spectrum wave form, Side band, Power in AM. FM, wave form, modulation index, Frequency spectrum, Comparison between AM FM Basic idea of PM AM demodulation, diode detector, clipping. Basic idea of FM demodulation. 7L

Module –11. Instrumentation: CRO. CRT, Basic block diagram, explanation of each block, need for time base, Measurement of voltage, current, time and phase.(will discuss in practical classes) Digital meters. Dual slope digital voltmeter. (will discuss in practical classes) 4L

Reference Books:

1. *Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press*
2. *A.S. Mahajan & A. A. Rangawala*
3. *Chattopadhay & Rakshit*
4. *Integrated Electronics, Millman and Halkias , TMH.*
5. *OP-Amp and Linear Integrated circuits, Gaykwad, Pearson.*
6. *OP-Amp and Linear Integrated circuits, Coughlin and Driscoll, PHI.*
7. *OP-Amp and Linear Integrated Circuits, Roychodhury and Jain , New Age*
8. *Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson Education.*
9. *Basic Electronics and Linear Circuits, N. N. Bhargava et. al., TMH.*
10. *Basic Electronics, Theraja, S. Chand.*
11. *Digital Circuits (Vol-I&II), D. Roychaudhuri, Platinum Publisher.*
12. *Digital Logic and Computer Design, Mano, Pearson.*
13. *Digital computer electronics, Malvino and Brown, Tata McGraw Hill.*
14. *Basic Electronics, Ghatak and De, Pearson.*
15. *Electronic Instrumentation, Kalsi , TMH*

Group – B; Thermal Physics- II; Marks – 30; Lectures – 30

Module –1. Introduction to Thermodynamics : Thermodynamic equilibrium, Equation of state-some examples, state function-path independence; response functions and their interrelations 3L
Module –2. First law of thermodynamics: External work, quasi-static process, path dependence of work, cyclic process; First law: Internal energy as a state function, differential form of first law. Thermodynamic view of Ideal gas: Joule's experiment :- U=U(T), Relation between two specific heats; quasi-static adiabatic process: relation between state variables. Isothermal atmosphere model, Adiabatic lapse rate 5L

Module –3. Second law of thermodynamics: Reversible and irreversible processes. Carnot's cycle-efficiency; Carnot's refrigerator and heat pump; second law -different statements and their equivalence; Carnot theorem; Thermodynamic scale of temperature. 4L

Module–4. Entropy: Clausius inequality, entropy as a state function, entropy principle, calculation of entropy change for reversible and irreversible processes; T-S diagram -efficiency of Carnot engine; entropy and disorder, principle of degradation of energy. 5L

Module –5. Thermodynamic Functions: Thermodynamic equilibrium and free energies. Legendre transformations, Enthalpy, Helmholtz and Gibbs' free energies; Maxwell's relations for hydrostatic system and its applications: TdS equations, energy equations, heat capacity equation, and other simple deductions. Thermodynamic potential for (i) surface film, (ii)stretched string (iii) magnetic system and (iv) dielectric system 6L

Module –6. Phase transitions : Equilibrium between phases, triple point : Gibbs' phase rule (statement only) and simple applications. First and higher order phase transitions, Ehrenfest criterion. Clausius-Clapeyron's equation - applications. Joule-Thomson effect; inversion temperature 5L

Module –7. Thermal radiation: Spectral emissive and absorptive powers, Kirchoff's law, blackbody radiation, energy density, radiation pressure. Stefan-Boltzmann law, Planck's law (no detailed derivation), solar temperature. 5L

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
6. Thermodynamics and an introduction to thermostatistics, H. B. Callen, 1985, Wiley.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
8. Thermal Physics, A. B. Gupta and H. P. Roy
9. Thermodynamics, E Fermi
10. Thermodynamics, E. Guha, Narosa Publishing House
11. Thermal Physics, F. Rief
12. Thermal Physics, M. N. Saha and B. N. Srivastava, The Indian Press

4th Semester

Paper – IV(Lab.); Course Code- PHSA-P4-p

Course Name: General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics, Computer programing & Numerical Analysis

Marks- 100

Course Outcome: General practical skills are developed in this course. The skill of construction of amplifier, oscillator, power supply etc. in electronics are developed. Also the measurement of conductivity of bad conductor is done. The computer practical build the programming skills of students.

Course Employability: The practical knowledge of circuit construction of basic building block of electronic devices is developed. Also, the skill to measure the conducting property of some bad conductor is developed. The programming skills are essential for higher studies.

Course Contents:

Group – A: General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics; Marks - 75

1. Determination of Young's modulus of the material of a given uniform bar by the method of flexure.

2. Determination of the coefficient of viscosity (η) of water by Poiseuille's Method.

3. Determination of the thermal conductivity of a bad conductor in the form of a disc by Lee and Chorton's method with Bedford correction

4. a) Study of the nature of the dependence of the dipolar field of a short bar magnet placed at a distance d using a deflection magnetometer

b) Determination of the horizontal component of earth's magnetic field using vibration magnetometer.

5. a) Verification of Thevenin's theorem for variable load resistance R_L connected in one side and voltage source in other side of a given T network.

b) Verification of Norton equivalent circuit with appropriate current source and admittance for same T network.

c) Verification of the maximum power transfer theorem for the same network. Verify the

theoretical and experimental results.

.6.With the help of a ballistic galvanometer draw the deflection dial reading ($d \sim \theta$) graph for the mutual inductance (M) of the given pair of coils.

7.Draw the resonance curve of a series LCR circuit. Hence determine the Q-factor of the circuit. Study the variation of Z_L and Z_C with frequency.

8.Draw the current –voltage (I_L-V_L) characteristics of a bridge rectifier i) without using a filter ii) using a capacitor and iii) pi-filter. Calculate percentage voltage regulation from the graphs at a specified value of load current.

9.Study of regulation characteristics (load regulation and line regulation) of Zener diode.

10.Draw the input and output characteristics curve of a given transistor in CE configuration for two different output voltages and four different base currents respectively. Show saturation and active regions in the graph. Calculate the current gain (ac and dc), input and output resistances from the characteristics curves.

11.Draw the static characteristics of the given JFET in common-source config

uration for four different gate voltages. Show saturation and ohmic regions in the graph.

12.Draw the static characteristics of the given MOSFET in common-source configuration for four different gate voltages.

13. a) Verify, using a voltmeter, the truth tables for the two input OR ; the two input AND and the NOT gates.

b) Establish NAND gate is an universal gate.

c) Implement binary to decimal converter using 4514/4515 chip

d) Implement the logic expression $L = \bar{X}.Y + X.\bar{Y}$, and verify it, using logic gates.

14. a) Determination of the refractive index μ of the material of prism for five lines of known wave lengths λ of the light source.

b) Draw the μ vs $\frac{1}{\lambda^2}$ graph. Verify Cauchy relation $\mu = A + \frac{B}{\lambda^2}$ and evaluate A and B.

Estimate the error in your observation and discuss the result obtained.

15. Determination of the wave length of the incident light source by Newton's ring method.

16. Prepare solution of known concentrations using the given solute:

i) Measure the rotations of plane of polarization for five different concentrations by volume of the optically active solutions and then determine the concentration of an unknown solution.

17. Draw the (*i* vs *H*) and (*d* vs *H*) curve using a Hall probe and Gauss meter.

Group – B: Computer programing & Numerical Analysis; Marks - 25

1. Write a program to arrange in ascending/descending order of a set of given numbers and find the smallest and biggest numbers.

2. Write a program to find the sum of any infinite series(converging)[sine, cosine] term by term with accuracy.
3. Write a program to find the solution of simple algebraic equation.
4. Find the solution of algebraic equation by Newton-Raphson's method.
5. Write a program to perform addition, subtraction, transpose, product of two matrices.
6. Write a program to evaluate the integral by Simpson's $1/3^{rd}$ rule.
7. Write a program to find mean, median and mode of some numbers.
8. Find the least square fit of a given set of data to a straight line.
9. Use of functions.

Reference Books:

1. Advanced Practical Physics (Vol 1), B. Ghosh. K.G. Mazumdar
2. Advanced Practical Physics (Vol 2), B. Ghosh.
3. An advanced course in Practical Physics, Chattopadhyay and Rakshit, New Central Book Agency.
4. Numpy beginners guide, Idris Alba, 2015, Packt Publishing.
5. Computational Physics, D.Walker, 1st Edn., 2015, Scientic International Pvt. Ltd.

5th Semester

Paper-V; Course Code- PHSA-P5-t

Course Name - Mechanics – III, Special Theory of Relativity, Quantum Mechanics, Atomic Physics & Laser

Marks- 100; No. of Lectures 100

Course Outcome: In mechanics, many particles problem, rotational and rigid body motions are learnt. In Special Theory of Relativity, basic knowledge of relativity, space-time and light cone are learnt. Quantum Mechanics is introduced up to hydrogen atom problem. In Atomic Physics and Laser, the spectroscopic behaviour of atomic transitions are learnt.

Course Employability: The advance knowledge of theoretical physics is introduced here. The knowledge of those topics is essential for higher level studies and research. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.

Course Contents:

Group – A; Mechanics – III; Marks – 30; No. Lecture - 30

Module –1. Top motion :Euler's equation, Force-free motion of rigid body, free spherical top. 4L

Module –2. Lagrangian Formulations: Constraints and degrees of freedom , Generalised coordinates, variational principle, Virtual work, D'Alembart's principle; Lagrange's equation for conservative systems and application to simple cases; Cyclic coordinates, Conservation principles; 8L

Module –3. Hamiltonian Formulations: Definition of Hamiltonian, Hamilton's equation and application to simple cases. Poisson's bracket and equation of motion. 6L

Module –4. Small Oscillations: Normal modes and eigen-frequencies, simple examples. 4L

Group – B: Special Theory of Relativity; **Marks – 20; Lectures – 20**

Module –1. Maxwell equation- invariance problem. 2L

Module –2. Special Theory :Postulates of special theory; simultaneity; Lorentz transformation along one of the axes – length contraction, time dilatation and velocity addition theorem, Michelson-Morley Experiment, Fizeau's experiment. Relativistic dynamics–variation of mass with velocity; energy momentum relation. Relativistic kinetics. Doppler effect, Steller aberration. 8L

Module –3.Concept of space-time: Euclidean and Minkowski. Invariant intervals in 1+1 and 3+1 dimensions . Four vectors. 4L

Module –4. Light cone : space like, time-like and light like four vectors, light cone, causality. 6L

Group – C: Quantum Mechanics; Marks – 30; Lectures – 30

Module –1. Historical developments: Planck's formula for black-body radiation, Photoelectric effect,Compton effect; de Broglie hypothesis, Davisson-Germer & G.P.Thomson's experiment, Wave particle duality, wave packet and group velocity. Heisenberg's uncertainty principle (statement) with illustrations. 6L

Module –2. Quantum Mechanics: Concept of wave function, Principle of superposition. Basic postulates of quantum mechanics. Dynamical variables as linear hermitian operators, eigenvalue equation satisfied by them. Momentum, energy and angular momentum operators. Result of measurement of observables, expectation values, Commutation relations between operators. Compatible observables and simultaneous measurements, Ehrenfest theorem. Time dependent and time independent Schrödinger equation. Eigen values and eigen function, Normalization and orthonormality, Stationary states , Equn. of continuity- interpretation of wave function, Probability current density, Properties of wave function, examples 12L

Module –3. Applications of Quantum Mechanics :One dimensional potential well and barrier, boundary conditions, bound and unbound states. Reflection and transmission coefficients for a rectangular barrier in one dimension – Free particle in one dimensional box, box normalization, momentum eigenfunctions of a free particle. Linear harmonic oscillator, energy eigenvalues from Hermite differential equation, wave function for ground state, parity of wave function. Schrodinger equation in spherical polar coordinates. Angular momentum operators and their commutation relations; eigenvalues and eigenfunctions of L^2 and L_z. 8L

Module –4. Hydrogen atom problem :Stationary state wavefunctions as simultaneous eigenfunctions of H, L^2, and L_z; Radial Schrodinger equation and energy eigenvalues, degeneracy of the energy eigenvalues. 4L

Group – D: Atomic Physics & Laser; Marks – 20; Lectures – 20

Module –1. Spectrum of hydrogen atom.,Good quantum numbers and selection rules. Stern-Gerlach experiment and intrinsic spin of the electron, Incompatibility of spin with classical ideas. 3L

Module –2. L-S coupling, doublet structure of spectral lines, spectra of alkali atoms. Bohr-Sommerfeld model, idea of fine structure 3L

Module –3. Magnetic moment of the electron, Lande g factor. Vector model – space quantization. theorem of addition of angular momenta [statement with examples]. Zeeman effect. 4L

Module –4. Pauli exclusion principle, shell structure. Hund's rule, spectroscopic terms of many electron atoms in the ground state. 2L

Module –5. Diatomic molecules –Rotational and vibrational energy levels. Basic ideas about molecular spectra. Raman effect and application to molecular spectroscopy (qualitative discussion only). P,Q,R branches selection rule, Band Envelope. Electronic spectra and Frank-Condon principle 4L

Module –6. Laser : Population inversion, Relation of Einstein's A and B coefficients; Lasing Action ; 3-level laser systems. 4L

Reference Books:

1. Classical Mechanics, H. Goldstein, C. P. Poole, J. L . Safko, 3rd Edn. 2002, Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz,1976, Pergamon.
3. The Classical Theory of Fields, L. D. Landau and E. M. Lifshitz, 4th Edn., 2003, Elsevier
4. Classical Mechanics, P. S. Joag, N. C. Rana, 1st Edn.,McGraw Hill.
5. Classical Mechanics, R Douglas Gregory, 2015,Cambridge University Press.
6. Classical Mechanics: An Introduction, Dieter Strauch, 2009, Springer.
7. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
8. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
9. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
10. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
11. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
12. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
13. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
14. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
15. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
16. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

5th Semester

Paper-VI; Course Code- PHSA-P6-t

Course Name - Electromagnetic Theory

Marks- 50; No. of Lectures-50

Revision done vide BoS dated : 16.05.2015

Course Outcome: The advance level theory of electromagnetic phenomena is learnt.

Course Employability: : The advance knowledge of Electromagnetic Theory is essential for higher level studies and research. The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.

Course Contents:

Marks- 50: Electromagnetic Theory; Lectures-50

Module –1. Generalization of Ampere's Law, Displacement Current, Maxwell's Field Equations, Wave equation for electromagnetic (EM) field and its solution – plane wave solutions, transverse nature of field, relation between E and B; energy density of field, Poynting vector and Poynting's theorem, boundary conditions. Spherical wave solution. 12L

Module –2. EM Waves in vacuum and an isotropic dielectric, wave equation, 5L

Module –3. EM Wave equation in conducting medium, reflection and transmission at metallic surface , skin effect and skin depth. 6L

Module –4. EM Waves in isotropic and anisotropic dielectric (phenomenology). Wave equation, and its solution; reflection and refraction at plane boundary; reflection and transmission coefficients, Fresnel's formula; change of phase on reflection; Different states of polarisation; Brewster's law; double refraction; Huygen's construction for uniaxial crystals; production and analysis of plane- circularly and elliptically polarised light by retardation plates; polaroids and their uses; rotatory dispertion and optical activity; biquartz and half shade polarimeter. 12L

Module –5. Dispersion : Equation of motion of an electron in a radiation field : Lorentz theory of dispersion- normal and anomalous; Sellmeier's and Cauchy's formulae, 6L

Module –6. Scattering: Scattering of radiation by a bound charge, Raylegh's scattering, Blue of the sky, absorption. 5L

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Optics, E. Hecht, 2016, Pearson.
3. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
4. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
5. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
6. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
7. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
8. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
9. Additional Books for Reference
10. Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.
11. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
12. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004,Cambridge University Press

6th Semester

Paper-VII; Course Code- PHSA-P7-t

Course Name - Nuclear Physics & Particle Physics, Statistical Physics & Project

Marks- 100; No. of Lectures-100

Revision done vide BoS dated : 16.05.2015

Course Outcome: In Nuclear and Particle Physics, the properties of nucleus and its energetics, different nuclear models and the detectors & accelerators, interaction of nuclear radiation with matter and particles itself are learnt. In Statistical Physics, classical and quantum statistics are learnt. In project part, students get flavour of research in physics.

Course Employability: Development of knowledge of nuclear and particle physics which is future energy source and can fulfil the daily human energy requirements. The understanding of nuclear reactors and the stellar energy source with evolution of universe.
The knowledge of statistical physics is very important to understand the physics of matter.
Theoretical and practical skills related to research are developed through different project works.
The content of course is also important to qualify the NET, SET and other job oriented examinations for Physics Honours students.

Course Contents:

Group – A: Nuclear Physics & Particle Physics; Marks – 50; Lectures – 50

Module –1. Bulk properties of nuclei : Nuclear mass, charge, size, binding energy, spin and magnetic moment. Isobars, isotopes and isotones; mass spectrometer (Bainbridge). 5L

Module –2. Nuclear structure : Nature of forces between nucleons, nuclear stability and nuclear binding, the liquid drop model (descriptive) and the Bethe-Weizsacker mass formula, application to stability considerations, extreme single particle shell model (qualitative discussion with emphasis on phenomenology with examples). 10L

Module –3. Unstable nuclei : **a) Decay laws** -- Secular and Transient equilibrium of radioactive substances. 2L
b) Alpha decay: alpha emission mechanism and spectra –velocity and energy of alpha particles. Geiger-Nuttal law. 3L
c) Beta decay : nature of beta ray spectra, the neutrino, energy levels and decay schemes, positron emission and electron capture, selection rules, beta absorption and range of beta particles (add-- Application of selection rules in beta-transitions) 4L
c) Gamma decay : gamma ray spectra and nuclear energy levels, isomeric states, Mention multipolarity of transitions and selection rules.. Gamma absorption in matter – photoelectric process, Compton scattering, pair production (qualitative). 4L

Module –4. Nuclear reactions : a) Conservation principles in nuclear reactions. Q-values and thresholds, nuclear reaction cross-sections, examples of different types of reactions and their characteristics. Bohr's postulate of compound nuclear reaction, Ghosal's experiment. 5L
(b) Nuclear fission : discovery and characteristics, explanation in terms of liquid drop model, fission products and energy release, spontaneous and induced fission, transuranic elements. Chain reaction and basic principle of nuclear reactors. 4L
c) Elementary idea of nuclear fusion. 1L

Module –5. Elementary particles : a) Four basic interactions in nature and their relative strengths, examples of different types of interactions. Quantum numbers – mass, charge, spin, isotopic spin, intrinsic parity, hypercharge. Charge conjugation. Conservation laws. 4L
b) Classifications of elementary particles – hadrons and leptons, baryons and mesons, elementary ideas about quark structure of hadrons . 4L

Module –6. Particle Accelerators: Linear accelerator, Cyclotron (fixed and variable energy) – basic theory, limitations , (Phase-stable mechanism of synchrotron, (Betatron - basic theory), 10L

Module –7. Detectors: GM counter, basic principle of semiconductor detectors for charge particles and g-rays; (CCD detector.). 4L

Group – B: Statistical Physics; Marks – 30; lectures - 30

Module –1 Foundation : i) Statistical Mechanics : Introduction; Simple examples of statistical approach; macrostates and microstates. **ii). Counting of microstates**: classical description in terms of phase space and quantum description in terms of wave functions. Explicit equivalence of the two approach-examples: (i) 1D harmonic oscillator, (ii) one free particle in a 1D box, **(iii)** one free particle in 3D box. General prescription.
ii). Hypothesis of equal a priori probability for microstates of an isolated system in equilibrium (Microcanonical ensemble). Interactions between two systems – thermal, mechanical and diffusive. Statistical definition of temperature, entropy, pressure, and chemical potential. 8L

Module –2:Classical Statistical Mechanics i).Canonical ensemble-Partition function (Z) of a system in thermal equilibrium with a heat bath. expression of average energy <E>, fluctuations in <E>; weakly interacting system, N ideal gas molecule - Pressure, Entropy and Helmholtz free energy in terms of Z. Examples of canonical systems:Classical dipoles in external field - Langevin function; spin ½ particles in external field; Rigid rotator and other simple problems. **ii)**.Law of equipartition of energy, its limit of validity and applications: 3D classical oscillators- Dulong and Petit's law- failure at low temperature, quantum oscillator, Lamp and scale arrangement - r.m.s. amplitude of the light spot. **ii)**.Grand canonical ensemble - grand partition function Z, Grand potential and its relation with thermodynamic parameters. fluctuations in particle numbers. 10L

Module –3: Quantum Statistics: Gibb's paradox, Identical particles and symmetry requirement. Derivation of MB, FD and BE statistics as the most probable distributions (micro-canonical ensemble). Classical limit of quantum statistics.

Number fluctuations in quantum gases: F.D and B.E. 3L

Module –4: Application of quantum statistics : i) Classical statistics : Maxwell-Boltzmann distribution law. Calculation of thermodynamic quantities for ideal monatomic gases. **ii)**.Bose-Einstein statistics : Application to radiation – Planck's law, Rayleigh Jeans law and Wein's distribution law as limiting cases, Wein's displacement law, Stefan's law; Radiation pressure. 4L

Module –5: Bose-Einstein condensation (qualitative discussion) **i).Fermi-Dirac statistics** : Fermi distribution at zero and non-zero temperatures. Fermi energy and its expression in terms of particle density. Degenerate and non-degenerate Fermi gas. Electron degeneracy pressure. Thermionic emission - Richardson-Dushman equation.
ii).Random walk and Brownian motion: 1D random walk problem, mean square displacement, Diffusion equation. Brownian motion - Langevin equation, Einstein equation. 5L

Group – C: Project; Marks - 20

Course Contents: Project topics as decided by the Guide and the student.

References:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by
8. K. Heyde (IOP- Institute of Physics Publishing, 2004).
9. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
10. Statistical Mechanics – Avijit Lahiri
11. Concepts in Thermal Physics – S.J.Blundell & K.M. Blundell
12. An Introduction to Thermal Physics – Daniel V. Schroeder
13. Elementary Statistical Physics – Charles Kittel

6th Semester

Paper-VIII; Course Code- PHSA-P8-t

Course Name - Solid State Physics

Marks- 50; No. of Lectures-50

Revision done vide BoS dated : 16.05.2015

Course Outcome: Different theoretical development and calculations are introduced to study the behaviour of solids.

Course Employability: The basic knowledge of Crystal Structure and properties of material is essential to study the higher level Physics and technologies . The content of course is also important to qualify the NET, SET and other job oriented examinations for UG and PG students.

Course Contents:

Module –1. Crystal Structure: Crystalline and amorphous solids. Elementary ideas about crystal structure: Lattice and bases, Unit cell, Fundamental types of lattices(SC, FCC, BCC), Crystal symmetry(translation, rotation, reflection), Coordination number, Nearest neighbor distance, Atomic radius, Atomic packing factor, Miller Reciprocal lattice. 7L

Module –2. X-rays diffraction and analysis of crystal structure: Continuous and characteristic X-rays; Laue and Bragg equations, Vector form of Bragg's law. Debye-Scherrer pattern, Intensity of diffracted beam, Intensity of X-ray lines for SC, BCC, FCC and NaCl crystals. 5L

Module–3. Different types of binding: Atomic binding,Crystal bonding: ionic, covalent, metallic and van der Waals. 3L

Module –4. Lattice Vibrations: Monatomic linear lattice : Dispersion relation, Phonons and lattice specific heat of solids – Einstein's and Debye's theory. 4L

Module –5. Free electron theory of metals : Free electron theory of metal: Ohm's law and conductivity, Sommerfeld free electron theory, Fermi energy, Fermi surface, Temperature variation of Fermi energy. Internal energy of free electron, Electronic specific heat, Wiedemann-Franz law. Hall effect. 7L

Module –6. Band theory of solids: Bloch theorem, Kronig-Penny model, Energy band structure, Brillouin zone. Concept of holes, Effective mass, Energy band diagram in conductors, semiconductors and insulators. 6L

Module –7a. Solid state electronics: Semiconductor device: Basis structure of p-n junction, band diagram, concept of potential barrier and depletion, current transport equation, Depletion and diffusion capacitances. 8L

Module –7b. Transistor: pnp and npn structure, space charge layer , potential barrier, expression of current component.

4L

Module –8. Dielectric properties of materials : Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization – molecular field in a dielectric; Clausius-Mosetti relation. 3L

Module –9. Magnetic properties of materials: Dia, para and ferro-magnetic properties of solids. Langevin's theory of diamagnetism. Classical and quantum theory of paramagnetism. Curie's law: spontaneous magnetization and domain structure;spontaneous magnetisation and its temperature dependence. Curie-Weiss law, explanation of hysteresis. 6L

Module –10. Introduction to Superconductivities: Electrical resistivity, Response of magnetic field, Meissner effect, Supper currents and penetration depth, Critical field and critical temperature. 3L

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
6. Solid State Physics, Rita John, 2014, McGraw Hill
7. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
8. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

6th Semester
Paper-IX(Lab.); Course Code- PHSA-P9-p
Course Name - Non-electronics, Electronics
Marks- 100

Course Outcome: Important physical constants/quantities like e/m, hall coefficient, bandgap energy of a solid, hysteresis loss etc. are measured. Also, the skill of design and fabrication of advance electronics circuits are developed.

Course Employability: Advance level instruments are used to measure the physical quantities. That gives a test of research work to the students. The development of skill to design and construct advance electronics circuits is helpful in future research work.

Course Contents:

Non-electronics

1. Determine e/m of electron using teltron tube.
2. Take the current vs deflection through anchor ring and plot the graph for BH curve.
3. Determine the capacitance of a given device for different values of bias voltage using LCR meter and plot the data.(maximum reverse bias voltage 5.0 volt)
4. Determine the Fourier spectrum of the output from the amplifier using DSO

5. Find the Hall coefficient of a given sample using given setup.

6. Study of temperature dependence of reverse saturation current of a semiconductor diode and determination of the band gap energy of the material

Electronics

1.a) Design of a series regulated power supply from a unregulated supply with 741 Op Amp, a transistor (2N3055) and a reference Zener voltage.

b) Design of a current limiting circuit and study of its current limiting performance.

2.Determination of h-parameter of a given transistor in CE mode applying a particular supply voltage with an AC source (amplitude restricted to small signal limit.

3.Design of a CE amplifier with a given mid-band gain and to study its performance.

4.To study the use of OP-AMP as (i) Inverting amplifier (ii) Non-inverting amplifier (iii) Unity gain buffer (iv) differential amplifier (v) Adder (vi) Integrator and Differentiator.

5. a) Use of two input NAND gates to implement SR Flip Flop circuits (Verify the truth table by measuring input and output voltages.).

b) Construct and verify T type Flip Flop using JK F/F using logic gates..

c) Design and study of a decade counter using IC 7490 (Apply clock to this circuit and record all the input and outputs in a truth table).

6.Design, fabrication and study of Wein-Bridge oscillator.

Reference Books:

1. Advanced Practical Physics (Vol 2), B. Ghosh.
2. An advanced course in Practical Physics, Chattopadhyay and Rakshit, New Central Book Agency.
3. Basic Electronics: A Text Lab Manual, Zbar, TMH.
4. Laboratory Manual for Electronic Devices and Circuits, Bell.

6th Semester

Paper-X(Lab), Course Code- PHSA-P10-p

Course Name - Optics

Marks- 50

Course Outcome: The use of advance optical instruments is learnt.

Course Employability: The development of skill to use advance and sophisticated optical instruments are helpful in future research work.

Course Contents:

1.Determination of the wave length of the monochromatic light by using a bi-prism.

2. Determination of the lines per unit length of the given diffraction grating and resolving power of the grating. Hence, determine the separation between the two components of D-lines of sodium using an adjustable slit.

3.Verification of Fresnel's equation of reflection of electromagnetic waves in the case of a dielectric medium with the help of a prism, spectrometer, a pair of polaroid's and sodium light.

4.Draw sinθ *vs.* λ graphs for second order using three standard given wave lengths from the Fraunhofer diffraction pattern of the given grating. Hence, determine the wave length of the given unknown line.

Reference Books:

1. Advanced Practical Physics (Vol 1), B. Ghosh.
2. An advanced course in Practical Physics, Chattopadhyay and Rakshit, New Central Book Agency.

B.Sc. Physics Generic Elective
Course Structure

16	General Properties of Matter Geometrical Optics Waves and Vibrations	1	**PHSG-P1-T**	**3**	50	General Properties of matter (GPM) where the basic principles of elasticity, viscosity and surface tension are learnt. In Geometrical Optics Fermat's principle and related topics along with different types of aberrations and optical instrument is learnt.
17	Heat and Thermodynamics Vector and Electricity	2	**PHSG-P2-T**	**2**	50	In Mechanics II the students are expected to learn the physics of system of particles, rotational motion, rigid body motion and the motion of a particle under central force. The basic physics behind the simple harmonic motion and wave motion are also learnt. In Physical Optics the basic phenomenon of interference, diffraction and polarisation are learnt.
18	General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics.	2	**PHSG-P2-P**	**1**	50	Different experimental skills related to Wave & Acoustics, general properties of mater, basic electronics optics and heat are developed.

19	Mechanics Physical Optics	3	**PHSG-P3-T**	**3**	50	In Mechanics the students are expected to learn the physics of system of particles, rotational motion, rigid body motion and the motion of a particle under central force. The basic physics behind the simple harmonic motion and wave motion are also learnt. In Physical Optics the basic phenomenon of interference, diffraction and polarisation are learnt.
20	Electronics Modern Physics	4	**PHSG-P4-T**	**2**	50	In electronics the basic of analog and digital electronics are learnt. In modern physics very basic of some advanced topics like Special Theory of Relativity, Quantum Mechanics, Solid State Physics and Nuclear Physics are learnt.
21	General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics	4	**PHSG-P4-P**	**1**	50	Students get the opportunity to do some experiments on General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics.

2 Year B.Sc. Physics(General) Syllabus

1st Semester
Paper - I; Course Code-PHSG-P1-t
Course Name - General Properties of Matter, Geometrical Optics, Waves and Vibrations
Marks- 50; No. of Lectures- 50

Course Outcome:. General Properties of matter (GPM) where the basic principles of elasticity, viscosity and surface tension are learnt. In Geometrical Optics Fermat's principle and related topics along with different types of aberrations and optical instrument is learnt.

Course Employability: The basic reason behind the different properties of matter and their applicability in daily life and industrial instruments are expected to learnt in GPM. The knowledge of geometrical optics is essential for the manufacturing or different optical instruments like microscope, telescope, camera, spectrometer, spectrophotometer etc. The content of course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students.

Course Contents:

Group A: General properties of matter; Marks- 20; Lectures-20

Module –1. Elasticity : Elastic moduli , Torsion of a cylinder, Cantilever, Bending moment, energy of bending, Cantilever fixed at one end and loaded at free end, Simply supported beam with concentrated load at the centre. 7L
Module –2. Viscosity: Newton's law, Newtonian and non-Newtonian liquids, Streamline and turbulent motions, critical velocity, Reynolds number, Poiseullie formula, Stokes' law (statement only). 7L

Module –3. Surface Tension : Molecular theory of surface tension, Surface tension and surface energy,excess pressure of curved liquid surfaces, Angle of contact, spreading of liquid, Elevation and depression of liquid columns in a capillary tube. 6L

Group B: Geometrical Optics; Marks-15; Lectures-15

Module –1. Light as electromagnetic transverse wave: short wavelength limit for ray (geometrical) optics (brief). 3L
Module –2. Fermat's principle, Laws of reflection and refraction at a plane surface, Refraction at a spherical surface, Lens formula, Equivalent focal length of two thin lenses separated at a distance. 5L
Module –3. Aberrations : Dispersion in a prism and in lens, Dispersive power, Chromatic aberration and its remedy, Different types of Seidel aberration (qualitative) and their remedy. 5L
Module –4. Optical Instruments : Entrance and exit pupils, Ramsden and Huygen eye-pieces, Magnifications of Astronomical telescope and compound microscope. 2L

Group C: Waves and Vibrations; Marks-15; Lectures-15

Module –1. Simple Harmonic Motion : Differential equation and its solution.
Module –2. Superposition of simple harmonic motions : Analytical treatment, Natural, forced and damped vibrations, Resonance.
Module –3. Wave Motion: Differential equation of plane progressive wave, energy and intensity. Bel, decibel and phon. Velocity of longitudinal wave in solid and gas, Velocity of transverse wave in string.
Module –4 Superposition of waves and interferences (brief discussion).

Reference Books:

1. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
6. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
7. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications

2nd Semester
Paper -II, Course Code- PHSG-P2-t;
Course Name - Heat and Thermodynamics, Vector and Electricity
Marks- 50; No. of Lectures- 50

Course Outcome: In Mechanics II the students are expected to learn the physics of system of particles, rotational motion, rigid body motion and the motion of a particle under central force. The basic physics behind the simple harmonic motion and wave motion are also learnt. In Physical Optics the basic phenomenon of interference, diffraction and polarisation are learnt.

Course Employability: The knowledge of motion of rigid body and related topics are essential for understanding the physical world of science and engineering. The knowledge of central force is necessary to understand the planetary motion of planets and satellites. The study of wave motion is essential to understand the modern day's communication. The study of physical optics helps to know the nature of light. The course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students.

Course Contents:

Group A: Heat and Thermodynamics; Marks-20; Lectures-20

Module –1. Kinetic theory of Gas : Perfect gas, Maxwell's law of distribution of molecular velocities (statement only with diagram)-rms, mean and most probable velocities, degrees of freedom, principle of equipartition of energy-application in simple cases. van der Walls equation (quantitative study), critical constants. 6L

Module –2. Thermodynamics : Basic concepts (equilibrium state, state function, exact and inexact differential), internal energy as state function. First law of thermodynamics. Isothermal and adiabatic changes- relations, indicator diagrams. Reversible and irreversible processes. Second law of thermodynamics, Carnot cycle, Entropy. 6L

Module –3. Radiation : Black body radiation. Stefan's law. Wien's displacement law. Planck's distribution law (only statement). 6L

Group B: Vector and Electricity; Marks-30; Lectures-30

Module –1. Vectors : Axial and polar vectors, Geometrical meaning of cross product, scalar triple product and vector triple product, Idea of partial differentiation, Scalar and vector fields- gradient, divergence and curl, statement of Gauss's divergence theorem and Stoke's theorem. 5L

Module –2. Electricity : **a). Electrostatics** :Coulomb's law in vector forms, calculations of for simple distributions of charges at rest, Work done on a charge in electrostatic field in term of a line integral, conservative nature of the electrostatic field, Electric potential, flux of the elctric field. Gauss' theorem, fields at the surface of a charged conductor. Dielectric medium, polarization, electric displacement vector , Relation between. 7L

Module –2. Electric Currents: Steady current and non-steady currents , continuity equation, current density Network analysis - Thevnin and Norton's theorem, Maximum power theorem. Varying currents - Charging and discharging of LR and C-R circuits. Alternating current: Applications of complex numbers in solving LR, CR , series LCR circuit problem, complex impedance and reactance, series and parallel resonances, Q-factor, power factor, resistive and reactive power, transmission of electric power [basic idea]. 8L

Module –3. Magnetostatics : Force on a charge in simultaneous electric and magnetic fields, Magnetic field due to a small current loop and concept of magnetic dipole, dipole moment , angular momentum and gyromagnetic ratio. 7L

Module –4. Time varying fields : Electromagnetic induction, self and mutual inductances in simple cases, electromagnetic field energy density. 3L

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
5. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press

2nd Semester

Paper – II(Lab.); Course Code- PHSG-P2-p

Course Name: General Properties of Matter, Wave & Acoustics, Heat, Geometrical Optics, Electricity & Electronics.

Marks- 50

Course Outcome: Different experimental skills related to Wave & Acoustics, general properties of mater, basic electronics optics and heat are developed.

Course Employability: Basic instruments handling capabilities are developed. That knowledge is essential for the experiments in higher physics.

Course Contents:

1. Determination of the volume of a solid cylinder by slide calipers and find out the density of the material by measuring the mass of the cylinder.
2 .Determination of external diameter of a capillary tube by screw gauge and internal diameter by travelling microscope.
3. Determination of radius of curvature of a concave mirror by spherometer and check by coincidence method.
4. Determination of radii of curvature of both the surfaceof a concave/convex lens by spherometer and estimation of the focal length of the lens (*r.i.* is known).

5. Determination of the value of resistance of carbon resistor by colour code and checking their actual values with the help of digital meter. Estimation of the equivalent resistance of some combinations of carbon resistance on bread board.
6. Determination of the modulus of rigidity of the material of the given wire by dynamical method.
7. Determination of the moment of inertia of a rectangular body about an axis passing through its centre of gravity and perpendicular to its length. Using a cylinder as known body, compare the value of moment of inertia thus obtained with theoretical value calculated with the measured mass and dimensions of the rectangular body.
8. Determination of the coefficient of linear expansion of the material of the given metallic rod using an optical lever.
9. Study the variation of pressure with temperature [from room temp to 60^{o} C] of a given mass of air at constant volume. Draw the pressure temperature graph and hence calculate the pressure coefficient of air using two points from the graph within the observed region. Readings will be taken at intervals of 5 or 6^{0}C.
10. Determination of the refractive index of a liquid and that of the material of the convex lens supplied by using the lens and a plane mirror.
11. Determination of the focal length of the given concave lens by combination method. Focal length of the given convex lens and that of its combination with the given concave lens are to be measured by displacement method for three distances between the object and the screen and each consecutive distance between the object and the screen should differ by 4 or 6 cm.
12. Determination of the focal length of the given concave lens by the auxiliary lens method.
13. Determination of the unknown frequency of a tuning fork with the help of a sonometer by drawing *n-l* curve. [The resonating length of the sonometer wire for tuning forks of at least five different frequencies are to be recorded].
14. a) Draw the current-voltage characteristics of an ordinary p-n junction diode in forward biased condition with experimentally obtained data. From the graph estimate the dynamic resistance of the diode for three different currents. Indicate the cut-in voltage of the diode.
b) Draw the reverse characteristics of a Zener diode and determine the break down voltage of the diode from graph.
15. Determination of the resistance per unit length of the bridge wire by Carey Foster's method. Then determine the resistance of an unknown resistor.
16. a) Draw the $\frac{R_t}{R_d}$ vs T calibration graph of a given torch bulb's filament using the given data.

T(K)	800	,1000	1200	1400	1600	1800	2000	2200	2400	2600	2800
R(t)/R(d)	1	1.23	1.63	1.97	2.33	2.69	3.08	3.48	3.89	4.31	4.76

b) Measure the resistance of the filament at the draper point and at eight other conditions by varying current (100 mA to 220 mA) and observing voltage across it. Now find the temperature from the calibration graph and corresponding power P radiated by the filament.
c) Draw $log_{10} P \ vs \ log_{10} T$ graph, estimate the slope near the high temperature region and hence verify Stefan's law. Discuss the result obtained.

Reference Books:

1.A Text Book on Practical Physics , K. G. Mazumdar, B. Ghosh
2. A Handbook of Degree Practical Physics , C R Dasgupta,A K Das, S Paul

3rd Semester
Paper -III, Course Code- PHSG-P3-t;
Course Name – Mechanics and Physical Optics
Marks- 50; No. of Lectures- 50

Course Outcome: In Mechanics the students are expected to learn the physics of system of particles, rotational motion, rigid body motion and the motion of a particle under central force. The basic physics behind the simple harmonic motion and wave motion are also learnt. In Physical Optics the basic phenomenon of interference, diffraction and polarisation are learnt.

Course Employability: The knowledge of motion of rigid body and related topics are essential for understanding the physical world of science and engineering. The knowledge of central force is necessary to understand the planetary motion of planets and satellites. The study of wave motion is essential to understand the modern day's communication. The study of physical optics helps to know the nature of light. The course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students.

Course Contents:

Group - A: Mechanics; Marks – 30; lectures – 30

Module – 1. Newton's Law: Limitations of Newton's laws of motion. Components of velocity and acceleration in (a) two dimensional Cartesian coordinate system. (b) Polar coordinate system $(\vec{r},\theta)$. Motion of a particle in a curved path [velocity and (radial, tangential) accelerations]. Frames of reference : inertial and non-inertial, examples. Equation of motion of a variable mass and rocket motion. [idea of multistage rocket]. Force in non-inertial frame : Rotating frame, Fictitious (pseudo) force a) centrifugal and b) coriolis force and its manifestation. 9L

Module – 2. **Angular Momentum and Motion of rigid body:** Angular momentum of a particle and of a rigid body. Torque on a rigid body, relation of angular momentum and torque.Conservation of angular momentum and examples. Angular and linear impulses. centre of mass, velocity and acceleration of cm. Centre of mass, velocity, acceleration, linear momentum, equation of motion of a system of two particles. Advantage of cm frame over laboratory frame. Kinetic energy of rotation and moment of inertia of a rigid body. Physical significance of moment of inertia. Parallel and perpendicular axes theorems with proofs (two dimensional). Moment of inertia of rectangular lamina and bar , solid cylinder and sphere. 13L

Module – 3. **Motion under central force :** i) Conservative force and non-conservative force, examples. Characteristics of central and non-central forces. a) central force is conservative force, b) angular momentum is conserved in central force. Equation of motion under attractive inverse square force, f(r)= $-\frac{c}{r^2}$ in polar coordinates system, shape of orbit, maximum and minimum values of r, turning points. Gravitational potential and intensity and their relation and applications. Gravitational self-energy and self-energy of a sphere. 8L

Group – B: Marks – 20; lectures – 20

Module – 1 . **Interference of light**: Idea of coherence, interference in thin films, Newton's ring. 6L

Module – 2. **Diffraction** : Fresnel and Fraunhofer class, Fresnel's half-period zones, zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory), resolving power. 7L

Module – 3. **Polarisation** : Different states of polarisation, Brewster's law, double refraction, retardation plate, polaroid, optical activity. **7**L

Reference Books:

1. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
6. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
7. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications.

4th Semester

Paper -IV, Course Code- PHSG-P4-t

Course Name – Electronics and Modern Physics

Marks- 50; No. of Lectures- 50

Course Outcome: In electronics the basic of analog and digital electronics are learnt. In modern physics very basic of some advanced topics like Special Theory of Relativity, Quantum Mechanics, Solid State Physics and Nuclear Physics are learnt.

Course Employability: The basic knowledge of electronics is essential to understand the modern day electronic devices and communication. The basic concept of Modern Physics gives some ideas of some recent topics developed

in physics. The course is important to qualify different examinations (e.g., School service, Clerkical job etc.) for the Physics General students.

Course Contents:

Group A: Electronics; Marks-20; Lectures-20

Module – 1. Diodes and Transistors : P-N junction diode, bridge rectifier, capacitance input filter, Zener diode, voltage regulator, Transistors --- alpha, beta and their interrelations; output characteristics in CE mode, single stage CE amplifier - approximate expressions of current and voltage gain with the help of 'Load Line'. 11L

Module – 2. Number System: binary and hexadecimal systems, Conversions of number s ; binary algebra (2's compliments). 3L

Module – 3. Logic gates :Idea OR, AND, NOT, EX-OR gates with truth tables. Statement of de Morgan's theorem and simple applications, NOR and NAND - universal gates. Adder circuits. 7L

Group B: Modern Physics; Marks-30; Lectures-30

Module – 1. **Special Theory of Relativity**: Postulates of STR, formulae of (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (iv) Mass variation, and (v) Mass-energy equivalence. 5L

Module – 2. Quantum theory of radiation : Planck's concept-radiation formula (statement only)-qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect. 4L

Module – 3. **Basic Quantum Mechanics** : Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schroedinger's equation, particle in a one dimensional infinite well-energy eigenvalues, wavefunction and its probabilistic interpretation. Bohr's theory of hydrogen spectra - concept of quantum number, Pauli exclusion principle. 11L

Module – 4. **Solid State Physics**: Crystalline nature of solid, diffraction of X-ray, Bragg's law; Miller indices. 5L

Module – 5. Nuclear Physics : Binding energy of nucleus, binding energy curve and stability; Radioactivity - successive disintegration, radioactive equilibrium, radioisotopes and their uses, nuclear reactions, fission and fusion. 5L

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Foundations of Electronics, Chattopadhyay and Rakshit, New Age.
5. Fundamental Principle of Electronics, B. Ghosh, Books & Allied.

4th Semester
Paper – IV(Lab.); Course Code- PHSG-P4-p
Course Name- General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics.
Marks- 50

Course Outcome: Students get the opportunity to do some experiments on General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics.

Course Employability: Different experimental skills related General Properties of Matter, Heat, Magnetism, Physical Optics, Electricity & Electronics are developed that helps in future studies.

Course Contents:

1.Determination of the Young's modulus of the material of the given uniform metallic bar by the method of flexure.
2.Record the rate of flow of water through a capillary tube at four different pressure differences below the critical height. Plot pressure differences vs rate of flow graph. Hence determine the coefficient of viscosity γ of water.
3.Study the nature of the dependence of the dipolar field of a short bar magnet placed at a distance d using a deflection magnetometer. Take three different positions at regular interval on either side of the needle only. Keep the deflection θ of the needle from the meridian so that dipolar approximation ($d^2 >> l^2$) is valid. Draw $\tan\theta \sim \frac{1}{d^3}$ graph. Determination of the horizontal component of earth's magnetic field using vibration magnetometer.
4.Determination of the resistance of a suspended coil galvanometer by method of half deflection. [Take five sets of the readings with two different values of shunt resistance]. Calculate the figure of merit of the galvanometer with any two sets of data obtained.
5.To verify the maximum power transfer theorem using a given T network, a variable load resistance R_L connected in one side and voltage source in other side.
6.Study of regulation characteristics of a bridge rectifier i) without using any filter and ii) using a capacitor filter.
7. a) To study the decay of C-R circuit using digital voltmeter. Estimate the
i) natural decay of the capacitor, ii) decay of the capacitor through a known resistor R. [Take at least seven readings for each case] Plot the data in the same graph. Calculate the value of the capacitance from the graph.
8.Draw the resonance curve of a series LCR circuit. Hence determine the Q-factor of the circuit.
Compare the experimental value of Q-factor with theoretically computed value of Q.
9. Draw the output characteristics of the given transistor in CE configuration for four different base currents. Show saturation and active regions in the graph. Calculate current gains and output admittance.
10.a) Verify, using a voltmeter, the truth tables for the two input OR (7432) ; the two input AND (7408) and the NOT (7404) gate. Implement the circuit given below using NOT (7404) gate and NAND (7400) gate. Verify its truth table.
11.Determination of the radius of curvature (*R*) of the curve surface of a plano-convex lens by Newton's ring method. [Take at least ten order numbers (*n*) of the dark rings]. Plot *n* vs D_n^2 graph where D_n is the diameter of the *n*-th dark ring. [Wave lengths of the incident light will be supplied].
12.Calibration of a given polarimeter and determination of the specific rotation of an optically active substance.
13.Determination of the angle of the prism by a spectrometer. Determine the refractive index μ of the material of prism for three lines of known wave lengths (λ). Draw the μ vs $\frac{1}{\lambda^2}$ graph.

Reference Books:

1. A Text Book on Practical Physics , K. G. Mazumdar, B. Ghosh
2. A Handbook of Degree Practical Physics , C R Dasgupta,A K Das, S Paul