जम्मू केंद्रीय विश्वविद्यालय
Central University of Jammu
भौतिकी एवं खगोल विज्ञान विभाग
Department of Physics and Astronomical Sciences
राया-सूचानी (बागला), साम्बा-181143, जम्मू (जम्मू और कश्मीर)
Rahya-Suchani (Bagla), Samba-181143, Jammu (J & K)

Sub: Minutes of the meeting of 9th Board of Studies (BOS) in the Dept. of Physics & Astronomical Sciences held on 31.07.2023

Minutes of the meeting of 9th Board of Studies (BOS) in the Dept. of Physics & Astronomical Sciences held on 31.07.2023 at 2 pm in the Department of Physics and Astronomical Sciences, Central University of Jammu.

Following members were present in the meeting:

Prof. Suram Singh,	Professor & Head of the Department	Chairman
Prof. Vinay Kumar,	Department of Physics & Astronomical Sciences	Member
Prof. Rajnikant,	Department of Physics, University of Jammu	Subject Expert
Prof. Pankaj Sharma,	Applied Science Department National Institute of Technical Teachers Training & Research (NITTR), Chandigarh	Subject Expert
Dr. Amit Tomar,	Assistant Professor, Department of Physics & Astronomical Sciences	Member
Dr. Sujata Kundan,	Assistant Professor, Department of Chemistry & Chemical Sciences	Member

The meeting began with a formal welcome note by the Chair. The agenda items were presented before the BoS.

The following recommendations / resolutions were taken:

Agenda: 1: Approval of ATRs of 8th Meeting of Board of studies held on 03.06.2022

Recommendation: Notification for Course matrix and Syllabus for Semester 1 and II for the batch 2022-23 issued vide notification no. 118/2022 dated 01-08-2023

Agenda: 2: Rationalization of syllabus for Sem 1 and 2 in 5 units instead of 4 units

Recommendation: Resolved and attached as **Annexure- I**

Agenda 3. Progress report of Ph.D. research Scholars of batch 2020 from 01.01.2023 to 30.06.2023.

Recommendation: All the students presented their six months research progress in DRC held on July 28, 2023

S. No.	Entry No.	Name of the Candidate	Supervisor	Research title for Ph.D.	Remarks of RAC	%age of research work
1.	0152020	Rajan Singh	Dr. Vinay Kumar	Effect of Temperature on Alkaline Orthophosphate Based Phosphors: Luminescence and Related Studies	Good	85%
2.	0252020	Isha Charak	Dr. Vinay Kumar	Synthesis and Luminescence Studies of Rare Earth Ion Doped Borate Phosphors	Good	84%

Akundan

Agenda 4

Approval of Syllabus for 3rd and 4th semester as per NEP 2020 w.e.f. session 2022-24.

Recommendation: Approved and attached as **Annexure-II**

Agenda 5

Approval of Ph.D. research topics (Synopsis) of the candidates of batch 2021 of the Department who have successfully completed their course work as recommended by RAC held on 01.03.2023.

S. No.	Entry No.	Name of the Candidate	Supervisor	Research title for Ph.D.	Date of Admission / Registration
1	21PPHY01	Aneeqa Basheer	Prof. Suram Singh	Systematic study of Quasiparticle Structure of Some Non-magic Transitional Nuclei	14-02-2022
2.	21PPHY02	Ayesha Bhandari	Prof. Vinay Kumar	Synthesis and Effect of Doping on TiO2 Powder / thin films for Optical and Sensing Applications	16-02-2022
3.	21PPHY03	Bandhna Verma	Prof. Vinay Kumar	Synthesis and Characterization of Organic-Inorganic Material Based Heterojunction for Optoelectronic Applications	17-02-2022
4.	21PPHY04	Umera Nawaz	Prof. Suram Singh	Phenomenological Study of Some Deformed Nuclei in the Heavy Mass Regions	15-02-2022

Progress report of Ph.D. research Scholars of batch 2021 upto 30.06.2023.

Sl.No.	Roll No.	Name	Supervisor	Research title for Ph.D.	Remarks of RAC	%age of research work
1.	21PPHY01	Aneeqa Basheer	Prof. Suram Singh	Systematic study of Quasiparticle Structure of Some Non-magic Transitional Nuclei	Good	20%
2.	21PPHY02	Ayesha Bhandari	Prof. Vinay Kumar	Synthesis and Effect of Doping on TiO2 Powder / thin films for Optical and Sensing Applications	Good	12%
3.	21PPHY03	Bandhna Verma	Prof. Vinay Kumar	Synthesis and Characterization of Organic-Inorganic Material Based Heterojunction for Optoelectronic Applications	Good	15%
4.	21PPHY04	Umera Nawaz	Prof. Suram Singh	Phenomenological Study of Some Deformed Nuclei in the Heavy Mass Regions	Good	20%

Approval of Ph.D. research topics (Synopsis) of the candidates of batch 2022 of the Department who have successfully completed their course work as recommended by RAC held on 28.03.2023

S. No.	Entry No.	Name of the Candidate	Supervisor	Research title for Ph.D.	Date of Admission / Registration
1	22PPHY01	Meena Sharma	Prof. Suram Singh	Theoretical investigation of structure of some deformed nuclei in medium mass region	19-07-2022

Recommendation: Approved

The meeting was ended with the formal vote of thanks to the chair.

1. 31/07/23

2. 31/07/23

3.

4.

5.

6. 31/07/2023

Head
Department of Physics &
Astronomical Sciences

31/07/23

Dean, School of Basic and Applied Sciences

Annexure-I

Course Matrix for Five Year Integrated B.Sc.-M.Sc. (Physics)
(Semesters I to X)
w.e.f. Academic Session 2022-2023

The first three years of the Integrated programme (Levels 5, 6, and 7) will be having a total number of 120 credits as shown in **Tables 1 and 2**. After completion of the third year of the Integrated programme (Level 7), the students will continue the programme in the following two streams.

1. **Stream 1** for those who have completed the first three years (Level 7) with CGPA greater than 7.5 **(Table 1)**

   After completing the first three years of the Integrated programme (Level 7), the students who have scored CGPA greater than 7.5 will be allowed to continue in the fourth year of the undergraduate programme (Level 8) to pursue and complete the Bachelor's degree with Research (which will be named as B.Sc. (Hons. / Research)) and these students will continue to one year Master's degree programme (Level 9) and receive Integrated B.Sc. (Hons. /Research)-M.Sc. degree (4+1 years) in Physics.

2. **Stream 2** for those students who have completed first three years (Level 7) with CGPA less than 7.5 **(Table 2)**

   After completing the first three years of the Integrated programme (Level 7), the students who have scored CGPA less than 7.5 will be allowed to continue in two years Master's degree programme (Level 8 and Level 9) and receive Integrated B.Sc.-M.Sc. (Physics) degree (3+2 years).

Note: However, students of stream 1 with CGPA greater than 7.5 may opt stream 2 directly also.

Table 1. Course Matrix for Five Year Integrated B.Sc.(Hons./Research)-M.Sc. Physics (4+1 years)

Stream 1: For those who have completed first three years of the Integrated programme (Level 7) with CGPA greater than 7.5

Semester	Core Course (CC) (Theory+Lab)	Open Elective Course (OEC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Value Addition Course (VAC)	Total Credits
I	CC-1 (3+1) CC-2 (3+1)	OEC-1 (4) OEC-2 (4)	AEC-1 (2)	SEC-1 (2)	-	20
II	CC-3 (3+1) CC-4 (3+1)	OEC-3 (4) OEC-4 (4)		SEC-2 (2)	VAC-1 (2)	20
III	**CC-5 (3+1)** **CC-6 (3+1)**	**OEC-5 (4)** **OEC-6 (4)**	**AEC-2 (2)**	**SEC-3 (2)**		**20**
IV	**CC-7 (3+1)** **CC-8 (3+1)**	**OEC-7 (4)** **OEC-8 (4)**		**SEC-4 (2)**	**VAC-2 (2)**	**20**
V	CC-9 (3+1) CC-10 (3+1)	OEC-9 (4) OEC-10 (4) OEC-11 (4)	-	-	-	20
VI	CC-11 (3+1) CC-12 (3+1)	OEC-12 (4) OEC-13 (4) OEC-14 (4)	-	-	-	20
VII	CC-13 (3+1) CC-14 (3+1) CC-15 (3+1)	OEC-15 (4) OEC-16 (4)	-	SEC-5 (2)	-	22
VIII	Project/ Dissertation/ Internship (12)	OEC-17 (4) OEC-18 (4)	-	SEC-6 (2)	-	22
Total	**72**	**72**	**4**	**12**	**4**	**164**
IX	CC-16 (3+1) CC-17 (3+1) CC-18 (3+1)	OEC-19 (4) OEC-20 (4)	-	SEC-7 (2)	-	22
X	Project/ Dissertation/ Internship (12)	OEC-21 (4) OEC-22 (4)	-	SEC-8 (2)	-	22
Total	**24**	**16**	**-**	**4**	**-**	**44**
Grand Total	**96**	**88**	**4**	**16**	**4**	**208**

Table 2. Course Matrix for Five Year Integrated B.Sc.-M.Sc. Physics (3+2 years)

Stream 2: For those who have completed first three years of the Integrated programme (Level 7) with CGPA less than 7.5

Semester	Core Course (CC)	Open Elective Course (OEC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Value Addition Course (VAC)	Total Credits
I	CC-1 (3+1) CC-2 (3+1)	OEC-1 (4) OEC-2 (4)	AEC-1 (2)	SEC-1 (2)	-	20
II	CC-3 (3+1) CC-4 (3+1)	OEC-3 (4) OEC-4 (4)		SEC-2 (2)	VAC-1 (2)	20
III	**CC-5 (3+1)** **CC-6 (3+1)**	**OEC-5 (4)** **OEC-6 (4)**	**AEC-2 (2)**	**SEC-3 (2)**		**20**
IV	**CC-7 (3+1)** **CC-8 (3+1)**	**OEC-7 (4)** **OEC-8 (4)**		**SEC-4 (2)**	**VAC-2 (2)**	**20**
V	CC-9 (3+1) CC-10 (3+1)	OEC-9 (4) OEC-10 (4) OEC-11 (4)	-	-	-	20
VI	CC-11 (3+1) CC-12 (3+1)	OEC-12 (4) OEC-13 (4) OEC-14 (4)	-	-	-	20
Total	**48**	**56**	**4**	**8**	**4**	**120**
VII	CC-13 (3+1) CC-14 (3+1) CC-15 (3+1)	OEC-15 (4) OEC-16 (4)	-	SEC-5 (2)	-	22
VIII	CC-16 (3+1) CC-17 (3+1) CC-18 (3+1)	OEC-17 (4) OEC-18 (4)	-	SEC-6 (2)	-	22
IX	CC-19 (3+1) CC-20 (3+1) CC-21 (3+1)	OEC-19 (4) OEC-20 (4)	-	SEC-7 (2)	-	22
X	Project/ Dissertation/ Internship (12)	OEC-21 (4) OEC-22 (4)	-	SEC-8 (2)	-	22
Total	**48**	**32**	**-**	**8**	**-**	**88**
Grand Total	**96**	**88**	**4**	**16**	**4**	**208**

Abbreviation(s):

Core Course	CC
Open Elective Course	OEC
Ability Enhancement Course	AEC
Skill Enhancement Course	SEC
Value Addition Course	VAC

Agenda item -2: Rationalized syllabus for Sem 1 and 2 in 5 units instead of 4 units

Syllabus

B.Sc(H)-M.Sc. Physics			
Semester :	I	**Type:**	Core
Course Name:	Mechanics	**Course Code:**	
Credits:	4	**L T P:**	3-0-2

Course Outcomes:

CO 1	*Understand Coordinate systems, laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance.*
CO 2	*Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.*
CO 3	*Apply Kepler's law to describe the motion of planet sand satellite in circular orbit,through the study of law of Gravitation.*
CO 4	*In the laboratory course, the student shall perform experiments related to mechanics.*

Old Syllabus	Rationalized syllabus
Unit-I Coordinate systems: Cartesian, polar, spherical, and cylindrical. Newton's law of motion, conservation of momentum; impulse; momentum of variable mass system-motion of rocket; work and energy theorem, conservative and non-conservative forces, potential energy, energy diagram; stable and unstable equilibrium; elastic and inelastic collisions between particles.	**Unit-I** Coordinate systems: Cartesian, polar, spherical, and cylindrical. Newton's law of motion, conservation of momentum; impulse; momentum of variable mass system-motion of rocket; work and energy theorem, conservative and non-conservative forces, potential energy, energy diagram; stable and unstable equilibrium; elastic and inelastic collisions between particles.
Unit-II Dynamics of a system of particles, centre of mass, moment of inertia: calculation of moment of inertia for rectangular, cylindrical and spherical bodies; Angular momentum of a particle and system of particles, conservation of angular momentum; torque, rotation about a fixed axis, kinetic energy of rotation; motion involving both translation and rotation.	**Unit-II** Dynamics of a system of particles, centre of mass, moment of inertia: calculation of moment of inertia for rectangular, cylindrical and spherical bodies; Angular momentum of a particle and system of particles, conservation of angular momentum; torque, rotation about a fixed axis, kinetic energy of rotation; motion involving both translation and rotation.
Unit-III Kepler's laws, two body problem and its reduction to one body problem and its solution; the energy equation and energy diagram; Law of gravitation: Gravitational force and potential energy, inertial and gravitational mass, potential and field due to spherical shell and solid sphere; motion of a particle under central force field, orbits of artificial satellites.	**Unit-III** Kepler's laws, two body problem and its reduction to one body problem and its solution; the energy equation and energy diagram; Law of gravitation: Gravitational force and potential energy, inertial and gravitational mass, potential and field due to spherical shell and solid sphere; motion of a particle under central force field, orbits of artificial satellites.

Unit IV

Inertial and Non-Inertial, Fictitious forces. Equation of motion with respect to a uniformly accelerating frame. Equation of motion with respect to a uniformly rotating frame - Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Bending of a beam. Fluid Motion: compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Pascal's law and Archimedes principle. Poiseuille's equation.

Text and 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 University Physics.

Unit IV

Inertial and Non-Inertial, Fictitious forces. Equation of motion with respect to a uniformly accelerating frame. Equation of motion with respect to a uniformly rotating frame - Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Bending of a beam.

Unit V

Fluid Motion: compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Pascal's law and Archimedes principle. Poiseuille's equation.

Text and 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 University Physics.

B.Sc(H)-M.Sc. Physics			
Semester :	I	**Type:**	Core
Course Name:	Mechanics Lab	**Course Code:**	

List of Experiments:

1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine **g** and velocity for a freely falling body using Digital Timing Technique
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

Text and Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11thEdn, 2011, Kitab Mahal.

Semester :	I	**Type:**	Core
Course Name:	Mathematical Physics-I	**Course Code:**	IPHY1C002T
Credits:	3	**L T P:**	3-0-0

Course learning outcome:

CO1	*Revise the knowledge of calculus, vectors, vector calculus, probability and probability distributions. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.*
CO2	*Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.*
CO3	*Learn the Diracde lt a function its properties, which have applications in various branches of Physics, especially quantum mechanics.*
CO4	*The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. Highlights the use of computational methods to solve physical problems, Students can use any one operating system Linux or Microsoft Windows*

Old Syllabus	Rationalized syllabus
UNIT-I Limits, continuity, average and instantaneous quantities. differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series. First Order Differential Equations and Integrating Factor. Second Order Differential equations: Homogeneous Equations with constant coefficients, Wronskian and general solution	**UNIT-I** Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series. First Order Differential Equations and Integrating Factor.
UNIT-II . Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. Definition of Dirac delta function Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.	**UNIT-II** Second Order Differential equations: Homogeneous Equations with constant coefficients, Wronskian and general solution Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Orthogonal Curvilinear Coordinates.
UNIT-III Recapitulation of vectors: Properties of vectors. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative.	**UNIT-III** Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. Definition of Dirac delta function Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. **UNIT-IV** Recapitulation of vectors: Properties of vectors. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

UNIT-IV

Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes, Theorems and their applications (no rigorous proofs).

Text and Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris,2013, 7thEdn., Elsevier.
2. Differential Equations, George F. Simmons, 2007, McGraw Hill.
3. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
4. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.
5. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.
6. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

Vector Differentiation: Directional derivatives and normal derivative.

UNIT-V

Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes, Theorems and their applications (no rigorous proofs).

Text and Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris,2013, 7thEdn., Elsevier.
2. Differential Equations, George F. Simmons, 2007, McGraw Hill.
3. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
4. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.
5. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.
6. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

B.Sc(H)-M.Sc. Physics			
Semester :	I	**Type:**	Core
Course Name:	Mathematical Physics Lab-I	**Course Code:**	IPHY1C002T
Credits:	1	**L T P:**	0-0-2

List of Experiments:

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.

Text and Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw---Hill Pub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn., 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher& C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3rdEdn., 2007, Wiley India Edition.

B.Sc.(H)-M.Sc. Physics			
Semester:	II	**Type:**	Core
Course Name:	Electricity and Magnetism	**Course Code:**	IPHY1C003T
Credits:	3	**L T P:**	3-0-0

Course learning outcome: *After going through the course, the student should be able to*

CO 1	*Demonstrate Gausslaw, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.*
CO 2	*Explainanddifferentiatethevector(electricfields,Coulomb'slaw)andscalar(electricpotential,electric potential energy)formalisms of electrostatics*
CO 3	*Apply Gauss's law of electrostatics to solve a variety of problems*
CO 4	*Describe the magnetic field produced by magnetic dipoles and electric currents.*
CO 5	*Explain Faraday - Lenz and Maxwelllaws to articulate the relationship between electric and magnetic fields*
CO 6	*Understand the dielectric properties, magnetic properties of materials and phenomena of electromagnetic induction*
CO 7	*In the laboratory course the student will get an opportunity to verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments. Student Should be able to verify of various circuit laws, network theorems elaborated above, using simple electric circuits*

Old Syllabus	Rationalized syllabus
Unit-I Electrostatics: Gradient, Divergence, Curl, second derivatives and fundamental theorems for divergence and curl. Electrostatics: Coulomb's law, principle of superposition, Concept of electric field, electric potential, Electric field and potential due to discrete and continuous charge distribution, relation between electric intensity and potential, electric dipole and dipole moment, **Unit-II** Dielectrics: non-polar molecules, Polar molecules, Polar and non-polar molecules in an electric field, polarization,Electric polarization of matter, polarization charges and polarization vector, electric susceptibility Electric polarization vector, Electric field in dielectric, Gauss law in dielectric, Relation between three electric vectors: displacement vector (D), electric vectors (E), and polarization vectors (P).	**Unit-I** Electrostatics: Gradient, Divergence, Curl, second derivatives and fundamental theorems for divergence and curl. Electrostatics: Coulomb's law, principle of superposition, Concept of electric field, electric potential, Electric field and potential due to discrete and continuous charge distribution, relation between electric intensity and potential, electric dipole and dipole moment, **Unit-II** Dielectrics: non-polar molecules, Polar molecules, Polar and non-polar molecules in an electric field, polarization,Electric polarization of matter, polarization charges and polarization vector, electric susceptibility Electric polarization vector, Electric field in dielectric, Gauss law in dielectric, Relation between three electric vectors: displacement vector (D), electric vectors (E), and polarization vectors (P).

B.Sc.(H)-M.Sc. Physics			
Semester:	II	**Type:**	Core
Course Name:	Electricity and Magnetism	**Course Code:**	IPHY1C003T
Credits:	3	**L T P:**	3-0-0

Course learning outcome: *After going through the course, the student should be able to*

CO1	*Demonstrate Gausslaw, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.*
CO2	*Explainanddifferentiatethevector(electricfields,Coulomb'slaw)andscalar(electricpotential,electric potential energy)formalisms of electrostatics*
CO3	*Apply Gauss's law of electrostatics to solve a variety of problems*
CO4	*Describe the magnetic field produced by magnetic dipoles and electric currents.*
CO5	*Explain Faraday - Lenz and Maxwelllaws to articulate the relationship between electric and magnetic fields*
CO6	*Understand the dielectric properties, magnetic properties of materials and phenomena of electromagnetic induction*
CO7	*In the laboratory course the student will get an opportunity to verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments. Student Should be able to verify of various circuit laws, network theorems elaborated above, using simple electric circuits*

Old Syllabus	Rationalized syllabus
Unit-I Electrostatics: Gradient, Divergence, Curl, second derivatives and fundamental theorems for divergence and curl. Electrostatics: Coulomb's law, principle of superposition, Concept of electric field, electric potential, Electric field and potential due to discrete and continuous charge distribution, relation between electric intensity and potential, electric dipole and dipole moment, **Unit-II** Dielectrics: non-polar molecules, Polar molecules, Polar and non-polar molecules in an electric field, polarization,Electric polarization of matter, polarization charges and polarization vector, electric susceptibility Electric polarization vector, Electric field in dielectric, Gauss law in dielectric, Relation between three electric vectors: displacement vector (D), electric vectors (E), and polarization vectors (P).	**Unit-I** Electrostatics: Gradient, Divergence, Curl, second derivatives and fundamental theorems for divergence and curl. Electrostatics: Coulomb's law, principle of superposition, Concept of electric field, electric potential, Electric field and potential due to discrete and continuous charge distribution, relation between electric intensity and potential, electric dipole and dipole moment, **Unit-II** Dielectrics: non-polar molecules, Polar molecules, Polar and non-polar molecules in an electric field, polarization,Electric polarization of matter, polarization charges and polarization vector, electric susceptibility Electric polarization vector, Electric field in dielectric, Gauss law in dielectric, Relation between three electric vectors: displacement vector (D), electric vectors (E), and polarization vectors (P).

Unit-III Magnetostatics: Concept of magnetic field,Biot-Savart's law, application of Biot-Savart's law, Ampere's circuital law. Gauss's law of magnetism, Magnetic field: Magnetic field inside a toroid, solenoid, magnetic dipole moment, magnetisation of matter, relation between magnetic field (B), magnetism intensity(H) and magnetization vector (M), Magnetic susceptibility and permeability **Unit-IV** Electromagnetic induction: Magnetic flux, Faraday's experiments, Faraday's law of electromagnetic induction, Lenz's law, Self-induction, Mutual induction, energy stored in a magnetic field, Ballistic galvanometer: current and charge sensitivity, electromagnetic damping, logarithmic damping current density, Equation of continuity, surface charge density, Ohm's law, Relation between current density and resistivity, electric power, electric energy, current and power in an electrical circuit, Joule's law in electricity. **Text and Reference Books:** 1. Edward M. Purcell, Electricity and Magnetism, (McGraw-Hill Education). 2. Arthur F. Kip, Fundamentals of Electricity and Magnetism, (Mc Graw-Hill). 3. J.H.Fewkes&John Yarwood, Electricity and Magnetism, (Oxford Univ. Press). 4. David J. Griffiths, Introduction to Electrodynamics, (Benjamin Cummings).	**Unit-III** Magnetostatics: Concept of magnetic field,Biot-Savart's law, application of Biot-Savart's law, Ampere's circuital law. Gauss's law of magnetism, Magnetic field: Magnetic field inside a toroid, solenoid, magnetic dipole moment, magnetisation of matter, relation between magnetic field (B), magnetism intensity(H) and magnetization vector (M), Magnetic susceptibility and permeability **Unit-IV** Electromagnetic induction: Magnetic flux, Faraday's experiments, Faraday's law of electromagnetic induction, Lenz's law, Self-induction, Mutual induction, energy stored in a magnetic field, **UNIT-V** Ballistic galvanometer: current and charge sensitivity, electromagnetic damping, logarithmic damping current density, Equation of continuity, surface charge density, Ohm's law, Relation between current density and resistivity, electric power, electric energy, current and power in an electrical circuit, Joule's law in electricity. **Text and Reference Books:** 1. Edward M. Purcell, Electricity and Magnetism, (McGraw-Hill Education). 2. Arthur F. Kip, Fundamentals of Electricity and Magnetism, (Mc Graw-Hill). 3. J.H.Fewkes&John Yarwood, Electricity and Magnetism, (Oxford Univ. Press). 4. David J. Griffiths, Introduction to Electrodynamics, (Benjamin Cummings).

B.Sc.(H)-M.Sc. Physics			
Semester:	II	**Type:**	Core
Course Name:	Electricity and Magnetism Lab	**Course Code:**	IPHY1C003L
Credits:	1	**L T P:**	0-0-2

List of Experiments

1. Resistance

(i) To test a diode and transistor using (a) a multimeter and (b) a CRO.
(ii) To measure (a) voltage, (b) frequency and (c) phase difference using a CRO.
(iii) To study the characteristics of a series RC circuit using R, L and C.
(iv) To determine a low resistance by Carey Foster's Bridge.
(v) To determine a low resistance by a potentiometer.
(vi) To determine high resistance by leakage of a capacitor.

2. Ballistic Galvanometer

(i) To determine the (a) charge sensitivity and (b) current sensitivity of B.G.
(ii) To determine the (a) logarithmic decrement and (b) CDR of a B.G.

3. Capacitance

(i) To determine the ratio of two capacitances by de Sauty's bridge.
(ii) To determine the dielectric constant of a dielectric placed inside a parallel plate capacitor using a B.G.

4. Self & Mutual Inductance

(i) To determine self-inductance of a coil by Anderson's bridge using AC.
(ii) To determine self-inductance of a coil by Rayleigh's method.
(iii) To determine the mutual inductance of two coils by absolute method using a B.G.

5. A.C Circuits

(i) To study the response curve of a series LCR circuit and determine its(a) resonant frequency, (b) impedance at resonance and (c) quality factor Q, and (d) band width.
(ii) To study the response curve of a parallel LCR circuit and determine its (a) anti-resonant frequency and (b) quality factor Q.

Text Book sand References:

1. GeetaSanon, B.Sc. Practical Physics, (R.Chand &Co).
2. B.L.Workshop and H.T. Flint, Advanced Practical Physics, (Asia Publishing House, New Delhi).
3. InduPrakash and Ramakrishna, A Text Book of Practical Physics, (Kitab Mahal, New Delhi).
4. D.P. Khandewal, A Laboratory Manual of Physics for Undergraduate Classes, (VaniPublication House, New Delhi).

B.Sc.(H)-M.Sc. Physics			
Semester:	II	**Type:**	Core
Course Name:	Waves and Optics	**Course Code:**	IPHY1C004T
Credits:	3	**L T P:**	3-0-0

Course learning outcome: This course will able the student to

CO 1	*Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems*
CO 2	*Understand the principle of superposition of waves, so thus describe the formation of standing waves*
CO 3	*Apply basic knowledge of principles and theories about the behavior of light and the physical environment to conduct experiments*
CO 4	*Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.*
CO 5	*Understandtheworkingofselectedopticalinstrumentslikebiprism,interferometer, diffractiongrating, and holograms.*
CO 6	*In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt first hand*

Old Syllabus	Rationalized syllabus
Unit-I	**Unit-I**
Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. Lissajous Figures with frequency ratio (1:1 and 1:2).	Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. Lissajous Figures with frequency ratio (1:1 and 1:2).
Plane and Spherical Waves. Longitudinal and Transverse Waves. Travelling Waves. Wave Equation. Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Standing (Stationary) Waves in a String. Normal Modes of Stretched Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes.	**Unit-II**
Unit-II	Plane and Spherical Waves. Longitudinal and Transverse Waves. Travelling Waves. Wave Equation. Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Standing (Stationary) Waves in a String. Normal Modes of Stretched Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes.
Electromagnetic nature of light. Huygens Principle. Temporal and Spatial Coherence. Interference: Division of amplitude and wavefront. Young's double slit, Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' relations. Interference in Thin	**Unit-III**
	Electromagnetic nature of light. Huygens Principle. Temporal and Spatial Coherence. Interference: Division of amplitude and wavefront. Young's double slit, Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' relations. Interference in Thin

Films, Fringes of equal inclination, Fringes of equal thickness, Newton's Rings, Michelson Interferometer, Visibility of Fringes, Fabry-Perot interferometer.

Unit-III

Diffraction: Fraunhofer and Fresnel, Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating, Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Unit-IV

Introduction to polarization, Types of polarization- plane, circular, elliptical, Polarization by reflection of light, Brewster's law, Law of Malus, Polarisation by double refracting uniaxial crystal , Linear polarizer (Polaroid), Fabrication of linear polarizer by Nicol prism.

Text and Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, Pergamon Press.
4. Optics, AjoyGhatak, 2008, Tata McGraw Hill.
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Films, Fringes of equal inclination, Fringes of equal thickness, Newton's Rings, Michelson Interferometer, Visibility of Fringes, Fabry-Perot interferometer.

Unit-IV

Diffraction: Fraunhofer and Fresnel, Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating, Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Unit-V

Introduction to polarization, Types of polarization- plane, circular, elliptical, Polarization by reflection of light, Brewster's law, Law of Malus, Polarisation by double refracting uniaxial crystal , Linear polarizer (Polaroid), Fabrication of linear polarizer by Nicol prism.

Text and Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, Pergamon Press.
4. Optics, AjoyGhatak, 2008, Tata McGraw Hill.
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

B.Sc.(H)-M.Sc. Physics			
Semester:	II	**Type:**	Core
Course Name:	Waves and Optics Lab	**Course Code:**	IPHY2C004L
Credits:	1	**L T P:**	0-0-2

1. Springs

(i) To study the motion of a spring and calculate (a) spring constant (b) value of g, and modulus of rigidity.

(ii) To investigate the motion of coupled oscillators.

2. Melde's Experiment

(i) To determine the frequency of an electricity maintained tuning fork by Melde's experiment.

(ii) To verify λ^2-T law by Melde's experiment.

3. Interference

(i) To determine wavelength of sodium light using Fresnel bi-prism.

(ii) To determine wavelength of sodium light using Newton's rings.

(iii) To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped film.

(iv) To determination wavelength of sodium light Michelson's interferometer.

4. Diffraction

(i) To determine the diameter of a thin wire by studying the diffraction produced by it.

(ii) To determine the wavelength of laser light using diffraction of single slit.

(iii) To determine the wavelength of (1) sodium and (2) mercury light using plane diffraction grating.

(iv) To determine the dispersive power of a plane diffraction grating.

(v) To determine the resolving power of a plane diffraction grating.

(vi) To determine the (1) wavelength and (2) angular spread of He-Ne laser using plane- diffraction grating

(vii) To study the polarization of light by reflection and to determine the polarizing angle for air-glass interface.

(viii) To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.

Text Books and References:

1. B.L.Workshop and H.T. Flint, Advanced Practical Physics, (Asia Publishing House,New Delhi).
2. InduPrakash and Ramakrishna, A Text Book of Practical Physics, (Kitab Mahal, New Delhi).
3. D. P.Khandewal, A Laboratory Manual of Physics for Undergraduate Classes, (VaniPublication House, New Delhi).

Syllabus of Open Electives Courses

offered by

Department of Physics and Astronomical Sciences

Sr. No.	Level (UG/PG)	Course Code	Course Name	Nature of Open Elective
1.	UG	IPHY1O001T	General Physics-I	OEC
2.	UG	IPHY1O002T	Renewable Energy and Energy Harvesting	OEC
3.	UG	IPHY1O003T	Astronomy and Astrophysics	OEC
4.	UG	IPHY1O004T	Basics of Atmospheric Physics	OEC
5.	UG	IPHY1O005T	A Course on MatLab	SEC
6.	UG	IPHY1O006T	Introduction to SciLab	SEC
7.	UG	IPHY1O007T	Physics Lab Skill	VAC

B.Sc.(H)-M.Sc. Physics			
Semester:	I or II	**Type:**	Open Elective
Course Name:	General Physics	**Course Code:**	IPHY1O001T
Credits:	3	**L T P:**	3-0-0

COURSE OUTCOMES:

CO 1	*To understand the Laws of Thermodynamics*
CO 2	*To learn Kinetic Theory of Gases*
CO 3	*To learn theory of radiations*
CO 1	*To revised electrostatics and magnetostatics*

Old Syllabus	Rationalized syllabus
Unit-I **Laws of Thermodynamics:** Thermodynamic Description of system: Zeroth Law ofthermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between C_P and C_V,.Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Enthalpy, Gibbs, Helmholtz and Internal Energyfunctions, Third law of thermodynamics. Concept of absolute zero temperature. **Unit-II** **Kinetic Theory of Gases:** Derivation of Maxwell's law of distribution of velocitiesand its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases;mono-atomic and diatomic gases. **Unit-III** **Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of EnergyDensity, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan	**Unit-I** **Laws of Thermodynamics:** Thermodynamic Description of system: Zeroth Law ofthermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between C_P and C_V,.Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Enthalpy, Gibbs, Helmholtz and Internal Energyfunctions, Third law of thermodynamics. Concept of absolute zero temperature. **Unit-II** **Kinetic Theory of Gases:** Derivation of Maxwell's law of distribution of velocitiesand its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases;mono-atomic and diatomic gases. **Unit-III** **Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of EnergyDensity, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan

Boltzmann Law and Wien's displacement law from Planck's law.

Unit-IV

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.

Magnetism: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro-magnetic materials.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G.L. Salinger. 1988, Narosa.
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
7. Electricity & Magnetism, J.H. Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

Boltzmann Law and Wien's displacement law from Planck's law.

Unit-IV

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.

UNIT-V

Magnetism: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro-magnetic materials.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G.L. Salinger. 1988, Narosa.
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
7. Electricity & Magnetism, J.H. Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

B.Sc.(H)-M.Sc. Physics			
Semester:	I or II	**Type:**	Generic Elective
Course Name:	General Physics Lab	**Course Code:**	IPHY10001L
Credits:	1	**L T P:**	0-0-2

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. (i) To test a diode and transistor using (a) a multimeter and (b) a CRO.
   (ii) To measure (a) voltage, (b) frequency and (c) phase difference using a CRO.
   (iii) To determine a low resistance by Carey Foster's Bridge.
8. To determine the (a) charge sensitivity and (b) current sensitivity of B.G.
9. To determine the ratio of two capacitances by de Sauty's bridge.
10. To determine self-inductance of a coil by Anderson's bridge using AC.
11. To determine the mutual inductance of two coils by absolute method using a B.G.
12. To study the response curve of a series LCR circuit and determine its(a) resonant frequency, (b) impedance at resonance and (c) quality factor Q, and (d) band width.
13. To study the response curve of a parallel LCR circuit and determine its (a) anti-resonant frequency and (b) quality factor Q.

Text Book sand References:

1. Geeta Sanon, B.Sc. Practical Physics

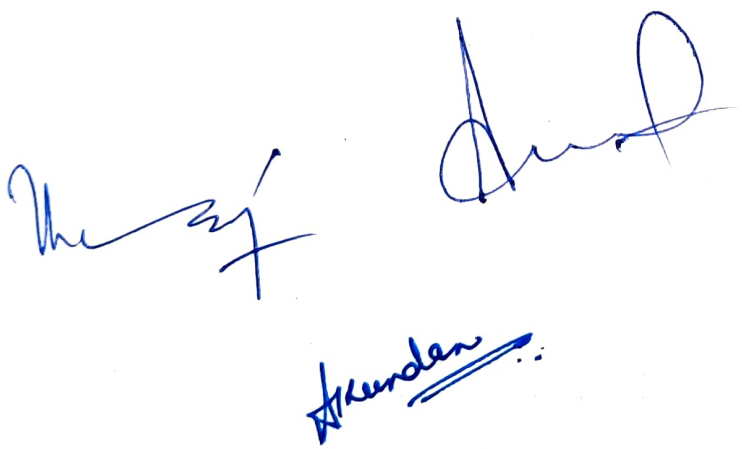
Int. B.Sc(H)-M.Sc. Physics			
Semester:	1 or 2	**Type:**	Open Elective
Course Name:	Renewable Energy and Energy Harvesting	**Course Code:**	IPHY10002T
Credits:	4	**L T P:**	4-0-0

Course Learning Outcomes:

CO1	*The emphasis of course is on applications in solving problems of interest to physicists.*
CO2	*The students are to be examined entirely on the basis of problems, seen and unseen*

Old Syllabus	Rationalized syllabus
UNIT-I **Fossil fuels and Alternate Sources of energy**: Fossil fuels and nuclear energy and their limitation, need of renewable energy, non-conventional energy sources. developments in offshore Wind Energy, Tidal Energy, Wave energy systems, biomass, biochemical conversion, biogas generation, tidal energy, Hydroelectricity.	**UNIT-I** **Fossil fuels and Alternate Sources of energy**: Fossil fuels and nuclear energy and their limitation, need of renewable energy, non-conventional energy sources. developments in offshore Wind Energy, Tidal Energy, Wave energy systems, biomass, biochemical conversion, biogas generation, tidal energy, Hydroelectricity.
UNIT-II **Solar energy:** Solar energy and its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond, solar water heater, solar distillation, solar cooker, solar green houses, Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**UNIT-II** **Solar energy:** Solar energy and its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond, solar water heater, solar distillation, solar cooker, solar green houses, Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.
UNIT-III **Wind Energy Harvesting:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.	**UNIT-III** **Wind Energy Harvesting:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.
UNIT-IV **Ocean Energy, Geothermal Energy and Hydro Energy:** Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Geothermal Resources, Geothermal Technologies. Hydropower resources and technologies, environmental impact of hydro power sources.	**UNIT-IV** **Geothermal Energy and Hydro Energy:** Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, **UNIT-V** **Ocean Energy:** Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Geothermal Resources, Geothermal Technologies. Hydropower resources and technologies, environmental impact of hydro power sources.

Reference Books:	Reference Books:
1. Non-conventional energy sources - G.D. Rai - Khanna Publishers, New Delhi. Solar energy - M P Agarwal - S Chand and Co. Ltd.	1. Non-conventional energy sources - G.D. Rai - Khanna Publishers, New Delhi. Solar energy - M P Agarwal - S Chand and Co. Ltd.
2. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.	2. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
3. Godfrey Boyle, Renewable Energy, Power for a sustainable future, 2004, Oxford University Press, in association with The Open University.	3. Godfrey Boyle, Renewable Energy, Power for a sustainable future, 2004, Oxford University Press, in association with The Open University.
4. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009. J.Balfour, M.Shaw and S.Jarosek, Photovoltaics, Lawrence J Goodrich (USA)	4. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009. J.Balfour, M.Shaw and S.Jarosek, Photovoltaics, Lawrence J Goodrich (USA)



Int. B.Sc.(H)-M.Sc. Physics			
Semester:	1 or 2	**Type:**	Open Elective
Course Name:	Astronomy and Astrophysics	**Course Code:**	IPHY1O002T
Credits:	4	**L T P:**	4-0-0

Old Syllabus	**No Change in existing syllabus**
Unit-I **Observational Data:**celestial sphere, geometry of the sphere,spherical Trigonometry, astronomical coordinates-equatorial, horizon, ecliptic and galactic systems of coordinates, conversion from one system of co-ordinates to another; perturbations of coordinates, constellations, sidereal time & solar time, astronomical time systems, calendars.	**Unit-I** **Observational Data:**celestial sphere, geometry of the sphere,spherical Trigonometry, astronomical coordinates-equatorial, horizon, ecliptic and galactic systems of coordinates, conversion from one system of co-ordinates to another; perturbations of coordinates, constellations, sidereal time & solar time, astronomical time systems, calendars.
Unit-II **Telescopes & instrumentation:** Different optical configurations for aastronomical telescopes, mountings, plate scale and diffraction limits. Telescopes for gamma ray, X-ray, UV, IR; radio astronomy, stellarphotometry- solid state, photo-multiplier tube and CCD based photometers, spectroscopy and polarimetry using CCD detectors.	**Unit-II** **Telescopes & iinstrumentation:** Different optical configurations for astronomical telescopes, mountings, plate scale and diffraction limits. Telescopes for gamma ray, X-ray, UV, IR; radio astronomy, stellarphotometry- solid state, photo-multiplier tube and CCD based photometers, spectroscopy and polarimetry using CCD detectors.
Unit-III **Photometric concepts:** intensity, flux density, luminosity, magnitude scale-apparent and absolute magnitude, distance modulus; determination of mass, luminosity, radius, temperature and distance of a star, colour index; **Stellar classification:** Henry-Draper and modern M-K classification schemes, H-R diagram, empirical mass-luminosity relation.	**Unit-III** **Photometric concepts:** intensity, flux density, luminosity, magnitude scale-apparent and absolute magnitude, distance modulus; determination of mass, luminosity, radius, temperature and distance of a star, colour index; **Stellar classification:** Henry-Draper and modern M-K classification schemes, H-R diagram, empirical mass-luminosity relation.
Unit-IV **Stars:** Ordinary stars, binary stars, variable stars,**Sun**: physical characteristics of sun-basic data, solar rotation, solar magnetic fields, photosphere- granulation, sunspots, Babcock model of sunspot formation, solar atmosphere-chromosphere and corona, **Variable stars:** classes of variable stars, pulsation mechanism, classical cepheids as distance indicators, **Compact Stars:** white dwarfs, neutron stars and black holes.	**Unit-IV** **Stars:** Ordinary stars, binary stars, variable stars,**Sun**: physical characteristics of sun-basic data, solar rotation, solar magnetic fields, photosphere- granulation, sunspots, Babcock model of sunspot formation, solar atmosphere-chromosphere and corona, **Variable stars:** classes of variable stars, pulsation mechanism, classical cepheids as distance indicators, **Compact Stars:** white dwarfs, neutron stars and black holes.

Unit-V

The Milky Way: Methods of Distance Measurement, Stellar Statistics, Structural Components of the Milky Way, The Rotation of the Milky Way

Galaxies: Classification of Galaxies, the Big Bang theory, the origin and evolution of galaxies

Text Books and References:

1. M. Zeilik, Astronomy-The Evolving Universe, (Cambridge Univ. Press).
2. Morrison, Introduction to Astronomy & Cosmology, (Wiley).
3. C.R. Kitchin, Telescopes and Techniques, (Springer).
4. A.A. Henden& R.H. Kaitchuk, Astronomical Photometry, (William-Bell).
5. E. Budding, An Introduction to Astronomical Photometry, (Cambridge Univ. Press).
6. R.A. Freedman & W.J. Kaufmann, Universe (W.H. Freeman & Co).
7. H. Karttunen et al.,Fundamental Astronomy, (Springer).
8. P.V. Foukal, Solar Astrophysics, (Wiley-VCH).
9. Bhatnagar & W.C. Livingston, Fundamentals of Solar Astronomy, (World Scientific).

Unit-V

The Milky Way: Methods of Distance Measurement, Stellar Statistics, Structural Components of the Milky Way, The Rotation of the Milky Way

Galaxies: Classification of Galaxies, the Big Bang theory, the origin and evolution of galaxies

Text Books and References:

1. M. Zeilik, Astronomy-The Evolving Universe, (Cambridge Univ. Press).
2. Morrison, Introduction to Astronomy & Cosmology, (Wiley).
3. C.R. Kitchin, Telescopes and Techniques, (Springer).
4. A.A. Henden& R.H. Kaitchuk, Astronomical Photometry, (William-Bell).
5. E. Budding, An Introduction to Astronomical Photometry, (Cambridge Univ. Press).
6. R.A. Freedman & W.J. Kaufmann, Universe (W.H. Freeman & Co).
7. H. Karttunen et al.,Fundamental Astronomy, (Springer).
8. P.V. Foukal, Solar Astrophysics, (Wiley-VCH).
9. Bhatnagar & W.C. Livingston, Fundamentals of Solar Astronomy, (World Scientific).

B. Sc(H)-M. Sc. Physics			
Semester :	1 or 2	**Type:**	Open Elective
Course Name:	Basics of Atmospheric Physics	**Course Code:**	IPHY100041
Credits:	4	**L T P:**	4-0-0

COURSE OUTCOMES:

After study of this course, students will be able to:

CO 1	*Understand general features of earth's atmosphere*
CO 2	*Learn about the dynamics of atmosphere*
CO 3	*Learn about the RADAR and LIDAR*

Old Syllabus	No Change in existing syllabus
Unit-I	**Unit-I**
General features of Earth's atmosphere	**General features of Earth's atmosphere**
Thermal structure of the Earth's Atmosphere, Composition of atmosphere, Hydrostatic equation, Potential temperature, Atmospheric Thermodynamics, Greenhouse effect, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze. Instruments for meteorological observations including RS/RW, meteorological processes and convective systems, fronts, Cyclones and anticyclones, thunderstorms.	Thermal structure of the Earth's Atmosphere, Composition of atmosphere, Hydrostatic equation, Potential temperature, Atmospheric Thermodynamics, Greenhouse effect, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze. Instruments for meteorological observations including RS/RW, meteorological processes and convective systems, fronts, Cyclones and anticyclones, thunderstorms.
Unit-II	**Unit-II**
Atmospheric Dynamics:	**Atmospheric Dynamics:**
Scale analysis, Fundamental forces, Basic conservation laws, The Vectorial form of the momentum equation in rotating coordinate system, scale analysis of equation of motion, Applications of the basic equations, Circulations and vorticity, Atmospheric oscillations, Quasi biennial oscillation, annual and semi-annual oscillations, Mesoscale circulations, The general circulations, Tropical dynamics.	Scale analysis, Fundamental forces, Basic conservation laws, The Vectorial form of the momentum equation in rotating coordinate system, scale analysis of equation of motion, Applications of the basic equations, Circulations and vorticity, Atmospheric oscillations, Quasi biennial oscillation, annual and semi-annual oscillations, Mesoscale circulations, The general circulations, Tropical dynamics.
Unit-III	**Unit-III**
Atmospheric Waves	**Atmospheric Waves**
Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption, non-linear consideration	Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption, non-linear consideration

Unit-IV	Unit-IV
Atmospheric Radar and Lidar Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications, Application of Lidar to study atmospheric phenomenon. Data analysis tools and techniques.	**Atmospheric Radar and Lidar** Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications, Application of Lidar to study atmospheric phenomenon. Data analysis tools and techniques.
Unit-V	**Unit-V**
Atmospheric Aerosols Spectral distribution of the solar radiation, Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Observational techniques for aerosols, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere, Aerosol studies using Lidars.	**Atmospheric Aerosols** Spectral distribution of the solar radiation, Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Observational techniques for aerosols, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere, Aerosol studies using Lidars.
Text books and references 1. Fundamental of Atmospheric Physics – Murry L Salby; Academic Press, Vol 61, 1996 2. The Physics of Atmosphere – John T. Houghton; Cambridge University press; 3 rdedn. 2002. 3. An Introduction to dynamic meteorology – James R Holton; Academic Press, 2004 4. Radar for meteorological and atmospheric observations – S Fukao and K Hamazu, Springer Japan, 2014	**Text books and references** 1. Fundamental of Atmospheric Physics – Murry L Salby; Academic Press, Vol 61, 1996 2. The Physics of Atmosphere – John T. Houghton; Cambridge University press; 3 rdedn. 2002. 3. An Introduction to dynamic meteorology – James R Holton; Academic Press, 2004 4. Radar for meteorological and atmospheric observations – S Fukao and K Hamazu, Springer Japan, 2014

B.Sc(H)-M.Sc. Physics			
Semester :	1 or 2	**Type:**	Open Elective
Course Name:	A course on MATLAB	**Course Code:**	IPHY1O004T
Credits:	2	**L T P:**	2-0-0

Course Outcomes:

CO	*The aim of this course is to enable the students to familiar and experience with tools of MATLAB*

Old Syllabus	Rationalized syllabus
UNIT -I Introduction to MATLAB, The MATLAB Environment, MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output. • Vectors, Arrays – Matrices **UNIT -II** MATLAB Functions , Built-in Functions User defined Functions Graphics with MATLAB. Files and File Management – Import/Export , Basic 2D, 3D plots , Graphic handling **UNIT -III** Programming with MATLAB 09 Hrs, Conditional Statements, Loops , MATLAB Programs – Programming and Debugging. ,Applications of MATLAB Programming. **UNIT -IV** Mathematical Computing with MATLAB, Algebraic equations , Basic Symbolic Calculus and Differential equations , Numerical Techniques and Transforms	**UNIT -I** Introduction to MATLAB, The MATLAB Environment, MATLAB Basics – Variables, Numbers, Operators, Expressions, **UNIT -II** Input and output. • Vectors, Arrays – Matrices MATLAB Functions , Built-in Functions User defined Functions Graphics with MATLAB. **UNIT -III** Files and File Management – Import/Export , Basic 2D, 3D plots , Graphic handlingProgramming with MATLAB 09 Hrs, Conditional Statements, Loops , **UNIT -IV** Mathematical Computing with MATLAB, MATLAB Programs – Programming and Debugging. , **UNIT-V** Applications of MATLAB Programming. Algebraic equations , Basic Symbolic Calculus and Differential equations , Numerical Techniques and Transforms
Text Books and References: 1. "A Guide to MATLAB - for Beginners and Experienced Users", 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006). 2. "Essentials of MATLAB Programming", 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009). 3. "MATLAB Demystified", David McMahon, The McGraw-Hill	**Text Books and References:** 1. "A Guide to MATLAB - for Beginners and Experienced Users", 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006). 2. "Essentials of MATLAB Programming", 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009). 3. "MATLAB Demystified", David McMahon, The McGraw-Hill

Companies, (2007). 4. "MATLAB® for Engineers", 3rd Ed., Holly Moore, Pearson Education, Inc., (2012). 5. "Engineering computation with MATLAB", 2nd Ed., David M. Smith, Pearson Education, Inc., (2010).	Companies, (2007). 4. "MATLAB® for Engineers", 3rd Ed., Holly Moore, Pearson Education, Inc., (2012). 5. "Engineering computation with MATLAB", 2nd Ed., David M. Smith, Pearson Education, Inc., (2010).

B.Sc(H)-M.Sc. Physics			
Semester :	1 or 2	**Type:**	Open Elective
Course Name:	A course on SciLab	**Course Code:**	IPHY10004T
Credits:	2	**L T P:**	2-0-0

Course Outcomes:

CO	*The aim of this course is to enable the students to familiar and experience with tools of SciLab*

Old Syllabus	Rationalized syllabus
UNIT-I Installation of the software, Scilab. Basic syntax, Mathematical Operators, Predefined constants, Built in functions. **UNIT-II** Complex numbers, Polynomials, Vectors, Matrix. Handling these data structures using built in functions. Programming - Functions - Loops - Conditional statements - Handling .sci files **UNIT-III** Installation of additional packages e.g. 'optimization' , Graphics handling - 2D, 3D - Generating .jpg files , Function plotting - Data plotting **UNIT-IV** Applications - Numerical Linear Algebra (Solving linear equations, eigen values atc.) - Numerical Analysis – iterative methods - ODE – Blotting solution curves Comparison with C / C++/ Matlab **Text Books and Reference:** 1. Ramachandran Hema (Author), Nair AchuthsankarSSkylab (A Free Software To Matlab) S.Chand Publisher 2. Anil Kumar Verma, SCILAB: A Begineer's Approach , Cengage Publishers	**UNIT-I** Installation of the software, Scilab. Basic syntax, Mathematical Operators, Predefined constants, Built in functions. **UNIT-II** Complex numbers, Polynomials, Vectors, Matrix. Handling these data structures using built in functions. Programming - Functions . **UNIT-III** Loops - Conditional statements - Handling .sci files Installation of additional packages e.g. 'optimization' **UNIT-IV** Graphics handling - 2D, 3D - Generating .jpg files , Function plotting - Data plotting Numerical Linear Algebra (Solving linear equations, eigen **UNIT-V** Numerical Analysis – iterative methods - ODE – Blotting solution curves Comparison with C C++/ Matlab **Text Books and Reference:** 1. Ramachandran Hema (Author), Nair AchuthsankarSSkylab (A Free Software To Matlab) S. Chand Publisher 2. Anil Kumar Verma, SCILAB: A Begineer's Approach , Cengage Publishers

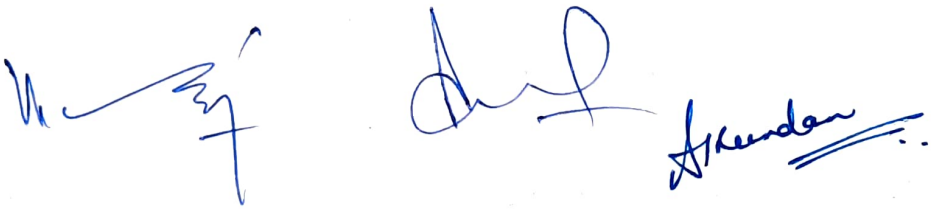
B.Sc(H)-M.Sc. Physics			
Semester :	1 or 2	**Type:**	Open Elective
Course Name:	Physics Lab Skill	**Course Code:**	IPHY1O007T
Credits:	2	**L T P:**	2-0-0

Course Outcomes:

CO	*The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode*

Old Syllabus	Rationalized syllabus
UNIT-I Introduction: Measuring units. conversion to SI and CGS. Familiarization with meterscale, Vernier calliper, Screw gauge and their utility.	**UNIT-I** Introduction: Measuring units. conversion to SI and CGS. Familiarization with meterscale, Vernier calliper, Screw gauge and their utility.
UNIT-II Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. Mechanical Skill: Concept of workshop practice.	**UNIT-II** Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. Mechanical Skill: Concept of workshop practice.
UNIT-III Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay. Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel.	**UNIT-III** Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply.
UNIT-IV Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.	**UNIT-IV** Timer circuit, Electronic switch using transistor and relay. Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel.
	UNIT-V Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

Reference Books:	Reference Books:
1. A text book in Electrical Technology - B L Theraja – S. Chand and Company. 2. Performance and design of AC machines – M.G. Say, ELBS Edn.3 3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd. 4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes 5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland	1. A text book in Electrical Technology - B L Theraja – S. Chand and Company. 2. Performance and design of AC machines – M.G. Say, ELBS Edn.3 3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd. 4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes 5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland



Semester – III

Course Code	Course	Type	Credits	Contact hours per week (L-T-P)
	Mathematical Physics-II (Theory +Lab)	CC	3+1	3-0-2
	Thermal (Theory +Lab)	CC	3+1	3-0-2
As provided by concerned deptt.	Open Elective Course-5	OEC	4	As provided by concerned deptt.
As provided by concerned deptt.	Open Elective Course-6	OEC	4	As provided by concerned deptt.
As provided by concerned deptt./ SWAYAM platform	Any course from the approved basket or by MOOC on SWAYAM platform	AEC	2	2-0-0
As provided by concerned deptt./ SWAYAM platform	Any course from the approved basket or by MOOC on SWAYAM platform	SEC	2	2-0-0
	Total		20	

Semester – IV

Course Code	Course	Type	Credits	Contact hours per week (L-T-P)
	Mathematical Physics-III (Theory +Lab)	CC	3+1	3-0-2
	Modern Physics (Theory +Lab)	CC	3+1	3-0-2
As provided by concerned deptt.	Open Elective Course-7	OEC	4	As provided by concerned deptt.
As provided by concerned deptt.	Open Elective Course-8	OEC	4	As provided by concerned deptt.

Course Code	Course	Type	Credits	Contact hours per week (L-T-P)
As provided by concerned deptt./ SWAYAM platform	Any course from the approved basket or by MOOC on SWAYAM platform	SEC	2	2-0-0
As provided by concerned deptt./ SWAYAM platform	Any course from the approved basket or by MOOC on SWAYAM platform	VAC	2	2-0-0
	Total		20	

Examination Pattern:

Course	Credit	CIA	MSE	ESE	Max. Marks
Core Course (Theory+Practical)	Theory (3)	15	20	40	75
	Practical (1)	10	-	15	25
Theory	4	25	25	50	100
Theory	2	12.5	12.5	25	50

List of Open electives courses offered by Department of Physics and Astronomical Sciences

Sr. No.	Level (UG/PG)	Course Code	Course Name	Nature of Open Elective
1.	UG		Analog Electronics	OEC
2.	UG		Communication System	OEC
3.	UG		Digital Systems And Applications	OEC
4.	UG		Numerical Methods	OEC
5.	UG		Atomic And Molecular Physics	OEC
6.	UG		Introduction to LaTex	SEC
7.	UG		Basic of Computer Programming	AEC
8.	UG		Weather forecasting	SEC
9.	UG		Electrical Circuits And Network Skills	SEC
10.	UG		Basic Instrumentation Skills	SEC

Syllabus of Integrated B.Sc.(H)-M.Sc.Physics

SemesterIII

Course Code	Course	Type	Credits	Contact hours per week (L-T-P)
	Mathematical Physics-II (Theory +Lab)	Core	3+1	3-0-2
	Analog Electronics (Theory +Lab)	Core	3+1	3-0-2

Core Course(CC)

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	III	**Type:**	Core
Course Name:	**MATHEMATICAL PHYSICS-II**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-0-2

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1	*Learn the Fourier analysis of periodic functions and their applications in simple physical problems.*
CO2	*Understand the differentiation and integration of Fourier series.*
CO3	*Solve linears econdorder differential equations using the power series method.*
CO4	*Learn about the special functions, such as the Hermite polynomial, the Legendre polynomial, the Laguerre polynomial and Bessel functions.*
CO5	*Analyze the differential equations of special functions and their applications in various physical problems.*
CO6	*Learn the beta and gamma functions and apply the basics for computation of integrations.*

UNIT-I

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.**Partial Differential Equations**: Solutions to partial differential equations. using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes.

UNIT-II

Special Functions and their properties: Frobenius method and its applications to differential equations: Legendre, Bessel, Hermite and Laguerre Differential Equations. Singular Points of Second Order Linear Differential Equations and their importance. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality, Simple recurrence relations. Properties of Bessel Functions of the First Kind and second kind: Generating Function, simple recurrence relations, Zeros of Bessel Functions and Orthogonality.Hermite and Laguerre Differential Equations and properties.

UNIT-III

Greens functions: Dirac delta functions-properties and representations, Definitions and physical significance of Greens functions, Greens function for ordinary differential operators, first order linear differential operators and second order linear differential operators. Greens functions for partial differential operators, Laplace diffusion

equation and wave equation operators, solution of boundary value problems using greens function for Laplace, Poisson and wave equations.

UNIT-IV

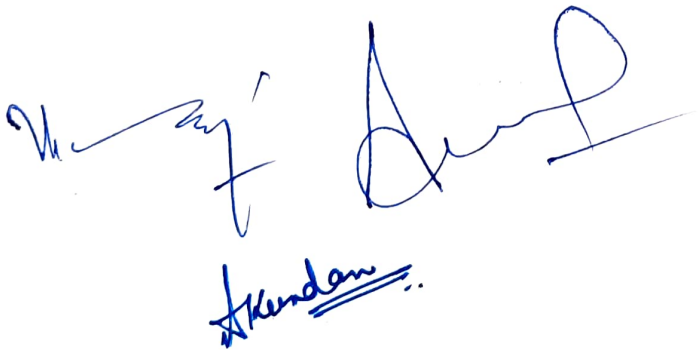
Fourier series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.

UNIT-V

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability integral). **Tensors:** definition and properties (inner and outer products, contraction)

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books



Int. B.Sc(H)-M.Sc. Physics			
Semester :	III	**Type:**	Core
Course Name:	**Mathematical Physics-II Lab**		

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1 *Learn the basics of numerical computation software scilab.*

CO2 *Understand the curve fitting procedures using scilab.*

CO3 *Examine the solutions of first and second order differential equations using scilab.*

CO4 *Investigate the generation and plotting of special functions like Bessel's function and Legendrepolynomial.*

CO5 *Derive the solutions of linear systems of equations using scilab.*

CO6 *Solve computationally the oscillator, newton's law of cooling, wave equation, heat equation, Poisson's equation, Laplace equation and mesh equations of electrical circuits.*

Topics	*Description with applications*
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalarand array operations, Hierarchy of operations, Built inScilab functions, Introduction toplotting, 2D and 3Dplotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multi dimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary

	and formatted functions, Numerical methods and developing the skills of writing a program (2).
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Solution of ODE, First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Second order Differential Equation • Harmonic oscillator (no friction) • Damped Harmonic oscillator • Over damped • Critical damped • Oscillatory • Forced Harmonic oscillator • Transient and • Steady state solution • Apply above to LCR circuits also
Using Scicos / xcos	• Generating square wave, sine wave, saw tooth wave • Solution to harmonic oscillator • Study of beat phenomenon • Phase space plots

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas& M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan,
4. 1940, Jones & Bartlett.
5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
6. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
7. Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand& Company
8. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

Core Course (CC)

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	III	**Type:**	Core
Course Name:	**THERMALPHYSICS**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-0-2

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO1 *Learn the fundamental laws of thermodynamics.*

CO2 *Understand the concept of internal energy, enthalpy, entropy and free energies*

CO3 *Examine the principle and working of Carnotengines.*

CO4 *Determine thermodynamic potential and analy maxwell's thermodynamic relations.*

CO5 *Understand and compare the behavior of ideal and real gases.*

CO6 *Learn the basics of kinetic theory of gases and analyze the distribution of velocitiesin an ideal gas.*

Unit-I

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes. Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Unit-II

Second Law of Thermodynamics: Second law of thermodynamics, Carnot theorem, thermodynamic scale of temperature and its identify with gas scale, entropy changes in reversible and irreversible processes law of increase of entropy with examples, T-S diagram entropy and disorder . heat death of universe, impossible of attaining absolute zero, Nernst heat theorem and third law of thermodynamics, Adiabatic expansion, Joule-Thomson expansion, temperature of inversion and Critical temperature of gas . principle of regenerative cooling and of cascade cooling.

Unit-III

Thermodynamic Potentials: Extensive and intensive thermodynamic variable, Maxwell's general relations. Applications to Joule-Thomson cooling, Clausius – Clapeyron latent heat equations, Thermodynamic potential and equilibrium of thermodynamics system, relation with thermodynamics variables, cooling due to adiabatic demagnetization productions and measurement of very low temperatures.

Unit-IV

Kinetic Theory of Gases: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Doppler Broadening of Spectral Lines and Stern's Experiment, Mean, RMS and Most Probable Speeds, Degrees of Freedom. Lawof Equipartition of Energy (No proof required). Specific heats of Gases.

Unit-V

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance. Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. TheVirial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases.

Text / Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	III	**Type:**	Core
Course Name:	**THERMAL PHYSICS LAB**		

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1	*Learn the basics of thermodynamics.*
CO2	*Develop the equivalence between work and heat.*
CO3	*Examine the coefficient of thermal conductivity of good and bad conductors of heat.*
CO4	*Calibratea thermocouple for a specific range of temperature.*
CO5	*Explore the principle and working of Platinum Resistance Thermometer.*
CO6	*Determine Stefan's Constant. Measure Planck's constant using black body radiation*

Atleast 06 experiments from the following:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using

(1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

8. To determine Stefan's Constant.
9. Measurement of Planck's constant using black body radiation.
10. Torecordandanalyzethecoolingtemperatureofahotobjectasafunctionoftimeusingathermocoupleand suitable data acquisition system.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

CORE COURSE(CC)

Semester IV

Course Code	Course	Type	Credits	Contact hours per week (L-T-P)
	Mathematical Physics-III (Theory +Lab)	Core	3+1	3-0-2
	Modern Physics (Theory +Lab)	Core	3+1	3-0-2

CoreCourse(CC)

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	IV	**Type:**	Core
Course Name:	Mathematical Physics-III	**Course Code:**	
Credits:	4	**L T P:**	3-0-2

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn the concepts of complex numbers, function of complex variables and analyze their singularities.*
CO 2	*Perform integration of functions of complex variables.*
CO 3	*Understand the basics of Fourier and Laplace Transforms.*
CO 4	*Solve simple physics problems using Fourier and Laplace Transforms.*
CO 5	*Analyze theorems involving integral transforms and their applications.*
CO 6	*Develop the skills of solving various physics problems entailing complex variables, functions of complex variables and their integrals, and integral transforms.*

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Simply and multiply connected region, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions

UNIT-II

Matrices, Addition and Multiplication of Matrices: Null Matrices. Diagonal, Scalar and Unit Matrices. Upper-Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew Hermitian Matrices. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Similar Matrices. Trace of a Matrix Eigen – values and Eigen vectors of a Matrix.

UNIT-III

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional wave and diffusion / heat flow equations.

CoreCourse(CC)

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	IV	**Type:**	Core
Course Name:	Mathematical Physics-III	**Course Code:**	
Credits:	4	**L T P:**	3-0-2

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn the concepts of complex numbers, function of complex variables and analyze their singularities.*
CO 2	*Perform integration of functions of complex variables.*
CO 3	*Understand the basics of Fourier and Laplace Transforms.*
CO 4	*Solve simple physics problems using Fourier and Laplace Transforms.*
CO 5	*Analyze theorems involving integral transforms and their applications.*
CO 6	*Develop the skills of solving various physics problems entailing complex variables, functions of complex variables and their integrals, and integral transforms.*

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula. De Moivre's theorem, Simply and multiply connected region, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions

UNIT-II

Matrices, Addition and Multiplication of Matrices: Null Matrices. Diagonal, Scalar and Unit Matrices. Upper-Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew Hermitian Matrices. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Similar Matrices. Trace of a Matrix Eigen – values and Eigen vectors of a Matrix.

UNIT-III

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional wave and diffusion / heat flow equations.

UNIT-IV

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

UNIT-V

Introduction to Probability: Definition, Independent random variable: sample space and probability distribution functions. Binomial, Gaussian, and Poisson distribution with examples. Mean and variance.

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	IV	**Type:**	Core
Course Name:	**Mathematical Physics-III Lab**		

CO 1	*Learn the computational skills of solving differential equations*
CO 2	*Examine the solutions of first and second order differential equations using scilab.*
CO 3	*Evaluate the Dirac Delta Function using scilab.*
CO 4	*Investigate the Frobenius method and Fourier series solutions using scilab.*
CO 5	*Analyze curve fitting procedures and perform Integral transform using scilab.*
CO 6	*Estimate error in a set of data recorded in a physics experiment.*
CO 7	*Explore the scilab proficiency in analyzing simple physics problems.*

Scilab based simulations experiments based on Mathematical Physics problems like

1. Solve differential equations:

$dy/dx = e^{-x}$ with $y = 0$ for $x = 0$

$dy/dx + e^{-x}y = x^2$

$d^2y/dt^2 + 2\ dy/dt = -y$

$d^2y/dt^2 + e^{-t}dy/dt = -y$

2. Dirac Delta function:

$\frac{1}{\sqrt{2\pi\sigma^2}} \int e^{\frac{-(x-2)^2}{2\sigma^2}} (x+3)dx$, for $\sigma = 1, 0.1, 0.01$ and show it tend to 5.

3. Fourier Series: Program to sum $\sum_{n=1}^{\infty}(0.2)^n$, evaluate the Fourier coefficients of a given periodic function (square wave)

4. Frobenius method and Special functions:

$$\int_{-1}^{+1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}, Plot\, P_n(x),\ j_\theta(x)$$

Show recursion relation.

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.

7. Evaluation of trigonometric functions e.g. *sin0*, Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.

8. Integral transform: FFT of e^{-x^2}

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press

2. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications

3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896

4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444

5. Scilab (A free software to Matlab): H. Ramchandran, A.S.Nair. 2011 S.Chand& Company

6. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

Int. B.Sc(H)-M.Sc. Physics			
Semester :	IV	**Type:**	Core
Course Name:	MODERN PHYSICS	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Understand the concept of Relativity*
CO 2	*Understand the interference and basics of the wave theory.*
CO 3	*Know the basic concepts of old Quantum theory.*
CO 4	*Know the basic concepts of need of quantum mechanics.*
CO 5	*Have an understanding of basics of Lasers.*

Unit-I

Theory of Relativity-I

Introduction to Frames of Reference; inertial and non- inertial, Gallian Transformation, Gallian Invariance of Newton's law, Laws of conservation of Linear momentum and Energy, Michelson-Morley Experiment and its outcome.Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Twin Paradox, Basic idea of General theory of relativity.

Unit-II

Theory of Relativity-II

Relativistic momentum and relativistic form of Newton's law, Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Four Vector, Minkowski space

Unit-III

Quantum theory of Light

Hertz's Experiment, Black Body radiation, ultraviolet catastrophe, Stefan's law, Rayleigh Jean's Law and Planck's Law, Light quantisation and the photoelectric effect, Compton effect, X-rays: Production and properties, de-Broglie wavelength and matter waves; Davisson-Germer experiment.

Unit-IV

Wave-particle duality. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Wave function and its significance, probability interpretation: Normalized wave functions as probability amplitudes, Heisenberg uncertainty principle (Statement with illustration and examples).

Unit-V

Optical Fibre: Optical fibre and its types, Critical angle of propagation, modes of propagation, Acceptance angles, Numerical aperture, Pulse dispersion, Attenuation and its various mechanism, Advantages and applications of optical fibres.

Lasers: Interaction of light with matter, (absorption, spontaneous, Einstein's prediction, stimulated emission), Einstein's relations, Light amplification, Population inversion, Pumping, Principal pumping schemes (three and four levels) Optical resonant cavity, conditions for laser action, Types of lasers (Ruby, He- Ne and semiconductor), Characteristics and applications of laser.

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. Modern Physics, 3rd Ed., R A Serway, C. J. Moses, C. A. Moyer, 2005, Cengage Lerning.
4. Modern Physics, 3rd Ed., Randy Harris, 2018 , Pearson Learning India.

Int. B.Sc(H)-M.Sc. Physics			
Semester :	IV	**Type:**	Core
Course Name:	MODERN PHYSICS LAB	**Course Code:**	
Credits:	1	**L T P:**	0-0-2

COURSE OUTCOMES:

CO 1	*Learn the basic concepts of modern physics.*
CO 2	*Determinethewavelengthandangularspreadoflaserlightusingthediffractionmethod.*
CO 3	*Validate experimentally the value of Planck's constant.*
CO 4	*Understand Photo-electric effect by plotting photo current versus intensity and wavelength of light and maximum energy of photo-electrons versus frequency of light.*
CO 5	*Investigate the rotational spectrum of Iodine vapour.*
CO 6	*Derive the work function of materials.*
CO 7	*Design the Millikan drop apparatus to determine the charge of an electron.*
CO 8	*Examine wavelength of H-alphaemission line of Hydrogenatom.*

Atleast 06experiments from following:

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11thEdn, 2011,Kitab Mahal

Open Elective Course (CC)

Common Basket for Semester-III &IV

(Choose any two OEC course in each semester)

Sr. No.	Level (UG/PG)	Course Code	Course Name	Nature of Open Elective
1.	UG		Analog Electronics	OEC
2.	UG		Communication System	OEC
3.	UG		Digital Systems And Applications	OEC
4.	UG		Numerical Methods	OEC
5.	UG		Atomic And Molecular Physics	OEC

Open Elective Course(CC)

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**ANALOGELECTRONICS**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-0-2

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1 *Know the fundamentals of Semiconductor physics and P-Ndiodes.*

CO2 *Apply the knowledge of semi conductors and P-Ndiodes to understand the working of rectifiers and filters.*

CO3 *Understand and analyze the characteristics of BJT in various configurations.*

CO4 *Learn the process of amplification and feedback in amplifiers.*

CO5 *Understand the theory, working and applications of various oscillator circuits.*

CO6 *Have an understanding of the physics of Op-Ampandits applications.*

UNIT-I

Semiconductor Diodes: p-and n-type semiconductors. Energy Level Diagram. Conductivity and Mobility. Concept of Drift velocity. pn- Junction Fabrication (Simple Idea). Barrier Formation in pn Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.

UNIT-II

Two-terminal Devices and their Applications: Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, Capacitor filter. Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.

UNIT-III

Bipolar Junction transistors (BJT): n-p-n and p-n-p Transistors. Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Characteristics of CB, CE and CC Configurations. Current gains and their Relations, Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cut-off and Saturation Regions. Field effect transistors (Basic principle of operations only). Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains.

UNIT-IV

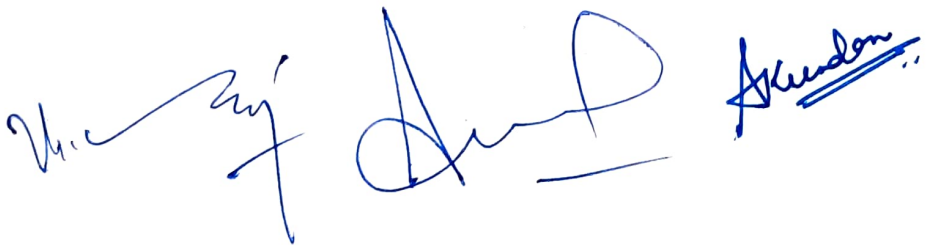
Amplifiers and Oscillators: Classification of Class A, B & C Amplifiers. Frequency response of a CE amplifier. Coupled Amplifier: Two stage RC-coupled amplifier. Feedback in Amplifiers: effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators

UNIT-V

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. Applications of Op-Amps: Linear - (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear (1) inverting and non-inverting comparators, (2) Schmidt triggers. Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation),

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall. Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6th Edn.,2009, PHI.
3. Learning Electronic Devices & circuits, S.Salivahanan&N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
5. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer.
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India.



Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**Analog Electronic Lab**		

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1 *Understand the V-I characteristics of Zener diode and solar cells.*

CO 2 *Analyze the characteristics of a transistor and an amplifier.*

CO 3 *Design the inverting and non-inverting amplifier using Op-amp.*

CO 4 *Explore the functioning of Op-amp as an Integrator and a Differentiator.*

CO 5 *Understand the theory and working of oscillator circuits for a specific response.*

CO 6 *Design electronic circuits for the solution of simultaneous equation and differential equation.*

CO 7 *Design a digital to analog converter (DAC) of given specifications.*

CO 8 *Analyze voltage regulation using Zener diode.*

Atleast 06 experiments from the following:

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. Tostudythefrequencyresponseofvoltagegainofatwostage RC-coupledtransistoramplifier.
7. To design a Wienbridge oscillator for given frequency using an op-amp.
8. To design a phases hift oscillator of given specifications using BJT.
9. To design a digital to analog converter (DAC) of given specifications.
10. To design an inverting amplifier using Op-amp (741, 351)for dc voltage of given gain
11. (a)To design inverting amplifier using Op-amp(741,351) &study its frequency response

(b) To design non-inverting amplifier using Op-amp (741,351) & study frequency response

12. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode

    (b) To study the zero-crossing detector and comparator.

13. TodesignaprecisionDifferentialamplifierofgivenI/OspecificationusingOp-amp.

14. To investigate the use of anop-ampas an Integrator.

15. To investigate the use of anop-amp as a Differentiator.

16. To design a circuit to simulate the solution of simultaneous equation and 1st/2nd order differential equation.

Reference Books:

1. Basic Electronics: A text labmanual, P.B.Zbar,A.P. Malvino, M.A.Miller,1994,Mc-GrawHill.
2. OP-Amps and Linear Integrated Circuit, R.A. Gayakwad,4th edition,2000,Prentice Hall.
3. Electronic Principle, Albert Malvino,2008,Tata Mc-Graw Hill.
4. Electronic Devices &circuitTheory,R.L.Boylestad&L.D.Nashelsky,2009,Pearson
5. Integrated Electronics, J. Millman and C.C.Halkias,1991, TataMc-Graw Hill.
6. Electronics: Fundamentals and Applications, J.D.Ryder, 2004, PrenticeHall.
7. SolidStateElectronicDevices,B.G.Streetman&S.K.Banerjee,6th Edn.,2009,PHILearning
8. ElectronicDevices&circuits,S.Salivahanan&N.S.Kumar,3rd Ed.,2012,TataMc-GrawHill
9. OP-Amps and LinearIntegratedCircuit,R.A.Gayakwad,4th edition,2000,PrenticeHall
10. Microelectronic circuits, A.S. Sedra, K.C.Smith, A.N.Chandorkar,2014,6th Edn., Oxford University Press.
11. Semi conductor Devices: Physics and Technology, S.M. Sze, 2nd Ed.,2002, Wiley India.
12. MicroelectronicCircuits,M.H.Rashid,2nd Edition, Cengage Learning
13. Microelectronic Devices & Circuits, David A. Bell, 5th Edn.,2015,Oxford University Press

Int. B.Sc(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**COMMUNICATION SYSTEMS**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-0-2

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn amplitude modulation and demodulation techniques.*
CO 2	*Understand frequency modulation and demodulation techniques.*
CO 3	*Learn various digital communication techniques.*
CO 4	*Examine cellular communication and satellite communication.*
CO 5	*Understand advantage and disadvantages of digital transmission.*
CO 6	*Figure noise in transmission lines.*

Unit-I

Noise - Introduction, internal and external noises, signal to noise ratio and noise figure. Block diagram of electronic communication system. Modulation-need and types of modulation - AM, FM&PM. Amplitude modulation– representation, modulation index, expression for instantaneous voltage, power relations, frequency spectrum. DSBFC, DSBSC and SSBSC (mention only). Limitations of A M. Demodulation-AM detection: principles of detection, linear diode, principle of working and wave forms.

Unit-II

Frequency Modulation: definition, modulation index, FM frequency spectrum diagram, band width requirements, frequency deviation and carriers wing, FM generator-varactor diode modulator.

FM detector –principle, slope detector- circuit, principle of working and waveforms. Block diagram of FM transmitter and Receiver. Comparison of AM and FM.

Unit- III

Introduction to pulse and digital communications, digital radio, sampling theorem, types- PAM, PWM, PPM, PCM – quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits – Shannon limit for information capacity, and width requirements, data transmission speed, noise, crosstalk, echo suppressors, distortion and equalizer, MODEM–modes, classification, interfacing (RS232). TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA.

Unit- IV

Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN),frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3Gand 4G concepts.

Unit- IV

Satellite communication: Introduction, to Orbit, types of orbits, Block diagram of satellite transponder.

Reference Books:

1. Electronic Communication, George Kennedy,3rd edition, TMH.
2. Electronic Communication, Roddy andCoolen,4th edition, PHI.
3. Electronic Communication systems, Kennedy &Davis, IV edition-TATA McGraw Hill.
4. Advanced Electronic Communication systems,Wayne Tomasi-6thedition,Lowpricededition-Pearson education.

Int. B.Sc. (H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**COMMUNICATION SYSTEMS LAB**		

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn amplitude modulation and demodulation techniques.*
CO 2	*Analyze Amplitude Modulation and Frequency Modulation Transmitter/Receiver.*
CO 3	*Understand Time Division Multiplexing and demultiplexing.*
CO 4	*Examine Pulse-Amplitude Modulation (PAM)modulator and demodulator.*
CO 5	*Analyze Frequency-Shift Keying(FSK)modulation.*
CO 6	*Explore pulse and digital communication types.*
CO 7	*Portray the working of Voltage Controlled Oscillator (VCO) using IC566.*
CO 8	*Analyze Frequency Modulation (FM) using IC8038.*

Atleast 06 experiments from the following:

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM - Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators
11. Amplitude modulator and Amplitude demodulator
12. Study of FM modulator usingIC8038
13. Study of VCO using IC 566
14. Study of Time Division Multiplexing and demultiplexing

Reference Books:

1. Electronic Communication, George Kennedy,3rd edition,TMH.
2. Electronic Communication, Roddy andCoolen,4th edition, PHI.
3. Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.
4. Advanced Electronic Communication systems, Wayne Tomasi-6thedition,Lowpricededition-Pearson education.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**DIGITAL SYSTEMS AND APPLICATIONS**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-0-2

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn the fundamentals of digital logic gate-circuits and Boolean algebra.*
CO 2	*Understand the circuitry, working and applications of data processing circuits and arithmetic circuits.*
CO 1	*Learn the theory and working principle of basic sequential circuits like flip-flops of various types.*
CO 4	*Apply the knowledge off lip-flops to various shift registers, counters and their applications.*
CO 5	*Understand the working of Timer ICs, Memory ICs and their applications.*
CO 6	*Learn the basics of microprocessor and assembly Language.*

Unit-I

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (i) Study of Waveform, (ii) Measurement of Voltage, Current, Frequency, and Phase Difference. **Integrated Circuits** (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.

Unit-II

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity. **Boolean algebra:** De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Min-terms and Max-terms. Conversion of a Truth table into Equivalent Logic Circuit by (i) Sum of Products Method and (ii) Karnaugh Map.

Unit-III

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. **Arithmetic Circuits:** Binary Addition. Binary Subtraction using 2's Complement. Halfand Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. **Sequential Circuits:** SR, D, and JK Flip-Flops. Clocked (Level and

Edge Triggered)Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.

Unit-IV

Timers: IC 555: block diagram and applications: A stable multi vibrator and Mono stable multi vibrator **Shift registers:** Serial-in-Serial-out, Serial-in-Parallel-out, **Counters(4 bits):** Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Unit-V

Computer Organization: Input / Output Devices. Data storage (idea of RAM and ROM).Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.

Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram.Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle. Timing diagram of MOV and MVI.

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2ndEdn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
5. Logic circuit design, Shimon P. Vingron, 2012, Springer.
6. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
7. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**DIGITAL ELECTRONICS LAB**		

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn the working of Digital circuits and logic gates.*
CO 2	*Understand the various arithmetic circuits like adders, subtractors, binary adders etc.*
CO 3	*Design multivi brator of given specifications using555 Timer.*
CO 4	*Implement and investigate combinational logic systems.*
CO 5	*Design various flip-flop circuits using logic gates and ICs.*
CO 6	*Understand the basic1-byte, 2-byte programming using 8085 Microprocessor.*
CO 7	*Design combinational logic system for a specified Truth Table.*
CO 8	*Build4-bit Counter and shift register using D-type / JK Flip-Flop ICs.*

Atleast04experimentseachfromsectionAandSectionB

Section-A: Digital Circuits Hardware design / Verilog Design

1. To design a combinational logic system for a specified Truth Table.
   (b) To convert Boolean expression into logic circuit & design it using logic gate ICs.
   (c) To minimize a given logic circuit.
2. Half Adder, Full Adder and 4-bitbinaryAdder.
3. Half Subtractor, Full Subtractor, Adder-Subtract or using Full Adder I.C.
4. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
5. To build JK Master-slave flip-flop using Flip-Flop ICs
6. To build a4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
7. Tomakea4-bitShift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
8. To design an a stable multi vibrator of given specifications using555Timer.
9. To design a mono stable multivibratorofgivenspecificationsusing555 Timer.

Section-B: Programs using 8085 Microprocessor:

1. Addition and subtraction of numbers using direct addressing mode
2. Addition and subtraction of numbers using indirect addressing mode
3. Multiplication by repeated addition.
4. Division by repeated subtraction.

5. Handlingof16-bitNumbers.
6. Use of CALL and RETURN Instruction.
7. Block data handling.
8. Other programs (e.g.Parity Check, using interrupts, etc.).

Reference Books:

1. Modern Digital Electronics, R.P.Jain, 4th Edition,2010,TataMcGrawHill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P.Malvino,M.A.Miller,1994, Mc-GrawHill.
3. Microprocessor Architecture Programming and applications with 8085,R.S.Goankar, 2002,Prentice Hall.
4. Microprocessor 8085: Architecture, Programming and interfacing,A.Wadhwa,2010,PHILearning.

OpenElectiveCourses(OEC)

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**NUMERICALMETHODS**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-0-2

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1 *Understand about the solution of equations and eigen value problems.*

CO 2 *Analyze Newton's forward and backward interpolation formulae ,Central difference interpolation formula, Gauss forward and backward interpolation formulae, Langranges interpolation formula and Newton's divided difference formulae.*

CO 3 *Examine the solutions of Trapezoidalrule, Simpson's1/3rdand3/8thrules, Boole's rule and Weddle's rule.*

CO 4 *Solve numerically the ordinary differential equations.*

CO 5 *Determine solutions of simultaneous algebraic equations.*

CO 6 *Predict numerical solutions of differentiation and integration.*

UNIT I

Solution of algebraic and transcendental equations , Fixed point iteration method , Newton Raphson method . Solution of linear system of equations ,Gauss elimination method , Pivoting , Gauss Jordan method , Iterative methods of Gauss Jacobi and Gauss Seidel , Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II

Interpolation with unequal intervals, Lagrange's interpolation, Newton's divided difference interpolation, Cubic Splines , Difference operators and relations , Interpolation with equal intervals , Newton's forward and backward difference formulae.

UNIT III

Approximation of derivatives using interpolation polynomials, Numerical integration using Trapezoidal, Simpson's 1/3 rule , Romberg's Method, Two point and three point Gaussian quadrature formulae , Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV

Single step methods , Taylor's series method, Euler's method, Modified Euler's method , Fourth order Runge ,Kutta method for solving first order equations , Multi step methods , Milne's and Adams — Bash forth predictor corrector methods for solving first order equations.

UNIT V

Finite difference methods for solving second order two — point linear boundary value problems — Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain — One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods — One dimensional wave equation by explicit method.

References Books:

1. K.Atkinson and W.Han, Elementary NumericalAnalysis, JohnWiley,2006.
2. Numerical Methods in Engg & Science: B.S. Grewal: Khanna publications.
3. Numerical Methods for Scientific and Engg. Computations: M.K. Jain, S.R.K. Iyenger and R.K. Jain-Wiley Eastern Ltd
4. Taneja, H.C."Advanced Engineering Mathematics", IK International, NewDelhi.
5. Introductory Methods of Numerical Analysis: S.S. Shastri, PHI learning pvt limited.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**NUMERICALMETHODS LAB**		

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Understand about the root solution of non-linear equations*
CO 2	*Understand about the curve fitting*
CO 3	*Solve numerically the ordinary differential equations.*
CO 4	*Determine solutions of simultaneous algebraic equations.*
CO 5	*Predict numerical solutions of differentiation and integration.*

Atleast06experimentsfrom the following list:

1. To Find The Roots of Non-Linear Equation Using Bisection Method.
2. To Find The Roots of Non-Linear Equation Using Newton's Method.
3. Curve Fitting By Least – Square Approximations.
4. To Solve The System of Linear Equations Using Gauss - Elimination Method.
5. To Solve The System of Linear Equations Using Gauss - Seidal Iteration Method.
6. To Solve The System of Linear Equations Using Gauss - Jorden Method.
7. To Integrate Numerically Using Trapezoidal Rule.
8. To Integrate Numerically Using Simpson's Rules.
9. To Find The Largest Eigen Value Of A Matrix By Power - Method.
10. To Find Numerical Solution Of Ordinary Differential Equations By Euler's Method.
11. To Find Numerical Solution Of Ordinary Differential Equations By Runge- Kutta Method.
12. To Find Numerical Solution Of Ordinary Differential Equations By Milne's Method.
13. To Find The Numerical Solution Of Laplace Equation.
14. To Find The Numerical Solution Of Wave Equation.
15. To Find The Numerical Solution Of Heat Equation.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	**ATOMIC AND MOLECULAR PHYSICS**	**Course Code:**	
Credits:	4 (3+1)	**L T P:**	3-1-0

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Understand about the atoms and atomic spectra*
CO 2	*Understand about the Zeeman's Effect*
CO 3	*explain the change in behavior of atoms in external applied electric*
CO 4	*Explain rotational, vibrational, electronic and Raman spectra of molecules.*

UNIT-I

Atomic Spectra: Inadequacy of Bohr atomic model, correction due to finite mass of the nucleus, Rydberg constant in terms of reduced mass, Excitation and Ionisation potentials, Franck-Hertz experiment, Bohr-Sommerfeld Model of atom, vector model of an atom, Electron spin, space quantisation, magnetic moment of an electron due to its orbital motion. Stern-Gerlach experiment and its theory, Spin-orbit interaction and Fine structure of spectral lines

UNIT-II

One- and two-valence electron systems: Quantum numbers and selection rules, Pauli's exclusion principle, Electronic configuration of atoms, Pauli Exclusion principle and electron configuration, quantum states, Spectral notations of quantum states. Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na atom, selection rules, sodium Doublet. **Two- valence electron systems:** Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ coupling schemes. Singlet Triplet separation for interaction energy of LS coupling, Lande's Interval rule, Problems.

UNIT-III

Zeeman Effect : Early discoveries and developments, Experimental arrangement, Normal and anomalous Zeeman Effect Problems, Stark effect (Qualitative discussion), **X-ray spectroscopy:** Nature of X-rays, Discrete and continuous X-ray spectra, Daune and Hunt's Rule, X-ray emission spectra, Mosley's law and its applications, Auger effect , Problems

UNIT-IV

Molecular Spectra: Molecular formation, the H molecular ion, H_2 – molecule. Salient features of molecular spectra. Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules, Theory of pure rotation and rotation- vibration spectra, Raman and IR spectra, simple applications.

UNIT-V

Raman spectroscopy: Classical theory of Raman Effect. Molecular polarizability, Quantum theory of Raman Effect, Experimental set up for Raman Effect, Applications of Raman spectroscopy

Books Recommended:

1. Atomic Physics (Modern Physics), S N Ghosal, (S. Chand)
2. Concepts of Modern Physics 4th edition, Arthur Baiser (McGraw Hill International edition)
3. Introduction to Atomic spectra, H.E White.(McGraw Hill International edition)
4. Introduction to Atomic and Molecular Spectroscopy ,V.K.Jain, Narosa Publication.
5. Molecular Structure And Spectroscopy, 2nd Edition, G. Aruldhas(PHI Learning).
6. Physics of Atoms and Molecules, 2nd edition B H Bransden and C J Joachain, Pearson International.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	OEC
Course Name:	ATOMIC AND MOLECULAR PHYSICS LAB		

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*gain knowledge in some apparatus and can analysis of atomic spectra*
CO 2	*develop skill in assembling various kinds of apparatus, data taking manually as well as using computer interfaced instruments and data analysis.*
CO 3	*Assemble / design a setup for a given measurement and analyze the data and to prepare their laboratory reports.*
CO 4	*to analyze data and optimized errors in a measurement*

1. Determining the electric unit charge after Millikan and verifying the charge quantification - Measuring the suspension voltage and the falling speed.
2. Determining the specific charge of the electron
3. To study Frank-Hertz phenomenon using Neon lamp.

4. To demonstrate the Faraday Effect using flint glass.

5. To determine the phase shift between the normal and extraordinary light beam produced by given dielectric fluid (nitrobenzene) and to plot a graph between the phase shift and square of electric field or square of voltage. (Kerr effect)

6. To measure the wavelengths of the Balmer Series of visible emission lines from hydrogen tube.

7. To study Zeeman effect.

Skill/Ability Enhancement Courses

Common for Semester-III&IV

(Choose any one SEC/AEC course each semester (III &IV)

Sr. No.	Level (UG/PG)	Course Code	Course Name	Nature of Open Elective
1.	UG		Introduction to LaTex	SEC
2.	UG		Basic of Computer Programming	AEC
3.	UG		Weather forecasting	SEC
4.	UG		Electrical Circuits and Network Skills	SEC
5.	UG		Basic Instrumentation Skills	SEC

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	SEC
Course Name:	**Introduction to LaTex**	**Course Code:**	
Credits:	2	**L T P:**	2-0-0

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	Introduce with a software that is being widely used for typesetting especially in Mathematics field.
CO 2	*Understand typing with LaTex software.*
CO 3	*To make conference proceedings and presentations*
CO 4	*Understand to write project report, paper and articles.*

UNIT I

Basics: What is LaTeX, Basics for document structuring, preamble preparation, saving a folder. Installation of LaTeX i) Installation of Kile and MikeTeX. ii) Class and packages iii) Latex programming and commands, sample packages iv) Error messages: Some sample errors, list of LaTeX error messages

UNIT II

Formatting of output document :i) Fonts, symbols, indenting, paragraphs, line spacing, word spacing, titles and subtitles ii) Document class, page style, parts of the documents, table of contents iii) Command names and arguments, environments, declarations iv) Theorem like declarations, comments within text,

UNIT –III

Mathematical formulae :i) Mathematical environments, math mode ,mathematical symbols ii) Graphic package, multivalued functions, drawing matrices iii) Tables, tables with captions iv) References to figures and tables in text

UNIT –IV

Drawing with LaTeX i) picture environments ii) extended pictures, other drawing packages iii) Preparing book, project report in LaTeX.

UNIT-V

Introduction to creating slides, adding frames, dividing the slide into multiple columns, adding different blocks, etc

Reference Book :

1. Guide to LATEX, fourth edition, Helmut Kopka, Patrick W. Daly

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	AEC
Course Name:	Basic of Computer Programming	**Course Code:**	
Credits:	2	**L T P:**	2-0-0

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Develop a C program.*
CO 2	*Control the sequence of the program and give logical outputs.*
CO 3	*Implement strings in your C program.*
CO 4	*Store different data types in the same memory.*
CO 5	*Manage I/O operations in your C program.*
CO 6	*Repeat the sequence of instructions and points for a memory location.*

Unit I

Operating Systems, types of operating systems; introduction to programming (C++/fortran-95 programming languages): Number Systems, Computer Codes, Computer Arithmetic.

Unit II

Basic idea of compilers; data and statements: data types, constants and variables; mathematical, relational, logical and bitwise operators; precedence of operators, expressions and statements, local and global variables; auto, static and external variables.Control statements: if-state ment, if-else statement, nested-if structure, else-if statement; go to statement, switch statement; unconditional and conditional looping, while loop, do-while loop, for loop, break and continue statements, nested loops.

Unit III

Arrays and structures: one- and two-dimensional arrays, functions, function prototypes, function call by value and by references, idea of function overloading, Structures, Recursion.

Unit IV

Brief idea of classes, objects and inheritance: classes and objects; member functions in a class; idea of Strings and Pointers.

Unit V

Programs: roots of a quadratic equation, Calculate the factorial of number using recursion and normal method, fitting a straight line to a data, deviations about an average, arrange a List of numbers in ascending and descending order binary search.

Text Books and References:

1. Schaum's Outline of Programming with C++, John R. Hubbard, McGraw-Hill.

2. Numerical Recipes in C++: The Art of Scientific Computing, Teukolsky, Vetterling and Flannery, (Cambridge University Press).

3. Mete...

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	SEC
Course Name:	**WEATHER FORECASTING**	**Course Code:**	
Credits:	2	**L T P:**	2-0-0

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn regarding the causes and effects of different weather phenomenon*
CO 2	*Understand basic forecasting techniques*
CO 3	*Learn about climate change*
CO 4	*Understand the basics of weather forecasting*

UNIT-1

Introduction to atmosphere: physical structure and composition of atmosphere, variation of pressure and temperature with height; temperature sensors: atmospheric pressure: its measurement: cyclones and anticyclones

UNIT-II

Measuring the weather: Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws

UNIT-III

Weather systems: Global wind systems; air masses and fronts: classifications jet streams, local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.

UNIT-IV

Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate.

UNIT-V

Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.

Reference books:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman& Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	SEC
Course Name:	**ELECTRICALCIRCUITSANDNETWORKSKILLS**	**Course Code:**	
Credits:	2	**L T P:**	2-0-0

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn basics of electrical circuits and their working principles.*
CO 2	*Understand working theory of Generators / Transformers and AC and DC motors.*
CO 3	*Learn the various passive components and their connections.*
CO 4	*Examine electrical wiring and explore electrical protection techniques.*
CO 5	*Analyze alternating current source dielectrical circuits.*
CO 6	*Understand resistors, inductors and capacitors.*

UNIT-I

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series - parallel combinations.AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

UNIT-II

Electrical Circuits: Basic electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

UNIT-III

Electric Motors: Single – phase,
three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters and motors. Speed &power of ac motor. **Solid-State Devices:** Resistors, inductors and capacitors. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

UNIT-IV

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device.

UNIT-V

Electrical Wiring: Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Insulation. Solid and stranded cable. Preparation of extension board.

Reference Books:

1. Electrical Circuits, K. A. Smith andR.E.Alley,2014, Cambridge University Press A text book in Electrical Technology-B L Theraja-S Chand &Co.
2. A text book of Electrical Technology-A K Theraja
3. Performance and design of AC machines-MG Say ELBSE dn.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :		**Type:**	SEC
Course Name:	**BASIC INSTRUMENTATION SKILLS**	**Course Code:**	
Credits:	2	**L T P:**	2-0-0

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO 1	*Learn the necessary working knowledge on accuracy, precision, resolution, range and errors /uncertainty in measurements.*
CO 2	*Gain knowledge on the working and operations of multimeter.*
CO 3	*Understand about digital instruments like voltmeter and mili voltmeter.*
CO 4	*Understand the working, theory and applications of CRO for measurements.*
CO 5	*Understand the concept of impedance bridges and Q-meters.*
CO 6	*Learn about the block diagram and working of a digital meter and its various associated parameters.*

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

UNIT-II

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only).Specifications of an electronic Voltmeter / Multimeter and their significance. AC milli voltmeter: Type of AC milli voltmeters. Block diagram ac milli voltmeter, specifications and their significance.

UNIT-III

Oscilloscope: Block diagram of basic CRO. CRT, brief discussion on screen phosphor, visual persistence. Time base operation, synchronization. CRO use for the measurement of voltage (dc and ac), frequency and time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope : principle of working.

UNIT-IV

Impedance Bridges and Q-meters: Block diagram of bridge working principles of basic (balancing type) R L C bridge. Specifications of R L C bridge .Block diagram and working principles of a Q-Meter.

UNIT-V

Digital Instruments: Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles and block diagram of digital voltmeter. Principle of time interval, frequency and period measurement using universal counter / frequency counter, time-base stability, accuracy and resolution.

Reference Books:

1. A text book in Electrical Technology – B L Theraja- S Chand and Co. Performance and design of AC machines-M G Say ELBS Edn.
2. Digital Circuits and systems, Venugopal, 2011, Tata Mc Graw Hill. Logic circuit design, Shimon P. Vingron, 2012, Springer.
3. Digital Electronics, Subrata Ghoshal,2012,Cengage Learning.
4. Electronic Devices and circuits, S. Salivahanan & N.S. Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill