SYLLABUS

(Under National Education Policy – 2020)

For the Programs under

The Faculty of Science and Technology

In the subject of

Physics

(Semesters III & IV)

(To be effective from Academic year 2024-25)

Program : B.Sc.
Subject : Physics
Year: Second Year
Semesters: III and IV

Preamble:
This syllabus is a part of the B.Sc Program in Physics of the Hyderabad and Sind National Collegiate University to be taught in Semesters 3 and 4 from the academic year 2023-24 onwards.

This syllabus aims to provide adequate skills, training and knowledge to the students which enhance their thinking and application abilities.

The theory courses of both semesters comprising of Mathematical Physics, Mechanics, Thermal Physics and Wave Optics are devoted to core Physics.

The detailed syllabus in each theory course is designed to fit in with the existing First Year syllabus of the Program in terms of continuity. The Second Year syllabus mainly seeks to orient the learner towards applications of the laws and principles of Physics imparted to them in the First Year.

The Practical courses of both semesters strives to maintain a close connection with the theory courses with the purpose of providing the learner an immediate exposure to an aspect of experiential learning.

Objectives:

Upon completion of the Second Year of the B. Sc Program in Physics with this syllabus the Learner should be able to:

1. acquire good knowledge and understanding of concepts, principles, and experimental findings in the areas of core Physics such as Mathematical Physics, Mechanics, Thermal Physics and Wave Optics.
2. think critically and acquire high problem solving abilities.
3. through the self-learning component work effectively in a team and present complex technical concepts in a clear, precise, concise, and simple language for better understanding.
4. through the self-learning component identify, mobilize appropriate resources required for a project and manage a project to its completion in a responsible manner.
5. use computers for simulation studies in Physics and appropriate software for numerical and statistical analysis of data.
6. learn to access websites of renowned Physics laboratories in order to locate, retrieve and evaluate information related to Physics.

Second Year – Semester III

Course Name: Mechanics 2

Course Code:PHY201B **Total Credits:03**

COURSE OBJECTIVES:

- To introduce angular momentum, its conservation principle. To write the expressions for moment of inertia for different mass distribution.
- To introduce different types of pendulums, forced oscillations and resonance
- To introduce fictitious forces in non-inertial frames

COURSE OUTCOME:

After completion of the course, the students

- Will be introduced angular momentum and its conservation principle
- Will be able to write the expressions for moment of inertia about the given axis of symmetry for different uniform mass distributions
- Will be understood various applications of translational and rotational motions simultaneously in certain phenomena such as rolling of a disc without slipping on a plane surface
- Will be introduced central force and its application to motion of planets and satellites
- Will be introduced about forced oscillations and resonance
- Will be introduced about fictitious forces in non-inertial frames and their implications

Unit	Contents	No. of Lectures
1	**Rotational Dynamics:** Angular momentum of a particle and a system of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of inertia, Kinetic energy of rotation, Motion involving both rotation and translation.	15
2	**Compound Pendulum and Oscillations:** **2.1 Compound Pendulum:** Expression for period, maximum and minimum time period, centres of suspensions and oscillations, reversible compound pendulum, Kater's pendulum, Compound pendulum and simple pendulum-relative study **2.2 Oscillations:** Damped and forced oscillations, Transient and steady states, Resonance, Sharpness of resonance, Power dissipation, Quality factor.	15
3	**Gravitation, central force of motion and Non-inertial Systems:** **3.1 Gravitation:**	

	Law of gravitation, Gravitational potential energy, Inertial and Gravitational mass, Potential and field due to spherical shell and solid sphere **3.2 Central force of motion:** Motion of a particle under a central force field, Two-body problem, and its reduction to one -body problem and its solution, The energy equation and energy diagram, Kepler's laws, Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning systems (GPS). **3.3 Non-inertial Systems:** Non-inertial frames and fictitious forces, Uniformly rotating frame, Laws of Physics in uniformly rotating coordinate systems, Centrifugal force, Coriolis force and its implications.	15

Self-Learning topics (Unit wise)

Unit	Topics
I	Angular momentum of a particle and a system of particles, Torque
II	Compound pendulum and simple pendulum-relative study
III	Law of Gravitation, Basic idea of global positioning systems (GPS)

Reference Books:

1. An introduction to Mechanics by D. Kleppner, R J Kolenkow, 2010, Mc-Graw Hill
2. Mechanics, Berkeley Physics, Volume I, C Kittel, W Knight, et.al. 2007, Tata McGraw Hill
3. Principles of Physics, Resnick, Halliday and Walker, 2023, 12th ed. Wiley
4. Analytical Mechanics, G R Fowles and G L Cassiday, 2005, Cengage Learning.
5. Feynman Lectures Volume I, R P Feynman, R B Leighton, M Sands, 2008, Pearson Education.
6. University Physics, Roland Lane Resse, 2003, Thomson Brooks/Cole
7. Engineering Mechanics, Basudeb Bhattacharya, 2nd edition, 2015, Oxford University Press

Additional Reference Books:

1. Mechanics, D S Mathur, S Chand and Company Ltd. 2000.
2. Theoretical mechanics, M R Spiegel, Tata Mc-Graw Hill, 2006.

Course Name: Practical Course 3(Physics Major)
(Practical based on Mechanics 2)
Course Code: PHY201D **Total Credit:01**
COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	No. of Lectures
1. Resonance Pendulum 2. Bar Pendulum 3. Kater's Pendulum 4. Spring Mass Oscillator 5. Flat spiral spring 6. LCR series resonance 7. LCR parallel resonance 8. LCR transients	3 lectures per batch 2 hours per experiment

Reference Books:

1. Advanced Practical Physics, B. L. Worsnop and H.T. Flint, 2021, Khosla Publishing House
2. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal.
3. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Practical Physics, G L Squires, 2015, 4th edition, Cambridge University Press
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Course Name: Wave Optics
Course Code: PHY202B **Total Credits:03**
COURSE OBJECTIVE:

- To introduce the physics behind interference, diffraction and polarization
- To introduce the concept of resolving power
- To introduce different types of Lasers and their working principles

COURSE OUTCOME:

- Will be able to understand the physics of interference, diffraction, and polarization.
- Learns about resolving power of optical instruments
- Learns about production, properties and types of Lasers.

Unit	Contents	No. of Lectures
1	**Wave Optics, Interference of light waves:** **1.1 Wave Optics:** Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle, Concept of Coherence, Temporal and Spatial Coherence. **1.2 Interference of light waves:** Division of amplitude and wavefront, Interference in thin films: parallel and wedge-shaped films, fringes of equal inclination (Haidinger Fringes); fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index, Michelson Interferometer (1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	15
2	**Diffraction, Fresnel Diffraction, Fraunhofer Diffraction:** **2.1 Diffraction:** Difference between Diffraction and interference, Types of Diffraction **2.2 Fresnel Diffraction:** Fresnel's assumptions. Fresnel's half-period zones for plane wave, Explanation of rectilinear propagation of light, Fresnel's integral, Fresnel diffraction pattern of a straight edge, a slit and cylindrical obstacle. **2.3 Fraunhofer Diffraction:** Condition for Fraunhofer Diffraction, Single slit, Circular aperture, Double slit, Multiple slits, Diffraction grating.	15
3	**Polarization, Resolving Power, LASER :** **3.1 Polarization:** Introduction to polarization, Description of linear, circular, and elliptical polarization, Propagation of electromagnetic waves in anisotropic media, Uniaxial and biaxial crystals, Light propagation in uniaxial crystal, Double refraction, Polarization by double refraction, Nicol prism, Ordinary and extraordinary refractive indices, Production, and detection of plane, circularly and elliptically polarized light, Phase retardation plates: quarter wave and half wave plates **3.2 Resolving Power:** Rayleigh Criteria of resolution, Resolving Power of Telescope, Resolving Power of Prism, Resolving Power of Grating. **3.3 LASER:**	15

	Einstein's A and B coefficients, Metastable states, Spontaneous and stimulated emissions, Optical Pumping and population inversion, Principle of Laser, Properties of Laser, Ruby Laser and He-Ne Laser.	

Self-Learning topics (Unit wise)

Unit	Topics
I	Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle
II	Difference between Diffraction and interference, Types of Diffraction
III	Introduction to polarization, Rayleigh Criteria of resolution, Resolving Power of Telescope

Reference Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 2020, Cambridge University Press.
3. Optics, Ajoy Ghatak, 2020, Tata McGraw Hill
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
5. Principles of Optics, B.K. Mathur and T.P. Pandya, 1995, Kanpur Gopal Printing Press.
6. A Textbook of Optics, Dr. N. Subrahmanyam, Brij Lal and Dr. M.N. Avadhanulu, 2012, S. Chand Publications.
7. Principles of Physical optics, 2nd edition, Charles A. Bennett, Wiley, 2022

Course Name: Practical Course 4 (Major Physics)

(Practical based on Wave optics)

Course Code: PHY202D **Total Credit:01**

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	No. of Lectures
1. Cauchy constants of the material of a prism using mercury source. 2. To determine the wavelength of sodium source using Michelson's interferometer. 3. To determine wavelength of sodium light using Fresnel Biprism. 4. To determine wavelength of sodium light using Newton's Rings. 5. To determine diameter of a thin wire using wedge shaped film.	3 lectures per batch 2 hours per experiment

6. To determine wavelength of source using plane diffraction grating. 7. Refractive index of a liquid using LASER 8. Double refraction 9. Resolving Power of telescope	

Reference Books:

1. Advanced Practical Physics, B. L. Worsnop and H.T. Flint, 2021, Khosla Publishing House
2. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal.
3. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Practical Physics, G L Squires, 2015, 4th edition, Cambridge University Press
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Physics Minor

Course Name: Mechanics 2 and Wave Optics

Course Code:PHY203B **Total Credit:03**

COURSE OBJECTIVE:

- To introduce different types of pendulums, forced oscillations and resonance
- To introduce the physics behind interference and polarization
- To introduce the concept of resolving power
- To introduce different types of Lasers and their working principles

COURSE OUTCOME:

- Learn about forced oscillations and resonance
- Understand the physics of interference, diffraction, and polarization.
- Learns about resolving power of optical instruments
- Learns about production, properties, and types of Lasers.

Unit	Contents	No. of Lectures
1	**Compound Pendulum and Oscillations:** **1.1 Compound Pendulum:** Expression for period, maximum and minimum time period, centres of suspensions and oscillations, reversible compound pendulum, Kater's pendulum, Compound pendulum and simple pendulum-relative study **1.2 Oscillations:**	15

	Damped and forced oscillations, Transient and steady states, Resonance, Sharpness of resonance, Power dissipation, Quality factor.	
2	**Wave Optics, Interference of light waves:** **2.1 Wave Optics:** Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle, Concept of Coherence, Temporal and Spatial Coherence. **2.2 Interference of light waves:** Division of amplitude and wavefront, Interference in thin films: parallel and wedge-shaped films, fringes of equal inclination (Haidinger Fringes); fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index, Michelson Interferometer (1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer	15
3	**3.1 Polarization:** Introduction to polarization, Description of linear, circular, and elliptical polarization, Propagation of electromagnetic waves in anisotropic media, Uniaxial and biaxial crystals, Light propagation in uniaxial crystal, Double refraction, Polarization by double refraction, Nicol prism, Ordinary and extraordinary refractive indices, Production, and detection of plane, circularly and elliptically polarized light, Phase retardation plates: quarter wave and half wave plates **3.2 Resolving Power:** Rayleigh Criteria of resolution, Resolving Power of Telescope, Resolving Power of Prism, Resolving Power of Grating **3.3 LASER:** Einstein's A and B coefficients, Metastable states, Spontaneous and stimulated emissions, Optical Pumping and population inversion, Principle of Laser, Properties of Laser, Ruby Laser and He-Ne Laser	15

Self-Learning topics (Unit wise)

Unit	Topics
I	Compound pendulum and simple pendulum-relative study
II	Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle,
III	Introduction to polarization, Rayleigh Criteria of resolution, Resolving Power of Telescope

References:

1. An introduction to Mechanics by D. Kleppner, R J Kolenkow, 2010, Mc-Graw Hill
2. Mechanics, Berkeley Physics, Volume I, C Kittel, W Knight, et.al. 2007, Tata McGraw Hill
3. Principles of Physics, Resnick, Halliday and Walker, 2023, 12th ed. Wiley
4. Analytical Mechanics, G R Fowles and G L Cassiday, 2005, Cengage Learning.
5. Feynman Lectures Volume I, R P Feynman, R B Leighton, M Sands, 2008, Pearson Education.
6. University Physics, Roland Lane Resse, 2003, Thomson Brooks/Cole
7. Engineering Mechanics, Basudeb Bhattacharya, 2nd edition, 2015, Oxford University Press
8. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
9. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 2020, Cambridge University Press.
10. Optics, Ajoy Ghatak, 2020, Tata McGraw Hill
11. Fundamentals of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
12. Principles of Optics, B.K. Mathur and T.P. Pandya, 1995, Kanpur Gopal Printing Press.
13. A Textbook of Optics, Dr. N. Subrahmanyam, Brij Lal and Dr. M.N. Avadhanulu, 2012, S. Chand Publications.
14. Principles of Physical optics, 2nd edition, Charles A. Bennett, Wiley, 2022

Additional Reference Books:

1. Mechanics, D S Mathur, S Chand and Company Ltd. 2000.
2. Theoretical mechanics, M R Spiegel, Tata Mc-Graw Hill, 2006.

Course Name: Practical Course 3 (Minor Physics)

(Practical based on Minor Physics Syllabus)

Course Code: PHY203D **Total Credit:01**

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS **(Practical based Mechanics2 and Wave Optics (Minor Physic Syllabus)**	**No. of Lectures**
1. Resonance Pendulum 2. Bar Pendulum 3. Kater's Pendulum 4. Flat spiral spring 5. Spring mass oscillator 6. To determine wavelength of sodium light using Newton's Rings. 7. To determine diameter of a thin wire using wedge shaped film.	3 lectures per batch 2 hours per experiment

8. To determine wavelength of source using plane diffraction grating. 9. Refractive index of a liquid using LASER 10. Double refraction 11. Resolving Power of telescope	

Reference Books:

1. Advanced Practical Physics, B. L. Worsnop and H.T. Flint, 2021, Khosla Publishing House
2. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal.
3. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Practical Physics, G L Squires, 2015, 4th edition, Cambridge University Press
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Second Year - Semester IV

Course Name: Thermodynamics

Course Code: PHY205B **Total Credit:03**

COURSE OBJECTIVE:

- To introduce basic concepts and the laws of thermodynamics
- To introduce the concept of entropy and thermodynamic potential
- To explain phase transition and applications of Maxwells relations

COURSE OUTCOME:

- Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics.
- Learn about entropy and thermodynamic potential
- Will able to explain phase transition and various applications of Maxwell's relations

Unit	Contents	No. of Lectures
1	**First and Second law of thermodynamics:** **1.1 Recapitulation:** Concept of system, surrounding, Thermodynamic equilibrium, state and state variable, equation of state, heat and work **1.2 First Law of Thermodynamics:** First Law of Thermodynamics and its differential form, Internal energy, First law & various processes, Applications of first law: general relation between C_P and C_V, Work done during isothermal and adiabatic processes, Compressibility and expansion co-efficient. **1.3 Second law of thermodynamics:** Reversible and irreversible process with examples. Conversion of work into heat and heat into work, Heat Engines, Carnot's cycle, Carnot engine & efficiency, Refrigerator & coefficient of performance, Second Law of thermodynamics: Kelvin-Planck and Clausius Statements and their equivalence, Carnot's theorem.	15

2	**Entropy and Thermodynamic potential:** **2.1 Entropy:** Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Reversible and Irreversible Cycles. Temperature–Entropy diagrams **2.2 Thermodynamic Potentials:** Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy.	15
3	**Phase Transition and Maxwell's relations:** **3.1 Recapitulation:** Anomalous behaviour of water and phase transition **3.2 Phase transition:** First and second order phase transition **3.3 Maxwell's relations:** Third Law of Thermodynamics. Unattainability of Absolute Zero. Derivation and applications of Maxwell's relations: (1) Clausius - Clapeyron equation (2) values of Cp-Cv (3) TdS equations (4) Joule-Kelvin coefficient for ideal and Van der Waal gases (5) Energy equations (6) Change of temperature during adiabatic process	15

Self-Learning topics (Unit wise)

Unit	Topics
I	Concept of system, surrounding, Thermodynamic equilibrium, state and state variable, equation of state, heat and work
II	Thermodynamic Potentials: Internal Energy, Enthalpy
III	Anomalous behaviour of water and phase transition, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas.

Reference Books:

1. Heat and Thermodynamics, 8th edition, M.W. Zemansky, Richard Dittman, 2017, McGraw-Hill.
2. An introduction to Thermodynamics and Statistical Mechanics, 2nd edition, Keith Stowe, Cambridge University Press, 2007
3. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press.
4. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 2017, Tata McGraw-Hill.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
6. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, 2nd edition, Sears & Salinger, 1998, Narosa.

7. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press.
8. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications

Name: Practical Course 5 (Major Physics)

(Practical based on Thermodynamics)

Course Code: PHY205D **Total Credit:01**

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	No. of Lectures
1. Verification of Stefan's law 2. Phase transition 3. Constant Volume Air Thermometer 4. Thermal conductivity of a bad conductor using Lee's method 5. Specific heat of liquid 6. Determination of Joule's constant 7. To determine the temperature co-efficient of resistance by platinum resistance thermometer 8. Constant Pressure Air Thermometer 9. Thermo-emf of a Thermocouple	2 hours per experiment

Reference Books:

1. Advanced Practical Physics, B. L. Worsnop and H.T. Flint, 2021, Khosla Publishing House
2. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal.
3. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Practical Physics, G L Squires, 2015, 4th edition, Cambridge University Press

Course Name: Mathematical Physics 2

Course Code:PHY206B **Total Credit:03**

COURSE OBJECTIVE:

- To introduce Fourier Series and its applications in Physics
- To introduce Fourier Transform and its applications in Physics
- To explain the applications of partial differential equations in Physics

COURSE OUTCOME:

- Learn about Fourier analysis of periodic functions, functions with arbitrary period, and nonperiodic functions. Learn about their applications and about summing of infinite series.
- Learn about Fourier transform, inverse Fourier transform and their applications
- Learn about beta, gamma and error functions and their applications to solve integrals.
- Learn about methods of solving various partial differential equations applicable to important phenomena in Physics

Unit	Contents	No. of Lectures
1	**Fourier Series:** **1.1 Recapitulation:** Periodic Functions, Orthogonality of sine and cosine function, Dirichlet conditions (statement only) **1.2 Fourier of periodic functions:** Fourier series, Expansion of periodic functions, Determination of Fourier coefficients, Even and odd functions and their Fourier expansion and summing of infinite series **1.3 Fourier series of other functions:** Representation of Fourier series in complex form, expansion of function in arbitrary period, expansion of non-periodic function over an interval and Parseval Identity.	15
2	**Fourier Transforms and Some Special Integrals:** **2.1 Recapitulation:** Properties of translation, change of scale, complex conjugation etc. and Gaussian function **2.2 Integral transform and Fourier Transforms:** Fourier transform, Fourier integral theorem, Inverse Fourier transforms, Fourier sine and cosine transform, Convolution theorem, Properties of Fourier transforms **2.3 Applications of Fourier Transforms:** Fourier transform of Gaussian, finite wave train and other important functions. Application of Fourier transform to solve partial differential equations **2.4 Some special integrals:** Gamma functions and its property and application, Error function and its property and application	15
3.	**3.Partial Differential Equations:** **3.1 Recapitulation** Second order homogeneous and non-homogeneous ordinary differential equation, transformation of Cartesian coordinate system to cylindrical and spherical coordinate system	

	3.2 Partial Differential Equation: Partial differential equations, Examples of Partial differential equations in Physics, Solution to partial differential equations using separation of variable method **3.3 Applications of partial differential equations:** Laplace equation in Cartesian cylindrical and spherical coordinate system, solution of Laplace's equation wave equation and diffusion equation	

Self-Learning topics (Unit wise)

Unit	Topics
I	Periodic functions, Orthogonality of sine and cosine functions, Dirichlet conditions (statement only)
II	Properties of translation**,** change of scale, complex conjugation etc. and Gaussian function
III	Second order homogeneous and non-homogeneous ordinary differential equation, transformation of Cartesian coordinate system to cylindrical and spherical coordinate system

Reference Books:

1. Mathematical Methods in the Physical Sciences, 3rd edition, Mary L Boas, Wiley Eastern
2. Essential Mathematical Methods, K F Riley and M P Hobson, 2011, Cambridge University Press
3. Mathematical Methods for Physicists, Arfken, Weber, 2012, Harris, Elsevier
4. Fourier Analysis M R Spiegel, 2004, Tata McGraw-Hill
5. Engineering Mathematics by S Pal and S C Bhunia, 2015, Oxford University Press

Name: Practical Course 6 (Major Physics)

(Practical based on Mathematical Physics 2)

Course Code: PHY206D **Total Credit:01**

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	No. of Lectures
1. Problem on Fourier Series – I 2. Problem on Fourier Series – II 3. Problem on Fourier Series - III 4. Problem on Fourier Transform – I 5. Problem on Fourier Transform - II	2 hours per experiment

6. Problem on Fourier Transform – III 7. Problem on Partial Differential Equations - I 8. Problem on Partial Differential Equations – II 9. Problem on Partial Differential Equations – III	

Reference Books:

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
4. Simulation of ODE/PDE models with MATLAB ®, OCTAVE and SCILAB:Scientific and Engineering Applications: A W Vouwer, P Saucez, C V Fernandez, 2014, Springer

Physics (Minor)

Course Name: Thermodynamics and Mathematical Physics 2

Course Code:PHY207B **Total Credit:03**

COURSE OBJECTIVE:

- To introduce basic concepts and the laws of thermodynamics
- To introduce the concept of entropy and thermodynamic potential
- To explain the applications of partial differential equations in Physics

COURSE OUTCOME:

- Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics.
- Learn about entropy and thermodynamic potential
- Learn about methods of solving various partial differential equations applicable to important phenomena in Physics

Unit	Contents	No. of Lectures
1	**First and Second law of thermodynamics:** **1.1 Recapitulation:** Concept of system, surrounding, Thermodynamic equilibrium, state and state variable, equation of state, heat and work **1.2 First Law of Thermodynamics:** First Law of Thermodynamics and its differential form, Internal energy, First law & various processes, Applications of first law: general relation between C_P and C_V, Work done during isothermal	15

	and adiabatic processes, Compressibility and expansion co-efficient. **1.3 Second law of thermodynamics:** Reversible and irreversible process with examples. Conversion of work into heat and heat into work, Heat Engines, Carnot's cycle, Carnot engine & efficiency, Refrigerator & coefficient of performance, Second Law of thermodynamics: Kelvin-Planck and Clausius Statements and their equivalence, Carnot's theorem.	
2	**Entropy and Thermodynamic potential:** **2.3 Entropy:** Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Reversible and Irreversible Cycles. Temperature–Entropy diagrams **2.4 Thermodynamic Potentials:** Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy.	15
3	**3.Partial Differential Equations:** 3.1 **Recapitulation:** Second order homogeneous and non-homogeneous ordinary differential equation, transformation of Cartesian coordinate system to cylindrical and spherical coordinate system **3.2 Partial Differential Equation:** Partial differential equations, Examples of Partial differential equations in Physics, Solution to partial differential equations using separation of variable method **3.3 Applications of partial differential equations:** Laplace equation in Cartesian cylindrical and spherical coordinate system, solution of Laplace's equation wave equation and diffusion equation.	15

Self-Learning topics (Unit wise)

Unit	Topics
I	Concept of system, surrounding, Thermodynamic equilibrium, state and state variable, equation of state, heat and work
II	Thermodynamic Potentials: Internal Energy, Enthalpy
III	Second order homogeneous and non-homogeneous ordinary differential equation, transformation of Cartesian coordinate system To cylindrical and spherical coordinate system

Reference Books:

1. Heat and Thermodynamics, 8th edition, M.W. Zemansky, Richard Dittman, 2017, McGraw-Hill.
2. An introduction to Thermodynamics and Statistical Mechanics, 2nd edition, Keith Stowe, Cambridge University Press, 2007
3. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press.
4. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 2017, Tata McGraw-Hill.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
6. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, 2nd edition, Sears & Salinger, 1998, Narosa.
7. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press.
8. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications
9. Mathematical Methods in the Physical Sciences, 3rd edition, Mary L Boas, Wiley Eastern
10. Essential Mathematical Methods, K F Riley and M P Hobson, 2011, Cambridge University Press
11. Mathematical Methods for Physicists, Arfken, Weber, 2012, Harris, Elsevier
12. Fourier Analysis M R Spiegel, 2004, Tata McGraw-Hill
13. Engineering Mathematics by S Pal and S C Bhunia, 2015, Oxford University Press

Name: Practical Course 3(Physics - Minor)

(Practical based on Thermodynamics and Mathematical Physics 2 -Minor Physics)

Course Code:PHY207D **Total Credit:01**

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS **(Practical Based On Thermodynamics and Mathematical Physics 2 (Minor))**	**No. of Lectures**
1. Verification of Stefan's law 2. Constant Volume Air Thermometer 3. Thermal conductivity of a bad conductor using Lee's method 4. Specific heat of liquid 5. Determination of Joule's constant 6. To determine the temperature co-efficient of resistance by platinum resistance thermometer 7. Constant Pressure Air Thermometer 8. Thermo-emf of a Thermocouple 9. Problems on Partial Differential Equations - I 10. Problems on Partial Differential Equations – II 11. Problems on Partial Differential equations – III	2 hours per experiment

References:

1. Advanced Practical Physics, B. L. Worsnop and H.T. Flint, 2021, Khosla Publishing House
2. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal.
3. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Practical Physics, G L Squires, 2015, 4th edition, Cambridge University Press
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

NOTE for Practical Courses (Physics -Major and Physics -Minor):

The Learner is expected to perform at least **six** experiments given in the syllabus and keep a record of them in a Journal. The journal must be examined by the Teacher – in – Charge periodically and certified by the Head of Department at the end of the Course failing which the Learner will not be permitted to appear for the Practical Examination.

However, the HOD may issue a 'Journal Lost Certificate' if he/she is satisfied that the Learner has satisfactorily completed all experiments. The Learner possessing such a certificate may be allowed to appear for the Practical Examination.

Scheme of Examination
(For Physics -Major and Physics-Minor)

A) Internal Assessment: (Total Marks: 40)

1. **Self-Learning Evaluation: (Marks: 15)**

Learner will either give a PowerPoint presentation or a Video Presentation of the topics marked for self – study in each unit of the theory course

2. **Practical Assessment: (to be conducted out of 50 marks per section and reduced to out of 25 marks per section)**

Particulars	Max Marks Allotted
Experiment	40
Journal	05
Viva	05
Total	50
Reduced Total	25

B) Semester End Examination: Theory Assessment: (Total Marks: 60)

For Physics - Major

1. A Question Paper consisting of 4 Main Questions as per the following pattern:

Q1 – pertaining to units 1, 2 & 3
A. Answer in Brief: …. (10 marks)
(i)
(ii)
(iii)
(iv)
(v)
B. Fill in the Blanks: …. (05 marks)
(i)
(ii)
(iii)
(iv)
(v)

Q2 – pertaining to unit 1
A. Attempt ANY ONE: …. (10 marks)
(i)
(ii)
B. Attempt ANY ONE: …. (05 marks)
(i)
(ii)
Q3 – pertaining to unit 2
A. Attempt ANY ONE: …. (10 marks)
(i)
(ii)
B. Attempt ANY ONE: …. (05 marks)
(i)
(ii)
Q4 – pertaining to unit 3
A. Attempt ANY ONE: …. (10 marks)
(i) …. (10 marks)
(ii)
B. Attempt ANY ONE: …. (05 marks)
(i)
(ii)

For Physics - Minor

1. A Question Paper consisting of 4 Main Questions as per the following pattern:

Q1 – pertaining to unit 1
A. Attempt ANY ONE: …. (10 marks)
(i)
(ii)
B. Attempt ANY ONE: …. (05 marks)
(i)
(ii)
Q2 – pertaining to unit 2
A. Attempt ANY ONE: …. (10 marks)
(i)
(ii)
B. Attempt ANY ONE: …. (05 marks)
(i)
(ii)

Q3 – pertaining to unit 3

A. Attempt ANY ONE: …. (10 marks)

(i) …. (10 marks)

(ii)

B. Attempt ANY ONE: …. (05 marks)

(i)

(ii)

Q4 – pertaining to units 1, 2 & 3

A. Answer in Brief: …. (10 marks)

(i)

(ii)

(iii)

(iv)

(v)

B. Fill in the Blanks: …. (05 marks)

(i)

(ii)

(iii)

(iv)

(v)

Skill Enhancement Course

Semester - III
Course Name: Weather Forecasting
Course Code: PHY201C **Total Credit:02**

COURSE OBJECTIVE:

- To introduce weather systems and weather measurement
- To introduce basics of weather forecasting

COURSE OUTCOME:

- Learner will be introduced to basic theoretical information about weather forecasting and climate.

Unit	Content	No. of Lectures
1	**Measurement of weather, weather systems:** **1.1 Introduction to weather:** Elementary idea of atmosphere: Physical structure and composition, compositional layering of the atmosphere, variation of pressure and temperature with height, air temperature, requirement to measure air temperature, temperature sensors: types, atmospheric pressure: its measurement, cyclones and anti-cyclones, its characteristics. **1.2 Measuring the weather:** Wind, forces acting to produce wind; wind speed direction: units and its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws **1.3 Weather systems:** Global wind systems, air masses and fronts, classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes	**15**
2	**Climate, Basics of weather forecasting:** 2.1 **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 2.2 **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; satellite observations in weather forecasting; weather maps; uncertainty and predictability; probability forecast	**15**

Practical Course
COURSE OUTCOME:

- In the laboratory course, students will able to corelate theory with practicals.
- The students will able to understand the causes and effects of different weather phenomenon.

Course Name: Practical Course SEC-I
(Practical based on Weather Forecasting)
Course Code: PHY204D **Total Credit:01**

CONTENTS	No. of Lectures
1. Study of synoptic charts & weather reports, working principle of weather station. 2. Processing and analysis of weather data: a) To calculate the sunniest time of the year b) To study the variation of rainfall amount and intensity by wind direction c) To observe the sunniest / driest day of the week d) To examine maximum and minimum temperature throughout the year e) To evaluate the relative humidity of the day f) To examine the rainfall amount month wise 3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind charts and its analysis. 4. Formats and elements in different types of weather forecasts / warning (both aviation and non- aviation)	3 lectures per batch 2 hours per Experiment

Reference Books:

1. Aviation Meteorology, I.C. Joshi, 3rd edition, 2014 Himalayan books
2. The weather observers Hand book, Stefan Burt, 2012, Cambridge University press
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur
4. Textbook of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur
5. Why the weather, Charls Franklin Books, 1924, Chpraman and Hall, London
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artimis Press

Semester -IV

Course Name: Radiation Safety

Course Code:PHY202C **Total Credit:02**

COURSE OBJECTIVE:

- To introduce interaction of radiation with matter
- To introduce different types of radiation detectors, radiation hazards and safety

COURSE OUTCOME:

- Learner will be introduced to basic theoretical information about radiation hazards and safety.

Unit	Content	No. of Lectures
1	**Basics of Atomic and Nuclear Physics, Interaction of radiation with matter:** **1.1 Basics of Atomic and Nuclear Physics:** Basic concepts of atomic structure; X-ray characteristics and production, concept of bremsstrahlung and auger electron, the composition of nucleus and its properties, mass number, isotopes of an element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reactions, fusion fission **1.2 Interaction of radiation with matter:** Types of radiations: alpha, beta, gamma and neutron, their sources, sealed and unsealed sources Interaction of photons: Photoelectric effect, Compton scattering, Pair production, Linear and Mass attenuation coefficients, Interaction of charged particles: Heavy charged particles- Beth-Bloch formula, scaling laws, Mass stopping power, Range, straggling, channelling and Cherenkov radiation, Beta particles – collision, and radiation loss (Bremsstrahlung) Interaction of neutrons: Collision, slowing down and Moderation	**15**
2	**Radiation Detectors and Safety Management:** **2.1 Radiation Detection and Monitoring Devices:** Radiation quantities and units- Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective effective dose, Annual Limit of Intake (ALI) and Derived Air Concentration (DAC). Radiation Detection- Basic concepts and working principle of gas detectors (Ionization, chambers, proportional counter, Multi-Wire Proportional Counter (MWPC) and Gieger Muller (GM) counter). Scintillation detectors (Inorganic and Organic Scintillators). Solid	**15**

	state detectors and Neutron Detectors, Thermo luminescent Dosimetry. **2.2 Radiation safety management:** Biological effects on ionizing radiation, operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction to safety and risk management of radiation, Nuclear waste and disposal management, Brief idea of Accelerator Driven Sub-critical (ADS) system for waste management **2.3 Application of Nuclear techniques:** Application in medical science (e.g. MRI, PET, Projection imaging Gamma camera, Radiation therapy), Archaeology, Art, Crime detection, mining and oil. Industrial uses: Tracing, Gauging, Material Modification, Sterization, food preservation	

Practical Course

Course Name: Practical Course SEC-II

Course Code: PHY208D **Total Credit:01**

COURSE OUTCOME:

- In the laboratory course, students will able to corelate theory with practicals.

CONTENTS **(Practical based on SEC)**	**No. of Lectures**
1. Study of background radiation level using Radiation meter. **Characteristics of Geiger Muller (GM) Counter:** 2. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source) 3. Study of counting statistics of background radiation using GM counter 4. Study of radiation in various materials in (e.g. KSO_4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage. 5. Study of absorption of beta particles in aluminium using GM counter 6. Detection of alpha particles using reference source and determine its half life using spark counter 7. Gamma spectrum of gas light mantle (Source of Thorium)	3 lectures per batch 2 hours per Experiment

Reference Books:

1. W.E. Burcham and M. Jobes, Nuclear and Particle Physics, Longman, 1995
2. G.F. Knoll, Radiation Detection and Measurement
3. Thermoluminescence Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger, (Medical Physics Handbook 5)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of radiology", John Wright and Sons, UK, 1989
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Handbook series, No. 6, Adam Hilger Ltd., Bristol, 1981
6. Practical Applications of Radioactivity and Nuclear radiations, G.C. Lowental and P.L.Airey, Cambridge University Press, U.K. 2001
7. A. Martin and S.A. Harbisor, An introduction to radiation protection, John Willey and Sons, INC New York, 1981
8. NCRP, ICRP, ICRU, IAEA, AERB publications
9. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publisher, INC, London, 1981
10. Handbook on Radiation Environment, Volume 1 and 2, Editor :Dinesh Kumar Aswal, 2024

NOTE for Practical Courses (Skill Enhancement Course):

The Learner is expected to perform at least **six** experiments given in the syllabus and keep a record of them in a Journal. The journal must be examined by the Teacher – in – Charge periodically and certified by the Head of Department at the end of the Course failing which the Learner will not be permitted to appear for the Practical Examination.

However, the HOD may issue a 'Journal Lost Certificate' if he/she is satisfied that the Learner has satisfactorily completed all experiments. The Learner possessing such a certificate may be allowed to appear for the Practical Examination.

Scheme of Examination
(For Skill Enhancement Course in Physics)

A) Internal Assessment: (Total Marks: 25)

1. **Practical Assessment: (to be conducted out of 40 marks per section and reduced to out of 20 marks per section)**

Particulars	Max Marks Allotted
Experiment	40
Journal	05
Viva	05
Total	50
Reduced Total	25

B) Semester End Examination: Theory Assessment: (Total Marks: 50)

1. A Question Paper consisting of 2 Main Questions as per the following pattern:

Q1 – pertaining to unit 1

(A) Attempt ANY Two: …. (20 marks)

(i)
(ii)
(iii)
(iv)

(B) Attempt ANY One: …. (05marks)

(i)
(ii)

Q2 – pertaining to unit 2

(A) Attempt ANY Two: …. (20 marks)

(i)
(ii)
(iii)
(iv)

(B) Attempt ANY One: …. (05marks)

(i)
(ii)

SYLLABUS

(Under National Education Policy – 2020)

Generic Elective / Interdisciplinary

(Offered by Physics Department to S.Y.B.A. and S.Y.B.Com. students)

(Astronomy)

Bachelor of Science Program – Second Year

(Semester III & IV)

(To be effective from Academic year 2024-25)

Preamble:

This syllabus is a part of the Bachelor Program (Generic Elective / Interdisciplinary) of the Hyderabad and Sind National Collegiate University to be taught in Semesters III and IV from the academic year 2024-25 onwards.

This syllabus aims to provide adequate skills, training and knowledge to the students which enhance their thinking and application abilities.

The theory and Practical courses of both semesters comprising of Observational Astronomy, Galactic and Extra Galactic Astronomy, Astronomical Instruments, Dark Energy and Dark Matter and Big Bang Theory .

The detailed syllabus in each theory course is designed to introduce Basic and Advanced knowledge of the respective course to learners.

Semester III

Course Name: Galactic and Extra-Galactic Astronomy
Course code: PHY204B **Total Credit:02**
COURSE OBJECTIVE:

- To provide students the Concept of Galactic and Extra Galactic Astronomy
- To understand the concept of Observational Techniques, Gravitational Lenses and Cosmic Magnification.

COURSE OUTCOME:

After completion of the course students will be able:

- Explain Classification of Galaxies, Group and Cluster of Galaxies, Galactic Structure, Dwarfs, Dark Matter and Star Formation Processes.
- Explain the concept of Observational Techniques, Gravitational Lenses and Cosmic Magnification.

Unit	Content	No. of Lectures
1	**Galactic and Extra-Galactic Astronomy:** **1.1 Introduction to Galaxies:** Overview of Galaxies: Definition and Classification, Morphology of Galaxies: Dwarfs, Ellipticals, Spirals, and Irregulars, Characteristics of Galaxy Types **1.2. Galactic Morphology:**	**15**

	Rotation Curves and Their Implications, Dark Matter: Theoretical, Framework and Observational Evidence, Interstellar Medium, Composition and Dynamics, Star Formation Processes **1.3 Extragalactic Astronomy Overview:** Introduction to Extragalactic Astronomy, Hubble Sequence: Classification of Galaxies Based on Morphology, Groups and Clusters of Galaxies: Structure and Formation	
2	**Observational Techniques:** **2.1. Optical Observations:** Instruments and Techniques, X-ray Observations: Insights into High-Energy Phenomena, Utilizing Different Observational Methods for Galaxy Studies **2.2. Active Galactic Nuclei and Quasars:** Understanding BL Lacs and Quasars: High-Energy Phenomena, Unified Models of AGN: Explaining Variability and Diversity **2.3. Gravitational Lenses and Cosmic Magnification :** Gravitational Lensing: Principles and Applications, Using Gravitational Lensing to Study Distant Objects, Cosmic Magnification: Amplifying the View of the Universe **2.4. Galaxy Formation and Evolution:** Overview of Galaxy Formation Theories, Evolutionary Processes: Mergers, Collisions, and Interactions, Probing the Evolution of Galaxies Across Cosmic Time	**15**

References:

1. "Galactic Dynamics" by James Binney and Scott Tremaine (2011, Princeton University Press)
2. "Extragalactic Astronomy and Cosmology: An Introduction" by Peter Schneider (2015, Springer)
3. "Galaxy Formation and Evolution" by Houjun Mo, Frank van den Bosch, and Simon White (2010, Cambridge University Press)
4. "The Cosmic Cocktail: Three Parts Dark Matter" by Katherine Freese (2014, Princeton University Press)
5. "The Hubble Space Telescope: From Concept to Success" by David J. Shayler and David M. Harland (2002, Springer) .
6. An Introduction to Astrophysics:- Baidyanath Basu, PrenTice-Hall India
7. An Introduction to Astronomy and Astrophysics by Pankaj Jain, CRC Press
8. Cosmos by Carl Sagan

Course Name: Practical Course OE -1
(Practical Course Based on Galactic and Extra-Galactic Astronomy)

Total Credit:01

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	No. of Lectures
1. Familiarity with the night sky - familiar with the astronomical objects visible to naked eye in the night sky using the software Stellarium. 2. Familiar with Constellations- familiar with the Constellations in the night sky using the software Stellarium. 3. Study of Solar spectrum 4. In this experiment you will study the solar spectrum taken from space and on Earth. You will identify some prominent spectral lines and determine their equivalent width. 5. Planetary Distances- Measure the distances of planets in our Solar System. 6. Draw constellation map of a) Orion b) Auriga c) Taurus d) Ursa Major (Big Dipper) marking of pole star. 7. Data analysis technique using virtual observatory	3 lectures per batch 2 hours per experiment

References:

1. Abhyankar K.D., 2001, Astrophysics - Stars and Galaxies, Tata McGraw Hill Pub.
2. Shu F., 1981, Physical Universe-An Introduction to Astronomy, University Science Books, U.S

Semester IV

Course Name:The Universe
Course code: PHY208B **Total Credit:02**

COURSE OBJECTIVE:

1. To understand the concept of Large-Scale Structure of the Universe and Galaxy dynamics and Kinematics.
2. To learn about Galactic Archaeology, Galaxy Surveys and Catalogs.
3. To know the concept of Interactions Between Galaxies

COURSE OUTCOME:

After completion of the course students will be able:

1. to explain concept of Large-Scale Structure of the Universe and Galaxy dynamics and Kinematics.
2. to describe about Galactic Archaeology, Galaxy Surveys and Catalogs
3. to explain the theory of interactions between Galaxies

Unit	Content	No. of Lectures
1	**1.1 Large-Scale Structure of the Universe** Introduction to the Large-Scale Structure, Cosmic Web: Filaments, Voids, and Clusters, Mapping the Distribution of Galaxies in the Universe **1.2. Galaxy Dynamics and Kinematics** Galaxy Motions Within Clusters and Groups, Investigating Galaxy Dynamics through Redshift Surveys, Implications for Understanding the Evolution of Galaxies **1.3: Galactic Archaeology**, Stellar Populations: Ages, Metallicities, and Chemical Abundances, Using Stellar Archaeology to Reconstruct Galactic Histories, Insights into Galaxy Formation from the Stellar Fossil Record **1.4. Multi-Messenger Astronomy in Extragalactic Context** Gravitational Wave Astronomy: Detecting Mergers of Compact Objects, Neutrino Astronomy: Tracing High-Energy Cosmic Events, Combining Different Messengers to Study Extragalactic Phenomena **1.5: Galaxy Surveys and Catalogs** Overview of Large-Scale Galaxy Surveys, Creating and Analyzing Galaxy Catalogs, Utilizing Surveys to Study Galaxy Distribution and Evolution	**15**

2	**2.1 Active Star Formation in Galaxies** Star Formation Rates and Efficiencies in Different Galaxy Types, Tracing Star Formation History through Different Cosmic Epochs, Impacts of Star Formation on Galaxy Evolution 2.2 **Interactions Between Galaxies** Galaxy-Galaxy Interactions: Tidal Forces and Merger Dynamic induced Star Formation and Nuclear Activity in Interacting Systems, Observational Evidence for Galaxy Interactions and Their Consequences 2.3 **Future Directions in Galactic and Extragalactic Astronomy** Emerging Technologies and Instruments for Galaxy Studies, The Role of Next-Generation Telescopes in Advancing the Field, Questions and Challenges in Galactic and Extragalactic Astronomy.	**15**

References:

1. "Galactic Dynamics" by James Binney and Scott Tremaine (2011, Princeton University Press)
2. "Extragalactic Astronomy and Cosmology: An Introduction" by Peter Schneider (2015, Springer)
3. "Galaxy Formation and Evolution" by Houjun Mo, Frank van den Bosch, and Simon White (2010, Cambridge University Press)
4. "The Cosmic Cocktail: Three Parts Dark Matter" by Katherine Freese (2014, Princeton University Press)
5. "The Hubble Space Telescope: From Concept to Success" by David J. Shayler and David M. Harland (2002, Springer) .
6. An Introduction to Astrophysics:- Baidyanath Basu, Prentice-Hall India
7. An Introduction to Astronomy and Astrophysics by Pankaj Jain, CRC Press

Course Name: Practical Course OE -2
(Practical Course Based on The Universe)

Total Credit:<u>01</u>

COURSE OUTCOME:

- In laboratory course, the students will able to correlate theory concepts with practical.

CONTENTS	No. of Lectures
1. Resolving power of telescope. 2. Study of Diffraction using plane grating. 3. Measurement of the solar constant. 4. To obtain proper motion of Barnard's star using Aladin. 5. Determine the period of revolution of sun using virtual laboratory.	3 lectures per experiment 2 hours per batch

6. Size and Distance comparison of Planets	

References:

1. Abhyankar K.D., 2001, Astrophysics - Stars and Galaxies, Tata McGraw Hill Pub.
2. Shu F., 1981, Physical Universe-An Introduction to Astronomy, University Science Books, U.S

NOTE :

The Learner is expected to perform at least **six** experiments given in the syllabus and keep a record of them in a Journal. The journal must be examined by the Teacher – in – Charge periodically and certified by the Head of Department at the end of the Course failing which the Learner will not be permitted to appear for the Practical Examination.

However, the HOD may issue a 'Journal Lost Certificate' if he/she is satisfied that the Learner has satisfactorily completed all experiments. The Learner possessing such a certificate may be allowed to appear for the Practical Examination.

Scheme of Examination

A) Internal Assessment: (Total Marks: 25)

1. **Assignment /Field visit report : (Marks: 10)**

Learner will submit the assignment on some the topics of the theory course.

2. **Practical Assessment: (Marks 10)**

Learner will submit practical manual on comprising of the practicals conducted in laboratory.

3. **Attendance : (Marks 05)**

B) Semester End Examination: Theory Assessment: (Total Marks: 45)

Question Paper consisting of 3 Main Questions as per the following pattern:

Q1 – pertaining to unit 1 and 2

Attempt ANY FIVE: …. (10 marks)

(i)

(ii)

(iii)

(iv)

(v)

(vi)

Q2 – pertaining to unit 1

Attempt ANY TWO: …. (20 marks)

(i)

(ii)

(iii)

(iv)

Q3 – pertaining to unit 2

Attempt ANY TWO: …. (20 marks)

(i)

(ii)

(iii)

(iv)