



**Effective from Session: 2024-25**

| Course Code       | B010101T/PY113                                                                                                                                                                                                                                                                                                                                                                                                  | Title of the Course | Mathematical Physics and Newtonian Mechanics | L | T | P | C |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------|---|---|---|---|
| Year              | First                                                                                                                                                                                                                                                                                                                                                                                                           | Semester            | First                                        | 5 | 1 | 0 | 4 |
| Pre-Requisite     | 10+2 with Physics and Mathematics                                                                                                                                                                                                                                                                                                                                                                               | Co-requisite        | Basic knowledge of Mathematics and Physics   |   |   |   |   |
| Course Objectives | This course aims to make student aware about the Indian Contributors in the field of science and Technology. Also, this course gives students the competence about the methods and techniques of Mathematical Physics and Newtonian Mechanics. At the end of the course, the students are expected to have hands on experience in modeling, implementation and calculation of physical quantities of relevance. |                     |                                              |   |   |   |   |
| Course Outcomes   |                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                              |   |   |   |   |
| CO1               | Recognize the contribution of Indian Mathematician and Scientists, understand the difference between types of scalars, vectors, pseudo-scalars and the different operations possible with vector quantities.                                                                                                                                                                                                    |                     |                                              |   |   |   |   |
| CO2               | To understand the physical interpretation of gradient, divergence and curl and their mutual conversion through different theorems.                                                                                                                                                                                                                                                                              |                     |                                              |   |   |   |   |
| CO3               | Comprehend the difference and connection between different coordinate systems and study the origin of pseudo forces in rotating frame and study the response of the classical systems to external forces and their elastic deformation.                                                                                                                                                                         |                     |                                              |   |   |   |   |
| CO4               | To understand the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors                                                                                                                                                                                                                                                                                                                       |                     |                                              |   |   |   |   |
| CO5               | To understand the various concepts related to dynamics of classical particles, rotating reference frames and Coriolis force.                                                                                                                                                                                                                                                                                    |                     |                                              |   |   |   |   |
| CO6               | To understand the basic concepts of dynamics of rigid bodies and the concepts behind elastic behaviour.                                                                                                                                                                                                                                                                                                         |                     |                                              |   |   |   |   |
| CO7               | To get an idea of the concepts behind the planetary motion and various types of satellites.                                                                                                                                                                                                                                                                                                                     |                     |                                              |   |   |   |   |
| CO8               | Comprehend the different features of Simple Harmonic Motion (SHM) and wave propagation.                                                                                                                                                                                                                                                                                                                         |                     |                                              |   |   |   |   |

| Unit No. | Title of the Unit                        | Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Contact Hrs. | Mapped CO |
|----------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| 1        | Indian Knowledge System + Vector Algebra | Ancient Indian Physics, Ancient and Medieval Indian Contributors in the development of Physics, Modern Indian Physicist in Science and Technology<br>Coordinate rotation, reflection and inversion as the basis for defining scalars, vectors, pseudo-scalars and pseudo-vectors (include physical examples). Component form in 2D and 3D. Geometrical and physical interpretation of addition, subtraction, dot product, wedge product, cross product and triple product of vectors. Position, separation and displacement vectors. | 7            | CO1       |
| 2        | Vector Calculus                          | Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl and their significance. Vector integration, Line, Surface (flux) and Volume integrals of vector fields. Gradient theorem, Gauss-divergence theorem, Stoke-curl theorem, Greens theorem and Helmholtz theorem (statement only). Introduction to Dirac delta function.                                                                                                                                                                | 8            | CO2       |
| 3        | Coordinate Systems                       | 2D and 3D Cartesian, Spherical and Cylindrical coordinate systems, basis vectors, transformation equations. Expressions for displacement vector, arc length, area element, volume element, gradient, divergence and curl in different coordinate systems. Components of velocity and acceleration in different coordinate systems. Examples of non-inertial coordinate system and pseudo-acceleration.                                                                                                                               | 8            | CO3       |
| 4        | Introduction to Tensors                  | Principle of invariance of physical laws w. r. t. different coordinate systems as the basis for defining tensors. Coordinate transformations for general spaces of nD, contravariant, covariant and mixed tensors and their ranks, 4-vectors. Index notation and summation convention. Symmetric and skew-symmetric tensors. Invariant tensors, Kronecker delta and Epsilon (Levi Civita) tensors. Examples of tensors in physics.                                                                                                   | 7            | CO4       |
| 5        | Dynamics of a System of Particles        | Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws and their deductions. Rotating frames of reference, general derivation of origin of pseudo forces (Euler, Coriolis and centrifugal) in rotating frame, and effects of Coriolis force.                                                                                                                          | 8            | CO5       |
| 6        | Dynamics of a Rigid Body                 | Angular momentum, Torque, Rotational energy and the inertia tensor. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants, bending of beam and torsion of cylinder.                                                                                                                                    | 8            | CO6       |
| 7        | Motion of Planets and Satellites         | Two particle central force problem, reduced mass, relative and centre of mass motion. Newton's law of gravitation, gravitational field and gravitational potential. Kepler's laws of planetary motion and their deductions. Motions of geo-synchronous and geo-stationary satellites and basic idea of Global Positioning System (GPS).                                                                                                                                                                                              | 7            | CO7       |
| 8        | Wave Motion                              | Differential equation of simple harmonic motion and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Differential equation of wave motion. Plane progressive waves in fluid media, reflection of waves and phase change, pressure and energy distribution. Principle of superposition of waves, stationary waves, phase and group velocity.                                                                                          | 7            | CO8       |

### **Reference Books:**

1. Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", McGraw Hill, 2017, 2e
2. A. W. Joshi, "Matrices and Tensors in Physics", New Age International Private Limited, 1995, 3e
3. Charles Kittel, Walter D. Knight, Malvin A. Ruderman, Carl A. Helmholz, Burton J. Moyer, "Mechanics (In SI Units): Berkeley Physics Course Vol 1", McGraw Hill, 2017, 2e.
4. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 1", Pearson Education Limited, 2012
5. Hugh D. Young and Roger A. Freedman, "Sears and Zemansky's University Physics with Modern Physics", Pearson Education Limited, 2017, 14e
6. D.S. Mathur, P.S. Hemme, "Mechanics", S. Chand Publishing, 1981, 3e

### e-Learning Source:

1. MIT Open Learning - Massachusetts Institute of Technology, <https://openlearning.mit.edu/>
2. National Programme on Technology Enhanced Learning (NPTEL), <https://www.youtube.com/user/npTELind>
3. Uttar Pradesh Higher Education Digital Library, <http://heeecontent.upscdc.gov.in/SearchContent.aspx>
4. Swayam Prabha - DTH Channel, [https://www.swayampabha.gov.in/index.php/program/current\\_he/8](https://www.swayampabha.gov.in/index.php/program/current_he/8)

### Course Articulation Matrix: (Mapping of COs with POs and PSOs)

| PO-PSO |     | PSO |     |     |     |     |     |      |      |      |      |
|--------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C0     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| C01    | 2   |     |     |     |     |     | 1   | 2    |      | 1    |      |
| C02    | 3   |     |     |     |     |     | 2   | 3    |      | 1    |      |
| C03    | 2   |     |     |     |     |     | 1   | 1    | 2    | 2    |      |
| C04    | 3   |     |     |     |     |     | 2   | 2    |      | 3    |      |
| C05    | 2   |     |     |     |     |     | 3   | 1    |      | 1    |      |
| C06    | 1   |     |     |     |     |     | 2   | 3    |      | 1    |      |
| C07    | 3   |     |     |     |     |     | 2   | 3    |      | 1    |      |
| C08    | 1   |     |     |     |     |     | 1   | 2    |      | 2    |      |

**1-Low Correlation; 2-Moderate Correlation; 3-Substantial Correlation**

Name &amp; Sign of Program Coordinator

**Sign & Seal of HoD**



# Integral University, Lucknow

|                                 |                                                                                                                                                                      |                     |       |                                 |   |   |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------|---------------------------------|---|---|
| Effective from Session: 2024-25 |                                                                                                                                                                      |                     |       |                                 |   |   |
| Course Code                     | B010102P/PY114                                                                                                                                                       | Title of the Course |       | Mechanical Properties of Matter |   |   |
| Year                            | First                                                                                                                                                                | Semester            | First | L                               | T | P |
|                                 |                                                                                                                                                                      |                     |       | 0                               | 0 | 4 |
| Pre-Requisite                   | 10+2 with Physics                                                                                                                                                    | Co-requisite        |       |                                 |   |   |
| Course Objectives               | The purpose of this undergraduate course is to impart practical knowledge/measurements in mechanics through different experiments related to its theoretical course. |                     |       |                                 |   |   |

|                 |                                                                            |  |  |  |  |  |
|-----------------|----------------------------------------------------------------------------|--|--|--|--|--|
| Course Outcomes |                                                                            |  |  |  |  |  |
| CO1             | Understand the Moment of Inertia and find the MI of an irregular body.     |  |  |  |  |  |
| CO2             | Determine elastic properties of rigid materials.                           |  |  |  |  |  |
| CO3             | Understand the surface tension and viscosity of fluid.                     |  |  |  |  |  |
| CO4             | Analyse waves and oscillations and understand the dynamics and gravitation |  |  |  |  |  |
| CO5             | Demonstrate uses of Sextant by measuring dimensions of a given object.     |  |  |  |  |  |

| Experiment No. | Title of the Experiment | Content of Unit (*Offline)                                                                                                           | Contact Hrs. | Mapped CO |
|----------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| 1              | Flywheel                | Moment of inertia of a flywheel                                                                                                      | 4            | CO1       |
| 2              | Inertia Table           | Moment of inertia of an irregular body by inertia table                                                                              | 4            | CO1       |
| 3              | Static Method           | Modulus of rigidity by statical method (Barton's apparatus)                                                                          | 4            | CO2       |
| 4              | Maxwell's Needle        | Modulus of rigidity by dynamical method (sphere / disc / Maxwell's needle)                                                           | 4            | CO2       |
| 5              | Flexure Method          | Young's modulus by bending of beam                                                                                                   | 4            | CO2       |
| 6              | Searle's Method         | Young's modulus and Poisson's ratio by Searle's method                                                                               | 4            | CO2       |
| 7              | Poisson's Ratio         | Poisson's ratio of rubber-by-rubber tubing                                                                                           | 4            | CO2       |
| 8              | Capillary Rise Method   | Surface tension of water by capillary rise method                                                                                    | 4            | CO3       |
| 9              | Jaeger's Method         | Surface tension of water by Jaeger's method                                                                                          | 4            | CO3       |
| 10             | Poiseuille's Method     | Coefficient of viscosity of water by Poiseuille's method                                                                             | 4            | CO3       |
| 11             | Compound Pendulum       | Acceleration due to gravity by bar pendulum                                                                                          | 4            | CO4       |
| 12             | Sonometer               | Frequency of AC mains by Sonometer                                                                                                   | 4            | CO4       |
| 13             | Sextant                 | Height of a building by Sextant                                                                                                      | 4            | CO5       |
| 14             | C.R.O.                  | Study the waveform of an electrically maintained tuning fork / alternating current source with the help of cathode ray oscilloscope. | 4            | CO4       |

| Unit No. | Title of the Unit   | Content of Unit (*Online Virtual Lab)         | Contact Hrs. | Mapped CO |
|----------|---------------------|-----------------------------------------------|--------------|-----------|
| 1        | Flywheel            | Torque and angular acceleration of a flywheel | ---          | ---       |
| 2        | Torsion             | Torsional oscillations in different liquids.  | ---          | ---       |
| 3        | Flywheel            | Moment of inertia of flywheel.                | ---          | ---       |
| 4        | Newton's Second Law | Newton's second law of motion.                | ---          | ---       |
| 5        | Ballistic Pendulum  | Ballistic pendulum.                           | ---          | ---       |
| 6        | Collision Balls     | Collision balls.                              | ---          | ---       |
| 7        | Projectile Motion   | Projectile motion.                            | ---          | ---       |
| 8        | Collision           | Elastic and inelastic collision.              | ---          | ---       |

**Reference Books:**

- I. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
- S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
- R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
- S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

**e-Learning Source:**

- Virtual Labs at Amrita Vishwa Vidyapeetham, <https://vlab.amrita.edu/?sub=1&brch=74>
- Digital Platforms /Web Links of other virtual labs may be suggested / added to this lists by individual Universities.

\* A student has to perform at least 7 experiments from the Offline Experiment List and 3 from the Online Virtual Lab Experiment List / Link.

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) |     |      |      |      |      |      |     |      |      |      |
|----------------------------------------------------------------|-----|------|------|------|------|------|-----|------|------|------|
| PO-PSO CO                                                      | PO1 | PO2  | PO3  | PO4  | PO5  | PO6  | PO7 | PSO1 | PSO2 | PSO3 |
| CO1                                                            | 2   | ---- | ---- | ---- | ---- | ---- | 3   | 3    | ---- | 3    |
| CO2                                                            | 2   | ---- | ---- | ---- | ---- | ---- | 3   | 3    | ---- | 3    |
| CO3                                                            | 3   | ---- | ---- | ---- | ---- | ---- | 2   | 3    | ---- | 3    |
| CO4                                                            | 2   | ---- | ---- | ---- | ---- | ---- | 3   | 3    | ---- | 3    |
| CO5                                                            | 3   | ---- | ---- | ---- | ---- | ---- | 2   | 3    | ---- | 2    |

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|                                    |                    |
|------------------------------------|--------------------|
|                                    |                    |
| Name & Sign of Program Coordinator | Sign & Seal of HoD |



## Integral University, Lucknow

|                                 |                                                                                                                                                                    |                     |                                           |  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------|--|
| Effective from Session: 2024-25 |                                                                                                                                                                    |                     |                                           |  |
| Course Code                     | B010201T/PY115                                                                                                                                                     | Title of the Course | Thermal Physics and Semiconductor Devices |  |
| Year                            | First                                                                                                                                                              | Semester            | Second                                    |  |
| Pre-Requisite                   | 10+2 with Physics                                                                                                                                                  | Co-requisite        |                                           |  |
| Course Objectives               | The objective of this undergraduate course is to impart the knowledge of basic and advance concepts of thermodynamics, circuit fundamentals and basic electronics. |                     |                                           |  |

| Course Outcomes |                                                                                                                           |  |  |  |
|-----------------|---------------------------------------------------------------------------------------------------------------------------|--|--|--|
| CO1             | To understand the 0 <sup>th</sup> and 1 <sup>st</sup> law of thermodynamics and their applications.                       |  |  |  |
| CO2             | To understand the 2 <sup>nd</sup> and 3 <sup>rd</sup> law of thermodynamics and their applications.                       |  |  |  |
| CO3             | Comprehend the kinetic model of gases w.r.t. various gas laws.                                                            |  |  |  |
| CO4             | Study the implementations and limitations of fundamental radiation laws.                                                  |  |  |  |
| CO5             | To understand the various electrical circuits, Network theorems and different types of AC bridges and their applications. |  |  |  |
| CO6             | To get a deep insight in the semiconductor physics and the basic solid-state devices.                                     |  |  |  |
| CO7             | To understand the working of transistors and its various biasing techniques                                               |  |  |  |
| CO8             | To get familiar with multimeter and CRO and learn how to use them for the various types of electrical measurements.       |  |  |  |

| Unit No. | Title of the Unit                                       | Content of Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Contact Hrs. | Mapped CO |
|----------|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| 1        | 0 <sup>th</sup> & 1 <sup>st</sup> Law of Thermodynamics | State functions and terminology of thermodynamics. Zeroth law and temperature. First law, internal energy, heat and work done. Work done in various thermodynamical processes. Enthalpy, relation between CP and CV. Carnot's engine, efficiency and Carnot's theorem. Efficiency of internal combustion engines (Otto and diesel).                                                                                                                                                                                                                                                                                                               | 8            | CO1       |
| 2        | 2 <sup>nd</sup> & 3 <sup>rd</sup> Law of Thermodynamics | Different statements of second law, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynamical processes. Third law of thermodynamics and unattainability of absolute zero. Thermodynamical potentials, Maxwell's relations, conditions for feasibility of a process and equilibrium of a system. Clausius- Clapeyron equation, Joule-Thompson effect.                                                                                                                                                                                                                                                | 8            | CO2       |
| 3        | Kinetic Theory of Gases                                 | Kinetic model and deduction of gas laws. Derivation of Maxwell's law of distribution of velocities and its experimental verification. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and poly atomic).                                                                                                                                                                                                                                                                                                                                                                | 7            | CO3       |
| 4        | Theory of Radiation                                     | Blackbody radiation, spectral distribution, concept of energy density and pressure of radiation. 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.                                                                                                                                                                                                                                                                                                                                                                                       | 7            | CO4       |
| 5        | DC & AC Circuits                                        | Growth and decay of currents in RL circuit. Charging and discharging of capacitor in RC, LC and RCL circuits. Network Analysis - Superposition, Reciprocity, Thevenin's and Norton's theorems. AC Bridges - measurement of inductance (Maxwell's, Owen's and Anderson's bridges) and measurement of capacitance (Schering's, Wein's and de Sauty's Bridges).                                                                                                                                                                                                                                                                                      | 7            | CO5       |
| 6        | Semiconductors & Diodes                                 | P and N type semiconductors, qualitative idea of Fermi level. Formation of depletion layer in PN junction diode, field & potential at the depletion layer. Qualitative idea of current flow mechanism in forward & reverse biased diode. Diode fabrication. PN junction diode and its characteristics, static and dynamic resistance. Principle, structure, characteristics and applications of Zener, Tunnel, Light Emitting, Point Contact and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification efficiency and voltage regulation. Basic idea about filter circuits and voltage regulated power supply. | 8            | CO6       |
| 7        | Transistors                                             | Bipolar Junction PNP and NPN transistors. Study of CB, CE & CC configurations w.r.t. active, cutoff & saturation regions; characteristics; current, voltage & power gains; transistor currents & relations between them. Idea of base width modulation, base spreading resistance & transition time. DC Load Line analysis and Q-point stabilisation. Voltage Divider Bias circuit for CE amplifier. Qualitative discussion of RC coupled amplifier (frequency response not included).                                                                                                                                                            | 7            | CO7       |
| 8        | Electronic Instrumentation                              | Multimeter: Principles of measurement of dc voltage, dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.<br>Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, electron gun, electrostatic focusing and acceleration (no mathematical treatment). Front panel controls, special features of dual trace CRO, specifications of a CRO and their significance. Applications of CRO to study the waveform and measurement of voltage, current, frequency & phase difference.                                                                                            | 8            | CO8       |

### Reference Books:

1. M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997, 7e
2. F.W. Sears, G.L. Salinger, "Thermodynamics, Kinetic theory & Statistical thermodynamics", Narosa Publishing House, 1998
3. Enrico Fermi, "Thermodynamics", Dover Publications, 1956
4. S. Garg, R. Bansal, C. Ghosh, "Thermal Physics", McGraw Hill, 2012, 2e
5. Meghnad Saha, B.N. Srivastava, "A Treatise on Heat", Indian Press, 1973, 5e
6. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
7. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
8. B.G. Sreetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
9. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
10. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e
11. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

### e-Learning Source:

1. Swayam - Government of India, <https://swayam.gov.in/explorer?category=Physics>
2. National Programme on Technology Enhanced Learning (NPTEL), <https://npTEL.ac.in/course.html>
3. Coursera, <https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy>
4. edX, <https://www.edx.org/course/subject/physics>
5. MIT Open Course Ware - Massachusetts Institute of Technology, <https://ocw.mit.edu/courses/physics/>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) |     |     |     |     |     |     |     |      |      |      |      |
|----------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| PO-PSO<br>CO                                                   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
|                                                                |     |     |     |     |     |     |     |      |      |      |      |
| CO1                                                            | 1   |     | 2   |     |     | 2   | 3   | 3    |      | 1    |      |
| CO2                                                            | 2   |     |     |     |     |     | 3   | 3    |      | 1    |      |
| CO3                                                            | 3   |     | 2   |     |     | 2   | 3   | 3    | 1    |      |      |
| CO4                                                            | 1   |     | 1   |     |     |     | 3   | 3    |      | 2    |      |
| CO5                                                            | 2   |     | 2   |     |     |     | 3   | 3    |      | 2    |      |
| CO6                                                            | 2   |     |     |     |     |     | 3   | 3    |      | 1    |      |
| CO7                                                            | 3   |     | 2   |     |     | 2   | 3   | 3    |      | 1    |      |
| CO8                                                            | 1   |     | 1   |     |     |     | 3   | 3    |      | 2    |      |

### 1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

|                                    |  |                    |
|------------------------------------|--|--------------------|
|                                    |  |                    |
| Name & Sign of Program Coordinator |  | Sign & Seal of HoD |



## Integral University, Lucknow

| Effective from Session: 2024-25 |                                                                                                                                                                      |                                                                                                                                                       |              |                                                    |              |           |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------|--------------|-----------|
| Course Code                     | B010202P/PY116                                                                                                                                                       | Title of the Course                                                                                                                                   |              | Thermal Properties of Matter & Electronic Circuits |              |           |
| Year                            | First                                                                                                                                                                | Semester                                                                                                                                              | Co-requisite | L                                                  | T            | P         |
|                                 |                                                                                                                                                                      |                                                                                                                                                       |              | 0                                                  | 0            | 4         |
| Pre-Requisite                   | 10+2 with Physics                                                                                                                                                    |                                                                                                                                                       |              |                                                    |              |           |
| Course Objectives               | The purpose of this undergraduate course is to impart practical knowledge/measurements in mechanics through different experiments related to its theoretical course. |                                                                                                                                                       |              |                                                    |              |           |
|                                 | Course Outcomes                                                                                                                                                      |                                                                                                                                                       |              |                                                    |              |           |
|                                 | CO1                                                                                                                                                                  | Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the thermal properties.    |              |                                                    |              |           |
|                                 | CO2                                                                                                                                                                  | Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the electronic properties. |              |                                                    |              |           |
| CO3                             | Measurement precision and perfection is achieved through Lab Experiments.                                                                                            |                                                                                                                                                       |              |                                                    |              |           |
| CO4                             | Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.                                                            |                                                                                                                                                       |              |                                                    |              |           |
| Experiment No.                  | Title of the Unit                                                                                                                                                    | Content of Unit (*Offline)                                                                                                                            |              |                                                    | Contact Hrs. | Mapped CO |
| 1                               | Callender and Barne's Method                                                                                                                                         | Mechanical Equivalent of Heat by Callender and Barne's method                                                                                         |              |                                                    | 4            | CO1/3     |
| 2                               | Searle's Apparatus                                                                                                                                                   | Coefficient of thermal conductivity of copper by Searle's apparatus                                                                                   |              |                                                    | 4            | CO1/3     |
| 3                               | Thermal Conductivity                                                                                                                                                 | Coefficient of thermal conductivity of rubber                                                                                                         |              |                                                    | 4            | CO1/3     |
| 4                               | Lee and Charlton's disc method                                                                                                                                       | Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method                                                              |              |                                                    | 4            | CO1/3     |
| 5                               | Stefan's Constant                                                                                                                                                    | Value of Stefan's constant                                                                                                                            |              |                                                    | 4            | CO1/3     |
| 6                               | Stefan's Law                                                                                                                                                         | Verification of Stefan's law                                                                                                                          |              |                                                    | 4            | CO1/3     |
| 7                               | Thermocouple                                                                                                                                                         | Variation of thermo-emf across two junctions of a thermocouple with temperature                                                                       |              |                                                    | 4            | CO2/3     |
| 8                               | Platinum Resistance Thermometer                                                                                                                                      | Temperature coefficient of resistance by Platinum resistance thermometer                                                                              |              |                                                    | 4            | CO2/3     |
| 9                               | Charging and Discharging                                                                                                                                             | Charging and discharging in RC and RCL circuits                                                                                                       |              |                                                    | 4            | CO2/3     |
| 10                              | A. C. Bridges                                                                                                                                                        | A.C. Bridges: Various experiments based on measurement of L and C                                                                                     |              |                                                    | 4            | CO2/3     |
| 11                              | Series and Parallel Resonance                                                                                                                                        | Resonance in series and parallel RCL circuit                                                                                                          |              |                                                    | 4            | CO2/3     |
| 12                              | Semiconductor Diodes                                                                                                                                                 | Characteristics of PN Junction, Zener, Tunnel, Light Emitting and Photo diode                                                                         |              |                                                    | 4            | CO2/3     |
| 13                              | Transistors                                                                                                                                                          | Characteristics of a transistor (PNP and NPN) in CE, CB and CC configurations                                                                         |              |                                                    | 4            | CO2/3     |
| 14                              | Half wave and Full Wave Rectifies                                                                                                                                    | Half wave & full wave rectifiers and Filter circuits                                                                                                  |              |                                                    | 4            | CO2/3     |
| 15                              | Power Supply                                                                                                                                                         | Unregulated and Regulated power supply                                                                                                                |              |                                                    | 4            | CO2/3     |
| 16                              | CRO                                                                                                                                                                  | Various measurements with Cathode Ray Oscilloscope (CRO)                                                                                              |              |                                                    | 4            | CO2/3     |
| Unit No.                        | Title of the Unit                                                                                                                                                    | Content of Unit (*Online Virtual Lab)                                                                                                                 |              |                                                    | Contact Hrs. | Mapped CO |
| 1                               | Heat transfer                                                                                                                                                        | Heat transfer by radiation                                                                                                                            |              |                                                    | —            | ---       |
| 2                               | Heat transfer                                                                                                                                                        | Heat transfer by conduction                                                                                                                           |              |                                                    | —            | ---       |
| 3                               | Heat transfer                                                                                                                                                        | Heat transfer by natural convection                                                                                                                   |              |                                                    | —            | ---       |
| 4                               | Phase Change                                                                                                                                                         | The study of phase change                                                                                                                             |              |                                                    | —            | ---       |
| 5                               | Stefan's Constant                                                                                                                                                    | Black body radiation: Determination of Stefan's constant                                                                                              |              |                                                    | —            | ---       |
| 6                               | Law of Cooling                                                                                                                                                       | Newton's law of cooling                                                                                                                               |              |                                                    | —            | ---       |
| 7                               | Lee's disc apparatus                                                                                                                                                 | Lee's disc apparatus                                                                                                                                  |              |                                                    | —            | ---       |
| 8                               | Thermocouple                                                                                                                                                         | Thermo-couple: Seebeck effects                                                                                                                        |              |                                                    | —            | ---       |
| 9                               | Familiarisation with resistor                                                                                                                                        | Familiarisation with resistor                                                                                                                         |              |                                                    | —            | ---       |
| 10                              | Familiarisation with capacitor                                                                                                                                       | Familiarisation with capacitor                                                                                                                        |              |                                                    | —            | ---       |
| 11                              | Familiarisation with inductor                                                                                                                                        | Familiarisation with inductor                                                                                                                         |              |                                                    | —            | ---       |
| 12                              | Ohm's Law                                                                                                                                                            | Ohm's Law                                                                                                                                             |              |                                                    | —            | ---       |
| 13                              | RC Differentiator and integrator                                                                                                                                     | RC Differentiator and integrator                                                                                                                      |              |                                                    | —            | ---       |
| 14                              | Semiconductor Diodes                                                                                                                                                 | VI characteristics of a diode                                                                                                                         |              |                                                    | —            | ---       |
| 15                              | Half wave and Full Wave Rectifies                                                                                                                                    | Half & Full wave rectification                                                                                                                        |              |                                                    | —            | ---       |
| 16                              | Capacitative rectification                                                                                                                                           | Capacitative rectification                                                                                                                            |              |                                                    | —            | ---       |
| 17                              | Zener Diode                                                                                                                                                          | Zener Diode voltage regulator                                                                                                                         |              |                                                    | —            | ---       |
| 18                              | Common Emitter Characteristics                                                                                                                                       | BJT common emitter characteristics                                                                                                                    |              |                                                    | —            | ---       |
| 19                              | Common Base Characteristics                                                                                                                                          | BJT common base characteristics                                                                                                                       |              |                                                    | —            | ---       |
| 20                              | Common Emitter Amplifier                                                                                                                                             | Studies on BJT CE amplifier                                                                                                                           |              |                                                    | —            | ---       |



|                           |                                                                                                                                                   |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference Books:</b>   |                                                                                                                                                   |
| 1.                        | B. L. Worsnop, H. T. Flint, “Advanced Practical Physics for Students”, Methuen & Co. Ltd., London, 1962, 9e                                       |
| 2.                        | S. Panigrahi, B. Mallick, “Engineering Practical Physics”, Cengage Learning India Pvt. Ltd., 2015, 1e                                             |
| 3.                        | R. L. Boylestad, L. Nashelsky, “Electronic Devices and Circuit Theory”, Prentice-Hall of India Pvt. Ltd., 2015, 11e                               |
| 4.                        | A. Sudhakar, S. S. Palli, “Circuits and Networks: Analysis and Synthesis”, McGraw Hill, 2015, 5e                                                  |
| <b>e-Learning Source:</b> |                                                                                                                                                   |
| 1.                        | Virtual Labs at Amrita Vishwa Vidyapeetham, <a href="https://vlab.amrita.edu/?sub=1&amp;brch=194">https://vlab.amrita.edu/?sub=1&amp;brch=194</a> |
| 2.                        | Virtual Labs an initiative of MHRD Govt. of India, <a href="http://vlabz.iitkgp.ac.in/be/#">http://vlabz.iitkgp.ac.in/be/#</a>                    |
| 3.                        | Digital Platforms/Web Links of other virtual labs may be suggested/added to this list by individual Universities.                                 |

\* A student has to perform at least 7 experiments from the Offline Experiment List and 3 from the Online Virtual Lab Experiment List / Link.

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) |     |     |     |     |     |     |     |      |      |      |      |
|----------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| PO-PSO                                                         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
| CO                                                             |     |     |     |     |     |     |     |      |      |      |      |
| CO1                                                            | 2   |     |     |     |     |     | 3   | 3    |      |      | 3    |
| CO2                                                            | 2   |     |     |     |     |     | 3   | 3    |      |      | 3    |
| CO3                                                            | 3   |     |     |     |     |     | 2   | 3    |      |      | 2    |
| CO4                                                            | 2   |     |     |     |     |     | 3   | 2    |      |      | 2    |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

|                                                               |                                                               |
|---------------------------------------------------------------|---------------------------------------------------------------|
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| Name & Sign of Program Coordinator                            | Sign & Seal of HoD                                            |



## Integral University, Lucknow

Effective from Session: 2022-23

| Course Code       | 1010101V/PY117                                                                                                                                                          | Title of the Course |       | Electrician | L | T | P | C |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------|-------------|---|---|---|---|
| Year              | First                                                                                                                                                                   | Semester            | First |             | 2 | 1 | 0 | 3 |
| Pre-Requisite     | 10+2 with Physics                                                                                                                                                       | Co-requisite        |       |             |   |   |   |   |
| Course Objectives | The purpose of this vocational course is to impart basic and key knowledge of electrical trade so that after completing this course the learner can work in this field. |                     |       |             |   |   |   |   |

### Course Outcomes

|     |                                                                                                  |
|-----|--------------------------------------------------------------------------------------------------|
| CO1 | Familiarized with the occupational safety and basic physics necessary for the electrician trade. |
| CO2 | Know the different devices, measuring instruments and electrical wiring.                         |
| CO3 | Understand the power generation, transmission and control.                                       |
| CO4 | Learn the practical techniques of the electrical trade.                                          |

| Unit No. | Title of the Unit            | Content of Unit                                                                                                                                                                                                                                                                                                                 | Contact Hrs. | Mapped CO |
|----------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| 1        | <b>Electrician Basics</b>    | Occupational Safety and Health, Conductor, semiconductors, Insulator and electric cables, Tools for an Electrician, Soldering and D.C theory, Basic Electricity, Electrical accessories, Electro-chemical effect and chemical cell, Magnetism and electromagnetism, Alternating current theory, Earthing and Basic electronics. | 8            | CO1       |
| 2        | <b>Electrician Theory-I</b>  | Transistor, Amplifiers, Oscillators, Specific solid-state devices, Digital electronics, Electrical wiring, Direct current generator, Direct current motor, Transformer and Electrical measuring instruments.                                                                                                                    | 8            | CO2       |
| 3        | <b>Electrician Theory-II</b> | Machine control panel, Electrical instrument, Electrical power generation, Electrical power transmission, Underground cables, Power distribution, Speed control and maintenance of electric machines, Electronic theory and communication.                                                                                      | 8            | CO3       |
| 4        | <b>Electrical Practical</b>  | Trade safety and first aid, Tools, wire, and joints, Allied trades, Resistor, and capacitor, Alternating current (A.C.) circuit, Cell and battery, Magnetic field, Earthing and Semi-conductor diode.                                                                                                                           | 8            | CO4       |

### Reference Books:

- National Electrical Code 2020 Handbook (NFPA)
- Practical Electrical Wiring: Residential, Farm, Commercial and Industrial, 2014 Edition (F.P. Hartwell, Herbert P. Richter)
- Electrical Motor Controls for Integrated Systems, 5th Edition (Gary Rockis, Glen A. Mazur).
- Ultimate Guide: Wiring, 8th Edition
- Electrical Trainee Guide, Level 1 by NCCER.

### e-Learning Source:

- <https://www.youtube.com/channel/UCB3jUEvCLRbCw7QED0vnXYg>
- <https://www.youtube.com/channel/UCpbl0bpvjxIVI-V8Olspzw>
- <https://www.youtube.com/c/CraigMichaudElectricalInstructor/featured>
- <https://www.youtube.com/channel/UCwf9niZNaW8mkECB6GT6raQ>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) |        |     |     |     |     |     |     |     |      |      |      |      |
|----------------------------------------------------------------|--------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                                                                | PO-PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 |
|                                                                | CO     |     |     |     |     |     |     |     |      |      |      |      |
|                                                                | CO1    | 2   | -   | -   | -   | -   | -   | 1   | 2    | -    | -    | 1    |
|                                                                | CO2    | 3   | -   | -   | -   | -   | -   | 2   | 2    | -    | -    | 2    |
|                                                                | CO3    | 3   | -   | -   | -   | -   | -   | 3   | 3    | -    | -    | 3    |
| CO4                                                            | 3      | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | -    | 3    |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

|                                    |  |                    |
|------------------------------------|--|--------------------|
|                                    |  | Sign & Seal of HoD |
| Name & Sign of Program Coordinator |  |                    |



## Integral University, Lucknow

|                                 |                                                                                                                           |                     |                                     |   |   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------|---|---|
| Effective from Session: 2024-25 |                                                                                                                           |                     |                                     |   |   |
| Course Code                     | B010205/PY118                                                                                                             | Title of the Course | Artificial Intelligence and Physics |   |   |
| Year                            | First                                                                                                                     | Semester            | Second                              | L | T |
|                                 |                                                                                                                           |                     |                                     | 4 | 0 |
| Pre-Requisite                   | 10+2 with Physics and Mathematics                                                                                         | Co-requisite        |                                     | 0 | 0 |
| Course Objectives               | To make student aware about the basics of artificial intelligence and how it is useful in the different areas of physics. |                     |                                     |   |   |

| Course Outcomes |                                                                                        |  |  |  |  |
|-----------------|----------------------------------------------------------------------------------------|--|--|--|--|
| CO1             | To learn the basics of Artificial Intelligence and problem solving through it          |  |  |  |  |
| CO2             | To learn the basics of Machine Learning and Natural Language Processing                |  |  |  |  |
| CO3             | To learn the basic Physics behind the Quantum Computing                                |  |  |  |  |
| CO4             | To know the different applications of Artificial Intelligence in the field of Physics. |  |  |  |  |

| Unit No. | Title of the Unit                                                                                     | Content of Unit                                                                                                                                                                                                                                                                                                                                                        | Contact Hrs. | Mapped CO |
|----------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| 1        | Introduction to Artificial Intelligence (AI) and Problem Solving through Artificial Intelligence (AI) | History and evolution of AI, comparison of human and computer skill, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent.<br>Defining problem as a state space search, analyzing the problem, solving problem by searching, informed search and Uninformed Search. | 8            | CO1       |
| 2        | Machine Learning Basics and natural Language Processing                                               | Neural networks and deep learning, Supervised and unsupervised learning, Feature selection and engineering, learning from observation, knowledge in learning.<br>Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system                                                     | 8            | CO2       |
| 3        | Physics of Quantum Computing for Artificial Intelligence (AI)                                         | What is Quantum Computing, Postulates of Quantum Mechanics, Qubit – the smallest unit, Qubit – Bloch sphere representation, Multiple Qubit states and Quantum Gates, Quantum Circuits, No Cloning Theorem and Quantum Teleportation, Super Dense Coding                                                                                                                | 8            | CO3       |
| 4        | Applications of Artificial Intelligence (AI) in Physics                                               | AI's role in Data Analysis and Simulations, AI and Particle Physics, AI and Astrophysics, AI and Atmospheric Physics, AI in Computational Physics and Material Science, AI and Relativity, AI and Thermodynamics.                                                                                                                                                      | 8            | CO4       |

### Reference Books:

|                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Artificial Intelligence by Patrick Henry Winston, 3 <sup>rd</sup> Edition, Addison – Wesley Publishing Company                                                                                                                                                                                                                                                               |
| 2. Explorations in Artificial Intelligence and Machine Learning by Roberto V. Zicari, CRC Press                                                                                                                                                                                                                                                                                 |
| 3. A Textbook of Artificial Intelligence by Hema Dhingra, Rashi Bansal, Sayan Banerjee and Dr. Shalini Verma, Goyal Brothers Publications                                                                                                                                                                                                                                       |
| 4. Artificial Intelligence by R.B. Mishra, PHI Learning Private Limited                                                                                                                                                                                                                                                                                                         |
| 5. Machine Learning and Artificial Intelligence by Ameet V Joshi, Springer Nature Switzerland                                                                                                                                                                                                                                                                                   |
| <b>e-Learning Source:</b>                                                                                                                                                                                                                                                                                                                                                       |
| 1. Quantum Information and Computing, <a href="#">NPTEL :: Physics - NOC: Quantum Information and Computing</a>                                                                                                                                                                                                                                                                 |
| 2. What Artificial Intelligence can do for Physics? <a href="https://www.oecd-ilibrary.org/docs/server/724b14a6-en.pdf?expires=1705508062&amp;id=id&amp;accname=guest&amp;checksum=FE6968ED4CB05F58A07011FE37211CB9">https://www.oecd-ilibrary.org/docs/server/724b14a6-en.pdf?expires=1705508062&amp;id=id&amp;accname=guest&amp;checksum=FE6968ED4CB05F58A07011FE37211CB9</a> |
| 3. Applications of Artificial Intelligence in Physics, <a href="#">1345437330.pdf (inspirajournals.com)</a>                                                                                                                                                                                                                                                                     |
| 4. How Artificial Intelligence is disrupting Physics, <a href="#">How Artificial Intelligence is Disrupting Physics (bbntimes.com)</a>                                                                                                                                                                                                                                          |
| 5. Four Uses of AI in Physics, <a href="#">Four Uses for AI in Physics.</a>                                                                                                                                                                                                                                                                                                     |
| 6. The Handbook of Artificial Intelligence, <a href="#">handbookofartific01barr.pdf (archive.org)</a>                                                                                                                                                                                                                                                                           |

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) |     |     |     |     |     |     |     |      |      |
|----------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|
| PO-PSO CO                                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 |
| CO1                                                            | 3   | 1   | 1   |     |     |     | 3   | 1    |      |
| CO2                                                            | 3   | 1   | 1   |     |     |     | 3   |      | 2    |
| CO3                                                            | 3   | 2   | 2   |     |     |     | 3   | 1    |      |
| CO4                                                            | 3   | 2   | 2   |     |     |     | 3   |      | 2    |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

|                                    |  |                    |
|------------------------------------|--|--------------------|
|                                    |  | Sign & Seal of HoD |
| Name & Sign of Program Coordinator |  |                    |