S.Y.B.Sc. (Physics)

<u>Semester-III</u>

&

Semester-IV

Syllabus

2019 Pattern

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce, Baramati

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

Course Structure for S.Y.B.Sc. Physics 2019 pattern

Semester	Paper Code	Title of Paper	No. of Credits
I	PHY 2301	A] Electronics-I/ B] Instrumentation	3
	PHY 2302	Thermal Physics	3
	PHY 2303	Practical-I	2
II	PHY 2401	Mathematical Methods of Physics-I	3
	PHY 2402	Elements of Modern Physics	3
	PHY 2403	Practical-II	2

Program Outcomes

PO1: Disciplinary Knowledge

PO2: Critical Thinking and Problem solving

PO3: Social competence

PO4: Research-related skills and Scientific temper

PO5: Trans-disciplinary knowledge

PO6: Personal and professional competence

PO7: Effective Citizenship and Ethics

PO8: Environment and Sustainability

PO9: Self-directed and Life-long learning

Class : S.Y.B.Sc. (Semester- III)
Paper code : PHY 2301
Paper : A Title of Paper: Electronics-I
Credit : 3 No. of lectures: 48

Learning outcomes:

On successful completion of this course the students will be able to

1. CO1: Apply laws of electrical circuits to different circuits.
2. CO2: Understand the properties and working of transistors.
3. CO3: Understand the functions of operational amplifiers.
4. CO4: Design circuits using transistors and operational amplifiers.
5. CO5: Understand the Boolean algebra and logic circuits.
6. CO6: Use of knowledge in electronics based project work for demonstration.
7. CO7: Application of logic and electronics for new ideas and societal demands.

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UNIT-1: NETWORK THEOREMS **[8]**

1.1 Kirchhoff's laws (revision)

1.2 Voltage and Current divider circuits

1.3 Thevenin's theorem

1.4 Norton's theorem

1.5 Super-position theorem

1.6 Maximum power transfer theorem

1.7 Problems.

UNIT-2: Transistors **[12]**

2.1 Bipolar junction transistors, n-p-n and p-n-p Transistors

2.2 Transistor biasing

2.3 CB, CC, CE configurations and their Characteristics- Active, saturation and cut-off regions. **2.4** Current gains α, β, γ and their relationships.

2.5 DC operating point and AC and DC Load line, Q-Point.

2.6 Problems

UNIT-3: Operational Amplifiers **[10]**

3.1 Operational Amplifier

3.2 Characteristics of an Ideal and Practical Op-Amp (IC 741),

3.3 Concept of Virtual ground.

3.4 Applications of Op-Amps: Inverting and Non-inverting Amplifiers, Adder, Subtractor, Differentiator, Integrator, Problems

UNIT-4: Feed Back and Oscillator **[6]**

4.1 Basic principles of feedback,

4.2 Positive & negative feedback, Advantages of negative feedback,

4.3 Feedback circuits – voltage series & shunt, current series & shunt.

4.4 Oscillators, Types, Barkhausen Criterion

4.5 RC Oscillator -Phase Shift Oscillator

UNIT-5: Digital Electronics **[12]**

5.1 Binary Number system.

5.2 Decimal to Binary and Binary to Decimal Conversion,

5.3 Octal Numbers,

5.4 Hexadecimal Numbers,

5.5 ASCII code, Excess-3 code, Gray Code.

5.6 Basic Gates- AND, OR and NOT Gates. XOR and XNOR Gates

5.7 NAND and NOR Gates as Universal Gates. De Morgan's Theorems.

5.8 Boolean Laws. Simplification of Logic Circuit using Boolean algebra.

5.9 Binary Addition. Binary Subtraction using 2's Complement Method.

Reference Books:

1. Electronics Principles, Malvino, 8th Edition Tata Mc-Graw Hills.
2. Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi.
3. Op Amp and Linear integrated circuits, Ramakant Gaikwad, Prentice Hall of India Pub.
4. Integrated Circuts, K.R. Botkar, Khanna Publications, New Delhi
5. Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	3							
CO 2	3								
CO 3	3								
CO 4	3	3		2					
CO 5									
CO 6		2				2			2
CO7			3	2	2		2	2	

Justification

PO1: Disciplinary Knowledge

CO1: Apply laws of electrical circuits to different circuits.Weightage: 3

Applying laws of electrical circuits directly aligns with building disciplinary knowledge in electronics.

CO2: Understand the properties and working of transistors.Weightage: 3

Understanding the properties and working of transistors contributes directly to disciplinary knowledge in electronics.

CO3: Understand the functions of operational amplifiers.Weightage: 3

Understanding the functions of operational amplifiers is essential in building disciplinary knowledge in electronics.

CO4: Design circuits using transistors and operational amplifiers.Weightage: 3

Designing circuits with components contributes directly to disciplinary knowledge in electronics.

PO2: Critical Thinking and Problem Solving

CO1: Apply laws of electrical circuits to different circuits.Weightage: 3

Applying laws of electrical circuits requires critical thinking and problem-solving skills.

CO4: Design circuits using transistors and operational amplifiers.Weightage: 3

Designing circuits involves critical thinking and problem-solving skills in the context of electronics.

CO6: Use of knowledge in electronics based project work for demonstration.Weightage: 2

Applying knowledge in project work involves problem-solving skills, but the link may not be as direct as in other cases.

PO3: Social Competence

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 3

Applying logic and electronics for societal demands directly contributes to social competence.

PO4: Research-related Skills and Scientific Temper

CO4: Design circuits using transistors and operational amplifiers.Weightage: 2

Designing circuits can be part of research-related skills, but the link may not be as direct.

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for new ideas contributes to developing a scientific temper.

PO5: Trans-disciplinary Knowledge

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for new ideas can have applications beyond the discipline, contributing to trans-disciplinary knowledge.

PO6: Personal and Professional Competence

CO6: Use of knowledge in electronics-based project work for demonstration.Weightage: 2

Applying knowledge in project work contributes to personal and professional competence, though the link may not be as direct.

PO7: Effective Citizenship and Ethics

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for societal demands may have ethical implications, contributing to effective citizenship.

PO8: Environment and Sustainability

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for societal demands can indirectly contribute to considerations of environment and sustainability.

PO9: Self-directed and Life-long Learning

CO6: Use of knowledge in electronics-based project work for demonstration.Weightage: 2

Applying knowledge in project work is relevant to self-directed and life-long learning, though the link may not be as direct.

Class : S.Y.B.Sc. (Semester- III)
Paper code : PHY 2301
Paper : B Title of Paper: Instrumentation
Credit : 3 No. of lectures: 48

(For the students who have offered Electronic Science at F. Y. B. Sc.)

Learning outcomes: -

After successful completion of this course the students will be able to-

CO1: Understand the principles and functions of different instruments.

CO2: Use different instruments for measurement of various parameters.

CO3: Getting information about various sensing parameter conditions for instrumentation.

CO4: Design experiments or demo using sensors for application.

CO5: Design application based instrumentation for demonstration using sensors.

CO6: Use of knowledge in electronics based project work for demonstration.

CO7: Application of logic and electronics for new ideas and societal demands.

Unit 1: Fundamentals of Measurement (10)

1.1 Aims of measurement [Ref 1, Pages: 1-2]
1.2 Functional elements of typical measurement system (block diagram and its explanation)
[Ref 1, Pages: 6-8]
1.3 Standard measurements and types of calibration methods [Ref 1, Pages: 19-27]
1.4 Static characteristics (accuracy, precision, sensitivity, linearity, repeatability, reproducibility, drift, hysteresis, resolution) [Ref 1, Pages: 29-33]
1.5 Dynamic characteristics: concepts of zero, first and second order systems, examples of
first-order resistance thermometer and thermal element, examples of second order: U-tube manometer and seismic motion [Ref 1, Pages: 81-106]
1.6 Errors in measurement. (Definition and types)
1.7 Problems.

Unit 2: Transducers (10)

2.1 Measurement of displacement: variable resistance, inductance and capacitance methods.
Variable capacitance transducers [Ref 1, Pages: 815-825]
2.2 Measurement of force: Load cell, cantilever beam
2.3 Measurement of temperature: I) Scales of temperature (Kelvin, Celsius, Fahrenheit etc.)
II) Methods of temperature measurement:

a. Non-electrical method – liquid filled thermometer, bimetallic thermometer.
b. Electrical method – Platinum resistance thermometer
c. Thermistor – PTC and NTC with characteristics
d. Radiation method – Type of pyrometers, selective and total radiation pyrometer

2.4 Problems [Ref 1, Pages: 739-758, 788-793].

Unit 3: Measurement of Pressure and Flow (10)

3.1 Unit of pressure, concept of vacuum, absolute gauge, and differential pressure
3.2 Elastic transducer – diaphragm, corrugated diaphragm, bellows, Bourdon tube
3.3 Electric type - LVDT, strain gauge
3.4 Flow meters- Introduction, definition and units, classification of flow meters
3.5 Mechanical type flow meter- orifice plate, venture tube, flow nozzle
3.6 Electric type flow meter-electromagnetic flow meter, ultrasonic flow meters.
3.7 Problems.

Unit 4: Analog Signal Conditioning (10)

4.1 Steps involved in Signal Conditioning, impedance matching
4.2 OP-AMP and its characteristics (ideal and practical), basic modes of operation
4.3 OP-AMP circuit used in instrumentation –precision rectifier, comparator, logarithmic amplifier, current to voltage and voltage to current converters
4.4 Instrumentation amplifier (Three OP-AMP configuration) [Ref 1, Pages: 873-903]
4.5 Active Filters-Low pass, High pass, band pass and band reject filter [Ref 1, Pages: 913- 918]
4.6 Problems.

Unit 5: Display Devices (08)

5.1 Cathode ray Oscilloscope (CRO)- block diagram of general purpose oscilloscope and its basic applications
5.2 Digital storage oscilloscope (DSO)
5.3 LED display-OLED and AMOLED
5.4 LCD display

Reference Book:

1. A course in Electrical and Electronic Instrumentation [19th edition, 2012]- A. K. Sawhney (DhanpatRai& Co. Pvt. Ltd., New Delhi)
2. Instrumentation devices and systems- Rangan, Sarma, Mani [Tata McGraw Hill]
3. Instrumentation Measurement and Analysis – Nakra, Choudhari [Tata McGraw Hill]
4. Electronics Instrumentation – H.S.Kalsi [Tata McGraw Hill]
5. Sensor and Transducers – Patranabis [PHI]
6. Fundamental of Industrial Instrumentation- AlokBarua [Wiley India]
7. Instrumentation, measurement and systems-Nakra andChaudhary.

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								
CO 2	3								
CO 3		3							
CO 4	3	3		2					
CO 5	3								
CO 6		2				2			2
CO7			3	2	2		2	2	

Justification

PO1: Disciplinary Knowledge

CO1: Understand the principles and functions of different instruments.Weightage: 3

Understanding the principles and functions of instruments directly contributes to building disciplinary knowledge in instrumentation.

CO2: Use different instruments for the measurement of various parameters.Weightage: 3

The practical application of using instruments aligns directly with disciplinary knowledge in instrumentation.

CO4: Design experiments or demos using sensors for application.Weightage: 3

Designing experiments using sensors demonstrates a deeper understanding and application of disciplinary knowledge.

CO5: Design application-based instrumentation for demonstration using sensors.Weightage: 3

Designing application-based instrumentation further extends the application of disciplinary knowledge in instrumentation.

PO2: Critical Thinking and Problem Solving

CO3: Getting information about various sensing parameter conditions for instrumentation.Weightage: 3

Obtaining information about sensing parameters involves critical thinking and problem-solving skills.

CO4: Design experiments or demos using sensors for application.Weightage: 3

Designing experiments using sensors requires critical thinking and problem-solving skills.

CO6: Use of knowledge in electronics based project work for demonstration.Weightage: 2

Applying knowledge in project work involves problem-solving skills, but the link may not be as direct as in other cases.

PO3: Social Competence

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 3

Applying logic and electronics for societal demands directly contributes to social competence.

PO4: Research-related Skills and Scientific Temper

CO4: Design experiments or demos using sensors for application.Weightage: 2

Designing experiments using sensors can be part of research-related skills, but the link may not be as direct.

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for new ideas contributes to developing a scientific temper.

PO5: Trans-disciplinary Knowledge

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for new ideas can have applications beyond the discipline, contributing to trans-disciplinary knowledge.

PO6: Personal and Professional Competence

CO6: Use of knowledge in electronics-based project work for demonstration.Weightage: 2

Applying knowledge in project work contributes to personal and professional competence, though the link may not be as direct.

PO7: Effective Citizenship and Ethics

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for societal demands may have ethical implications, contributing to effective citizenship.

PO8: Environment and Sustainability

CO7: Application of logic and electronics for new ideas and societal demands.Weightage: 2

Applying logic and electronics for societal demands can indirectly contribute to considerations of environment and sustainability.

PO9: Self-directed and Life-long Learning

CO6: Use of knowledge in electronics-based project work for demonstration.Weightage: 2

Applying knowledge in project work is relevant to self-directed and life-long learning, though the link may not be as direct.

Class : S.Y.B.Sc. (Semester- III)
Paper code : PHY 2302
Paper : II Title of Paper: Thermal Physics
Credit : 3 No. of lectures: 48

Learning Outcome:

After successfully completing this course, the student will be able to:

CO1: Describe the thermodynamic properties of a material.

CO2: Understand the ideal & real gas equation

CO3: Apply the laws of thermodynamics to formulate the relations necessary to analyse a thermodynamic process.

CO4: Understand the principle of the refrigerators to calculate coefficient of performance

CO5: Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.

CO6: Apply the concepts and principles of black-body radiation to analyse radiation phenomena in thermodynamic systems

CO7: Use of knowledge in day to day life concerning thermal properties of Materials

Unit 1: Kinetic Theory of gases and Transport Phenomena (12L)

Review, Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path, Transport phenomena-Transport of momentum (viscosity), Transport of thermal energy (conduction), Transport of mass (diffusion), Degrees of freedom, Law of equipartition of energy and its application to specific heat of gases (mono and diatomic).

Unit 2: Thermodynamic Potentials (10L)

Enthalpy, Gibbs free energy, Helmholtz and Internal Energy functions, Maxwell's relations & applications, Throttling process, Clausius- Clapeyron Equation (First and second order) , Expression for (CP – CV), CP/CV, TdS equations and its applications

Unit 3: Low temperature Physics (13L)

Joule-Thomson effect, porous plug experiment, liquefaction of gases, adiabatic demagnetization, practical applications of low temperatures , refrigerating machines, electroflux refrigerator, Frigidaire, air conditioning machines, effects of CF_2 Cl_2 on Ozone layer.

Unit 4: Theory of radiation (13L)

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, 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.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications

4. Heat and Thermodynamics, M. W. Zemasky and R. Dittman, 1981, McGraw Hill
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F. W. Sears & G. L. Salinger. 1988, Narosa
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications
8. Heat and Thermodynamics - J. B. Rajam & C. L. Arora
9. Thermal Physics, A.B. Gupta and H. Roy, Books and Allied (P) Ltd., (2002.)

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								
CO 2	3								
CO 3	3	3							
CO 4	3								
CO 5	3			2					
CO 6	3	2							2
CO7			3		2	2	2	2	

Justification

PO1: Disciplinary Knowledge

CO1: Describe the thermodynamic properties of a material.Weightage: 3

Describing thermodynamic properties directly contributes to building disciplinary knowledge in thermodynamics.

CO2: Understand the ideal & real gas equation.Weightage: 3

Understanding gas equations is fundamental to building disciplinary knowledge in thermodynamics.

CO3: Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.Weightage: 3

Applying thermodynamic laws contributes directly to disciplinary knowledge in thermodynamics.

CO4: Understand the principle of refrigerators to calculate coefficient of performance.Weightage: 3

Understanding the principles of refrigerators contributes directly to disciplinary knowledge in thermodynamics.

CO5: Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.Weightage: 3

Identifying and describing the statistical nature of thermodynamic concepts contributes directly to disciplinary knowledge.

CO6: Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.Weightage: 3

Applying concepts and principles of black-body radiation contributes directly to disciplinary knowledge in thermodynamics.

PO2: Critical Thinking and Problem Solving

CO3: Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.Weightage: 3

Applying thermodynamic laws requires critical thinking and problem-solving skills.

CO6: Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.Weightage: 2

Applying concepts and principles to analyze radiation phenomena involves critical thinking, but the link may not be as direct.

PO3: Social Competence

CO7: Use of knowledge in day-to-day life concerning thermal properties of Materials.Weightage: 3

Applying thermodynamic knowledge in day-to-day life contributes to social competence.

PO4: Research-related Skills and Scientific Temper

CO5: Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.Weightage: 2

Identifying and describing the statistical nature of thermodynamic concepts can be part of research-related skills, but the link may not be as direct.

PO5: Trans-disciplinary Knowledge

CO7: Use of knowledge in day-to-day life concerning thermal properties of Materials.Weightage: 2

Applying thermodynamic knowledge in day-to-day life can have applications beyond the discipline, contributing to trans-disciplinary knowledge.

PO6: Personal and Professional Competence

CO7: Use of knowledge in day-to-day life concerning thermal properties of Materials.Weightage: 2

Applying thermodynamic knowledge in day-to-day life contributes to personal and professional competence.

PO7: Effective Citizenship and Ethics

CO7: Use of knowledge in day-to-day life concerning thermal properties of Materials.Weightage: 2

Applying thermodynamic knowledge in day-to-day life may have ethical implications, contributing to effective citizenship.

PO8: Environment and Sustainability

CO7: Use of knowledge in day-to-day life concerning thermal properties of Materials.Weightage: 2

Applying thermodynamic knowledge in day-to-day life can indirectly contribute to considerations of environment and sustainability.

PO9: Self-directed and Life-long Learning

CO6: Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.Weightage: 2

Applying concepts and principles in the analysis of radiation phenomena is relevant to self-directed and life-long learning, though the link may not be as direct.

Class : S.Y. B. Sc. (Semester- III I)
Paper code : PHY 2303
Paper : III Title of Paper: Practical-I
Credit : 2 No. of Practical: 10

Learning Outcome:

After successfully completing this laboratory course, the students will be able to do the following:

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.

CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

CO6: Use of experiment to analyse various experimental parameters concerning their application .

CO7: Experimental Models for easy understanding and explanation Physics concepts.

List of Experiments: (Students have to perform Any 10 Experiments)

1. Circuit Theorems (Thevenin's, Norton's and Maximum power transfer theorem)
2. Transistor characteristics (CE configuration)
3. Thermal conductivity of rubber tube
4. OPAMP as inverting and non inverting amplifier
5. Study of logic gates (using IC) and verification of De Morgan's theorem
6. Use of CRO (AC/DC voltage measurement, frequency measurement)
7. Measurement of displacement (linear and angular) using potentiometer/variable inductor
8. Measurement of force using load cell.
9. Measurement of pressure using elastic diaphragm (in variable Capacitor/Bourdon Tube)
10. OPAMP as an adder and subtractor
11. Platinum Resistance Thermometer
12. Integrator and differentiator using IC 741
13. Temperature controller using Thermistor
14. Temperature controller using Thermocouple
15. Study of thermal conductivity by Lee's method
16. Phase shift Oscillator using IC 741

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								
CO 2		3							
CO 3				2			3	2	
CO 4	3	3		2					
CO 5			3		2				
CO 6						2			2
CO7									

Justification

PO1: Disciplinary Knowledge

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.Weightage: 3

Acquiring technical skills in a laboratory setting is fundamental to building disciplinary knowledge.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.Weightage: 3

Visualizing and experiencing abstract concepts directly contribute to disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.Weightage: 3

Critical thinking is essential in collecting and interpreting data in a laboratory setting.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.Weightage: 3

Visualizing abstract concepts contributes to critical thinking skills.

PO3: Social Competence

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.Weightage: 3

Collaborative learning and teamwork in a laboratory setting directly contribute to social competence.

PO4: Research-related Skills and Scientific Temper

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.

Weightage: 2

Understanding laboratory procedures is part of research-related skills, but the link may not be as direct.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.Weightage: 2

Visualizing abstract concepts can be part of developing a scientific temper, but the link may not be as strong.

PO5: Trans-disciplinary Knowledge

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Weightage: 2

Collaborative learning and teamwork contribute to trans-disciplinary knowledge, but the link may not be as strong.

PO6: Personal and Professional Competence

CO6: Use of experiment to analyze various experimental parameters concerning their application.Weightage: 2

Analyzing experimental parameters can contribute to personal and professional competence, but the link may not be as direct.

PO7: Effective Citizenship and Ethics

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.Weightage: 3

Understanding laboratory procedures, especially safety and scientific methods, directly contributes to effective citizenship.

PO8: Environment and Sustainability

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.

Weightage: 2

Adhering to laboratory safety procedures can indirectly contribute to considerations of environment and sustainability.

PO9: Self-directed and Life-long Learning

CO6: Use of experiment to analyze various experimental parameters concerning their application.Weightage: 2

Analyzing experimental parameters is relevant to self-directed and life-long learning, though the link may not be as direct.