# Government Polytechnic Mumbai

*Department of Instrumentation Engineering*

# P-23 Curriculum

# Semester- II

(Course Contents)

**Government Polytechnic, Mumbai**
**(Academically Autonomous Institute, Government of Maharashtra)**
**Programme : Diploma in Instrumentation Engineering (Sandwich Pattern)**

**Learning and Assessment Scheme (P-23)** — **With Effect From Academic Year : 2023-24**
**Duration of Programme : 6 Semester** — **Duration : 16 WEEKS**
**Semester : Second** — **Scheme : P-23**

| Sr. No. | Course Code | Course Title | Course Type | Total IKS Hrs. For Sem. | Learning Scheme: Actual Contact Hrs./Week | | | Self-Learning (Term Work + Assignments) Hrs./Week | Notional Learning Hrs./Week | Credits | Assessment Scheme: Paper Duration (Hrs.) | Theory: FA-TH | | SA-TH | Total | | Based on LL & TL: Practical: FA-PR | | SA-PR | | | Based On Self-Learning: SLA | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CL | TL | LL | SLH | NLH | | | T1 Max | T2 Max | Max | Max | Min | Max | Min | Max: PR | Max: OR | Min | Max | Min | |
| 1 | SC23502 | Engineering Mathematics | AEC | 1 | 3 | 2 | -- | 1 | 6 | 3 | 2:30 | 20 | 20 | 60 | 100 | 40 | 25 | 10 | -- | -- | -- | 25 | 10 | 150 |
| 2 | SC23109 | Analytical Chemistry | DSC | 2 | 3 | -- | 2 | 1 | 6 | 3 | 2:30 | 20 | 20 | 60 | 100 | 40 | 25 | 10 | 25# | -- | 10 | 25 | 10 | 175 |
| 3 | IS23102 | Control System Components | DSC | -- | 4 | -- | 2 | -- | 6 | 3 | 2:30 | 20 | 20 | 60 | 100 | 40 | 25 | 10 | -- | 25# | 10 | -- | -- | 150 |
| 4 | IS23103 | Basics of Electrical and Electronic Engineering | AEC | 1 | 3 | -- | 4 | 1 | 8 | 4 | 2:30 | 20 | 20 | 60 | 100 | 40 | 25 | 10 | 25@ | -- | 10 | 25 | 10 | 175 |
| 5 | IS23603 | Electronic Measuring Instruments | SEC | -- | 3 | -- | 2 | 1 | 6 | 3 | -- | -- | -- | -- | -- | -- | 25 | 10 | 50# | -- | 20 | 25 | 10 | 100 |
| 6 | IS23602 | Process Automation Drawing | SEC | -- | -- | -- | 4 | 2 | 6 | 3 | -- | -- | -- | -- | -- | -- | 25 | 10 | 50@ | -- | 20 | 25 | 10 | 100 |
| 7 | IS23301 | Environmental Studies | VEC | 2 | -- | 2 | -- | -- | 2 | 1 | -- | -- | -- | -- | -- | -- | 25 | 10 | -- | 25@ | 10 | -- | -- | 50 |
| **Total** | | | | **6** | **16** | **4** | **14** | **6** | **40** | **20** | **10** | **80** | **80** | **240** | **400** | **160** | **175** | **70** | **150** | **50** | **80** | **125** | **50** | **900** |

**Abbreviations:** CL-Classroom Learning, TL-Tutorial Learning, LL- Laboratory Learning, FA-Formative Assessment, SA-Summative Assessment, IKS-Indian Knowledge System, SLA - Self Learning Assessment
**Legends:** @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination
**Note:**
1. FA-TH represents addition of two-20 marks class tests conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course, then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+TL+LL+SL) hours X 16 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. *Self-learning hours shall not be reflected in the Time Table.

**Course Category:** Discipline Specific Core Course (DSC): 1, Discipline Specific Elective (DSE):0, Value Education Course (VEC):1, Intern. /Apprentice. /Project /Community (INP):0, Ability Enhancement Course (AEC): 3, Skill Enhancement Course (SEC): 2, Interdisciplinary Elective (IDE): 0

| Department Coordinator, Curriculum Development, Dept. of Instrumentation Engineering | Head of Department, Dept. of Instrumentation Engineering | In-Charge Curriculum Development Cell | Principal, Government Polytechnic Mumbai |
|---|---|---|---|

| **Programme : Diploma in EE / EC / IS / CE / ME / CO / IF/AI & ML / RT** | |
|---|---|
| **Course Code: SC23502** | **Course Title : Engineering Mathematics** |
| **Compulsory / Optional: Compulsory** | |

| **Learning Scheme and Credits** | | | | | | **Assessment Scheme** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CL** | **TL** | **LL** | **SLH** | **NLH** | **Credits** | **FA-TH** | | **SA-TH (2:30 Hrs.)** | **FA-PR** | **SA** | | **SLA** | **Total** |
| | | | | | | **T1** | **T2** | | | **PR** | **OR** | | |
| 3 | 2 | -- | 1 | 6 | 3 | 20 | 20 | 60 | 25 | -- | -- | 25 | 150 |

**Total IKS Hrs. for course: 01 Hrs.**

**Abbreviations:** CL- Classroom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

**Note:**

1. FA-TH represents addition of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self-learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks

## I. Rationale:

An Engineering Mathematics course, covering integration, definite integration, differential equations, numerical methods, and probability distribution, equips engineering students with essential problem-solving tools. It enables them to model and analyze complex systems, make informed decisions and address real-world engineering challenges effectively.

## II. Industry / Employer Expected Outcome:

Engineers applying Mathematics should proficiently solve complex real-world problems, enhancing decision-making, design and innovation with precision and efficiency.

**III. Course Outcomes:** Students will be able to achieve & demonstrate the following COs on completion of course based learning.

| | |
|---|---|
| CO1 | Solve the broad-based engineering problems of integration using suitable methods. |
| CO2 | Use integration to find area, volume, mean value and root mean square value for given engineering related problems. |
| CO3 | Apply the differential equation to find the solutions of given programme specific problems. |
| CO4 | Apply numerical methods to solve programme specific problems. |
| CO5 | Use probability distributions to solve elementary engineering problems. |

**Course Content Details:**

| Unit No. | Theory Learning Outcomes (TLO's)aligned to CO's. | Topics / Sub-topics |
|---|---|---|
| 1 | **TLO1.1** Solve the given simple problem(s)based on rules of integration.<br>**TLO1.2** Evaluate the given simple integral(s) using substitution method.<br>**TLO1.3** Integrate given simple functions using the integration by parts.<br>**TLO1.4** Solve the given simple integral by partial fractions. | **Unit-I Indefinite Integration**<br>1.1 Simple Integration: Rules of integration and integration of<br>1.2 Standard functions<br>1.3 Integration by substitution.<br>1.4 Integration by parts.<br>1.5 Integration by partial fractions |
| **Course Outcome : CO1** | **Teaching Hours : 09 hrs.** | **Marks: 10** |
| 2 | **TLO2.1** Solve given examples based on definite Integration.<br>**TLO2.2** Use properties of definite integration to solve given problems.<br>**TLO2.3** Utilize the concept of definite integration to find the following (a)Area under the curve (b)Area between given two curves (c) Volume of revolution (d) Mean value (e) Root mean square value | **Unit- II Definite Integration and Applications**<br>2.1 Definite Integration: Definition, rules of definite integration with simple examples<br>2.2 Properties of definite integral (without proof) and simple examples.<br>2.3 Applications of integration: area under the curve, area between given two curves, volume of revolution, mean value and root mean square value. |
| **Course Outcome : CO2** | **Teaching Hours : 10 hrs.** | **Marks: 14** |
| 3 | **TLO3.1** Find the order and degree of given Differential equations.<br>**TLO3.2** Form simple differential equation for given elementary engineering problems.<br>**TLO3.3** Solve given differential equations using the methods of Variable separable and Exact Differential Equation (Introduce the concept of partial differential equation).<br>**TLO3.4** Solve given Linear Differential Equation.<br>**TLO3.5** Solve given programme specific problems using the category of differential equation. | **Unit-III Differential Equation**<br>3.1 Concept of Differential Equation.<br>3.2 Order, degree and formation of Differential equations<br>3.3 Methods of solving differential equations: Variable separable form, Homogeneous D.E., Exact Differential Equation, Linear Differential Equation<br>3.4 Application of differential equations and related engineering problem(s). |
| **Course Outcome : CO3** | **Teaching Hours : 10hrs.** | **Marks: 14** |
| 4 | **TLO4.1** Find roots of algebraic equations by using appropriate methods.<br>**TLO4.2** Solve the system of equations in three unknowns by using given methods.<br>**TLO4.3** Apply the concept of numerical integration to solve given engineering problems.<br>**TLO4.4** Solve problems using Yukti bhasa iterative methods for finding approximate square root. (IKS) | **Unit-IV: Numerical Methods and Numerical Integrations**<br>4.1 Solution of algebraic equations: Bisection method, Regula falsi method and Newton—Raphson method.<br>4.2 Solution of simultaneous equations containing three Unknowns by Gauss elimination method.<br>4.3 Solution of simultaneous equations containing three Unknowns by iterative methods: Gauss Seidal and Jacobi's method.<br>4.4 Numerical Integration: Trapezoidal rule, |

| | | |
|---|---|---|
| | | Simpson's 1/3rd rule, Simpson's 3/8 th rule. (Without proof)<br>4.5 Yukti bhasa iterative methods for finding approximate square root. (IKS) |
| **Course Outcome: CO4** | **Teaching Hours: 8** | **Marks: 12** |
| **5** | **TLO5.1** Solve given problems based on repeated trials using Binomial distribution.<br>**TLO5.2** Solve given problems when number of trials are large and probability is very small.<br>**TLO5.3** Utilize the concept of normal distribution to solve related engineering problems. | **Unit**-V: **Probability Distribution**<br><br>5.1 Binomial distribution.<br>5.2 Poisson's distribution.<br>5.3 Normal distribution. |
| **Course Outcome : CO5** | **Teaching Hours : 8** | **Marks: 10** |

**IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.**

| Sr No. | Practical / Tutorial / Laboratory Learning Outcome (LLO) | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|---|---|---|---|
| 1 | **LLO1.1** Solve simple problems of Integration by substitution | Integration by substitution | 2 | CO1 |
| 2 | **LLO2.1** Solve integration using by parts | Integration by parts | 2 | CO1 |
| 3 | **LLO3.1** Solve integration by Partial fractions | Integration by partial fractions. | 2 | CO1 |
| 4 | **LLO4.1** Solve examples on Definite Integral Based on given methods. | Definite Integral based on given methods. | 2 | CO2 |
| 5 | **LLO5.1** Solve problems on properties of definite integral. | Properties of definite integral | 2 | CO2 |
| 6 | **LLO6.1** Solve given problems for finding the area under the curve, area between two curves and volume of revolution. | Area under the curve, area between two curves and volume of revolution. | 2 | CO2 |
| 7 | **LLO7.1** Solve examples on mean value and root mean square value. | Mean value and root mean square value. | 2 | CO2 |
| 8 | **LLO8.1** Solve examples on order, degree and formation of differential equation. | Order, degree and formation of differential equation. | 2 | CO3 |
| 9 | **LLO9.1** Solve first order first degree D.E. using variable separable method and homogeneous method. | Variable separable method and homogeneous method. | 2 | CO3 |
| 10 | **LLO10.1** Solve first order first degree D.E. using exact differential equation and linear differential equation. | Exact differential equation and linear differential equation. | 2 | CO3 |
| 11 | **LLO11.1** Solve engineering application problems using differential equation. | Applications of differential equations. | 2 | CO3 |
| 12 | **LLO12.1** Solve problems on Bisection method and Regula falsi method. | Bisection Method and Regula Falsi Method | 2 | CO4 |
| 13 | **LLO13.1** Solve problems on Newton-Raphson method and Gauss elimination method. | Newton-Raphson method and Gauss elimination method. | 2 | CO4 |

| | | | | |
|---|---|---|---|---|
| 14 | **LLO14.1** Solve problems on Jacobi's method and Gauss Seidal Method. | Jacobi's method and Gauss Seidal Method. | 2 | CO4 |
| 15 | **LLO15.1** Solve examples on Trapezoidal rule, Simpson's1/3rd rule and Simpson's3/8$^{th}$ rule. | Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8thrule. | 2 | CO4 |
| | **LLO16.1** Solve problems on Bisection method, Regula falsi method, Newton-Raphson method using spread sheet. | Bisection method, Regula falsi method, Newton-Raphson method problems using spreadsheet. | 2 | CO4 |
| 17 | **LLO17.1** Use Yukti bhasa iterative methods for finding approximate value of square root and cube root. (IKS) | Yukti bhasa iterative methods for Finding approximate value of square root and cube root. (IKS) | 2 | CO4 |
| 18 | **LLO18.1** Solve engineering problems using Binomial distribution. | Binomial Distribution | 2 | CO5 |
| 19 | **LLO19.1** Solve engineering problems using Poisson distribution. | Poisson Distribution | 2 | CO5 |
| 20 | **LLO20.1** Solve engineering problems using Binomial distribution. | Normal Distribution | 2 | CO5 |

**Note:**

1. Take any 12 tutorials out of 20 and ensured that all the units are covered.
2. Take tutorial in the batch size of 20 to 30students.
3. Give students at least 10 problems to solve in each tutorial.

## V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Choose a real-world problem and formulate a differential equation to model it.
2. Solve the formulated differential equation and interpret the solution in the context of the problem
3. Collect examples based on real world applications of Integration
4. Collect examples based on real world applications of Definite Integration
5. Consider a fair six-sided die. Define a discrete random variable X as the number obtained when rolling the die. Construct the probability distribution table for X
6. Collect examples based on real world applications of Newton Raphson Method.
7. Collect examples based on real world applications of Binomial Distribution.
8. Collect examples based on real world applications of Poisson Distribution.
9. Collect examples based on real world applications of Normal Distribution.
10. Collect examples based on real world applications of Differential Equations
11. Collect examples based on real world applications of Gauss Seidal Method.
12. Collect examples based on real world applications of Gauss Jacobi's Method

**(Attempt any 5-7 Assignment from the given list.)**

## VI. Specification Table:

| Unit No | Topic Title | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|
| | | R Level | U Level | A Level | Total Marks |
| 1 | Indefinite Integration | 2 | 4 | 4 | 10 |
| 2 | Definite Integration and Applications | 2 | 4 | 8 | 14 |

| | | | | | |
|---|---|---|---|---|---|
| 3 | Differential Equation | 2 | 4 | 8 | 14 |
| 4 | Numerical Methods and Numerical Integrations | 2 | 4 | 6 | 12 |
| 5 | Probability Distribution | 2 | 4 | 4 | 10 |
| | **Total** | 10 | 20 | 30 | 60 |

## VII. Assessment Methodologies/Tools

**Formative assessment (Assessment for Learning)**

1. Two offline unit tests of 20 marks each.
2. Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)
3. Rubrics for continuous assessment of self-learning assignments/ micro project/ activities based on process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

1. End semester assessment based on theory examination. (60 Marks)

## VIII. Suggested COs - POs Matrix Form

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | 1 | -- | -- | 1 | -- | 1 | -- | -- |
| CO2 | 3 | 1 | -- | -- | 1 | -- | 1 | -- | -- |
| CO3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | -- | -- |
| CO4 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | -- | -- |
| CO5 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | -- | -- |
| Legends: - High:03, Medium:02, Low:01, No Mapping: -- | | | | | | | | | |

## IX. Suggested Learning Materials / Books

| Sr. No | Title | Author, Publisher | ISBN code |
|---|---|---|---|
| 1 | Higher Engineering | Grewal B.S. | ISBN: 978-8174091956 |

| | | | |
|---|---|---|---|
| | Mathematics | Khanna publication New Delhi, 2013 | |
| 2 | A text book of Engineering Mathematics | Dutta.<br>Newage publication New Delhi, 2006 | ISBN: 978-8122416893 |
| 3 | Advance Engineering Mathematics | Kreysizg, Ervin,<br>Wiley publication New Delhi, 2016 | ISBN: 978-8126554232 |
| 4 | Advance Engineering Mathematics | Das H.K.<br>S. Chand publication New Delhi, 2008 | ISBN: 9788121903455 |
| 5 | Introductory Methods of Numerical Analysis | S.S. Sastry,<br>PHI Learning Private Limited, New Delhi. | ISBN: 978-8120345928 |
| 6 | Studies in the History of Indian Mathematics | C.S. Seshadri,<br>Hindustan Book Agency (India) P19 Green Park Extension New Delhi. | ISBN:978-9380250069 |
| 7 | Calculus and Its Applications | Marvin L. Bittinger David<br>J.E lenbogen Scott A. Surgent<br>Addison-Wesleyl0thEdition | ISBN: 978-0321694331 |
| 8 | An Introduction to Statistical Learning with Applications in R | Gareth James, Daniela<br>Witten, Trevor Hastie Robert and Tibshirani<br>Springer New York Heidelberg Dordrecht London | ISBN:978-1461471370<br>ISBN:978-1461471387<br>(eBook) |

## X. Learning Websites & Portals:

| Sr. No | Link /Portal | Description |
|---|---|---|
| 1 | https://www.wo1frama1pha.com/ | Solving mathematical problems, performing calculations, and visualizing mathematical concepts. |
| 2 | http://www.sosmath.com/ | Free resources and tutorials |
| 3 | http://mathworld.wolfram.com/ | Extensive math encyclopedia with detailed explanations of mathematical concepts |
| 4 | https://www.mathsisfun.com/ | Explanations and interactive lessons covering various math topics, from basic arithmetic to advanced |
| 5 | http://tutorial.math.1amar.edu/ | Comprehensive set of notes and tutorials covering a wide range of mathematics topics, including calculus |
| 6 | https://www.purplemath.com/ | Purple math is a great resource for students seeking help with algebra and other foundational math |
| 7 | https://www.brilliant.org/ | Interactive learning in Mathematics |
| 8 | https://www.edx.org/ | Offers a variety of courses |
| 9 | https://www.coursera.org/ | Coursera offers online courses in applied mathematics from universities and institutions around the |
| 10 | https://ocw.mit.edu/index.htm | The Massachusetts Institute of Technology (MIT) offers free access to course materials for a wide range |

**XI. Academic Consultation Committee/Industry Consultation Committee:**

| Sr. No | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mr. Santosh Bandekar | Lecturer in Mathematics | Government Polytechnic, Osmanabad |
| 2 | Mr. Abhijit S. Patil | Lecturer in Mathematics | Government Polytechnic, Mumbai |
| 3 | Mr. Vinod S. Patil | Lecturer in Mathematics | Government Polytechnic, Mumbai |

Coordinator
Curriculum Development,
Department of Science and Humanities dept.

Head of Department
Department of Science and Humanities dept.

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

| **Programme: Diploma in Instrumentation Engineering (Sandwich pattern)** | |
|---|---|
| **Course Code: SC23109** | **Course Title: Analytical Chemistry** |
| **Compulsory / Optional: Compulsory** | |

| **Learning Scheme and Credits** | | | | | | **Assessment Scheme** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CL** | **TL** | **LL** | **SLH** | **NLH** | **Credits** | **FA-TH** | | **SA-TH (2:30 Hrs.)** | **FA-PR** | **SA-** | | **SLA** | **Total** |
| | | | | | | **T1** | **T2** | | | **PR** | **OR** | | |
| 3 | - | 2 | 1 | 6 | 3 | 20 | 20 | 60 | 25 | 25# | - | 25 | 175 |

**Total IKS Hrs. for course: 2 Hrs.**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

**Note:**

1. FA-TH represents two class tests conducted during the term.
2. SA-TH represents the end term theory examination.
3. FA-PR represents tutorial/practical term work of 25 Marks.
4. SA-PR represent final end term practical term work of 25 Marks
5. SLA represents self-learning Assessment of 25 Marks.

## I. Rationale

Diploma engineers have to deal with various materials and equipment. This course is designed with fundamental information to help the diploma engineering students to apply the basic concepts and principles of chemistry to solve broad- based engineering problems. The basic concepts and principles of science related to engineering materials will help in understanding the technology courses where emphasis is on the applications of these in various technology domain applications.

## II. Industry / Employer Expected Outcome

This course is to be taught and implemented with the aim to develop in the student, the course outcomes (COs) leading to the attainment of following industry identified outcome expected from this course:

Apply principles of chemistry to solve broad based relevant engineering problems.

**III. Course Outcomes:** Students will be able to achieve & demonstrate the following COs on completion of course based learning:

| | |
|---|---|
| CO1 | Explain the structure, properties and behavior of molecules and compounds based on the types of chemical compound. |
| CO2 | Apply the concepts of electrochemistry in engineering field. |
| CO3 | Explain various spectroscopic technic for analysis. |
| CO4 | Apply methods of prevention of corrosion for environmental and safety concerns. |
| CO5 | Select suitable Alloy, Lubricants, material for a particular use effectively. |

**Course Content Details:**

| Unit No. | Theory Learning Outcomes (TLO) | Topics / Sub-topics |
|---|---|---|
| 1 | **TLO1.1** Explain the Indian chemistry<br>**TLO1.2** Explain the properties of given material based on the bond formation.<br>**TLO1.3** Describe the molecular structure of given solid, liquid and gases.<br>**TLO1.4** Describe the crystal structure of the given solids and Explain Properties of metallic solid. | **Unit-I Atomic Structure and Chemical bonding**<br>1.1 Indian Chemistry: -Philosophy of atom by Acharya Kanad.<br>1.2 Introduction of atom, Molecules, Fundamental Particles, Proton, Neutron, Electron. Their mass, charge, location. And symbol Bohr's theory, Postulates, Structure of modern atom. Atomic number and atomic mass number. Atomic weight Numerical based on atomic number & atomic mass number. Electronic configuration of element up to 30 elements<br>1.3 Electronic theory of valency: Assumptions, Chemical bonds: Types and characteristics of electrovalent bond, covalent bond, coordinate bond, hydrogen bond, and metallic bond.<br>1.4 Molecular arrangement in solid, liquid and gases. Structure of solids: crystalline and amorphous solids Properties of metallic solid, Unit cell: simple cubic, body center cubic (BCC), face center cubic (FCC), hexagonal close pack crystals. |
| **Course Outcome: CO1** | **Teaching Hours: 8hrs.** | **Marks: 10** |
| **2** | **TLO2.1** Explain various terms involved in electrolysis.<br>**TLO2.2** Describe mechanism of electrolysis of CuSO4 solution by using cu and pt rods<br>**TLO2.3** Solve numerical based on Faraday's first and second law of electrolysis.<br>**TLO2.4** Apply the concept of electrolysis in various uses. | **Unit –II Electro chemistry**<br>2.1 Definition of Electrochemistry, Electrolytes: Definition, Types.<br>Differences between Atom and ion. Definition of ionization & electrolytic dissociation, Arrhenius theory, Degree of ionization with factors affecting it.<br>2.2 Terms related to Electrolysis, Mechanism of electrolysis. Examples of: mechanism of Electrolysis of Cu SO 4 by using Cu electrodes.<br>2.3 Faradays First law and its mathematical derivation. Faradays second law & its mathematical derivation, Numerical based on laws of Faraday.<br>2.4 Application of Electrolysis: Electroplating, Electrorefining. |

| **Course Outcome: CO2** | **Teaching Hours :9 hrs.** | **Marks: 12** |
|---|---|---|
| **3** | **TLO3.1** Explain the nature of electromagnetic radiation.<br>**TLO3.2** Describe electromagnetic spectrum.<br>**TLO3.3** Describe interaction of electromagnetic radiation with matter.<br>**TLO3.4** Solve numerical based on various terms involved in spectroscopy. | **Unit- III Spectroscopy**<br>3.1 Electromagnetic radiation: Nature of electromagnetic radiation, Characteristic of electromagnetic radiation. Wave properties of electromagnetic radiation like wavelength, frequency, wave number, velocity, Particle properties of electromagnetic radiation.<br>3.2 Electromagnetic Spectrum: A range of wavelength. UV visible spectroscopy, IR spectroscopy.<br>3.3 Interaction of Electromagnetic Radiation with matter, Absorption, Emission Scattering, Fluorescence.<br>3.4 Numerical based on wavelength, wave number and frequency |
| **Course Outcome: CO3** | **Teaching Hours :9 hrs.** | **Marks: 12** |
| **4** | **TLO4.1** Explain the various type of corrosion<br>**TLO4.2** Describe the mechanism of different types of corrosion.<br>**TLO4.3** Identify the different factors affecting rate of corrosion for the given type of material<br>**TLO4.4** Select the protective measures to prevent the corrosion in the given corrosive medium. | **Unit–IV Corrosion**<br>4.1 Definition of corrosion. Types of corrosion. Atmospheric & Electrochemical Corrosion.<br>4.2 Mechanism of atmospheric corrosion, types of oxide film formed, (stable, unstable, volatile, with examples).<br>4.3 Electrochemical corrosion/immersed corrosion Definition. Example. Factors Affecting, Atmospheric & Electrochemical Corrosion.<br>4.4 Protection of metals from Corrosion: - By protective coatings a) organic coating (Paints and Varnishes), b) inorganic coating (Metallic Coating).<br>Different methods of Protective metallic coatings.<br>a) Hot dipping (Galvanizing & Tinning)<br>b) Sherardizing c) Metal Spraying |
| **Course Outcome: CO4** | **Teaching Hours :9 hrs.** | **Marks: 12** |
| **5** | **TLO5.1** Explain purposes and preparation methods of making the given alloy.<br>**TLO5.2** Explain non-engineering material.<br>**TLO5.3** Explain plastic, their types, and its compounding.<br>**TLO5.4** Explain rubber, their types, and synthesis. | **Unit–V: Metals and Non metal**<br>5.1 Metals & their characteristics, (hardness, ductility, malleability, toughness, brittleness, tensile strength, weldability, casting, forging, soldering)<br>5.2 Definition of alloy: purposes of preparation of Alloy. Preparation of binary alloy by fusion method. Classification of alloy: Ferrous and non-ferrous Alloy<br>5.3 Non-Metallic: Definition of non-metallic engineering materials |
| **Course Outcome: CO5** | **Teaching Hours :10 hrs.** | **Marks: 14** |

**IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.**

| Sr No | Laboratory Learning Outcomes | Laboratory Experiment/ Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|---|---|---|---|
| 1 | **LLO1.1** Follow safety rules in chemistry laboratory. | Introduction to chemistry laboratory instruments and glassware | 2 | CO1 |
| 2 | **LLO2.1** Identify cation and anion in given ionic solutions by performing selective test. | Identification of cation in given ionic solutions. ($Cu^{++}$, $Fe^{++}$, $Fe^{+++}$, $Cr^{+++}$, $Mn^{++}$, $Ni^{++}$, $Zn^{++}$, $Ca^{++}$, $Ba^{++}$, $Mg^{++}$ $NH4^{+)}$ | 2 | CO1 |
| 3 | **LLO3.1** Identify cation and anion in given ionic solutions by performing selective test. | Identification of anion in given ionic solutions. $Cl^-$, $Br^-$, $I^-$, CO3, SO4, NO3 | 2 | CO1 |
| 4 | **LLO4.1** Prepare solution of copper sulphate of 1N.<br>**LLO4.2** Determine electrochemical equivalent of copper. | Determination of electrochemical equivalent of copper by using cu - electrodes | 2 | CO2 |
| 5 | **LLO4.1** Prepare weak acid, weak base and strong acid, strong base.<br>**LLO4.2** Calibrate the conductivity meter.<br>**LLO4.3** Determine the conductivity of various sample solution. | Determination of conductivity of different electrolytes by using conductivity meter. | 2 | CO2 |
| 6 | **LLO6.1** Prepare Electrolyte Solution and connect circuit.<br>**LLO6.2** Determine the electrode potential of metal. | Determination of the electrode potential of iron metal. | 2 | CO2 |
| 7 | **LLO7.1** Identify the component of spectrophotometer.<br>**LLO7.2** Explain the function of spectrophotometer. | Identification of components of UV-visible spectrophotometer. | 2 | CO3 |
| 8 | **LLO8.1** Understand the function of component of spectrophotometer.<br>**LLO8.2** Measure the absorbance of the sample at different wavelengths. | To apply Beer Lamberts law to solutions and measure absorbance of the sample solution. | 2 | CO3 |
| 9 | **LLO9.1** Prepare solution of different concentration.<br>**LLO9.2** Measure the effect of concentration on absorbance | Study the effect of concentration on the absorbance of a substance | 2 | CO3 |
| 10 | **LLO10.1** Explain normality, molarity.<br>**LLO10.2** Prepare acidic and basic media. | Preparation of acidic and basic corrosive media. | 2 | CO4 |

| | | | | |
|---|---|---|---|---|
| 11 | **LLO11.1** Determine the extent of corrosion of iron or aluminum rod in acidic and basic media<br>**LLO11.2** Compare the corrosion behavior of Aluminum / Iron in acidic and basic media | Determination of rate of corrosion at different temperatures for Aluminium / iron rod in acidic and Basic medium and plot a graph of rate of corrosion. | 2 | CO4 |
| 12 | **LLO12.1** Explain acidic and Basic solution.<br>**LLO12.2** Determine pH of given sample solution. | To find out pH of different solutions using Lovibond comparator, pH paper, pH meter. | 2 | CO4 |
| 13 | **LLO13.1** Explain Redox reaction.<br>**LLO13.2** Determine the percentage of Iron from Hematite ore by Redox titration. | Standardization of $KMnO_4$ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by $KMnO_4$ solution | 2 | CO5 |
| 14 | **LLO14.1** Explain complexometric titration.<br>**LLO14.2** Determine the percentage of copper from copper ore. | Determine the percentage of copper in given copper ore. | 2 | CO5 |
| 15 | **LLO15.1** Explain Role of acid in reaction.<br>**LLO15.2** Determine the percentage of polymer. | Preparation of phenol formaldehyde / Bakelite plastic | 2 | CO5 |

**Note: Minimum 12 experiments are compulsory and should be chosen such that all COs will be covered.**

**V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):**

**Assignment**

1. Describe modern atomic structure.
2. Named four quantum numbers and their functions.
3. Write any four postulates of Bohrs atomic theory.
4. Explain covalent bond, ionic bond, coordinate bond, hydrogen bond.
5. Explain Corrosion with suitable example.
6. Demonstrate Mechanism of wet corrosion by waterline corrosion
7. Named the various factors affecting rate of corrosion.
8. Explain galvanizing and tinning.
9. Describe electrochemistry.
10. Explain mechanism of electrochemistry of copper sulphate using active electrode.
11. Explain faradays first and second law of electrolysis with mathematical expression.
12. Describe construction and working of UV visible spectrophotometer.
13. Distinguish between UV and IR.
14. Explain classification of corrosion.
15. Explain various alloys and their application.
16. List various properties of metal
17. Describe plastics.
18. Explain addition and condensation polymer.
19. Describe natural rubber and its constituents.

## VI. Specification Table:

| Unit No | Topic Title | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|
| | | R Level | U Level | A Level | Total Marks |
| 1 | Atomic Structure and Chemical bonding | 2 | 4 | 4 | **10** |
| 2 | Electrochemistry | 2 | 4 | 6 | **12** |
| 3 | Spectroscopy | 2 | 4 | 6 | **12** |
| 4 | Corrosion | 2 | 4 | 6 | **12** |
| 5 | Engineering Material | 4 | 6 | 4 | **14** |
| | **Total** | **12** | **22** | **26** | **60** |

## VII. Assessment Methodologies/Tools

**Formative assessment (Assessment for Learning)**

- Two offline unit tests of 20 marks each.
- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)
- Rubrics for continuous assessment of self-learning assignments/ micro project/ activities based on process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment based on rubrics for assessment for laboratory process and product related performance indicators. (25 Marks)
- End semester assessment based on theory examination. (60 Marks)
-

## VIII. Suggested COs - POs Matrix Form

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | -- | 1 | -- | -- | -- | 1 | 1 | -- |
| CO2 | 3 | 1 | -- | -- | -- | -- | 1 | -- | -- |
| CO3 | 3 | -- | -- | -- | 1 | -- | 1 | 1 | -- |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO4 | 3 | -- | 1 | -- | 1 | -- | 1 | 1 | 1 |
| CO5 | 3 | -- | 1 | -- | -- | -- | 1 | 1 | -- |
| Legends: - High:03, Medium:02, Low:01, No Mapping: -- | | | | | | | | | |

## IX. Suggested Learning Materials / Books

| Sr. No | Title | Author, Publisher | ISBN NO. |
|---|---|---|---|
| 1 | NCERT XI and XII text book | NCERT | ISBN 81-7450-648-9 (Part I) 81-7450-716-7 (Part II) |
| **2** | Engineering Chemistry | Jain and Jain, Dhanpat rai Publishing, New Delhi, | ISBN: 8174505083 |
| **3** | Engineering Chemistry | Dr. S.S. Dara, Dr. S.S. Umare, S. Chand publication | ISBN: 978-8121903592 |
| **4** | Applied Chemistry with Lab Manual | Anju Rawley, Devdatta V.Saraf, Khanna Book Publishing Co. (P) Ltd. New Delhi, 2021, | ISBN- 978-93-91505-44-8 |
| **5** | Polytechnic Chemistry | V.P. Mehta, Jain Brothers, Delhi | ISBN: 978-81-8360-093-X |

## X. Learning Websites & Portals

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | www.chem1.com | Chemistry instruction and education |
| 2 | www.onlinelibrary.wiley.com | Materials and corrosion |
| 3 | www.chemtube3d.com | Atomic structure and engineering material |
| 4 | www.chemistryclassroom.com | Chemical boding |
| 5 | www.sciencejoywagon.com/ | Electrochemistry |
| 6 | www.chem1.com | Chemistry instruction and education |
| 7 | www. chemistry.org | Virtual Labs, simulation |
| 8 | www.swayam.gov.in | Chemistry for engineer |

## XI. Academic Consultation Committee/Industry Consultation Committee:

| Sr. No | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mrs. Leena Khadke | Lecturer In Chemistry | Govt. Polytechnic Thane |

| | | | |
|---|---|---|---|
| 2 | Mrs. Sneha Suvarna | Lecturer In Chemistry | SBM Polytechnic Mumbai |
| 3 | Mr. Santosh Mulye | Lecturer In Chemistry | VES Polytechnic Mumbai |
| 4 | Mr. Pravin Meshram | Lecturer In Chemistry | Govt. Polytechnic Mumbai |

Coordinator
Curriculum Development,
Department of Science and Humanities dept

Head of Department
Department of Science and Humanities dept.

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

| **Programme: Diploma in Instrumentation Engineering (Sandwich Pattern)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code: IS23102** | | | | | | **Course Title: Control System Components** | | | | | | | |
| **Compulsory / Optional: Compulsory** | | | | | | | | | | | | | |
| **Learning Scheme and Credits** | | | | | | **Assessment Scheme** | | | | | | | |
| **CL** | **TL** | **LL** | **SLH** | **NLH** | **Credits** | **FA-TH** | | **SA-TH (2:30 Hrs.)** | **FA-PR** | **SA-** | | **SLA** | **Total** |
| | | | | | | **T 1** | **T 2** | | | **PR** | **OR** | | |
| 04 | -- | 02 | -- | 06 | 03 | 20 | 20 | 60 | 25 | -- | 25# | -- | 150 |

**Total IKS Hrs. for course: --- hrs.**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment, UT– Unit test

**Legends:** @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

**Note:**

1. FA-TH represents addition of two class tests (T1, T2) conducted during the term.
2. FA-PR represents tutorial/practical term work of 25 Marks.
3. SA-TH represents the end term theory examination of 60 Marks.
4. SA-PR/OR represents the end term Practical examination of 25 Marks

## I. Rationale

An Instrumentation diploma engineer has to deal with the testing, operation and maintenance of various control system components. This subject is introduced with the view that the students will get familiar with the operation of various systems such as pneumatic, hydraulic, and electrical and their basic components. This course will also help the students to understand the operation of different types of final control elements and auxiliary process control components.

## II. Industry / Employer Expected Outcome:

The industry expecting the smooth operation of components to optimize efficiency of control system.

## III. Course Outcomes:

Students will be able to achieve & demonstrate the following COs on completion of course based learning

| | |
|---|---|
| CO1 | Interpret hydraulic system and its component. |
| CO2 | Interpret pneumatic system and its component. |
| CO3 | Demonstrate construction and working of different types of control valves. |
| CO4 | Interpret the different types of Electrical system components. |
| CO5 | Interpret the application of auxiliary component. |

**Course Content Details:**

| Unit No. | Theory Learning Outcomes (TLO's) aligned to CO's | Topics / Sub-topics |
|---|---|---|
| 1 | **TLO1.1** Memorize the symbols, block diagram, working and applications of hydraulic system.<br>**TLO1.2** Discuss the pressure regulation in hydraulic system.<br>**TLO1.3** Demonstrate the operation different types of DCV, Pressure control valves, pumps and actuators.<br>**TLO1.4** Develop simple hydraulic circuits | **Unit-I Hydraulic System Components:**<br>1.1 Introduction<br>1.2 Block diagram of Hydraulic system.<br>1.3 Applications of Hydraulic system.<br>1.4 Hydraulic pumps: Centrifugal pump, reciprocating pump (construction and working principle)<br>1.5 Pressure regulation in hydraulic system<br>1.6 Directional control valve: Check Valve, Spool valve, shuttle valve, 2/2, 3/2, 4/2, 4/3, 5/2<br>1.7 Special valves: Direct type of relief valve, time delay valve, Sequence valve.<br>1.8 Actuators: single-acting cylinder & double-acting cylinders, rotary actuator.<br>1.9 Development of simple hydraulic circuits. |
| **Course Outcome:CO1** | **Teaching Hours:12 hrs.** | **Marks: 12** |
| 2 | **TLO2.1** Describe different components of pneumatic system with their symbols.<br>**TLO2.2** Identify the different air compressor with their construction and working principle.<br>**TLO2.3** Summarize the flapper Nozzle system, and Pneumatic relay.<br>**TLO2.4** Memorize the construction, working principle of P to I and I to P converter.<br>**TLO2.5** Develop simple pneumatic circuits | **Unit-II Pneumatic System Components**<br>2.1 Introduction<br>2.2 Block diagram of pneumatic system.<br>2.3 Air compressor types: - types, reciprocating type compressor (construction and working)<br>2.4 Flapper-nozzle system.<br>2.5 Pneumatic relay<br>2.6 Converters: Pneumatic to Electrical (P to I) and Electrical to PneumaticConverters (I to P).<br>2.7 Development of simple pneumatic circuits. |
| **Course Outcome: CO2** | **Teaching Hours : 10 hrs.** | **Marks:10** |
| 3 | **TLO3.1** Define and classify the control valve.<br>**TLO3.2** Illustrate the different types of control valve construction, ISA symbol, flow characteristics and applications.<br>**TLO3.3** Summarize the control valve parameters, problems.<br>**TLO3.4** Explain the selection criteria of control valve. | **Unit-III Control Valves**<br>3.1 Definition, terminology and classification.<br>3.2 Control valve types: Globe valve, Ball, Butterfly, Solenoid valves (construction, working, ISA symbols, advantages, disadvantages and applications)<br>3.3 Control Valve Actuators: - spring diaphragm type and piston type, electrical actuator.<br>3.4 Inherent flow characteristics of control valve<br>3.5 Control valve parameters: Control valve |

| | | |
|---|---|---|
| | | capacity (Cv), valve range ability, turn-down ratio and valve gain.<br>3.6 Control valve problems: Cavitation and flashing.<br>3.7 Valve positioners: Necessity and working principal<br>3.8 Selection criteria of control valves |
| **Course Outcome:CO3** | **Teaching Hours: 12 hrs.** | **Marks:12** |
| 4 | **TLO4.1** State the working principle, construction of single phase AC motor and DC shunt motor, stepper and servo motors.<br>**TLO4.2** Identify and recall the construction & working of different types of switches.<br>**TLO4.3** Summarize the working of different types of relays<br>**TLO4.4** Memorize the working principle; classify the different types of circuit breaker & its application.<br>**TLO4.5** State the working principle and use of Shape Memory alloy wires and coils as actuator. | **Unit-IV Electrical Control System Components**<br>4.1 Working principle, construction of single phase AC motor, DC shunt motor, stepper and servo motors.<br>4.2 Switches: Toggle switches, push buttons, DIP switch, rotary switch, thumbwheel switch, limit switches. (No theory question to be asked in exam on switches.)<br>4.3 Control Relays - Electro-mechanical relay, Reedrelay, Solid state relay, Overload relay,<br>4.4 Circuit breakers: -Need of Circuit Breaker, Operating Principle, and types: MCB, RCCB, ELCB, Air Circuit breaker, Vacuum Circuit breaker (symbolic representation, working, and applications)<br>4.5 Shape Memory alloy wires and coils as actuator |
| **Course Outcome: CO4** | **Teaching Hours :16 hrs.** | **Marks:16** |
| **5** | **TLO5.1** Illustrates the working of alarm annunciator.<br>**TLO5.2** Describe the operation of feeder and damper.<br>**TLO5.3** Explain the features of different types of transmitters.<br>**TLO5.4** Illustrate the working of temperature and pressure switch.<br>**TLO5.5** Illustrate the working of relief, safety and rupture disk. | **Unit-V Auxiliary Components**<br>5.1 Alarm annunciator.<br>5.2 Feeder and damper.<br>5.3 Transmitters: Live zero concept, 2 wire, 4 wire, DP Transmitter.<br>5.4 Temperature Switch and Pressure Switch.<br>5.5 Relief Valve, safety valve and rupture disk. (symbolic representation, working, applications)<br>5.6 Comparison between pneumatic, hydraulic and Electric systems. |
| **Course Outcome: CO5** | **Teaching Hours :10 hrs.** | **Marks:10** |

**IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.**

| Sr No | Practical / Tutorial / Laboratory Learning Outcome (LLO) | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevan COs |
|---|---|---|---|---|
| 1 | **LLO1.1** Test the hydraulic circuit of single acting cylinder. | Implementation and testing of Hydraulic circuits for single-acting cylinders. | 2 | CO1 |

| | | | | |
|---|---|---|---|---|
| 2 | **LLO2.1** Test the pneumatic circuit of single acting cylinder. | Implementation and testing of Pneumatic circuits for single-acting cylinders. | 2 | CO2 |
| 3 | **LLO3.1** Explain the internal cut section of single-seated globe valve. | To draw and identify the parts of cut-view section of single-seated globe valve. | 2 | CO3 |
| 4 | **LLO4.1** Demonstrate the function of electro-mechanical relay | To test and observe the operation of electro-mechanical relay | 2 | CO4 |
| 5 | **LLO5.1** Explain the reason behind the switching time of a temperature switch. | To find switching time of a temperature switch. | 2 | CO5 |
| 6 | **LLO6.1** Demonstrate the operation of Hydraulic circuits for double acting cylinders. | Implementation and testing of Hydraulic circuits for doubleacting cylinders. | 2 | CO1 |
| 7 | **LLO7.1** Testing of Pneumatic circuits for doubleacting cylinders | Implementation and testing of Pneumatic circuits for doubleacting cylinders. | 2 | CO2 |
| 8 | **LLO8.1** Interpret the pressure to current converter | To find the sensitivity of pressure to current converter | 2 | CO2 |
| 9 | **LLO9.1** Interpret the current to pressure converter. | To find the sensitivity of current to pressure converter. | 2 | CO2 |
| 10 | **LLO10.1** Identify internal parts of the different of control valve | To study different cut view/section of different types of control valve (Butterfly, Ball, Gate Valve) | 2 | CO3 |
| 11 | **LLO11.1** Demonstrate the operation of control valve actuator | To demonstrate the operation of control valve actuator | 2 | CO3 |
| 12 | **LLO12.1** Explain the necessity of valve positioner | To test he performance of a valve positioner. | 2 | CO3 |
| 13 | **LLO13.1** Test any type of switch | To test the given switch | 2 | CO4 |
| 14 | **LLO14.1** Describe the function of Solid-state Relay | To test and observe the operation of Solid-state Relay | 2 | CO4 |
| 15 | **LLO15.1** Explain the reason behind the switching time of a pressure switch. | To find the switching time of pressure switch | 2 | CO5 |
| 16 | **LLO16.1** Demonstrate the DP Transmitter. | To observe the operation of DP Transmitter. | 2 | CO5 |
| 17 | **LLO17.1** Describe functioning of Alarm Annunciator. | To observe the operation of Alarm Annunciator. | 2 | CO5 |

**Note: Experiments Sr. No. 1 to 5 is compulsory and should map all units and Cos. Remaining 07 experiments are to be performing on the importance of topic.**

**V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self-Learning):**

**a. Assignments on every topic & units.**

1. Develop a hydraulic circuit for a double acting cylinder speed control.

2. Develop an OR logic using pneumatic system.
3. Explain construction and working of globe valve.
4. Explain the working of the stepper motor and half step sequence logic.
5. Explain the features of different types of transmitters.

**b. Micro Project:**

1. Simple hydraulic system model for illustration of Pascal's law.
2. Simple pneumatic system model.
3. Control valve actuator of any type.
4. Position alarm using limit switch.
5. Damper position indicator using limit switch.
6. Temperature control system using temp switch.
7. Pressure control system using pressure switch.

## VI. Specification Table:

| Unit No | Topic Title | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|
| | | R Level | U Level | A Level | Total Marks |
| 1 | Hydraulic System Components | 4 | 4 | 4 | 12 |
| 2 | Pneumatic System Components | 2 | 4 | 4 | 10 |
| 3 | Control Valves | 4 | 4 | 4 | 12 |
| 4 | Electrical Control System Components | 4 | 8 | 4 | 16 |
| 5 | Auxiliary Components | 2 | 4 | 4 | 10 |
| | **Total** | **16** | **24** | **20** | **60** |

## VII. Assessment Methodologies/Tools

**Formative assessment (Assessment for Learning)**

- Two offline unit tests of 20 marks each.
- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment based on rubrics for assessment for laboratory process and product related performance indicators. (25 Marks)
- End semester assessment based on theory examination. (60 Marks)

## VIII. Suggested COs - POs Matrix Form

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Outcomes (POs) | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO-1 Basic and Discipline Specific Knowledge** | **PO-2 Problem analysis** | **PO-3 Design/ development of solutions** | **PO-4 Engineering Tools, Experimentation and Testing** | **PO-5 Engineering practices for society, sustainability and environment** | **PO-6 Project Management** | **PO-7 Life-long learning** | **PSO - 1** | **PSO - 2** |
| CO1 | 2 | 2 | 1 | 2 | 1 | -- | 2 | 2 | 1 |
| CO2 | 2 | 2 | 1 | 2 | 1 | -- | 2 | 2 | 1 |
| CO3 | 3 | 2 | 1 | 2 | 1 | -- | 2 | 2 | 1 |
| CO4 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 |
| CO5 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 |
| Legends: - High:03, Medium:02, Low:01, No Mapping: -- | | | | | | | | | |

## IX. Suggested Learning Materials / Books

| Sr.No | Title | Author | ISBN No. |
|---|---|---|---|
| 1 | Control System Component | M.D. Desai, Prentice Hall India Learning Private Limited; Standard Edition (1 January 2008) | ISBN:978-8120336056 |
| 2 | Pneumatic Systems: Principles and Maintenance | S. R. Majumdhar, McGraw Hill Education; 1st edition (1 July 2017) | ISBN:978-0074602317 |
| 3 | A text book of Electrical Technology | B.L. Thereja, AK Theraja, S Chand; Twenty Third edition | ISBN:978-8121924405 |
| 4 | Hydraulics and Pneumatics: A Technician's and Engineer's Guide | Andrew Parr, Butterworth-Heinemann; 3rd edition,2011 | ISBN:978-0080966748 |
| 5 | Process control and Instrumenttechnology | C. D. Johnson, Prentice Hall India Learning Private Limited; 8th edition,2006 | ISBN:978-8120330290 |
| 6 | Process Control | Peter Harriott, Tata McGraw Hill,1edition ,2012 | ISBN:978-0070993426 |
| **7** | Industrial Electronics | Thomas E. Kissell, Prentice Hall Publications,3rd edition, 2012 | ISBN:978-0131218642 |
| 8 | Pneumatics, Festo Didactic | Festo | -- |
| 9 | Hydraulics, Festo Didactic | Festo | -- |
| 10 | Actuator Design using shape memory coil | Tom Waram, T.C. Waram,1993 | ISBN:096994280X, 9780969942801 |

## X. Learning Websites & Portals

| Sr.No | Link / Portal | Description |
|---|---|---|
| 1 | https://nptel.ac.in/courses/112/105/112105047/ | ------ |
| 2 | https://nptel.ac.in/courses/112/103/112103249/ | ------ |
| 3 | https://www.youtube.com/watch?v=MbKrIieogNc | ------ |
| 4 | https://www.youtube.com/watch?v=FVR7AC8ExIM | ------ |
| 5 | https://www.youtube.com/watch?v=c-468UPUV2o | ------ |
| 6 | https://www.youtube.com/watch?v=w5_89hBeRAA | ------ |
| 7 | https://nptel.ac.in/courses/103/105/103105130/ | ------ |

## XI. Academic Consultation Committee/Industry Consultation Committee:

| Sr. No | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mr. Pradyot Shingare | Jr. Officer Maintenance | Avesta pharmaceutical Pvt. Ltd., Vikramgarh. |
| 2 | Mr. D. M. Naigade | Lecturer, Mechanical Engg. | Govt. Polytechnic . Karad |
| 3 | Dr. B.B. Sul | Head of Department Instrumentation Engineering | Govt. Polytechnic, Mumbai |
| 4 | Mr. K.U. Dawane | Lecturer in Instrumentation | Govt. Polytechnic, Mumbai |

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

| **Programme: Diploma in Instrumentation Engineering (Sandwich Pattern)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code: IS23103** | | | | | | **Course Title: Basics of Electrical and Electronic Engineering** | | | | | | | |
| **Compulsory / Optional: Compulsory** | | | | | | | | | | | | | |
| **Learning Scheme and Credits** | | | | | | **Assessment Scheme** | | | | | | | |
| **CL** | **TL** | **LL** | **SLH** | **NLH** | **Credits** | **FA-TH** | | **SA-TH (2:30 Hrs.)** | **FA-PR** | **SA-** | | **SLA** | **Total** |
| | | | | | | **T1** | **T2** | | | **PR** | **OR** | | |
| 3 | -- | 4 | 1 | 8 | 4 | 20 | 20 | 60 | 25 | 25@ | -- | 25 | 175 |

**Total IKS Hrs. for course: 01 Hrs.**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

**Note:**
1. FA-TH represents addition of two 20 marks class tests conducted during the term.
2. FA-PR represents tutorial/practical term work of 25 Marks.
3. SLA represents self-learning Assessment of 25 Marks.
4. SA-TH represents the end term theory examination of 60 Marks.
5. SA-PR represents the end term Practical examination of 25 Marks

## I. Rationale:

Instrumentation diploma holders comes across electrical and electronic circuits and networks while installation, mounting, testing and troubleshooting of process equipment in industries. All such instruments and equipment need electrical energy for its operation. Students should have the fundamental knowledge of electrical engineering and electronics engineering to handle electrical and electronic equipment, circuits and analyze the AC/DC circuits. This course intends to study the fundamental concepts of electrical and electronic components and circuits.

## II. Industry / Employer Expected Outcome:

The aim of this course is to help the student to achieve the following industry identified outcome through various learning experiences:

1. Understand the basic terminologies in electrical engineering.
2. Simplify the basic level circuits using different principles and theorems.
3. Understand the construction, operation and characteristic of basic electronic components.
4. Choose appropriate electronic components for given application.

**III. Course Outcomes:** Students will be able to achieve & demonstrate the following COs on completion of course based learning

| | |
|---|---|
| CO1 | Define different terminologies of electric circuits. |
| CO2 | Solve simple DC and AC circuits. |
| CO3 | Select appropriate diode for given application. |
| CO4 | Compare BJT with FET and MOSFET. |
| CO5 | Explain regulation and its circuits. |

**Course Content Details:**

| Unit No. | Theory Learning Outcomes (TLO's) aligned to CO's | Topics / Sub-topics |
|---|---|---|
| 1 | **TLO1.1** Define terms used in electrical engineering.<br>**TLO1.2** Demonstrate basic laws of electricity.<br>**TLO1.3** Demonstrate the relationships of passive components with different parameters.<br>**TLO1.4** Explain the concept of DC/AC current.<br>**TLO1.5** Draw phasor representation of passive components. | **Unit-I Basics of Electricity**<br>1.1 Concept of current, electric potential, potential difference, emf, electric power, energy and their units<br>1.2 Ohm's law, Kirchoff's current and voltage laws<br>1.3 Resistance, inductance (self & mutual), capacitance: definition, formulae and effect of temperature<br>1.4 Direct current and Alternating current (Single phase and Three phase)<br>1.5 Definition of Waveform, Instantaneous value, Cycle, Time period, Frequency, Amplitude, Peak value, Average value and RMS value, Form factor and Peak factor for sinusoidal (simple numerical)<br>1.6 Phase, phasor difference and phasor representation for resistor, inductor and capacitor<br>1.7 Ancient Indian knowledge: electricity using battery/cell |
| **Course Outcome: CO1** | **Teaching Hours: 08hrs** | **Marks: 10** |
| **2** | **TLO2.1** Simplify simple series and parallel circuits<br>**TLO2.2** Simplify simple DC networks using theorems<br>**TLO2.3** Simplify simple AC networks<br>**TLO2.4** Draw impedance triangle for basic RLC circuits<br>**TLO2.5** Explain power terminologies and power factor | **Unit-II Circuits and Networks**<br>2.1 DC series and parallel circuits, voltage divider and current divider rule, simple numerical<br>2.2 Statement, explanation and numerical of<br>2.2.1 Mesh/loop analysis<br>2.2.2 Node analysis<br>2.2.3 Thevenin's theorem<br>2.2.4 Norton's theorem<br>2.2.5 Superposition theorem<br>2.2.6 Maximum power transfer theorem<br>2.3 RL, RC and RLC circuits, impedance triangle<br>2.4 Star and Delta connections, it's conversion<br>2.5 Active, reactive and apparent power<br>2.6 Power factor and it's significance |

| | | |
|---|---|---|
| **Course Outcome: CO2** | **Teaching Hours: 12hrs** | **Marks: 16** |
| **3** | **TLO3.1** Draw characteristic of given diode<br>**TLO3.2** Compare different rectifiers<br>**TLO3.3** Differentiate between different clippers and clampers<br>**TLO3.4** Demonstrate applications of given diode | **Unit-III Diodes and it's Applications**<br>3.1 Symbol, Construction, working principle and V-I Characteristic of: Zener diode, LED, Photo diode<br>3.2 Rectifiers: Construction, operation and waveforms of Half wave, full wave (centre tapped, Bridge) rectifiers<br>3.3 Rectifier parameters: average DC value of voltage and current, ripple factor, ripple frequency, PIV, TUF and rectifier efficiency (no derivations, only definition and formulae)<br>3.4 Clippers: : Construction, operation and waveforms of positive, negative and biased clippers<br>3.5 Clampers: Construction, operation and waveforms of positive, negative and biased clampers<br>3.6 Zener diode as voltage regulator<br>3.7 LED applications: indicator, 7-segment display<br>3.8 Photodiode applications: alarm circuit, counter circuit<br>3.9 Ancient Indian knowledge: Vimaana types & control systems, power system |
| **Course Outcome: CO3** | **Teaching Hours: 08hrs** | **Marks: 12** |
| **4** | **TLO4.1** Identify given transistor and its symbol<br>**TLO4.2** Explain working of given BJT<br>**TLO4.3** Differentiate transistor configurations<br>**TLO4.4** Derive current, voltage equations for given biasing circuit<br>**TLO4.5** Differentiate BJT, FET and MOSFET | **Unit-IV Transistors**<br>4.1 Types of transistors and their symbols<br>4.2 Construction, working of PNP and NPN transistors<br>4.3 Construction, working and characteristic curves of CC, CB and CE configurations<br>4.4 Transistor biasing: DC load line, operating point and stabilization<br>4.5 Types of biasing: Circuit and derivations of fixed bias, base bias with emitter feedback, voltage divider bias<br>4.6 Construction, working and characteristic of JFET and MOSFET |
| **Course Outcome: CO4** | **Teaching Hours: 12hrs** | **Marks: 14** |
| **5** | **TLO5.1** Compare different passive filters<br>**TLO5.2** Define different voltage regulations<br>**TLO5.3** Explain given transistorized regulator | **Unit-V Voltage Regulators**<br>5.1 Types, working and waveforms of passive filters<br>5.2 Block diagram of DC regulated power supply<br>5.3 Load and line regulation<br>5.4 Construction and working of transistorized series and shunt regulators |
| **Course Outcome: CO5** | **Teaching Hours: 05hrs** | **Marks: 08** |

**IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.**

| Sr No | Practical / Tutorial / Laboratory Learning Outcome (LLO) | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of Hrs. | Relevant COs |
|---|---|---|---|---|
| 1 | **LLO1.1** Measure given electrical parameters | Measure current, voltage, power and energy in single-phase circuit | 02 | CO1 |
| 2 | **LLO2.1** Demonstrate behavior of current and voltage in resistive networks | Verify Kirchoff's current and voltage laws | 02 | CO1 |
| 3 | **LLO3.1** Demonstrate voltage and current divider rules | Measure voltages and currents in series and parallel resistive circuit | 04 | CO2 |
| 4 | **LLO4.1** Demonstrate the given network theorem | Verify Superposition theorem applicable to D.C. circuit | 04 | CO2 |
| 5 | | Verify Thevenin's theorem applicable to D.C. circuit | 02 | CO2 |
| 6 | | Verify Norton's theorem applicable to D.C. circuit | 02 | CO2 |
| 7 | | Verify Maximum power transfer theorem applicable to D.C. circuit | 02 | CO2 |
| 8 | **LLO5.1** Demonstrate given balanced star/delta circuit | Verify relationship between line and phase values of voltage and current in star and delta connected balanced load | 04 | CO2 |
| 9 | **LLO6.1** Measure given parameters using CRO/DSO of AC/DC waveforms | Observe AC and DC waveform on CRO and find magnitude of DC voltage, peak average, R.M.S. values and frequency of AC voltage | 02 | CO2 |
| 10 | **LLO7.1** Calculate different parameters of given RLC circuit | Determine impedance, phase angle of R-L series circuit, plot phasor diagram and also calculate active, reactive and apparent power consumed in R-L series circuit. | 04 | CO2 |
| 11 | **LLO8.1** Build the circuit for given diode characteristic | Plot the V-I characteristic of Zener diode | 02 | CO3 |
| 12 | **LLO8.2** Plot V-I characteristic of given diode | Plot the V-I characteristic of Photo diode | 02 | CO3 |
| 13 | **LLO9.1** Demonstrate the application circuit for given diode | Construct and test the circuit for Power ON indicator using LED | 02 | CO3 |
| 14 | | Construct and test object detector circuit using photodiode | 04 | CO3 |
| 15 | **LLO10.1** Build the circuit for given transistor characteristic | Plot V-I characteristics of BJT and find input and output resistance of BJT in CE Mode | 02 | CO4 |
| 16 | **LLO10.2** Plot V-I characteristic of given transistor | Plot V-I characteristics of BJT and find input and output resistance of BJT in CB Mode | 02 | CO4 |
| 17 | | Plot the V-I characteristic of FET | 02 | CO4 |

| | | | | |
|---|---|---|---|---|
| 18 | | Plot the V-I characteristic of MOSFET | 02 | CO4 |
| 19 | **LLO11.1** Demonstrate the voltage divider biasing circuit | Construct and test the circuit for voltage divider biasing | 02 | CO4 |
| 20 | **LLO12.1** Demonstrate the given clipper circuits with its waveform | Construct and test clipper circuit (Positive, negative and biased) Draw input and output waveform | 02 | CO4 |
| 21 | **LLO13.1** Demonstrate the given clamper circuits with its waveform | Construct and test clamper circuit (Positive, negative and biased) Draw input and output waveform | 02 | CO4 |
| 22 | **LLO14.1** Demonstrate the waveforms for given rectifier circuit | Construct and test half wave rectifier and draw input/output waveforms | 02 | CO5 |
| 23 | | Construct and test full wave bridge rectifier and draw input/output waveforms | 02 | CO5 |
| 24 | **LLO15.1** Demonstrate the waveforms for given filter circuit | Construct and test Capacitive filter using Bridge rectifier | 02 | CO5 |
| 25 | | Construct and test π filter using Bridge rectifier | 02 | CO5 |
| | | **Total Hours** | **60** | |

**Note: Minimum 20 experiments are compulsory and should be chosen such that all COs will be covered.**

**V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self-Learning):**

1. **Assignments: (Any four assignments)**
   1. Prepare comparison chart for Resistance, Inductance and Capacitance with their formulae. State its dependency on various parameters and also effect of temperature.
   2. Draw drawing sheet to show phasor representation of resistor, inductor and capacitor.
   3. Prepare drawing sheet of active, reactive and apparent power with suitable example.
   4. Prepare a chart showing comparison between all three types of rectifiers along with necessary diagram.
   5. Prepare a chart showing construction, and waveforms of all three types of clippers and clampers.
   6. Prepare Data Sheets of Zener, photo diodes and LED.
   7. Prepare Data Sheets of BJT, FET and MOSFET.
   8. Prepare chart showing different types of passive filters.
2. **Micro Project: (Any one micro project in group of two students)**
   1. Prepare model/circuit to verify Kirchoff's voltage and Current laws.
   2. Prepare model to verify Ohm's law.
   3. Prepare model to show change in resistance with its relative parameters.
   4. Prepare model to show change in inductance with its relative parameters.
   5. Prepare model to show change in capacitance with its relative parameters.
   6. Prepare circuit to verify Thevenin's Theorem.
   7. Prepare circuit to verify Norton's Theorem.
   8. Prepare circuit to verify Superposition Theorem.
   9. Build circuit for Half wave rectifier and test.
   10. Build circuit for full wave rectifier and test.
   11. Build circuit for all three types of clippers and test.

12. Build circuit for all three types of clampers and test.
13. Build regulator circuit using Zener diode and test.
14. Build alarm circuit using photodiode and test.
15. Build counter circuit using photodiode and test.
16. Build circuit to verify V-I characteristic of BJT.
17. Build circuit to verify V-I characteristic of FET.
18. Build circuit to verify V-I characteristic of MOSFET.
19. Build voltage divider biasing circuit and test.
20. Build circuit to test all three types of filters.
21. Build circuit for series regulator and test.
22. Build circuit for shunt regulator and test.

**3. Activities: (To be performed in group)**

1. Act play to understand the concept of Ohm's law, Kirchoff's voltage and current laws.
2. Prepare model using water tank, pipes and water tap to understand working of transistor.

## VI. Specification Table:

| Unit No | Topic Title | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|
| | | R Level | U Level | A Level | Total Marks |
| 1 | Basics of Electricity | 4 | 4 | 2 | 10 |
| 2 | Circuits and Networks | 2 | 6 | 8 | 16 |
| 3 | Diodes and it's Applications | 4 | 4 | 4 | 12 |
| 4 | Transistors | 4 | 6 | 4 | 14 |
| 5 | Voltage Regulators | 2 | 2 | 4 | 08 |
| | **Total Marks** | **16** | **22** | **22** | **60** |

## VII. Assessment Methodologies/Tools:

**Formative assessment (Assessment for Learning)**

- Two offline unit tests of 20 marks each.
- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)
- Rubrics for continuous assessment of self-learning assignments/ micro project/ activities based on process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment based on rubrics for assessment for laboratory process and product related performance indicators. (25 Marks)
- End semester assessment based on theory examination. (60 Marks)

## VIII. Suggested COs - POs Matrix Form

| Course Out-comes (COs) | Programme Outcomes (POs) | | | | | | | Programme Outcomes (POs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Know-ledge | PO-2 Problem Analysis | PO-3 Design/ Develop-ment of Solutions | PO-4 Engi-neering Tools, Experime-ntation | PO-5 Engi-neering Practices For Society, Sustain-ability and Environ-ment | PO-6 Project Manage-ment | PO-7 Life Long Learn-ing | PSO - 1 | PSO - 2 |
| **CO1** | 3 | 1 | 1 | -- | -- | 1 | 2 | 2 | -- |
| **CO2** | 3 | 2 | 1 | -- | -- | 1 | 2 | 2 | -- |
| **CO3** | 3 | -- | -- | -- | 1 | 1 | 2 | 2 | -- |
| **CO4** | 3 | -- | 1 | -- | -- | 1 | 2 | 2 | -- |
| **CO5** | 3 | -- | -- | -- | -- | 1 | 2 | 2 | -- |
| **Legends: - High:03, Medium:02, Low:01, No Mapping: --** | | | | | | | | | |

## IX. Suggested Learning Materials / Books

| Sr. No. | Title | Author, Publication, Edition and Year of Publication | ISBN NO. |
|---|---|---|---|
| 1 | Electrical Technology (Vol- I) | B. L. Theraja and A. K. Theraja, S. Chand and Co. Ltd. 64th Edition 2020 | 9788121924405 |
| 2 | Basic Electrical Engineering | V. K. Mehta and Rohit Mehta, S. Chand and Co. Ltd. 13th Edition 2012 | 978812190871 |
| 3 | Electrical Technology | Edward Hughes, ELBS Publications, 11th Edition 2012 | 9780582226968 |
| 4 | Electronic Devices and Circuit Theory | Boylestad Robert, Louis Nashelsky Pearson Education, 11th Edition, 2015 | 9789332542600 |
| 5 | A Text book of Applied Electronics | Sedha R. S. S. Chand Publications 3rd Edition, 2008 | 9788121927833 |
| 6 | Electronics Principles | Malvino Albert, David bates McGraw Hill Education 7th Edition, 2017 | 9780070634244 |
| **7** | Principles of Electronics | Mehta V.K. S. Chand and Company 7th Edition, 2014 | 9788121917230 |
| 8 | Basic Electronic Engineering | Baru V., Kaduskar R. Gaikwad S.T. Dreamtech Press 7th Edition, 2011 | 9789350040126 |

## X. Learning Websites & Portals

| Sr. No. | Link / Portal | Description |
|---|---|---|
| 1 | https://www.youtube.com/ "type name of topics" | Enter the topic you want to search |
| 2 | http://vlabs.iitkgp.ernet.in/be/#<br>http://vlabs.iitkgp.ernet.in/asnm/#<br>http://vlabs.iitkgp.ernet.in/psac/# | One can perform online practical's on all chapters |
| 3 | https://www.electronicshub.org/ | Chapter 3-5 theory topics |
| 4 | https://www.allaboutcircuits.com | Chapter 3-5 theory topics |
| 5 | https://www.slideshare.net/babaiarup3/basic-electronics-20135927 | Chapter 3-5 theory topics |
| 6 | https://en.wikipedia.org/wiki/"type name of topic" | Theory on all 1-5 topics |
| 7 | www.nptel.com | Chapter 3-5 theory topics also video lectures |
| 8 | www.electrical4u.com | Chapter 1-2 theory topics |
| 9 | www.khanacademy.org | Chapter 3-5 theory topics |
| 10 | www.tinkercad.com | One can build and simulate the circuit |

## XI. Academic Consultation Committee/Industry Consultation Committee:

| Sr. No. | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mr. Rahul Shewale | Executive Engineer | PWD, Vashi, Navi Mumbai |
| 2 | Mr. Anil C. Gurav | Lecturer in Electronics Engg. | St. Xavier's Polytechnic, Mahim, Mumbai |
| 3 | Mrs. Ashvini S. Patil | Lecturer in Electrical Engg. | Government Polytechnic, Mumbai |
| 4 | Mr. Firoz S. Bagwan | Lecturer in Instrumentation | Government Polytechnic, Mumbai |

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

| **Programme: Diploma in Instrumentation Engineering (Sandwich Pattern)** | |
|---|---|
| **Course Code: IS23603** | **Course Title: Electronic Measuring Instruments** |
| **Compulsory / Optional: Compulsory** | |

| **Learning Scheme and Credits** | | | | | | **Assessment Scheme** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CL** | **TL** | **LL** | **SLH** | **NLH** | **Credits** | **FA-TH** | | **SA-TH (2.30 Hrs.)** | **FA-PR** | **SA-** | | **SLA** | **Total** |
| | | | | | | **T1** | **T2** | | | **PR** | **OR** | | |
| 03 | -- | 02 | 01 | 06 | 03 | -- | -- | -- | 25 | 50# | -- | 25 | 100 |

**Total IKS Hrs. for course: ------**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

**Note:**
1. FA-PR represents tutorial/practical term work of 25 Marks.
2. SA-OR represents end term oral examination of 25 Marks.
3. SLA represents self-learning Assessment of 25 Marks.

## I. Rationale

Instrumentation engineers have to deal with the measuring instruments to acquaint information, analyze it and troubleshoot the faults in instrumentation systems. This course intends to study the facts, concepts, principles of analog &digital electronic measuring instruments and apply it to measure various signals indifferent industrial applications.

## II. Industry / Employer Expected Outcome

The aim of this course is to help the student to achieve the following industry identified outcome through various learning experiences: "Use basic electronic instruments for measuring various parameters".

## III. Course Outcomes:

Students will be able to achieve & demonstrate the following COs on completion of course based learning

| | |
|---|---|
| CO1 | Use analog bridges to measure given passive components. |
| CO2 | Measure electrical parameters by using analog meters. |
| CO3 | Measure electrical parameters by using digital meters. |
| CO4 | Use CRO and Function Generator to measure the electrical parameters of a given signal. |

**Course Content Details:**

| Unit No. | Theory Learning Outcomes (TLO's)aligned to CO's | Topics / Sub-topics |
|---|---|---|
| 1 | **TLO1.1** Explain the working of given bridges with sketches.<br>**TLO1.2** Describe the procedure to measure given unknown resistance, capacitance and inductance using relevant bridges.<br>**TLO1.3** Differentiate between AC and DC bridges. | **Unit-I Bridges**<br>1.1 DC bridges: Wheatstone Bridges, Kelvin bridges, measurement of resistance.<br>1.2 AC bridges: Use of Shearing bridge, Maxwell bridge. |
| **Course Outcome: CO1** | | **Teaching Hours: 05 hrs.** |
| 2 | **TLO2.1** Explain the construction and Working principle of the given Permanent magnet moving coil instrument with diagram.<br>**TLO2.2** Describe the procedure to convert PMMC instrument into DC/AC Ammeter and voltmeter for given range.<br>**TLO2.3** Explain the working of given type of ohmmeter with diagram.<br>**TLO2.4** Explain the construction and working of Analog multimeter with diagram.<br>**TLO2.5** Prepare specification of given analog meter. | **Unit -II Analog AC and DC meters**<br>2.1 Classification of Analog Instruments.<br>2.2 Permanent magnet moving coil and permanent magnet moving iron meter - Principle, Working, Construction<br>2.3 Analog DC Ammeters and Voltmeters<br>2.4 Analog AC Ammeter and Voltmeter-Average Responding type<br>2.5 Ohmmeter- series and shunt, Megohmmeter (Megger meter)<br>2.6 Analog Multimeter- block diagram and operation.<br>2.7 Analog source meter- block diagram and operation. |
| **Course Outcome: CO2** | | **Teaching Hours :12hrs.** |
| 3 | **TLO3.1** Determine Resolution, Sensitivity and Accuracy of digital display of the given digital display.<br>**TLO3.2** Explain the working and construction of given type of digital meter with diagram.<br>**TLO3.3** Describe the procedure to measure the given electrical parameter using relevant digital meter.<br>**TLO3.4** Prepare a specification for given digital meter. | **Unit-III Digital meters**<br>3.1 Resolution, Sensitivity and Accuracy of digital display.<br>3.2 Digital Voltmeter-Ramp type DVM, Successive approximation type DVM, Dual slope type DVM. (Block diagram, Operation and waveforms)<br>3.3 Digital Multi meter -Block Diagram and operation.<br>3.4 Digital frequency meter-Block Diagram and operation only.<br>3.5 LCR, Q- meter-Block diagram and operation only. |
| **Course Outcome: CO3** | | **Teaching Hours :10hrs.** |

| | | |
|---|---|---|
| 4 | **TLO4.1** Describe the given blocks and working of given type of oscilloscope with diagram.<br>**TLO4.2** Differentiate between CRO and DSO.<br>**TLO4.3** Describe the procedure to measure the given parameter using CRO and to test the given electronic /electrical components using CRO.<br>**TLO4.4** Prepare specification for given oscilloscope. | **Unit-IV Cathode ray oscilloscope**<br>4.1 Single beam/single trace, Digital Storage Oscilloscope-Basic block diagram, working<br>4.2 Components of CRO: Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, attenuator, delay line, specifications<br>4.3 CRO probe: general block diagram, types of probes<br>4.4 CRO measurement: voltage, time period, frequency, phase angle, Lissajous pattern. |
| **Course Outcome: CO4** | | **Teaching Hours :12 hrs.** |
| 5 | **TLO5.1** Describe the working of types of signal generator.<br>**TLO5.2** Describe the procedure to test the given signal using relevant type of function generator/ Pulse generator. | **Unit-V Signal generator**<br>5.1 Concept of signal generator.<br>5.2 Need, block diagram, operation, applications and specifications of signal generators: function generator and pulse generator.<br>5.3 Block diagram, operation, applications and specifications of logic analyzer |
| **Course Outcome: CO4** | | **Teaching Hours :06 hrs.** |

## IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

| Sr No | Practical / Tutorial / Laboratory Learning Outcome (LLO) | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|---|---|---|---|
| 1 | **LLO1.1** Identify the bridge to measure the resistance.<br>**LLO1.2** Find out value of unknown resistance by using wheat stone bridge. | Use Wheatstone bridge to determine unknown resistance. | 2 | CO1 |
| 2 | **LLO2.1** Identify the parts of PMMC instrument.<br>**LLO2.2** Demonstrate PMMC instrument to measure different electrical parameters. | Identify the parts of PMMC analog multimeter and perform measurement of different electrical parameters. | 2 | CO2 |
| 3 | **LLO3.1** Identify front panel control of DMM.<br>**LLO3.2** Demonstrate DMM instrument to measure different electrical parameters. | Identify the front panel control of DMM and measure different electrical parameters using DMM. | 2 | CO3 |
| 4 | **LLO4.1** Identify the type of given oscilloscope.<br>**LLO4.2** Identify front panel controls of CRO.<br>**LLO4.3** Calculate amplitude and frequency measurement of different electrical signal using CRO. | Identify the front panel control of CRO and measure amplitude and frequency of different signals using CRO. | 2 | CO4 |

| | | | | |
|---|---|---|---|---|
| 5 | **LLO5.1** Identify front panel controls of function generator.<br>**LLO5.2** Demonstrate amplitude and frequency of different waveforms available at the output of function generator. | Identify the front panel control of function generator and measure frequency and amplitude of different waveforms available at the output of function generator | 2 | CO4 |
| 6 | **LLO6.1** Use virtual lab simulator to stimulate Kelvin double bridge.<br>**LLO6.2** Determine the unknown resistance. | Use virtual lab to stimulate Kelvin double bridge for determination unknown resistance. | 2 | CO1 |
| 7 | **LLO7.1** Calculate the sensitivity of the given analog voltmeter. | Calculate the sensitivity of the given analog voltmeter. | 2 | CO2 |
| 8 | **LLO8.1** Measure the values of given resistance, inductance, capacitance. | Observe values of given resistance, inductance, capacitance using LCR meter. | 2 | CO3 |
| 9 | **LLO9.1** Generate Lissajous pattern on CRO.<br>**LLO9.2** Find out unknown frequency of given signal using Lissajous patterns.<br>**LLO9.3** Calculate phase difference with respect to given signal using Lissajous patterns | Measure unknown frequency and phase difference with respect to given signal using Lissajous patterns. | 2 | CO4 |
| 10 | **LLO10.1** Identify the type of given oscilloscope.<br>**LLO10.2** Select relevant knob of DSO to measure various parameters of given signal. | Identify the front panel control of DSO and measure various parameters of given signal. | 2 | CO4 |
| 11 | **LLO11.1** Select the bridge to measure the capacitance.<br>**LLO11.2** Find out value of unknown capacitance by using Schering bridge. | Use Schering bridge to determine unknown capacitance on virtual lab. | 2 | CO1 |
| 12 | **LLO12.1** Identify the bridge to measure the self - inductance.<br>**LLO12.2** Calculate the value of self-inductance of unknown coil by using Maxwell bridge. | Use Maxwell bridge to determine self-inductance of unknown coil on virtual lab. | 2 | CO1 |
| 13 | **LLO13.1** Test the given components using CRO.<br>**LLO13.2** Draw the observed nature of patterns/waveforms. | Testing of components using CRO. (Resistors, Capacitors, Transistors, PN junction diode, Zener Diode and LED). Draw the observed nature of patterns/waveforms. | 2 | CO4 |
| 14 | **LLO14.1** Use front panel controls to observe signal on DSO.<br>**LLO14.2** Measure amplitude and frequency of given signal using cursor method using DSO. | Measure amplitude and frequency of given signal using cursor method using DSO. | 2 | CO4 |
| 15 | **LLO15.1** Identify the given instrument.<br>**LLO15.2** Determine the frequency content of given signal. | Identify the front panel control of logic analyzer and determine the frequency content of given signal. | 2 | CO4 |
| | | **Total hrs.** | **30** | |

**Note: Minimum 12 experiments should be performed in a term for completion of TW (All COs should be covered compulsorily).**

**V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning): (Minimum 05 Assignments)**

1. Compile board specification of CRO, DSO, LCR meter, Logic analyzer using data sheets.
2. Develop a report of electronic instruments used in laboratory.
3. Prepare a chart to display types of units.
4. Prepare a chart to display types of instruments.
5. Prepare a chart to display different types of analog instruments.
6. Prepare a chart to display types of digital instruments mostly used in industries.
7. Prepare a chart to display front panel of CRO, DSO, LCR meter, Logic analyzer.
8. Prepare instruction chart for safety rule / safe handling of electronic measuring instruments.
9. Build and test Wheatstone bridge using LDR/potentiometer.
10. Build and test given power supply using CRO and DMM.
11. Find the fault in the given laboratory electronic measuring instruments.
12. Prepare a report on maintenance of any electronic instrument.
13. Visit exhibition and industries to collect information about electronic measuring instruments.

**VI. Specification Table:**

**----------Not Applicable----------**

**VII. Assessment Methodologies/Tools:**

**Formative assessment (Assessment for Learning)**

- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)
- Rubrics for continuous assessment of self-learning assignments/ micro project/ activities based on process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment based on rubrics for assessment for laboratory process and product related performance indicators. (50 Marks)

**VIII. Suggested COs – POs Matrix Form (Instrumentation Engineering)**

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO - 1 | PSO - 2 |
| CO1 | 2 | 1 | -- | 3 | -- | -- | 1 | 2 | -- |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO2 | 2 | -- | -- | 2 | -- | -- | 2 | 2 | -- |
| CO3 | 2 | -- | -- | 2 | -- | -- | 2 | 2 | 1 |
| CO4 | 2 | -- | -- | 3 | -- | -- | 2 | 2 | 1 |
| Legends: - High:03, Medium:02, Low:01, No Mapping: -- | | | | | | | | | |

**IX. Suggested Learning Materials / Books**

| Sr. No. | Title | Author, Publisher, Edition and Year Of publication | ISBN No. |
|---|---|---|---|
| 1 | Electrical and Electronic Measurements and Instrumentations | A. K. Sawhney, Dhanpat Rai and Co. 2015 | 9788177001006 |
| 2 | Electronic Instruments | H. S. Kalsi, Tata McGraw Hills,3rd edition, 2012 | 9780070702066 |
| 3 | Electronic Instrumentation and Measurement tech. | W. D. Cooper, 3rd edition Prentice Hall 1989 | 9780135932940 |
| 4 | Electronic Measurements and Instrumentation | K Lal Kishore, 2nd edition Pearson 2014 | 9788131721995 |
| 5 | Electronic Measurement and Instrumentation | R. S. Sedha, S. Chand and Company, New Delhi 2013 | 9788121997751 |
| 6 | Electronic Instrumentation and Measurement | Khurana & Rohit, 1st edition Vikas Publication House, New Delhi 2016 | 9789325990203 |

**X. Learning Websites & Portals**

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://nationalmaglab.org/magnet-academy/watch-play/interactive-tutorials/wheatstone-bridge/ | To stimulate Wheatstone bridge |
| 2 | https://asnm-iitkgp.vlabs.ac.in/List%20of%20experiments.html | To stimulate Kelvin, Schering, Maxwell bridge |
| 3 | https://www.allaboutcircuits.com/textbook/alternating-current/chpt-12/ac-voltmeters-ammeters/ | Voltmeter and Ammeter |
| 4 | https://www.elprocus.com/cro-cathode-ray-oscilloscope-working-and-application/ | Details of CRO |
| 5 | https://www.slideshare.net/dineshsharma9277/analog-and-digital-multimeters | Analog and Digital multimeters |
| 6 | https://www.electronics-notes.com/articles/test-methods/ | Description of instruments |
| 7 | https://www.youtube.com/ "type name of topics" | ------ |

**XI. Academic Consultation Committee/Industry Consultation Committee:**

| Sr. No | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mr. T. D. Shinde | Project Manager | Emerson Process Management Pvt. Ltd. |
| 2 | Mrs. V. A. Joshi | Head of Department | V. P. M. Polytechnic, Thane |
| 3 | Mr. S. G. Thube | Lecturer in Instrumentation Engg. | Government Polytechnic, Mumbai |
| 4 | Mrs. S. T. Shinde | Lecturer in Instrumentation Engg. | Government Polytechnic, Mumbai |

Coordinator
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

| Programme: Diploma in Instrumentation Engineering (Sandwich Pattern) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: IS23602 | | | | | | Course Title: Process Automation Drawing | | | | | | | |
| Compulsory / Optional: Compulsory | | | | | | | | | | | | | |
| Learning Scheme and Credits | | | | | | Assessment Scheme | | | | | | | |
| CL | TL | LL | SLH | NLH | Credits | FA-TH | | SA-TH (2:30 Hrs.) | FA-PR | SA- | | SLA | Total |
| | | | | | | T1 | T2 | | | PR | OR | | |
| -- | -- | 4 | 2 | 6 | 3 | -- | -- | -- | 25 | 50@ | -- | 25 | 100 |

**Total IKS Hrs. for course: -- hrs.**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment, IKS- Indian Knowledge System

**Legends:** @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

**Note:**
1. FA-PR represents tutorial/practical term work of 25 Marks.
2. SA-PR represent final end term practical term work of 50 Marks
3. SLA represents self-learning Assessment of 25 Marks.

## I. Rationale:

Instrumentation diploma engineers are expected to work in different process industries such as oil and gas refinery, petrochemical, chemical, power, fertilizer industries, etc. and also in EPC based project consultanciesas a design engineer, installation engineer, operation engineer, and maintenance engineer. Basic knowledge of International Society of Automation (ISA) symbols of various process instruments and equipment is essential for Instrumentation professional while referring various process automation drawings such as process flow diagram (PFD), process and instrumentation drawing (P & ID), loop diagrams, hookup diagrams, etc. This course is introduced with this view in mind that students will acquire knowledge and skills to identify, draw, and use ISA symbols on given process automation drawings

## II. Industry / Employer Expected Outcome:

The aim of this course is to help the student to achieve the following industry identified outcome through various learning experiences:

1. Identify and draw ISA symbols for different process instruments and process equipment.
2. Use appropriate drawing software tool to draw different process automation drawings.

## III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning:

| | |
|---|---|
| CO1 | Identify and draw the ISA symbols of various pipelines/instrument lines/signals and general process instruments. |
| CO2 | Identify and draw the ISA symbols of different process instruments and electrical schematic. |

| | |
|---|---|
| CO3 | Use appropriate drawing software tool to draw simple process flow diagram (PFD) of a process unit. |
| CO4 | Use appropriate drawing software tool to draw simple process and instrumentation diagram (P & ID) of a process unit. |
| CO5 | Use appropriate drawing software tool to draw simple loop diagram of given process control loop. |

## IV. Course Content Details:

| Unit No. | Theory Learning Outcomes (TLO's) aligned to CO's | Topics / Sub-topics |
|---|---|---|
| 1. | **TLO1.1** Identify ISA symbols of different instrument lines/signals, pipelines, and various general process instruments.<br>**TLO1.2** Draw ISA symbols of various instrument lines/signals and general process instruments using suitable drawing software tool.<br>**TLO1.3** Identify ISA symbols of measuring and regulating instruments - Flow/ Level/ Pressure/ Temperature.<br>**TLO1.4** Draw ISA symbols of measuring and regulating instruments (Flow/ Level/ Pressure/ Temperature) using suitable drawing software tool.<br>**TLO1.5** Define tag numbers for different process instruments- primary elements, transmitters, controllers, and regulators. | **Unit -I. Identification & Drawing of Basic ISA symbols**<br>1.1 **Instrument line symbols-** Pipeline (Process flow line), Instrument to process/equipment connection, Steam line, Cooling water line, Instrument air supply, Instrument electric supply, Pneumatic signal, Electronic/Electrical signal, Hydraulic signal, Guided electromagnetic/sonic signal, non-guided electromagnetic/sonic signal, software/data communication link, and wireless communication link.<br>1.2 **General process instrument symbols-** Discrete (single) instrument, Shared display & control instrument, Computer/software instruments, and Programmable Logic Controller (PLC) with reference to their locations- Field mounted, Front mounted on main control panel/console, & back mounted on main control panel/cabinet).<br>1.3 **Symbols of measuring instruments-**<br>1.3.1 Flow Instruments- Orifice plate, Orifice plate with flow indicator, Orifice plate with flow transmitter, Venturi tube, Pitot tube, Rotameter (Variable area flow indicator), Turbine-type flow indicator, Magnetic flowmeter, Ultrasonic flowmeter, Positive-displacement type flowmeter, Coriolis flowmeter, and Thermal mass flowmeter.<br>1.3.2 Level Instruments- Sight glass level gauge, Level indicator, Level transmitter, and Level transmitter with level alarm high, Radar/Ultrasonic level transmitter.<br>1.3.3 Pressure Instruments- Pressure indicator and Pressure transmitter.<br>1.3.4 Temperature Instruments- Temperature element with thermowell, temperature |

| | | |
|---|---|---|
| | | indicator, temperature transmitter.<br>1.4 **Symbols of regulating instruments**<br>Pressure reducing regulator, Pressure relief valve/ safety valve, Rupture disk, Temperature regulator, Level regulator, Flow regulator.<br>1.5 **Defining tag numbers for process instruments –** for primary variables- temperature/pressure/flow/level and covering major functions- sensing, indication, transmission, control, recording, and alarming. |
| **Course Outcome: CO1** | | |
| **2.** | **TLO2.1** Identify ISA symbols of different control valve bodies and actuators.<br>**TLO2.2** Draw ISA symbols of different control valve bodies and actuators using suitable drawing software tool.<br>**TLO2.3** Identify ISA symbols of electrical schematic devices.<br>**TLO2.4** Draw ISA symbols of electrical schematic devices using drawing suitable software tool. | **Unit -II. Identification & Drawing of ISA Symbols of Control Valves and Electrical Schematic Devices**<br>2.1 **Control valve body symbols-** General two-way valve, Globe valve, Two-way angle valve, Three-way angle valve, Butterfly valve, Ball valve, Plug valve, Diaphragm valve, Pinch valve, General damper/louver, Fail-Open (FO) valve, Fail-Closed (FC) valve, and Fail-Locked in last position (FL) valve.<br>2.2 **Control valve actuator symbols-** Spring-diaphragm actuator, Spring-diaphragm actuator with valve positioner, Rotary-motorized actuator, Solenoid actuator, single-acting and double-acting piston-cylinder actuators, electro-hydraulic actuator, valve actuator with electro-pneumatic converter, and hand wheel operated actuator.<br>2.3 **Electrical schematic devices symbols-** Normally Open (NO) momentary push button, Normally Closed (NC) momentary push button, single-pole normally open toggle switch, single-pole normally closed toggle switch, position limit switch, temperature limit switch, pressure limit switch, Level limit switch, Flow limit switch, Control relay coil, Relay coil contacts-NO & NC, Solenoid coil, Pilot light, Buzzer, Motor coil, Fuse, Thermal overload, Circuit breaker, and Transformer. |
| **Course Outcome: CO2** | | |

| | | |
|---|---|---|
| **3.** | **TLO3.1** Identify symbols of different process equipment drawn on given PFD of a process unit.<br>**TLO3.2** Draw symbols of different process equipment used in given PFD of a process unit using suitable drawing software tool.<br>**TLO3.3** Draw the PFD of given process unit using suitable drawing software tool.<br>**TLO3.4** Define line numbering. | **Unit -III. Identification & Drawing of Process Flow Diagram (PFD)**<br>3.1 Process equipment symbols- Distillation column, Jacketed vessel, Reactor, Vessel, Atmospheric tank, Bin, Shell-and-tube heat exchanger, Evaporator, Boiler, Rotary dryer, Crystallizer, Centrifugal and reciprocating Pumps & Compressors, Steam/gas turbine, Cooling tower, Cyclone separator, Conveyor belt, Agitator, Blower.<br>3.2 Overview of PFD for process unit(s) used in process industry- chemical/power/fertilizer/oil & gas refinery, etc.<br>3.3 Identification and drawing of process equipment symbols used in given PFD of a process unit.<br>3.4 Drawing PFD of given process unit used in process industry- chemical/power/fertilizer/oil & gas refinery, etc.<br>3.5 Pipeline and process equipment labelling. |
| **Course Outcome: CO3** | | |
| **4.** | **TLO 4- Course Outcome: CO4**<br>**TLO4.1** Identify symbols of various process instruments and process equipment drawn on given P & ID of process control loop- temperature/pressure/flow/level control loop.<br>**TLO4.2** Draw P & IDof given process control loop- temperature/pressure/flow/level control loop using suitable drawing software tool.<br>**TLO4.3** Define instrument tags, process equipment & pipe-line numbering. | **Unit -IV. Identification & Drawing of Process and Instrumentation Diagram (P & ID)**<br>4.1 Overview of P & IDs for temperature, pressure, flow, and liquid level process control loops.<br>4.2 Identification of ISA symbols of process instruments and equipment used in given P & ID of process control loop- temperature pressure / flow/ level control loop (in chemical/power/fertilizer/oil & gas refinery, etc.).<br>4.3 Drawing P & ID of given process control loop- temperature/pressure/flow/level control loop.<br>4.4 Defining instrument tag numbers and assigning pipe-line numbers. |
| **Course Outcome: CO3** | | |
| **5.** | **TLO5.1** Identify symbols of various process instruments, field devices- JBs, and wiring/cables used in given loop diagram- temperature/ pressure/flow /level control loop.<br>**TLO5.2** Draw loop of given process control loop-temperature/ pressure/ flow/ level control loop using | **Unit -V. Identification & Drawing of Loop Diagram**<br>**5.1** Overview of loop diagram for temperature, pressure, flow and level control loops.<br>**5.2** Identification of ISA symbols of instruments and loop wiring/cables from field to control room and from control room to field in given loop diagram.<br>**5.3** Drawing loop diagram of given control loop- |

| | | |
|---|---|---|
| | drawing software tool.<br>**TLO5.3** Define instrument tag numbers, JBs & Cables labelling. | temperature/pressure/flow/level control loop using software tool.<br>**5.4** Defining instrument tags and loop wiring/cables labelling |
| **Course Outcome: CO5** | | |

## V. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

| Sr. No. | Laboratory Learning Outcome (LLO) of Experiment/Practical / Tutorial | Title of (LLO) of Experiment/Practical / Tutorial | No. of Hrs. | Relevant COs |
|---|---|---|---|---|
| 1. | **LLO1.1** Identify and draw ISA symbols of different pipelines, instrument lines/signals, and different general process instruments. | Identify and draw ISA symbols of pipelines, instrument lines/signals, and various general process instruments using mechanical drawing tools. | 2 | CO1 |
| 2. | **LLO2.1** Use suitable drawing software tool to draw ISA symbols of different pipelines, instrument lines/signals, and various general process instruments. | Draw ISA symbols of different pipelines, instrument lines/signals, and various general process instruments using appropriate drawing software tool. | 2 | CO1 |
| 3. | **LLO3.1** Identify and draw ISA symbols of different measuring and regulating instruments-Flow/Level/Pressure/ Temperature.<br>**LLO3.2** Define instrument tag numbers. | Identify and draw ISA symbols of different measuring and regulating instruments-Flow/Level/Pressure /Temperature using mechanical drawing tools and write their tag numbers. | 2 | CO1 |
| 4. | **LLO4.1** Use suitable drawing software tool to draw ISA symbols of different measuring and regulating instruments-Flow/Level/Pressure / Temperature.<br>**LLO4.2** Define instrument tag numbers. | Draw ISA symbols of different measuring and regulating instruments-Flow/Level/Pressure /Temperature with tag numbers using appropriate drawing software tool. | 2 | CO1 |
| 5 | **LLO5.1** Identify and draw ISA symbols of different control valve bodies and actuators. | Draw ISA symbols of different control valve bodies and actuators using mechanical drawing tools. | 2 | CO2 |
| 6 | **LLO6.1** Use suitable drawing software tool to draw ISA symbols of different control valve bodies and actuators. | Draw ISA symbols of different control valve bodies and actuators using appropriate drawing software tool. | 2 | CO2 |
| 7 | **LLO7.1** Identify and draw ISA symbols of different electrical schematic devices. | Identify and draw ISA symbols of different electrical schematic devices using mechanical drawing tools. | 2 | CO2 |

| | | | | |
|---|---|---|---|---|
| 8 | **LLO8.1** Use suitable drawing software tool to draw ISA symbols of different electrical schematic devices. | Draw ISA symbols of different electrical schematic devices using appropriate drawing software tool. | 2 | CO2 |
| 9 | **LLO9.1** Identify and draw symbols of different process equipment used in given PFD of a process unit.<br>**LLO9.2** Define line numbering. | Identify and draw symbols of different process equipment used in given PFD of a<br>process unit using mechanical drawing tools. | 2 | CO3 |
| 10 | **LLO10.1** Use suitable drawing software tool to draw ISA symbols of different process equipment used in given PFD of a process unit.<br>**LLO10.2** Define line numbering. | Draw symbols of different process equipment used in given PFD of a process unit using appropriate drawing software tool. | 2 | CO3 |
| 11 | **LLO11.1** Draw a given PFD of a process unit in Chemical/Oil & Gas Refinery/ Fertilizer / Power Plant.<br>**LLO11.2** Define line numbering. | Draw a given PFD of a process unit in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO3 |
| 12 | **LLO12.1** Use suitable drawing software tool to draw a given PFD of a process unit in Chemical/Oil & Gas Refinery/ Fertilizer / Power Plant.<br>**LLO12.2** Define line numbering. | Draw a given PFD of a process unit in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO3 |
| 13 | **LLO13.1** Draw a given P & ID of temperature control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO13.2** Define instrument tag numbers.<br>**LLO13.3** Define line numbering. | Draw a given P & ID of temperature control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO4 |
| 14 | **LLO14.1** Use suitable drawing software tool to draw a given P & ID of temperature control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO14.2** Define instrument tag numbers.<br>**LLO14.3** Define line numbering. | Draw a given P & ID of temperature control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO4 |
| 15 | **LLO15.1** Draw a given P & ID of liquid level control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO15.2** Define instrument tag numbers.<br>**LLO15.3** Define line numbering. | Draw a given P & ID of liquid level control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO4 |
| 16 | **LLO16.1** Use suitable drawing software tool to draw a given P & ID of liquid level control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant. | Draw a given P & ID of liquid level control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO4 |

| | | | | |
|---|---|---|---|---|
| | **LLO16.2** Define instrument tag numbers.<br>**LLO16.3** Define line numbering. | | | |
| 17 | **LLO17.1** Draw a given Loop Diagram of temperature control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO17.2** Define instrument tag numbers.<br>**LLO17.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of temperature control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO5 |
| 18 | **LLO18.1** Use suitable drawing software tool to draw a given Loop Diagram of temperature control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO18.2** Define instrument tag numbers.<br>**LLO18.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of temperature control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO5 |
| 19 | **LLO19.1** Draw a given Loop Diagram of liquid level control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO19.2** Define instrument tag numbers.<br>**LLO19.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of liquid level control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO5 |
| 20 | **LLO20.1** Use suitable drawing software tool to draw a given Loop Diagram of liquid level control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO20.2** Define instrument tag numbers.<br>**LLO20.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of liquid level control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO5 |
| 21 | **LLO21.1** Draw a given P & ID of pressure control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO21.2** Define instrument tag numbers.<br>**LLO21.3** Define line numbering. | Draw a given P & ID of pressure control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO4 |
| 22 | **LLO22.1** Use suitable drawing software tool to draw a given P & ID of pressure control loop in | Draw a given P & ID of pressure control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software | 2 | CO4 |

| | | | | |
|---|---|---|---|---|
| | Chemical/ Oil & Gas refinery/ Fertilizer/ Power Plant.<br>**LLO22.2** Define instrument tag numbers.<br>**LLO22.3** Define line numbering. | tool. | | |
| 23 | **LLO23.1** Draw a given P & ID of liquid flow control loop in Chemical/ Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO23.2** Define instrument tag numbers.<br>**LLO23.3** Define line numbering. | Draw a given P & ID of liquid flow control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO4 |
| 24 | **LLO24.1** Use suitable drawing software tool to draw a given P & ID of liquid flow control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO24.2** Define instrument tag numbers.<br>**LLO24.3** Define line numbering. | Draw a given P & ID of liquid flow control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO4 |
| 25 | **LLO25.1** Draw a given Loop Diagram of pressure control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO25.2** Define instrument tag numbers.<br>**LLO25.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of pressure control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO5 |
| 26 | **LLO26.1** Use suitable drawing software tool to draw a given Loop Diagram of pressure control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO26.2** Define instrument tag numbers.<br>**LLO26.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of pressure control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO5 |
| 27 | **LLO27.1** Draw a given Loop Diagram of liquid flow control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant.<br>**LLO27.2** Define instrument tag numbers.<br>**LLO27.3** Define labelling/numbering for different junction boxes and cabling. | Draw a given Loop Diagram of liquid flow control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using mechanical drawing tools. | 2 | CO5 |
| 28 | **LLO28.1** Use suitable drawing software tool to draw a given Loop Diagram of liquid flow control loop in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant. | Draw a given Loop Diagram of liquid flow control loop used in Chemical/Oil & Gas refinery/Fertilizer/ Power Plant using appropriate drawing software tool. | 2 | CO5 |

| | | | | |
|---|---|---|---|---|
| | **LLO28.2** Define instrument tag numbers.<br>**LLO28.3** Define labelling/numbering for different junction boxes and cabling. | | | |

**Important Note:**
1. **Total 20 experiments be performed in a whole semester.**
2. **Experiment Nos. 1-2, 5-6, 9-10, 13-14, and 17-18 are compulsory and should map with all units and COs. While rest of ten (10) experiments be performed based on the importance of course topics.**

## VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self-Learning):

**Assignment:**

Read and understand different documents used in project engineering (1) Process flow sheet (2) Mechanical flowsheet (3) Instrument index sheet (4) Loop wiring diagram (5) Instrument specification sheet

**Micro project:**
1. Draw process flow diagram (PFD) of distillation column operation.
2. Draw process loop diagram (PFD) of multi-effect evaporation process.
3. Draw process and instrumentation diagram (P&ID) of one-element drum level control in boiler.
4. Draw process and instrumentation diagram (P&ID) of two-element drum level control in boiler.
5. Draw process and instrumentation diagram (P&ID) of three-element drum level control in boiler.
6. Draw process and instrumentation diagram (P&ID) of concentration control in single-effect evaporator.
7. Draw process and instrumentation diagram (P&ID) of top and bottom product composition control in distillation column.
8. Draw loop diagram of one-element drum level control in boiler.
9. Draw loop diagram of two-element drum level control in boiler.
10. Draw loop diagram of three-element drum level control in boiler.

## VII. Specification Table: NIL

## VIII. Assessment Methodologies/Tools

**Formative assessment (Assessment for Learning)**

- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)
- Rubrics for continuous assessment of self-learning assignments/ micro project/ activities based on process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment based on rubrics for assessment for laboratory process and product related performance indicators. (50 Marks)

## IX. Suggested COs - POs Matrix Form

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Outcomes (POs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basicand Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Developmentof Solutions | PO-4 EngineeringTools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO - 1 | PSO - 2 |
| CO1 | 3 | -- | 1 | 2 | -- | 2 | 2 | 2 | 2 |
| CO2 | 3 | -- | 1 | 2 | -- | 2 | 2 | 2 | 2 |
| CO3 | 3 | -- | 1 | 2 | -- | 2 | 2 | 2 | 2 |
| CO4 | 3 | -- | 1 | 2 | -- | 2 | 2 | 2 | 2 |
| CO5 | 3 | -- | 1 | 2 | -- | 2 | 2 | 2 | 2 |
| Legends: - High:03, Medium:02, Low:01, No Mapping: -- | | | | | | | | | |

## IX. Suggested Learning Materials / Books:

| Sr. No | Title | Author, Publication | ISBN NO. |
|---|---|---|---|
| 1 | Instrument Engineers' Handbook, Volume Two: Process Control and Optimization: | Bela G Liptak, CRC Press | ISBN: 978-0849310812 |
| 2 | Process Control Instrumentation Technology | C. D. Johnson, Pearson | ISBN: 978-0131194571 |
| 3 | Control System Documentation: Applying Symbols and Identification | Thomas Mcavinew andRaymond Mulley, The Instrumentation, Systems, and Automation Society | ISBN: 978-1556178962 |
| 4 | Piping and Instrumentation Diagram Development | Moe Toghraei, Wiley-AIChE | ISBN :978-1119329336 |
| 5. | ISA-5.1-1984 (R1992), Instrumentation Symbols and Identification | ISA Committee SP5 | ISBN :9780876648445 |

## X. Learning Websites & Portals:

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | https://www.texvyn.in/spi-intools#:~:text=Smart%20Plant%20Instrumentation%20(SPI)%20also,O%20assignm | This software has drawing tools required for this course. |

| | | |
|---|---|---|
| 2 | https://www.edrawsoft.com/ad/edrawmax-diagram-tool.html?gad=1&gclid=EAIaIQobChMIlJza3bTygQMVzpVLBR3f | This software has drawing tools required for this course. |
| 3 | https://discover.solidworks.com/solidworks-r-smarter-faster-together?utm_campaign=& utm_medium=cpc&ut | This software has drawing tools required for this course. |
| 4 | https://www.directindustry.com/prod/etap-ige-ige-xao/product-8807-1902194.html | This software has drawing tools required for this course. |
| 5 | https://www.electrographics.it/en/products/idea.php | This software has drawing tools required for this course. |

## XI. Academic Consultation Committee/Industry Consultation Committee:

| Sr. No | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mr. Sagar Tinkhede | Chief Executive Officer | PEC consulting and Engineers LLP, Andheri |
| 2 | Mr. S. R. Shiledar | Lecturer in Instrumentation engineering | GCOE, Ratnagiri |
| 3 | Mr. Shivaji G. Thube | Lecturer in Instrumentation engineering | Govt. Polytechnic, Mumbai |
| 4 | Mr. Firoj S. Bagwan | Lecturer in Instrumentation engineering | Govt. Polytechnic, Mumbai |

Coordinator
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

| **Programme: Diploma in Instrumentation Engineering (Sandwich Pattern)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code: IS23301** | | | | | **Course Title: Environmental Studies** | | | | | | | | |
| **Compulsory / Optional: Compulsory** | | | | | | | | | | | | | |
| **Learning Scheme and Credits** | | | | | | **Assessment Scheme** | | | | | | | |
| **CL** | **TL** | **LL** | **SLH** | **NLH** | **Credits** | **FA-TH** | | **SA-TH (2:30 Hrs.)** | **FA-PR** | **SA-** | | **SLA** | **Total** |
| | | | | | | **T1** | **T2** | | | **PR** | **OR** | | |
| -- | 2 | -- | -- | -- | 1 | -- | -- | -- | 25 | -- | 25@ | -- | 50 |

**Total IKS Hrs. for course: 02 hrs.**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

**Note:**
1. FA-PR represents tutorial/practical term work of 25 Marks.
2. SA-OR represents the end term Practical examination of 25 Marks

## I. Rationale

Technicians working in industries or elsewhere essentially require the knowledge of environmental studies so as to enable them to work and produce most efficient, economical and eco-friendly finished products. Environmental studies are the interdisciplinary academic field which systematically studies human interaction with the environment in the interests of solving complex problems. It is a broad field of study that includes also the natural environment, built environment, and the sets of relationships between them. Today we are facing grave environmental crises which led to affect the environment pollution, deletion of ozone layer, acid rain, global warming, etc. therefore it is necessary to study environmental issues to realize how human activities affect the environment and to protect the environment which remedies or precaution which need to be taken by human being.

## II. Industry / Employer Expected Outcome:

The aim of this course is to help the student to achieve the following industry identified outcome through various learning experiences:

Recognize and manage the environment related issues.

## III. Course Outcomes:

Students will be able to achieve & demonstrate the following COs on completion of course based learning.

| | |
|---|---|
| CO1 | Understand the Importance of the environmental studies. |
| CO2 | Select alternate energy resources for sustainable development. |
| CO3 | Apply techniques to reduce the pollution. |

| | |
|---|---|
| CO4 | Understand the Solid and E- Waste Management. |
| CO5 | Identify measures taken by the GOI to protect environment. |

**Course Content Details:**

| Unit No. | Theory Learning Outcomes (TLO's)aligned to CO's | Topics / Sub-topics |
|---|---|---|
| 1 | **TLO1.1** Explain the Scope and Importance of the environmental studies.<br>**TLO1.2** Discuss the need of public awareness about environment studies.<br>**TLO1.3** Explain the terms related to environmental studies.<br>**TLO1.4** Discuss the environment hazards. | **Unit- I Introduction to Environmental Studies**<br>1.1. Definition, scope and Importance/ significance of the environmental studies<br>1.2. Need for creating public awareness about environmental issues<br>1.3. Ways/means/methods of creating public awareness important terms related with Environmental Studies: Biosphere, Ecosystem, biotic & Abiotic components, Food chain and food web<br>1.4. Environmental Hazards: Global warming, Green House Effect, Ozone depletion, nuclear accidents.<br>IKS:<br>1.5. Introduction to concept of Panchmahabhutas; Concept of nature worship.<br>1.6. Understanding of environment in ancient Indian civilization |
| **Course Outcome:CO1** | | |
| **2** | **TLO2.1** List various natural resources.<br>**TLO2.2** Describe Renewable, Nonrenewable and Cyclic resources.<br>**TLO2.3** Discuss Conventional and nonconventional energy forms.<br>**TLO2.4** State the importance of energy conservation. | **Unit -II Environmental Resources**<br>2.1 Natural Resources - Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources**,** Renewable, Non-renewable and Cyclic Resources.<br>2.2 Types of Energy: Conventional and non-conventional.<br>2.3 Present global energy use and future demands.<br>2.4 Energy conservation. |
| **Course Outcome: CO2** | | |
| **3** | **TLO3.1** Define pollution and types of pollution**.**<br>**TLO3.2** State the effects of land pollution on environment and lives.<br>**TLO3.3** State various units and their functions of water treatment plant and sewage treatment.<br>**TLO3.4** State the needs of water conservation.<br>**TLO3.5** State sources and effects of air pollution and various methods to prevent air pollution. | **Unit -III Pollution and its Impact**<br>3.1 Definition of Pollution, Types – Natural and Artificial (Manmade)<br>3.2 Soil/Land Pollution – Causes, effect on environment and live preventive measures<br>3.3 Water pollution - Sources of water (surface and sub-surface), Sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards, flow diagram of water treatment plant, Water conservation. Wastewater generation (domestic and industrial), impacts, flow diagram of sewage treatment plant, CPCB Norms of sewage discharge. |

| | | |
|---|---|---|
| | **TLO3.6** State sources and effects of noise pollution. | 3.4 Air pollution - Causes, effects, Prevention, Ambient air quality standards.<br>3.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city. |
| **Course Outcome:CO3** | | |
| **4** | **TLO4.1** Explain the sources of E-waste and their impact.<br>**TLO4.2** Discuss the different types of industrial waste and their management.<br>**TLO4.3** Explain the Municipal solid waste management.<br>**TLO4.4** Explain the concept of carbon credit and carbon foot print. | **Unit -III E-Waste Management**<br>4.1 E-waste Generation- Sources and characteristics of E-waste, biomedical waste.<br>4.2 Toxicity due to hazardous substances in E-waste and their impact.<br>4.3 Metallic waste and non- metallic waste (lubricants, plastics rubber) from industries, collection and disposal.<br>4.4 Municipal solid waste- MSW (4R, principles, energy recovery, sanitary land field), Hazardous waste.<br>4.5 Concept of carbon credit, carbon foot print. |
| **Course Outcome: CO4** | | |
| **5** | **TLO5.1** Elaborate article (48-A) and (51-A(g))<br>**TLO5.2** State the roles and responsibilities of CPCB and MPCB<br>**TLO5.3** Define sustainable<br>**TLO5.4** Development and EIA.<br>**TLO5.5** Describe rain water harvesting and groundwater recharge.<br>**TLO5.6** State the role of information technology in Environmental studies | **Unit -IV Environmental Protection Act**<br>5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts (Air quality at 2004, air pollution control at 1981 and water pollution and control act 1996)<br>5.2 CPCB and MPCB norms and responsibilities, The role of NGOs.<br>5.3 Concept of sustainable development, EIA and environmental morality.<br>5.4 Management Measures - Rain water harvesting, Ground water recharge, Green Belt Development, interlinking of rivers.<br>5.5 Role of information technology in environment and human health. |
| **Course Outcome: CO5** | | |

## IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

| Sr No | Practical / Tutorial / Laboratory Learning Outcome (LLO) | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|---|---|---|---|
| 1 | **LLO1.1** Identify the need for creating public awareness about environmental issues. | Prepare poster/banner to spread awareness about importance of clean environment | 2 | CO1 |
| 2 | **LLO2.1** Discuss the impact of Global warming | Prepare presentation on impact of Global warming. | 2 | CO1 |

| | | | | |
|---|---|---|---|---|
| 3 | **LLO3.1** Discuss the different Natural resources | Write report on different Natural resources | 2 | CO2 |
| 4 | **LLO4.1** Demonstrate different ways of Conservation/Renewable energy | Prepare Model/project on Energy Conservation/Renewable energy | 2 | CO2 |
| 5 | **LLO5.1** Understand water pollution and their remedial action | Visit and prepare report on water treatment plant | 2 | CO3 |
| 6 | **LLO6.1** Understand waste water management | Visit and prepare report on sewage treatment plant | 2 | CO3 |
| 7 | **LLO7.1** Understand Air pollution and their remedial action | Write report on different sources of Air pollution and their effects and remedial action. | 2 | CO3 |
| 8 | **LLO8.1** Understand sources of water pollution and their remedial action | Write report on different sources of Water pollution and their effects and remedial action | 2 | CO3 |
| 9 | **LLO9.1** Understand Soil pollution and their remedial action | Plant a tree/adopt a tree for soil conservation and take weekly plant growth photo and submit | 2 | CO3 |
| 10 | **LLO10.1** Identify the different sources of Solid and E-waste management. | Prepare Report on sources of Solid and E-waste | 2 | CO4 |
| 11 | **LLO11.1** Discuss the Human and Environment impacts of E-waste | Write a report on Environmental Impact on Human health and how to reduce Solid and E-waste | 2 | CO4 |
| 12 | **LLO12.1** Discuss 4R's waste management | Prepare poster on 4R's of waste management | 2 | CO4 |
| 13 | **LLO13.1** Identify measures taken by the GOI to protect environment. | Write roles and Responsibilities of CPCB and MPCB. | 2 | CO5 |
| 14 | **LLO14.1** Understand Environment policies and Acts | Write a report on Environmental Policy and different Acts. | 2 | CO5 |
| 15 | **LLO15.1** Understand the rain water harvesting. | Visit nearby society and study the rain water Harvesting system submit visit report along with photo. | 2 | CO5 |
| | | **Total Hours** | **30** | |

**Note: Minimum 12 assignments/ Tutorial are compulsory and should map all units and Cos.**

**V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self-Learning):**

**a) Prepare a Report / Solve assignments on every topic.**

**b) Activities:**

1. Visit to a local area to spreading awareness on clean environmental.
2. Visit to a local polluted site (Urban/Rural/Industrial/Agricultural) and make report on it.
3. Study of common plants, insects, birds.
4. Study of simple ecosystems of ponds, river, hill slopes etc.

## VI. Specification Table: NIL

## VII. Assessment Methodologies/Tools

**Formative assessment (Assessment for Learning)**

- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (25 Marks)
- Rubrics for continuous assessment of self-learning assignments/ micro project/ activities based on process and product related performance indicators. (25 Marks)

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment based on rubrics for assessment for laboratory process and product related performance indicators. (25 Marks)
- End semester assessment based on theory examination. (60 Marks)

## VIII. Suggested COs - POs Matrix Form

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Outcomes (POs) | |
|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem analysis | PO-3 Design/ development of solutions | PO-4 Engineering Tools, Experimentation and Testing | PO-5 Engineering practices for society, sustainability and environment | PO-6 Project Management | PO-7 Life-long learning | PSO - 1 | PSO - 2 |
| CO1 | 1 | -- | -- | -- | 2 | 1 | 1 | 1 | 1 |
| CO2 | 1 | 1 | 1 | -- | 1 | 1 | 1 | 2 | 1 |
| CO3 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 |
| CO4 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| CO5 | 1 | -- | -- | -- | 1 | 1 | 1 | 1 | 1 |
| Legends: - High:03, Medium:02, Low:01, No Mapping: -- | | | | | | | | | |

## IX. Suggested Learning Materials / Books:

| Sr.No | Title | Author, Publisher, Edition and Year Of publication | ISBN |
|---|---|---|---|
| 1 | Environmental Studies | S.C. Sharma & M.P. Poonia Khanna Publishing House, New Delhi | ISBN: 978-9386173096 |

| | | | |
|---|---|---|---|
| 2 | Waste water treatment for pollution control and reuse | Arceivala, Soli Asolekar, Shyam Mc-Graw Hill Education India Pvt. Ltd. New York, 2007 | ISBN:978-0070620995 |
| 3 | Environmental Studies | Anindita Basak, Pearson Education, 2009 | ISBN: 978-8131721186 |
| 4 | Environmental Studies | R. Rajgopalan, Third Edition, Oxford University Press | ISBN:978-0199459759 |
| 5 | Environmental Studies | Dr. R. J. Ranjit Daniels, Dr. Jagdish Krishnaswamy, Wiley India, 2009 | ISBN:978-8126519439 |
| 6 | Basic Environment Science | Michael Allaby, Routledge Publication, 2nd Edition, 2000 | ISBN: 978-0415211765 |
| 7 | Environmental Science | Y.K. Singh New age International Publisher, 2006 | ISBN: 978-8122418484 |
| 8 | Environmental Studies | Erach Bharucha, University Grants Commission, New Delhi | -- |
| 9 | A text Book of Environmental Science | Arvind Kumar, APH publishing New Delhi | ISBN: 978-8176485890 |
| 10 | A text Book of Environmental Studies | Shashi Chawla, Tata Mc-Graw Hill New Delhi, 2017 | ISBN: 978-1259006388 |

## X. Learning Websites & Portals

| Sr. No | Link / Portal | Description |
|---|---|---|
| 1 | www.eco-prayer.org | ---- |
| 2 | www.cpcb.nic.in | ---- |
| 3 | www.indiaenvironmentportal.org.in | ---- |
| 4 | www.sustainabledevelopment.un.org | ---- |
| 5 | www.conserve-energy-future.com | ---- |
| 6 | www.saveonenergy.com | ---- |

**XI.Academic Consultation Committee/Industry Consultation Committee:**

| Sr. No | Name | Designation | Institute/Organization |
|---|---|---|---|
| 1 | Mr. P. S. Kadam | Deputy Engineer – Engineering Maintenance Dept | Maharashtra Industrial Development Corporation, Andheri East |
| 2 | Mr. K. M. Bagwan | Head of Civil Engineering | Govt. Polytechnic, Karad |
| 3 | Mr. U. B. Shinde | Lecturer in Instrumentation Engg. | Govt. Polytechnic, Mumbai |
| 4 | Mrs. K. U. Waghmare | Lecturer in Instrumentation Engg. | Govt. Polytechnic, Mumbai |

Coordinator
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai