सावित्रीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University, Pune, Maharashtra, India

Faculty of Science and Technology

National Education Policy (NEP)-2020 Compliant Curriculum

SE – Instrumentation and Control Engineering

(2024 Pattern)

(With effect from Academic Year 2025-26)

Nomenclature

AEC	Ability Enhancement Course
CCE	Comprehensive Continuous Evaluation
CEP	Community Engagement Project
CO	Course Outcomes
ESE	End-Semester Examination
MDM	Multidisciplinary Minor
OE	Open Elective
PCC	Program Core Course
VEC	Value Education Course
WK	Knowledge and Attitude Profile

Preface by Board of Studies

It gives me immense pleasure to present the newly framed syllabus for the Second Year (SE) of the B.E. program in Instrumentation and Control Engineering, developed in accordance with the guiding principles of the National Education Policy (NEP) 2020. This curriculum represents a significant step toward transforming technical education into a more holistic, flexible, and multidisciplinary learning journey, focused on developing not just competent professionals but also responsible citizens and lifelong learners.

In the context of NEP 2020, which emphasizes outcome-based education, interdisciplinary learning, and the integration of technology with pedagogy, this syllabus has been designed to equip students with a strong conceptual foundation, practical skill sets, and a mindset for innovation and research. Special attention has been paid to promote critical thinking, experiential learning, and ethical values alongside core technical knowledge.

Instrumentation and Control Engineering plays a pivotal role in modern industry and infrastructure-ranging from automation, robotics, and industrial IoT, to smart process control systems. The revised curriculum incorporates contemporary topics and emerging technologies, such as sensor technologies, digital systems, embedded platforms, and data-driven control, while ensuring alignment with the Program Outcomes (POs) and Program Specific Outcomes (PSOs) expected of engineering graduates.

In line with NEP 2020, the syllabus offers increased flexibility through elective choices, promotes academic credit mobility, and introduces skill-based learning modules and project-based assessments. The inclusion of interdisciplinary exposure, environmental and sustainability components, and the encouragement of local and global perspectives ensures a well-rounded education.

This effort has been a collaborative outcome of valuable contributions from experienced academicians, industry experts, alumni, and stakeholders. I express my heartfelt gratitude to Dr. Pramod D. Patil, Dean, Science and Technology, Savitribai Phule Pune University, Pune and all members of the Board of Studies for their active involvement, insights, and dedication throughout the process.

We hope that this curriculum will serve as a foundation for students to explore their potential and adapt to the fast-changing landscape of engineering and technology. Feedback and suggestions from faculty, students, and industry are always welcome to further enhance the relevance and impact of this syllabus.

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Department of Instrumentation & Control Engineering

Knowledge and Attitude Profile (WK)

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) in some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes related to a specific area, topic, or domain.

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Reference: Self-Assessment Report (SAR) Format Undergraduate Engineering Programs Graduate Attributes and Professional Competencies Version 4.0 (GAPC V4.0) - (August 2024) Page 55.

Department of Instrumentation & Control Engineering

Programme Outcomes (PO)

Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, attitude and behavior that students acquire through the program. On successful completion of B.E. Instrumentation & Control, graduating students/graduates will be able to:

PO1: **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: **Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: **Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

General Rules and Guidelines

- **Course Outcomes (CO):** Course Outcomes are narrower statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.
- **Assessment:** Assessment is one or more processes, carried out by the institution, that identify, collect, and prepare data to evaluate the achievement of Program Educational Objectives and Program Outcomes.
- **Evaluation:** Evaluation is one or more processes, done by the Evaluation Team, for interpreting the data and evidence accumulated through assessment practices. Evaluation determines the extent to which Program Educational Objectives or Program Outcomes are being achieved, and results in decisions and actions to improve the program

Guidelines for Examination Scheme

Theory Examination: The theory examination shall be conducted in two different parts Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

Comprehensive Continuous Evaluation (CCE) of 30 marks based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 30 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1	Unit Test	12 Marks	Units 1 & Unit 2 (6 Marks/Unit)
2	Assignments / Case Study	12 Marks	Units 3 & Unit 4 (6 Marks/Unit)
3	Seminar Presentation / Open Book Test/ Quiz	06 Marks	Unit 5

Comprehensive Continuous Evaluation (CCE) of 15 marks based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 15 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameter	Marks	Coverage of Units
1	Unit Test	10	Units 1 & Unit 2 (5 Marks/Unit)
2	Seminar Presentation / Open Book Test/ Assignments / Case Study	05	Units 3 & Unit 4

Format and Implementation of Comprehensive Continuous Evaluation (CCE)

- **Unit Test:**
  - **Format:** Questions designed as per Bloom's Taxonomy guidelines to assess various cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, and Create).
  - **Implementation:** Schedule the test after completing Units 1 and 2. Ensure the question paper is balanced and covers key concepts and applications.

- **Sample Question Distribution:**
  - **Remembering** (2 Marks): Define key terms related to [Topic from Units 1 and 2].
  - **Understanding** (2 Marks): Explain the principle of [Concept] in [Context].
  - **Applying** (2 Marks): Demonstrate how [Concept] can be used in [Scenario].
  - **Analyzing** (3 Marks): Compare & contrast [Two related concepts] from Units 1 and 2.
  - **Evaluating** (3 Marks): Evaluate the effectiveness of [Theory/Model] in [Situation].

- **Assignments / Case Study:** Students should submit one assignment or one Case Study Report based on Unit 3 and one assignment or one Case Study Report based on Unit 4.
  - **Format**: Problem-solving tasks, theoretical questions, practical exercises, or case studies that require in-depth analysis and application of concepts.
  - **Implementation**: Distribute the assignments or case study after covering Units 3 and 4. Provide clear guidelines and a rubric for evaluation.

- **Seminar Presentation:**
  Seminar Presentation Format:
  - **Format:** Oral presentation on a topic from Unit 5, followed by a Q&A session.
  - **Deliverables:** Presentation slides, a summary report in 2 to 3 pages, and performance during the presentation.
  - **Implementation:** Schedule the seminar presentations towards the end of the course. Provide students with ample time to prepare and offer guidance on presentation skills.

- **Open Book Test:**
  - **Format:** Analytical and application-based questions to assess depth of understanding.
  - **Implementation:** Schedule the open book test towards the end of the course, ensuring it covers critical aspects of Unit 5.

- **Quiz:**
  - **Format:** Quizzes can help your students practice existing knowledge while stimulating interest in learning about new topic in that course. You can set your quizzes to be completed individually or in small groups.
  - **Implementation:** Online tools and software can be used create quiz. Each quiz is made up of a variety of question types including multiple choice, missing words, true or false etc.

- **Example Timeline for conducting CCE:**
  - Weeks 1-4 : Cover Units 1 and 2
  - Week 5 : Conduct Unit Test (12 marks)
  - Weeks 6-8 : Cover Units 3 and 4
  - Week 9 : Distribute and collect Assignments / Case Study (12 marks)
  - Weeks 10-12 : Cover Unit 5
  - Week 13 : Conduct Seminar Presentations or Open Book Test or Quiz (6 marks)

- **Evaluation and Feedback:**
  - **Unit Test:** Evaluate promptly and provide constructive feedback on strengths and areas for improve- ment.
  - **Assignments / Case Study:** Assess the quality of submissions based on the provided rubric. Offer feedback to help students understand their performance.
  - **Seminar Presentation:** Evaluate based on content, delivery, and engagement during the Q&A session. Provide feedback on presentation skills and comprehension of the topic.
  - **Open Book Test:** Evaluate based on the depth of analysis and application of concepts. Provide feedback on critical thinking and problem-solving skills.

By following this scheme, you can ensure a structured and comprehensive evaluation of students'

understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

End-Semester Examination (ESE)

End-Semester Examination (ESE) of 70 marks written theory examination based on all the unit of course syllabus scheduled by university. Question papers will be sent by the University through QPD (Question Paper Delivery). University will schedule and conduct ESE at the end of the semester.

Format and Implementation of End-Semester Examination (ESE)

- Question Paper Design: Below structure is to be followed to design an End-Semester Examination (ESE) for a theory subject of 70 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines and 14 marks allocated per unit.
- Balanced Coverage: Ensure balanced coverage of all units with questions that assess different cognitive levels of Bloom's Taxonomy: Remember, Understand, Apply, Analyze, Evaluate, and Create. The questions should be structured to cover:
  - **Remembering**: Basic recall of facts and concepts.
  - **Understanding**: Explanation of ideas or concepts.
  - **Applying**: Use of information in new situations.
  - **Analyzing**: Drawing connections among ideas.
  - **Evaluating**: Justifying a decision or course of action.
  - **Creating**: Producing new or original work (if applicable).
- **Detailed Scheme for 70 marks:** Unit-Wise Allocation (14 Marks per Unit for 5-unit course and for 4-unit course 17 marks for two units and 18 marks for 2 units): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.
- **Detailed Scheme for 35 marks:** Unit-Wise Allocation (8 marks for unit-1 and 9 marks for unit 2, 3 and 4.): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

Curriculum Structure - Semester III

Second Year Engineering (2024 Pattern)
SE -Instrumentation and Control Engineering

Level 5.0														
Course Code	**Course Type**	**Course Name**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**					**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Theory**	**Tutorial**	**Practical**	**Total**
Semester III														
PCC-201-INC	Program Core Course	Sensors and Transducers	3	-	2	30	70	-	50	-	3	-	1	4
PCC-202-INC	Program Core Course	Signals and Systems	3	-	-	30	70	-	-	-	3	-	-	3
PCC-203-INC	Program Core Course	Linear Integrated Circuits	3	-	2	30	70	-	25	-	3	-	1	4
	Open Elective	Open Elective -I *	2	-	-	15	35	-	-	-	2	-	-	2
MDM-230-INC	Multidisciplinary Minor-I	Data Structures	2	-	2	30	70	-	25	-	2	-	1	3
EEM-240-INC	Entrepreneurship/ Economics/ Management	Entrepreneur Skills	-	1	2	-	-	50	-	-	-	1	1	2
VEC-250-INC	Value Education Course	Universal Human Values & Professional Ethics	2	-	-	15	35	-	-	-	2	-	-	2
CEP-260-INC	Field Projects /Community Engagement Projects	Community Engagement Project	-	-	4	-	-	25	-	25	-	-	2	2
Total			**15**	**01**	**12**	**150**	**350**	**75**	**100**	**25**	**15**	**01**	**06**	**22**
			28 Hrs.			**500 Marks**		**200 Marks**			**22 credits**			

Curriculum Structure - Semester IV

Second Year Engineering (2024 Pattern)
SE -Instrumentation and Control Engineering

Level 6.0															
Course Code	**Course Type**	**Course Name**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**					**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Theory**	**Tutorial**	**Practical**	**Total**
Semester IV														
PCC-204-INC	Program Core Course	Feedback Control System	3	-	2	30	70	-	25	-	3	-	1	4
PCC-205-INC	Program Core Course	Control System Components	3	-	-	30	70	-	-	-	3	-	-	3
PCC-206-INC	Program Core Course	Digital Electronics	2	-	-	30	70	-	-	-	2	-	-	2
PCC-207-INC	Program Core Course	Digital Electronics and Control System Components Lab	-	-	2	-	-	-	50	-	-	-	1	1
	Open Elective	Open Elective -II*	2	-	-	15	35	-	-	-	2	-	-	2
MDM-231-INC	Multidisciplinary Minor-II	Data Science	2	-	2	30	70	-	25	-	2	-	1	3
VSE- 270-INC	Vocational and Skill Enhancement Course	Excel Programming	-	1	2	-	-	25	-	-	-	1	1	2
AEC-281-INC	Ability Enhancement Course	Modern Indian Languages (Marathi/Hindi)	-	-	2	-	-	50	-	-	-	-	1	1
EEM-241-INC	Entrepreneurship /Economics/ Management Industrial Organization and Management	Industrial Organization and Management	-	1	2	-	-	25	-	-	-	1	1	2
VEC-251-INC	Value Education Course	Environmental Instrumentation	2	-	-	15	35	-	-	-	2	-	-	2
Total			**14**	**02**	**12**	**150**	**350**	**100**	**100**	**-**	**14**	**02**	**06**	**22**
			28 Hrs.			**500 Marks**		**200 Marks**			**22 Credits**			

* Note:
Students can opt for Open Electives offered by different faculty like Arts, Science, Commerce, Management, Humanities or Inter-Disciplinary studies.
Example – Open Elective I - Financial Accounting, Digital Finance, Digital Marketing can be opted from Commerce and Management faculty.
And Elective II - Project Management, Business Analytical, Financial Management can be opted from Inter-Disciplinary studies, Commerce and Management faculty respectively.

Savitribai Phule Pune University, Pune

Maharashtra, India

Faculty of Science and Technology

Semester - III

SE – Instrumentation & Control Engineering (2024 Pattern)

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Second Year of Engineering (2024 Pattern)

Course Code: PCC-201-INC Course Name: Sensors and Transducers

Teaching Scheme	Credit	Examination Scheme
Theory: 3 Hours/Week	**03**	**CCE : 30 Marks**
Practical: 2 Hours/week	**01**	**End-Semester: 70 Marks**
		Practical: 50 marks

Prerequisite Courses, if any:

Definition of transducer, sensors, classification of transducers & sensors.

Course Outcomes:

On completion of the course, learner will be able to:

1. Classify units, standards, performance characteristics of pressure, temperature, Flow, Level, Force, Torque, Displacement, and Speed Transducers
2. Summarize the working principles and applications of pressure, temperature, Flow, Level, Force, Torque, Displacement, Speed, Vibration, Viscosity and Density Transducers.
3. Select suitable sensors/transducers for physical parameter measurement.
4. Use dead weight and vacuum gauge tester to calibrate pressure gauges.
5. Examine characteristics of T/C, RTD and LVDT. Implement signal conditioning circuits for Thermocouple and RTD for given specification.

Course Contents

Unit I	Pressure Measurement	(10 Hours)

Classification and selection criteria of transducers. Definition, pressure scale, units and relations, manometers and their types, elastic pressure sensors, piezoelectric secondary pressure sensors, differential pressure sensors, high-pressure sensors, low-pressure sensors, standards, working principle, types, materials, capacitive (delta cell), Differential Pressure Transmitter (DPT), concept of live, dead zero, two and four wire transmitters, Dead Weight Tester.

Unit II	Temperature Measurement	(08 Hours)

Temperature scales, units and relations, classification of temperature sensors, working principle, types, materials, Non electrical sensors (bimetallic, thermometer), electrical sensors (RTD, Thermocouple, Thermistor, IC sensor LM35), Non-Contact temperature sensors (Radiation and optical). Design of signal conditioning circuits for RTD and Thermocouple.

Unit III	Flow Measurement	(08 Hours)

Classification of Flow transducers, types of flow, Bernoulli's equation for incompressible flow, primary or quantity meters (positive displacement flow meter), secondary or rate meter

(obstruction type, variable area type), electrical flow sensors (turbine type, electromagnetic type, and ultrasonic type), flow switches, Vortex shedding, anemometers, mass flowmeter: Coriolis flow meter, Application of DPT for flow measurement.

Unit IV	Level, Force and Torque Measurement	(08 Hours)

Standards, working principle, types, float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, laser type transducers, level gages, resistance, solid level detectors, fibre optic level detectors, Application of DPT for level measurement

Force and Torque measurement: Elastic elements, strain gauges, load cells, strain gauge torque meter, inductive torque meter and MEMS accelerometers

Unit V	Miscellaneous sensors	(06 Hours)

Displacement Measurement: Inductive-LVDT, capacitive, ultrasonic, optical and proximity sensors.

Speed Measurement: Tachometer, Magnetic pickups, Encoders, and Photo electric pickups.

Vibration Measurement: Piezoelectric, Seismic, Potentiometric.

Viscosity: Say bolt, Searle's rotating cylinder, Cone and plate, Falling and rolling ball

Density: Chain-balanced float type, Hydrometer (Buoyancy type)

flame sensor, smoke sensor, motion sensor

List of Experiments:

Students are expected to perform minimum 8 experiments out of which one experiment should be based on signal conditioning.

1. Calibration of pressure gauge using dead weight pressure tester.
2. To study differential pressure transmitter and its application for flow measurement
3. To study differential pressure transmitter and its application for level measurement
4. Compare performance of Thermocouple and RTD for temperature measurement
5. Determine temperature using LM35
6. Compare performance of Orifice and Venture for flow measurement
7. Evaluate performance characteristics of strain gauge load cell for weight measurement.
8. Determine characteristics LVDT for displacement measurement.
9. Compare performance of encoder and proximity sensor for speed measurement.
10. Determine characteristics of different proximity sensors.
11. Level measurement using ultrasonic sensors
12. Design a signal conditioning circuit for temperature measurement using Thermocouple
13. Design a signal conditioning circuit for temperature measurement using RTD.

Learning Resources

Text Books:

1. A.K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons, Eleventh ed., 2000.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis", Tata McGraw Hill Education, Second ed., 2004.
3. D.V.S. Murty, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
4. C. D. Johnson, "Process Control Technology", PHI-Seventh Edition, 1988
5. C. S. Rangan ,G..R.Sharma, V.S.V Mani, "Instrumentation Devices and Systems" McGraw Hill Education, Second ed. 2003.

Reference Books:

1. E.O. Doebelin, "Measurement Systems", McGraw Hill, Seventh ed., 2019.
2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
3. Sabrie Soloman, "Sensors Handbook", McGraw Hill Publication, Second ed., 2010.
4. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Third ed., 1995.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: PCC-202-INC Course Name: Signals and Systems

Teaching Scheme	Credit	Examination Scheme
Theory: 3 Hours/ Week	03	CCE : 30 Marks End-Semester: 70 Marks

Prerequisite Courses, if any:

Differential equation, matrix algebra, complex numbers.

Course Outcomes:

On completion of the course, learner will be able to:

1. Identify the type of signals and perform elementary operations on signals.
2. Classify systems based on their properties
3. Understand fundamental properties of LTI systems and be able to determine response of the system for given input.
4. Analyze and design of an LTI systems using Fourier transform and Laplace transform.
5. Apply the concept of Z-Transform to solve difference equations and to find the system stability.

Course Contents

Unit I	Fundamentals of Signals	(08 Hours)

Representation of Continuous and Discrete-time Signals, Unit Step, Unit Ramp, Unit Impulse, Sinusoidal and Complex Exponentials. Classification of signals – Periodic and Aperiodic Signal, Even and Odd Signal, Energy and Power Signal, Deterministic and Random signals. Transformation of Independent Variables –Time Shifting, Time Scaling and Time Reversal.

Unit II	Fundamentals of Systems	(08 Hours)

Representation of Continuous and Discrete Time Systems. Classification of systems - Static and Dynamic, Linear and Nonlinear, Time variant and Time Invariant, Causal and Non–Causal, Stable and unstable, Invertible and non- invertible systems. Block Diagram Representation and Interconnection of Systems

Continuous-Time LTI Systems: The Convolution Integral, Discrete-Time LTI Systems: The Convolution Sum. Properties of Linear Time-Invariant Systems.

Unit III	Fourier analysis of Continuous Time Signals	(08 Hours)

Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, Dirichlet condition for existence of Fourier series, orthogonality, basis functions, Magnitude and phase response.

Fourier Transform (FT) representation of Continuous-Time Aperiodic signals, Dirichlet condition for existence of Fourier transform, Properties of Continuous-Time Fourier Transform, Magnitude and phase response, FT of standard Continuous-Time signals.

Unit IV	Laplace Transform	(08 Hours)

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Laplace transform of standard periodic and Aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S-domain, Application of Laplace transform to the LTI system analysis.

Unit V	Z-Transform	(08 Hours)

Z-Transform, Significance and Properties of Region of Convergence, Properties of Z-Transform, Inverse Z Transform, relationship of Z-transform with Fourier transform, applications of Z-transform to solutions of difference equations.

Learning Resources

Text Books:

1. A. V. Oppenheim, A. S. Wilsky with S. H. Nawab, Signals and Systems, Prentice- Hall of India Private Limited, Second Edition, 1997.
2. A. Nagoor Kanni, Signals and Systems, Mc Graw Hill. 2nd Edition.
3. Ramesh Babu, Signals and Systems, Sci-Tech Publications, 2nd Edition.

Reference Books:

1. Alan V Oppenheim, Alan S Wilsky, Signals and Systems, PHI, Second ed. 2009
2. Proakis J. G and D. G. Manolakis, Digital Signal processing, Principles, Algorithms and Applications, Prentice Hall of India.

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Second Year of Engineering (2024 Pattern)

Course Code: PCC-203-INC Course Name: Linear Integrated Circuits

Teaching Scheme	Credit	Examination Scheme
Theory: 3 Hours/ Week	03	CCE : 30 Marks
Practical: 2 Hours/ Week	01	End-Semester: 70 Marks
		Practical: 25 marks

Prerequisite Courses, if any:

Functional block diagram of an operational amplifier, Ideal & Practical values of performance parameters, Inverting and Non-Inverting Amplifier.

Course Outcomes:

On completion of the course, learner will be able to:

1. Execute the applications of closed-loop Op-Amp circuits in feedback amplifiers to design and analyze various configurations.
2. Implement linear and non-linear applications of Operational amplifiers to develop integrated circuits for diverse functionalities.
3. Use timers and special purpose ICs effectively to create multivibrators and oscillators for different electronic systems.
4. Demonstrate the design and implementation of active filters and regulators to enhance the performance of electronic circuits.

Course Contents

Unit I	Closed loop Op- Amplifier circuits	(08 Hours)

Introduction to feedback amplifiers, Loading effect. Voltage series feedback (non-inverting amplifier with feedback): deriving close loop gain, input impedance, output impedance and bandwidth; Voltage follower and its applications. Voltage shunt feedback (Inverting amplifier with feedback): deriving close loop gain, input impedance, output impedance and bandwidth; Inverter circuit, Differential amplifier with one op-amp. With derivation of close loop gain.

Unit II	Linear Applications of an Operational amplifier	(08 Hours)

Voltage summing and subtracter, Integrator and practical integrator, Differentiator and practical differentiator, Instrumentation amplifier with three Op-amps, Current to Voltage converter with zero and span adjustment circuit, Voltage to current converter with zero and span adjustment circuit.

Unit III	Non-Linear Applications of an Operational amplifier	(07 Hours)

Comparator and its characteristics, Zero Crossing Detector (ZCD) and its use, Schmitt trigger with external bias, Precision half wave and full wave rectifiers.

Sine wave oscillators using op-amp.: Barkhausen criteria, Wein bridge oscillator, RC phase shift oscillator.

Unit IV	Timers and Special purpose ICs	(08 Hours)

Design and applications of Astable, Monostable (Re-triggerable and non-retrigger able) and Bistable Multivibrators using LM555. Voltage controlled oscillator (LM 566), Phase locked Loop (LM 565), V to F and F to V converter (LM331), Analog Multiplexer/Demultiplexer (CD 4051).

Unit V	Active filters and Regulators	(09Hours)

Filters: Definition, types and Difference between active and passive filters, their merits and demerits. Filter terminology: Pass band, stop band, cut off, Ripple, Q and order of the filter. Butterworth approximations, Low pass (LP), High pass (HP), Band pass (BP), Narrow band pass, Band reject, Notch filter, First and second order filters, (Design of LP, HP and BP filter).

Regulators: Performance parameters (line regulation, load regulation, ripple rejection), Fixed volt regulators (IC78xx, 79xx), Linear voltage regulator IC 723(High voltage, low voltage regulator circuits).

List of Experiments:

Students are expected to perform minimum 8 experiments

1. Designing and implementation of Instrumentation amplifier using LM324
2. Designing and implementation of Wien bridge oscillator using LM 741.
3. Designing and implementation of Comparator, Schmitt trigger and Zero Crossing Detector using LM 741.
4. Designing and implementation of Astable and Monostable multivibrator using LM555.
5. Design and implement VCO to determine free running frequency (F0) using LM 566.
6. Design and perform Analog Multiplexer/Demultiplexer using CD 4051.
7. Design and implement first/second order Butterworth Low Pass Filter using LM 741.
8. Design and implement first/second order Butterworth High Pass Filter using LM 741.
9. Design and implement Butterworth Band Pass Filter using LM 741.
10. Design and implement linear variable voltage regulator using LM723.
11. Design and implement fixed voltage regulator using 78xx.

Learning Resources

Reference Books

1. Ramakant Gaikwad, “Operational Amplifiers” PHI, 3rd ed., 1992.
2. William D. Stanley, “Operational Amplifiers with Linear Integrated Circuits”, 4th ed., Pearson Education India, 2002
3. D. Roy Choudhury, “Linear Integrated Circuits” New Age International, 4th edition.
4. Paul Horowitz, Winfield Hill, “The Art of Electronics”, 2nd Ed., Cambridge University.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: MDM-230-INC Course Name: Data Structures

Teaching Scheme	Credit	Examination Scheme	
Theory: 2 Hours/ Week	02	CCE :	30 Marks
Practical: 2 Hours/ Week	01	End-Semester :	70 Marks
		Practical :	25 Marks

Prerequisite Courses, if any:

Python programming, looping statements, conditional statements, functions.

Course Outcomes:

On completion of the course, learner will be able to:

1. Implement various data structures and algorithms using Python programming language effectively.
2. Implement various operations on linked lists such as insert, delete, traverse, and reversal.
3. Analyze sorting algorithms like Bubble Sort, Insertion Sort, Merge Sort, and Quicksort, demonstrating the ability to choose the most appropriate algorithm for a given scenario.
4. Design and implement binary search trees, traverse graphs using DFS and BFS, and apply these concepts to develop efficient solutions for graph-related problems.

Course Contents

Unit I	**Python Basics**	**(04 Hours)**

Variables, Data Types, Loops and Conditionals, Functions, Lambda Expressions, List Comprehension, Python Modules (Collections, Queue, Etc.).

Unit II	**Linked List and Sorting Algorithms**	**(06 Hours)**

Linked List - Node Creation, Node Structure, Insert, Delete, Traverse, Singly Linked List, Doubly Linked, Reversing a Linked Lit, List, Circular Linked List, Comparison to Python Lists and Applications of Linked Lists.

Unit III	**Recursion, Searching and Sorting Algorithms**	**(08 Hours)**

Recursion- Base Case and Recursive Case, Call Stack Visualization, Examples Like Factorial, Fibonacci, Reverse String, Tower of Hanoi, Recursion Vs Iteration.

Sorting & Searching Algorithms - Bubble Sort, Insertion Sort, Merge Sort, Quicksort, Stable Sorting, Linear Search and Binary Search.

Unit IV	**Trees & Graphs**	**(08 Hours)**

Trees - Tree Terminology: Root, Leaf, Height, Depth, Binary Tree Structure

Binary Search Tree: Insert, Search, Delete, Traversal Methods: In order, Preorder, Post order, Level-Order (Using Queue)

Graphs: What is a Graph, Representation: Adjacency Matrix, Adjacency List (Dictionary of Lists), Directed Vs Undirected, Weighted Vs Unweighted.

Graph Traversal - Depth-First Search (DFS), Breadth-First Search (BFS)

List of Experiments:

Students are expected to perform minimum 8 experiments

1. Write a Python program to implement Singly Linked List.
2. Write a Python program to implement Doubly Linked List.
3. Write a Python program to implement Circular Linked List.
4. Write a Python program to implement bubble sort.
5. Write a Python program to implement selection sort.
6. Write a Python program to implement merge sort, quick sort.
7. Write a Python program on linear search and binary search.
8. Write a Python programs to implement stacks using arrays / linked lists.
9. Write a Python programs to implement queues using arrays / linked lists.
10. Write a Python program to perform Binary Tree traversal operations.
11. Write a Python programs to perform Binary search tree operations.
12. Write a Python program to Travers in a graph using Depth first search.
13. Write a Python program to Travers in a graph using breadth first.

Learning Resources

Text Books:

1. Data Structures and Algorithms in Python by Michael Goodrich, Roberto Tamassia, Michael Goldwasser, Wiley Publication.
2. Open Data Structures (in pseudocode), Pat Mortin https://opendatastructures.org/ods-python/
3. Hands-On Data Structures and Algorithms with Python, Dr. Basant Agarwal, Packt publication.

Reference Books:

1. A First Course on Data Structures in Python, Donald R. Sheehy. https://donsheehy.github.io/datastructures/fullbook.pdf
2. Data Structures and Algorithms with Python, Kent D. Lee, Steve Hubbard, Springer Publication.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: EEM-240-INC **Course Name: Entrepreneur Skills**

Teaching Scheme	Credit	Examination Scheme
Tutorial: 1 Hours / Week **Practical: 2 Hours/ Week**	**01** **01**	**TW: 50 marks**

Course Outcomes:

On completion of the course, learner will be able to:

1. Define entrepreneurship and explain its role in the business world.
2. Identify and analyze various types of entrepreneurships and the importance of team building in entrepreneurial ventures.
3. Evaluate case studies of innovative entrepreneurship projects and assess their impact.
4. Create a detailed business model canvas and develop a technology-led startup plan.

Course Contents

1. Introduction to Entrepreneurship, what is Entrepreneurship GDC Program
2. Hand holding for Entrepreneurship GDC start-up stories
3. Entrepreneurship Types, Team Building
4. Innovation and Entrepreneurship, Solar Oven case-study Paradigm shift from Design to Entrepreneurship
5. Bio- Med Innovation and Entrepreneurship
6. New-age Entrepreneurship
7. Business Model Canvas
8. Technology led Entrepreneurship
9. Entrepreneurship as Academic Program - IITH case study
10. Creativity and Generating Product Ideas, From Idea to Proof of Concept, Network Entrepreneurship.
11. Learning from examples Start-up PITCHES - Using Lean Canvas Model Part
12. Learning from examples Start-up PITCHES - Using Lean Canvas Model Part 2

Assignments:

Students are expected to perform minimum 8 Assignments and Practical on above topics.

Learning Resources

Text Books:

1. Disciplined Entrepreneurship: 24 Steps to a Successful Startup by Bill Aulet

2. The Essence of Medical Device Innovation by B Ravi
3. THE FORTUNE AT BOTTOM OF PYRAMID: Eradicating Poverty Through Profits by C. K. Prahalad
4. Stay Foolish by Rashmi Bansal.
5. The Entrepreneurial Connection: East Meets West in the Silicon Valley by Gurmeet Naroola
6. Innovation By Design: Lessons from Post Box Design & Development by B. K. Chakravarthy , Janaki Krishnamoorthi

Reference Books:

1. Ries, Eric. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, Crown Business, 2011. ISBN: 9780307887894.
2. Kawasaki, Guy. The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything, Portfolio (Penguin Random House), 2015. ISBN: 9781591847847.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: VEC-245-INC Course Name: Universal Human Values and Professional Ethics

Teaching Scheme	Credit	Examination Scheme
Theory: 2 Hours / Week	02	CCE : 15 Marks End-Semester: 35 Marks

Course Outcomes:

On completion of the course, learner will be able to:

1. Recognize the concept of self-exploration as the process of value education and see they have the potential to explore on their own right.
2. Explore the human being as the coexistence of self and body to see their real needs / basic aspirations clearly.
3. Explain relationship between one self and the other self as the essential part of relationship and harmony in the family.
4. Interpret the interconnectedness, harmony and mutual fulfilment inherent in the nature and the entire existence.
5. Draw ethical conclusions in the light of Right understanding facilitating the development of holistic technologies production systems and management models.

Course Contents

Unit I	Introduction to Value Education	(07 Hours)

(i) Understanding Value Education

(ii) Self-exploration as the Process for Value Education

(iii) Continuous Happiness and Prosperity - the Basic Human Aspirations and their Fulfilment

(iv) Right Understanding, Relationship and Physical Facility

(v) Happiness and Prosperity - Current Scenario

(vi) Method to Fulfil the Basic Human Aspirations

Unit II	Harmony in the Human Being	(06Hours)

(i) Understanding Human being as the Co-existence of the Self and the Body

(ii) Distinguishing between the Needs of the Self and the Body

(iii) The Body as an Instrument of the Self

(iv) Understanding Harmony in the Self

(v) Harmony of the Self with the Body

(vi) Programme to Ensure self-regulation and Health

Unit III	Harmony in the Family and Society	(06 Hours)
(i) Harmony in the Family - the Basic Unit of Human Interaction "Trust' - the Foundational Value in Relationship (ii) 'Respect' - as the Right Evaluation (iii) Values in Human-to-Human Relationship (iv) Understanding Harmony in the Society (v) Vision for the Universal Human Order		
Unit-IV	**Harmony in the Nature (Existence)**	**(07 Hours)**
(i) Understanding Harmony in the Nature (ii) Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature (iii) Realizing Existence as Co-existence at All Levels (iv) The Holistic Perception of Harmony in Existence (v) Professional Ethics in the light of Right Understanding (vi) Strategies for Transition towards Value-based Life and Profession		

Learning Resources

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-7-3 (Printed Copy), 978-81- 957703-6-6 (e-book)
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-5-9 (Printed Copy), 978-81-957703-0-4 (e-Book)

Reference Books:

1. P. L. Dhar, R. R. Gaur, 1990, Science and Humanism, Commonwealth Publishers.
2. A. Nagaraj, 1999, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak
3. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
4. A. N. Tripathy, 2003, Human Values, New Age International Publishers.
5. E. G. Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
6. B. L. Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
7. M. Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics and Human Values, Eastern Economy Edition, Prentice Hall of India Ltd.
8. M. K. Gandhi, "The Story of my Experiments with Truth", Discovery Publisher

MOOC / NPTEL/YouTube Links:

1. Swayam Course on "Understanding Human Being Nature and Existence Comprehensively" by Dr. Kumar Sambhav, Director, UP Institute of Design (UPID), Noida.
   https://onlinecourses.swayam2.ac..
2. NPTEL Course on "Exploring Human Values: Visions of Happiness and Perfect Society" by Prof. A. K. Sharma, Department of Humanities and Social Sciences, IIT Kanpur.
   https://nptel.ac.in/courses/109104068

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: CEP-260-INC **Course Name: Field Project/Community Engagement Project**

Teaching Scheme	Credit	Examination Scheme
Practical: 4 Hours/ Week	**02**	**TW: 25 Marks** **Oral: 25 Marks**

Course Outcomes:

On completion of the course, learner will be able to:

1. Execute a structured problem-solving process to identify community challenges.
2. Implement various data collection methods during field visits.
3. Analyze collected data to develop insights and solutions.
4. Demonstrate effective communication skills through a comprehensive report presentation to stakeholders.

In this course, students will identify a significant challenge/problem faced by a certain community, apply a systematic approach to investigate the problem, conduct field visits to collect relevant data, analyze the collected data, summarize their findings and compile a detailed report about their study. This report may be presented to the stakeholders.

Activity: Group discussions, interaction with faculty mentor, Field visits, interaction with community, data collection.

Implementation

- A group of 3 to 4 students could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay/college premise.
- Each group /practical batch is allotted to a faculty member of the department as a mentor.
- A division of 60 students can have 3 batches of minimum 20 students. Practical load of 4 hours to be allocated to each batch.
- The group of students will be associated with a government official / village authorities /NGO etc. concerned, allotted by the district administration, during the duration of the project.
- The Community Engagement Project should be different from the regular programmes of NSS/NCC/Green Club/Hobby Clubs, Special Interests Groups etc.
- An activity book has to be maintained by each of the students to record the activities undertaken/ involved and will be countersigned by the concerned mentor/HoD.

- Project report shall be submitted by each student/group of students.
- An internal evaluation shall also be conducted by a committee constituted by the HoD. Evaluation to be done based on the active participation of the student and marks could be awarded by the mentor/HoD.
- Student's groups can conduct an awareness program on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e-waste management or any other activity in an area of their studies and as per his/her aptitude.
- Oral Examination shall consist of presentation and demonstration of the project work carried out by the project groups.

Suggestive list of topics under Community Engagement Project

The below lists are not exhaustive and open for HoD's or mentors to add, delete or modify. It is expected that the focus should be on specific local issues in their nearby areas. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability.

1. Use/ miss-use of cell phones
2. Career orientation of youth
3. Water facilities and drinking water availability
4. Health and hygiene of the school going students, home makers and old personals
5. Health intervention and awareness programs
6. Horticulture
7. Herbal and Nutrition
8. Traditional and Modern health care methods
9. Food habits
10. Air /Sound /Water pollution
11. Plantation and Soil protection
12. Renewable energy and Solar Systems
13. Yoga awareness and practice
14. Health care awareness programs and their impact
15. Organic farming
16. Food adulteration
17. Incidence of Diabetes and other chronic diseases
18. Blood groups and blood levels
19. Chemicals in daily life

20. Music and dance
21. Women education and empowerment

Project Scope

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustainability, mental health, or career planning for local stakeholders.
- Develop a simple prototype or solution that addresses a real-world problem (e.g., a water-saving device, simple mobile apps, or tools for community use).
- Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
- Promote health through awareness programs on hygiene, nutrition, and exercise.
- Teach basic computer or technical skills to students, staff, or the community

Proposal Submission

CEP Group should Submit a two-page project proposal, preferably prior to the term commencement outlining the following: -

- Title of the project
- Aim, Objective and expected outcome
- Plan of execution (timeline and activities).
- Place of the CEP and involvement of any local authority, NGP
- Required resources (if any).
- Get approval from the designated faculty mentor.

Learning Resources

Text Books:

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.
3. Design Thinking for Social Innovation. IDEO Press, 2015.
4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

MOOC / NPTEL/YouTube Links:

1. NPTEL course: Ecology and Society
   https://onlinecourses.nptel.ac.in/noc20_hs77/preview

Savitribai Phule Pune University, Pune

Maharashtra, India

Faculty of Science and Technology

Semester - IV

SE – Instrumentation & Control Engineering (2024 Pattern)

www.unipune.ac.in

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: PCC-204-INC **Course Name: Feedback Control Systems**

Teaching Scheme	Credit	Examination Scheme
Theory: 3 Hours/Week	**03**	**CCE : 30 Marks**
Practical: 2 Hours/week	**01**	**End-Semester: 70 Marks**
		Practical: 25 marks

Prerequisite Courses, if any:

Basics of Laplace Transforms and Differential Equation.

Course Outcomes:

On completion of the course, learner will be able to:

1. Develop the mathematical model of control systems
2. Analyze the Time domain response of control systems and calculate time domain specifications of second order systems.
3. Analyze the system stability in time domain using Root Locus method.
4. Analyze the system stability in frequency domain using Bode plot and Polar plot method.
5. Evaluate the parameters of PID controller through Zeigler Nichols and Cohen Coon Tuning method to optimize system performance.

Course Contents

Unit I	Fundamentals of Control System	(10 Hours)

Basic concept of control system, classification of control systems: Open Loop and Closed Control System, Transfer Function, concept of pole and zero, Modelling of Electrical and Mechanical systems using differential equations and transfer function, analogy between electrical and mechanical systems, Block diagram algebra, Signal Flow Graph: Mason's gain formula.

Unit II	Time domain analysis of Control System	(08 Hours)

Standard test signals: step, ramp, parabolic and impulse signal, type and order of control system, Concept of transient and steady state response, time response of first and second order systems to unit impulse, unit step input, time domain specifications of second order systems, derivation of time domain specifications, steady state error and static error coefficients.

Unit III	Stability analysis and Root Locus	(08 Hours)

Concept of stability: BIBO, nature of system response for various locations of poles in S-plane, Routh's-Hurwithz criterion. Root Locus: Angle and magnitude condition, Basic properties of root locus. Construction of root locus, Stability analysis using root locus.

Unit IV	Frequency domain analysis	(08 Hours)
Introduction to Frequency domain specifications, Polar Plot, Introduction to Bode plot, Asymptotic approximation: sketching of Bode plot, stability analysis using Bode plot.		
Unit V	**Control Actions and Tuning**	**(06 Hours)**
Process Characteristics: Process equation, capacity, self – regulation, disturbances, control lag, process lag, distance/velocity lag (dead time). Control actions (ON-OFF, proportional, integral, derivative, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative, Controller tuning by Ziegler-Nichols methods, Cohen Coon tuning method.		

List of Experiments:

(Experiment No: 1 to 7 to be performed on MATLAB software, Expt.No.8 and 9 to be performed on hardware setup.)

1. Introduction to Control System Toolbox in MATLAB.
2. Introduction to Simulink (Basic blocks used in Control system).
3. Calculation of time domain specifications.
4. Stability analysis using root locus approach.
5. Calculation of Steady state error of Type 0, 1, 2 systems.
6. Stability analysis using frequency response approach (Bode plot approach).
7. Simulation of controller settings of P, PI, PID controllers (Kp, Ti, Td) obtained through Ziegler Nichols method, Cohen-Coon method.
8. Step Response of RC electrical system.
9. Study of under damped, over damped and critically damped response of second order system (RLC electrical ckt).
10. Case study on control system.

Learning Resources

Text Books:

1. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 05th Ed.
2. B. S. Manke, "Linear Control Systems", Khanna Publishers, New Delhi, 02nd Ed.
3. A. K. Jairath, "Problems and Solutions of Control Systems", CBS Publishes, New Delhi, 6th Ed.
4. S. K. Bhattacharya, "Control System Engineering", Pearson India, 02nd Ed.

Reference Books:

1. K. Ogata, "Modern Control Engineering", PHI, New Delhi, 06th Ed..
2. Norman S. Nise, "Control System Engineering", John Wiley and Sons, 07th Ed.

3. B. C. Kuo, "Automatic Control Systems", PHI, New Delhi, 07th Ed.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: PCC-205-INC Course Name: Control System Components

Teaching Scheme	Credit	Examination Scheme
Theory: 3 Hours/ Week	03	CCE : 30 Marks End-Semester: 70 Marks

Prerequisite Courses, if any:

Basic Circuit Theory, Motor Fundamentals, Basics of Control Circuit, Mechanical Elements, Semiconductor Device.

Course Outcomes:

On completion of the course, learner will be able to:

1. Select switches, relays & contactors for industrial control applications.
2. Design and construct motor control circuits using standard symbols and understand motor protection techniques.
3. Examine and interpret pneumatic and hydraulic components, and circuits to develop effective control systems.
4. Demonstrate the use of power control elements, electrical fuse & circuit breakers, and actuators.
5. Assess and justify the selection and sizing of control valves for gas, vapour, and liquid services, including the use of positioners for enhanced performance.

Course Contents

Unit I	Industrial Control Devices	(08 Hours)

Switches: Principle, symbolic representation, working, application of Toggle switch, Slide switch, DIP switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Temperature switch, Pressure switch, Level switch, Flow switch.

Relays: Working, specifications/selection criteria and applications of electromechanical relay, Solid state relays.

Contactors: Working, specifications and applications of contactors. Comparison between relay & contactor.

Unit II	Sequencing & Interlocking for Motors	(08 Hours)

Standard symbols used in motor control wiring diagrams.

Sequencing and Interlocking Concepts: Applications in motor control: Start and stop operations, Emergency shutdown procedures and Direct-On-Line (DOL) and Star-Delta starting methods.

Motor Protection Techniques: Short circuit protection, Overload protection, Low/under-voltage protection, Phase reversal protection and Over-temperature protection.

Advanced Motor Control Operations: Reversing the direction of motor rotation, Braking methods, Variable speed starting and Jogging and inching controls.

Motor Control Canters (MCCs): Concept and wiring diagrams of MCCs for industrial applications.

Unit III	Introduction to Pneumatic & Hydraulic Systems	(08 Hours)

Comparison in between Pneumatic, hydraulic & electrical systems.

Pneumatic & Hydraulic components: Pneumatic & Hydraulic Power Supply and its components, Cylinders: Single acting & Double acting cylinder, Cushion, Double rod, Tandem, Multiple position, Rotary. Pneumatic & Hydraulic motors. Direction controlled valves and flow control, Special types of valves like relief valve, pressure reducing, Time delay valve, Pneumatic relay (Bleed & Non bleed, Reverse & direct).

Pneumatic & Hydraulic Circuits: Standard Symbols used for developing pneumatic & hydraulic circuits, Sequence diagram (step-displacement), Direction control, Speed control, Reciprocating, Sequencing, and Meter in, Meter out for hydraulic circuits.

Unit IV	Power Control Elements	(08 Hours)

Principle, characteristics, specifications and applications of SCR, UJT, TRIAC, DIAC, MOSFET, IGBT, Triggering and Commutation of SCR. Circuit Breaker and Fuses.

Actuators: Advantages, disadvantages and applications of spring and diaphragm, piston cylinder actuators and smart actuators. Design of a spring and diaphragm actuators.

Unit V	Control valves	(08 Hours)

Control valve terminology: Rangeability, turndown, viscosity index, valve capacity, distortion coefficient, AO, AC, fail-safe actions, cavitation, flashing and noise, their effects and remedies.

Control valve characteristics: Inherent and installed.

Control valve classification: advantages, disadvantages and applications of globe- Single seated, double seated, 3-way, diaphragm, rotary, angle, Gate, Needle, ball and butterfly valve.

Designing control valve for gas, vapor and liquid services: valve sizing by ANSI/ISA 75.01 std., high temperature-pressure service valves.

Positioners: Need, applications, types, effect on performance of control valve. Definition of Cavitation and Flashing.

Learning Resources

Text Books:

1. Industrial Electronics, Petruzella, McGraw-Hill, 01st Edition.

2. Pneumatic Instrumentation, Majumdhar, TMH, 01st Edition.
3. Industrial Hydraulics, Pipenger, McGraw-Hill Education, 3rd Edition.
4. Process Control, Instrument Engineering Hand book, B.G. Liptak, Butterworth-Heinemann Ltd, Butterworth-Heinemann Ltd, 3rd Edition.
5. MD Singh, K B Khanchandani, 'Power Electronics', McGraw Hill Company, 2nd edition.
6. C. D. Johnson, "Process control and Instrument technology", Tata McGraw Hill Publications, 08th Ed.
7. N.A. Anderson, Boca Ratan, "Instrumentation for Process measurement and control", Radnor Pennsylvania, CRC Press, 03rd Ed

Reference Books:

1. Pneumatics, Festo Didactic.
2. Hydraulics, Festo Didactic.
3. P. C. Sen,' Power Electronics', TMH, 2007, 02nd Edition.
4. Mohamad Rashid,' Power Electronics', PHI, 2nd edition, 2004.
5. "Control valve Handbook", ISA.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: PCC-206-INC Course Name: Digital Electronics

Teaching Scheme	Credit	Examination Scheme
Theory: 2 Hours/Week	02	CCE : 30 Marks End-Semester: 70 Marks

Prerequisite Courses, if any:

Logic gates, flip flops, logic devices.

Course Outcomes:

On completion of the course, learner will be able to:

1. Execute logical functions using different number systems, Boolean algebra, and minimization techniques to design and implement digital circuits effectively.
2. Implement various logic families, analyze their performance specifications, and demonstrate Proficiency in interfacing TTL and CMOS logic.
3. Use combinational and sequential logic circuits to solve complex problems, differentiate between different types of flip-flops, and relate the design of counters and registers with practical applications.
4. Test and compare the applications of programmable logic devices in digital clock and frequency counter circuits, showcasing their versatility and efficiency.

Course Contents

Unit I	Logic Families	(06 Hours)

Logic families: TTL, CMOS, RTL, DTL logic family. Digital IC specification terminology. CD40XX /74XX series digital ICs. Characteristics of TTL logic family. Interfacing of logic family. Tristate Logic, Comparison of Different logic families.

Unit II	Number system & Logic circuit minimization techniques	(06 Hours)

Number system: Introduction to number system and number system conversion. Boolean algebra, De-Morgan's Thermos, Minimization of combinational logic functions using SOP and PSO forms. Don't care Conditions. K-Maps up to 4 variables and Quine-McCuskey techniques.

Unit III	Combinational Logic Circuits	(06 Hours)

Introduction to Combinational logic circuits: half adder, full adder, half subtractor, full subtractor, decimal adder, decimal subtractor, magnitude comparator, decoders, encoders, multiplexer & demultiplexer. Implementation of combinational logic circuits.

Unit IV	Sequential Logic	(08 Hours)

Flip Flops: Study of SR, JK, MSJK, D, T types of flip flop, excitation tables, Conversion of Flip Flop.

Counters: Binary, BCD, Up-Down counters. Design of synchronous and asynchronous counter using T and D flip flops, Realization of counters using ICs 7490, 7492,7493 and 74193.

Shift Registers: Serial in Serial out, Parallel in Parallel out shift registers, Ring counter, Johnson counter.

Programmable logic array (PLA) - Input, Output Buffers, AND, OR, Invert/ Non-Invert Matrix.

Learning Resources

Text Books:

1. Floyd "Digital Principles", Pearson Education, 11th Ed.
2. Gothman, 'Digital Electronics',2nd edition, PHI
3. M. Morris Mano,' Digital Design', Pearson Education, 03rd Ed.

Reference Books:

1. Leach, Malvino , Saha; Digital Principles and Applications; 7th Edition, McGraw Hill
2. R. P. Jain; Modern Digital Electronics; 4th Edition, McGraw Hill

MOOC / NPTEL/YouTube Links: -

1. NPTEL Course: Digital Circuit
   https://onlinecourses.nptel.ac.in/noc21_ee75/preview
2. NPTEL Course: Digital Electronics Circuit
   https://onlinecourses.nptel.ac.in/noc25_ee20/preview

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: PCC-207-Instru **Course Name: Digital Electronics & Control System Components Laboratory**

Teaching Scheme	Credit	Examination Scheme
Practical: 2 Hours/Week	**01**	**Practical: 50 Marks**

Prerequisite Courses, if any:

Basics of Logic Gate & Logic Families, Basic Circuit Theory, Motor Fundamentals, Basic of Control Circuit, Mechanical Elements.

Course Outcomes:

On completion of the course, learner will be able to:

1. Execute logical functions using different number systems, Boolean algebra, and minimization techniques to design and implement digital circuits effectively.
2. Implement various logic families, analyze their performance specifications, and demonstrate Proficiency in interfacing TTL and CMOS logic.
3. Use combinational and sequential logic circuits to solve complex problems, differentiate between different types of flip-flops, and relate the design of counters and registers with practical applications.
4. Test and compare the applications of programmable logic devices in digital clock and Frequency counter circuits, showcasing their versatility and efficiency.
5. Design and construct motor control circuits using standard symbols and understand motor protection techniques.
6. Examine and interpret pneumatic and hydraulic components, and circuits to develop effective control systems

List of Experiments:

Students are expected to perform Minimum six Experiments from 1-8 and minimum four experiment from 9-14

Digital Electronics:

1. Design and Implementation of full adder and subtractor using logic gates.
2. Study and conversion of flip flop.
3. Design of ripple counter.
4. Design of non-sequential counter using T & D flip flop.
5. Design of Mod-N counter using 7490,7492 & 7493 ICs

6. Study of Multiplexer using IC 74151 and Demultiplexer using IC74138
7. Study of Presettable Up / down counter using IC 74193.
8. Interfacing of 7 segment LED display using IC 7447

Control System Components:

1. Implementation of Logic Gates using relays.
2. Implementation and testing of Pneumatic circuits.
3. Implementation and testing of Hydraulic circuits.
4. V-I characteristics of SCR.
5. Study of Control valve & plot installed characteristics of control valve
6. Control valve design using any software package.

Learning Resources

Text Books:

1. Floyd "Digital Principles", Pearson Education, 11th Ed.
2. Gothman, 'Digital Electronics',2nd edition, PHI
3. M. Morris Mano,' Digital Design', Pearson Education, 3rd Ed.
4. MD Singh, K B Khanchandani, 'Power Electronics', McGraw Hill Company, 2nd edition.
5. C. D. Johnson, "Process control and Instrument technology", Tata McGraw Hill Publications, 08th Ed.
6. N.A. Anderson, Boca Ratan, "Instrumentation for Process measurement and control", Radnor Pennsylvania, CRC Press, 03rd Ed

Reference Books:

1. Leach, Malvino ,Saha; *Digital Principles and Applications;* 7th Edition, McGraw Hill
2. R. P. Jain; *Modern Digital Electronics;* 4th Edition, McGraw Hill
3. P. C. Sen,' Power Electronics', TMH, 2007, 2nd Edition.
4. Mohamad Rashid,' Power Electronics', PHI, 2nd edition, 2004.

MOOC / NPTEL/YouTube Links: -

1. NPTEL Course: Digital Circuit
   https://onlinecourses.nptel.ac.in/noc21_ee75/preview
2. NPTEL Course: Digital Electronics Circuit
   https://onlinecourses.nptel.ac.in/noc25_ee20/preview

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: MDM-231-INC **Course Name: Data Science**

Teaching Scheme	Credit	Examination Scheme
Theory: 2 Hours/ Week	02	CCE : 30 Marks
Practical: 2 Hours/ Week	01	End-Semester: 70 Marks
		Practical: 25 Marks

Prerequisite Courses, if any:

Data Structure, Data Science Software Tools.

Course Outcomes:

On completion of the course, learner will be able to:

1. Execute data collection and sampling methods to gather data for analysis effectively.
2. Implement statistical tools and techniques to analyze and interpret data accurately.
3. Use data science packages for data processing, analysis, and visualization efficiently.
4. Demonstrate proficiency in exploratory data analysis techniques and present insights effectively.

Course Contents

Unit I	Data Science	(05 Hours)

Data Science Life Cycle, Data Science Software Tools, Programming Languages for Data Science, Applications of Data Science, types of data. Data Collection and Sampling.

Statistics: Descriptive Statistics: Measurement of central tendency (Mean, median and mode), measurement of spread (Range, IQR, variance, standard deviation), correlation, covariance and Inferential Statistics (Probability, Hypothesis testing).

Unit II	Data Science Packages	(08 Hours)

Numpy- Array Operation, Indexing//slicing, mathematical operations, Matrix operations, String operation.

Pandas- Basic pandas operation on data frame, append, loc and iloc, missing values, merge, concat , join, group by, pivot, melt, date_time index,

Matplotlib- Histogram, Line chart, bar chart, pie chart, scatter plot, subplot, imshow.

Seaborn- Histogram, line chart, pie chart, bar chart, scatter pot, heatmap, pairplot

Scipy- used for scientific purpose

Sklearn- used for Machine learning

Unit III	Exploratory Data Analysis	(06 Hours)

Identification of variables and data types, Univariate, bivariate, multivariate analysis,

Variable transformations, Missing value treatment (Mean /median/mode methods) Outlier treatment (Percentile, Std dev, IQR, Boxplot, Z score).		
Unit IV	**Data Cleaning and Data Visualization**	**(07 Hours)**
Categorical to Numerical: One hot encoding, dummies, Label encoding, Correlation Analysis, Feature Selection, Feature Rescaling (Normalization and Standardization) Feature Transformation(Log, exponential, square) **Tableau Desktop:** Different types of Databases, Connecting With Data, different types of charts, Creating Views and Analysis, case study.		

List of Experiments:

Students are expected to perform minimum 8 experiments

Tools Used: Anaconda, Language = Python, Data Visualization Tool , Tableau

1. Statistical Analysis of Dataset.
2. EDA of Dataset. Database: Toyota.csv
3. Classification of Cars. Database: Toyota.csv
4. Data Analysis of Dataset. Correlation Analysis of Dataset Database: Toyota.csv
5. Students Performance Analysis. Database: Students Performance.csv
6. Data visualization: Plot frequency distribution of fuel type using bar plot. Database: Toyota.csv
7. Create ‘Price class for cars’ having three categories: Low, Medium and High using control loops. Database: Toyota.csv
8. Case study on Tableau dashboard.
9. Text Analytics: Extract Sample document and apply following document preprocessing methods: Tokenization, POS Tagging, stop words removal, Stemming and Lemmatization
10. Create representation of document by calculating Term Frequency and Inverse Document Frequency.
11. Data Visualization: Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram. Database: titanic.csv
12. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names: 'sex' and 'age') Database: titanic.csv
13. Scan the dataset and give the inference as:

    1. List down the features and their types (e.g., numeric, nominal) available in the dataset.

2. Create a histogram for each feature in the dataset to illustrate the feature distributions.

3. Create a boxplot for each feature in the dataset.

4. Compare distributions and identify outliers. Database: Iris flower dataset

Learning Resources

Text Books:

1. Python for data analysis by O'Reilly
2. Data Visualization in python by Daniel Nelson
3. Mastering Python for Data Science by Samir Madhavan.

Reference Books:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing, and Presenting Data by John Wiley & Sons
2. Python for Data Analysis by W McKinney
3. Think Stats: Probability and Statistics for Programmers by Allen B. Downey

MOOC / NPTEL/YouTube Links: -

1. NPTEL Course: Data Science for Engineers https://onlinecourses.nptel.ac.in/noc25_cs20/preview
2. NPTEL Course: Python for Data Science https://onlinecourses.nptel.ac.in/noc25_cs60/preview

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: VSE-270-INC **Course Name: Excel programming**

Teaching Scheme	Credit	Examination Scheme
Tutorial: 1 Hours/Week	**01**	**Term work: 25 marks**
Practical: 2 Hours / Week	**01**	

Prerequisite Courses, if any:

Basic visual charts to represent data, basic formulas like AVERAGE, SUMIF, and COUNTIF.

Course Outcomes:

On completion of the course, learner will be able to:

1. Apply cell manipulation techniques to manipulate the cell data within worksheet or workbook.
2. Use formulas, functions logical expression, in Excel.
3. Apply function like VLOOKUP, HLOOKUP, INDEX, MATCH to organize the data in Excel.
4. Use Charts and Pivot table to represent data.
5. Use simple Micro, VBA code for repeated tasks.

Contents

1. Create Worksheets and Workbooks
2. Apply Custom Data Formats and Validation
3. Create and Manage Tables
4. Perform Operations with Formulas and Functions
5. Create Charts and Objects
6. Manage Workbook Options and Settings
7. Apply Custom Data Formats and Layouts
8. Create Advanced Formulas
9. Create Advanced Charts and Tables

Suggested List of Laboratory Experiments (Any eight)

Programming software: MS Excel

Following Experiment can be performed by step-by-step implementation of projects in excel may be on data science etc.

1. Study of Excel Environment - Navigating, worksheets and workbooks Spreadsheet terminology and working with Cell
2. Study of Relative and absolute cell references – including inter worksheet and inter

workbook, basic functions like SUM, AVERAGE, MIN, and MAX etc

3. Study of Formatting cells, rows, and columns, applying number formats, Conditional formatting, Referencing to another sheet and worksheet
4. Study of logical functions (AND, OR, NOT) and Nested IF statement
5. Study of Automating data transfer between Excel and Word/Outlook
6. Study of lookup functions ()
7. Study of Pivot tables and pivot charts
8. Study of various types of charts
9. Study of Excel Macros and VBA
10. Study of What-If analysis (Goal Seek, Scenario Manager)

Learning Resources

Reference Books:

1. Microsoft office Excel Documentation.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: AEC-281-INC **Course Name: Modern Indian Languages (Marathi)**

Teaching Scheme	Credit	Examination Scheme
Practical: 2 Hours/Week	01	Term work: 50 marks

अभ्यासक्रमाची उद्दिष्टे :

१. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.
२. प्रसारमाध्यमांतील संज्ञापनातील स्वरूप आणि स्थान स्पष्ट करणे.
३. व्यक्तिमत्त्व विकास आणि भाषा यांच्यातील सहसंबंध स्पष्ट करणे.
४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.
५. प्रसारमाध्यमांसाठी लेखनक्षमता विकसित करणे.

Course Contents

घटक	तपशील
१	१. भाषा आणि व्यक्तिमत्त्व विकास : सहसंबंध २. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे
२	प्रसारमाध्यमांसाठी लेखन १ वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितशोधन २ नभोवाणीसाठी भाषणाची संहितालेखन ३ दूरचित्रवाणीसाठी माहितीपटासाठी संहितालेखन

Case Study:

१	१. भाषा, जीवन व्यवहार आणि नवमाध्यमे, समाजमाध्यमे २. नवमाध्यमे आणि समाजमाध्यमांचे प्रकार : ब्लॉग, फेसबुक, ट्विटर. ३. नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर आणि परिणाम
२	१. वेबसाईट आणि ब्लॉग, ट्विटरसाठी लेखन २. व्यावसायिक पत्रव्यवहार

संदर्भ ग्रंथ :

१ सायबर संस्कृती, डॉ. रमेश वरखेडे
२ उपयोजित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई
३ ओळख माहिती तंत्रज्ञानाची, टिमोथी जे. ओ लिअरी
४ संगणक, अच्युत गोडबोले, मौज प्रकाशन, मुंबई.
५ इंटरनेट, डॉ. प्रबोध चोबे, मनोरमा प्रकाशन, मुंबई.
६ व्यावहारिक मराठी, डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर.
७ आधुनिक माहिती तंत्रज्ञानाच्या विश्वात, शिक्रापूरकर दीपक, मराठे उज्ज्वल, उत्कर्ष प्रकाशन, पुणे.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: AEC-281-INC **Course Name: Modern Indian Languages (Hindi)**

Teaching Scheme	Credit	Examination Scheme
Practical: 2 Hours/Week	01	Term work: 50 marks

उद्देश्य :

१. छात्रों में हिंदी भाषा श्रवण कौशल विकसित करना।
२. छात्रों में हिंदी भाषा संवाद कौशल विकसित करना।
३. छात्रों में हिंदी भाषा वाचन कौशल विकसित करना।
४. छात्रों में हिंदी भाषा लेखन कौशल विकसित करना।
५. हिंदी भाषा—विधि तथा भाषा—व्यवहार से अवगत करना।

Course Contents

इकाई	पाठ्यविषय
इकाई— I	**वर्ण विचार :** १) हिंदी वर्णमाला — परिचय २) लिपि — परिचय ३) वर्णो का उच्चारण और वर्गीकरण ४) स्वराघात ५) संधि : स्वर संधि, व्यंजन संधि, विसर्ग संधि।

Case Study:

इकाई— II	**भाषा कौशल शिक्षण : लघुकथाओं द्वारा भाषा कौशल शिक्षण (श्रवण, संवाद, वाचन, लेखन)** १) शिक्षा — ज्योति जैन २) पानी के पेड़ — ज्योति जैन ३) पशुभाषा — ज्योति जैन ४) अपशगुन — ज्योति जैन

संदर्भ ग्रंथ :

१. हिंदी भाषा शिक्षण — संपा. हिंदी अध्ययन मंडल, सावित्रीबाई फुले पुणे विश्वविद्यालय, पुणे, राजकमल प्रकाशन, नई दिल्ली।
२. हिंदी व्याकरण — पं. कामताप्रसाद गुरु, प्रकाशन संस्थान, नई दिल्ली।
३. प्रयोजनमूलक हिंदी — डॉ. माधव सोनटक्के, लोकभारती प्रकाशन, नई दिल्ली।

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: EEM-241-INC **Course Name: Industrial Organization & Management**

Teaching Scheme	Credit	Examination Scheme
Tutorial: 1 Hours/ Week	**01**	**Term Work: 25 marks**
Practical: 2 Hours/ Week	**01**	

Prerequisite Courses, if any:

Management, business characteristics, financial accounting, Industrial Engineering and Management.

Course Outcomes:

On completion of the course, learner will be able to:

1. Interpret the SWOT analysis, BCG Matrix, and Porter's 5 forces of competition to develop effective business strategies in industrial management.
2. Execute quality circles, statistical process control, and ISO standards for improving quality management practices in industries.
3. Implement manpower planning, training and development programs, and performance appraisal systems for effective human resource management in industries.
4. Use tools like Total Quality Management, Kaizen, and Six Sigma to enhance operational efficiency and ethical decision-making in industrial settings.

Course Contents

Concepts of Industrial Management **(04 Hours)**

Management, business characteristics and classifications, types of business organizations, Merits and Demerits, levels of management, Functions of management- planning, organizing, leading, and controlling, Developing Business environment: SWOT analysis, BCG Matrix, Porter's 5 forces of competition. Management techniques for developing strategy: Balanced score card. Performance Management and analysis techniques: Ishikawa diagrams, Business process Re-engineering

Inspection, Quality, Standards and Business Management **(04 Hours)**

Inspection: objectives, Principles, standards, Qualities of inspector, Role of R & D, Quality Circles/ Forums, Quality Objectives, Statistical Process Control

Standards: Introduction to ISO 9001 and ISO 14001

Business Management: Business expansion, Diversion, Mergers and Takeovers

Human Resources (Personnel) Management **(04 Hours)**

Objectives and functions of Personnel Management, Manpower planning, training and development, Motivation, Leadership, Appraisal and increments management, Job Descriptions / Role Summary

Professional ethics, IT and e-business, Management	**(03Hours)**

Concept of Ethics, ethics and morals, Professional ethics, Introduction to Management Information System (MIS), Enterprise Resource Planning Systems (ERP), e-business and strategies. **Tools:** P-D-C-A cycle, Total Quality Management (TQM), 5 Whys?, '5 S', Kaizen, Introduction to Six sigma.

List of Assignments:

Students are expected to perform minimum 8 assignments

1. Conduct motion study using process charts (e.g. man-machine charts, flow process charts)
2. Measure labor, machine, or material productivity
3. Develop different types of plant layouts (product, process, fixed-position)
4. Supply Chain and Inventory Simulation
5. Prepare a Job Description (JD) and Job Specification for a selected role
6. Design a performance appraisal form using a method such as 360-degree feedback or MBO (Management by Objectives).
7. Prepare a short HR policy document (e.g., attendance policy, code of conduct, dress code).
8. Design an onboarding program for a new employee, including induction schedule, welcome kit, and orientation topics.
9. Role-play or group debate on ethical decision-making in business scenarios.
10. Case study on Six Sigma or Total Quality Management (TQM)
11. Use Excel or project software to develop a Gantt chart for a small project.
12. Analyze an e-commerce website (e.g., Amazon, Flipkart).

Learning Resources

Text Books:

1. Industrial Engineering and Management- O.P. Khanna, Dhanpat Rai Publication.
2. Industrial organization and Engineering Economic- T. R. Banga and S. C. Sharma, Khanna Publication.

Reference Books:

1. Management in Engineering- Gail Freeman- Bell and James Balkwill (PHI).
2. The New Era of Management – R. L. Daft, THOMSON (India Edition).
3. Management Today – Principles and Practice – Gene, Burton, Manab Thakur – McGraw Hill.

Savitribai Phule Pune University

Second Year of Engineering (2024 Pattern)

Course Code: VEC-251-INC **Course Name: Environmental Instrumentation**

Teaching Scheme	Credit	Examination Scheme
Theory: 2 Hours/Week	02	CCE : 15 Marks End-Semester: 35 Marks

Prerequisite Courses, if any:

Basic sensors for measurement of parameters- noise, soil and water.

Course Outcomes:

On completion of the course, learner will be able to:

1. Identify the necessity of Instrumentation and Control for Environmental Monitoring.
2. Describe the standards of raw and treated water and analyse the effects of water quality on ecosystems.
3. Analyze the instrumentation set up for wastewater treatment plants and methods for effective waste treatment.
4. Evaluate the importance of air pollution monitoring and assess sound pollution impact on the environment.

Course Contents

UNIT-I	**Sensors, Detectors, Analysers for Environmental Instrumentation**	**(05 Hours)**

Necessity of Instrumentation & Control for environment, sensor requirement for environment. Instrumentation methodologies: Ultraviolet analysers, total hydrocarbon analysers using flame, ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments. Ingress protection, IP packages for environmental protection.

UNIT-II	**Water Quality Parameters and Water Treatment**	**(06 Hours)**

Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity detectors, Opacity monitors, pH analysers & their application, conductivity analysers & their application. Water treatment: Requirement of water treatment facilities, process design.

UNIT-III	**Waste Water Treatment plant**	**(06 Hours)**

Ground water monitoring, Instrumentation in assessment of soil & ground water pollution. Instrumentation set up for waste water treatment plant, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD).Flow monitoring: Non open channel flow measurement, open channel waste water flow measurement.

UNIT-IV	Air Pollution and Sound Monitoring Systems	(09 Hours)

Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipment's, analytical methods for air pollution studies. Control of air pollution. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring, Environmental Laws.

Instruments in Weather station: Instruments in Weather station like Barometer, Rain gauge, Ceilometer etc., Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring station (REMS)

Learning Resources

Text Books:

1. Walter J Weber, "Physici-chemical processes for water quality control", Wiley Inter-science Publications 2012.
2. M N Rao and S K S Rao, "Air pollution", TMH publications 26th reprint 2007.
3. Rao, M. N. and Rao, H. V. N, " Air Pollution", Tata McGraw Hill Publishing Company Limited, New Delhi, 1989, ISBN-13: 978-0074518717
4. Kenneth Wark, Cecil F.Warner,Wayne T.Davis, "Air Pollution: Its Origin and Control", Pearson; 3 edition (13 November 1997), ISBN-13: 978-0673994165
5. Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy, "Environmental Engineering". McGraw Hill Education; First edition (1 July 2017), ISBN-13: 978-9351340263
6. Patrick F. Cunniff, "Environmental Noise Pollution", John Wiley & Sons Inc (4 May 1977) , ISBN-13: 978-0471189435.
7. Gilber M Masters, "Environmental Engineering and Science", Pearson Education (1997).

Reference Books:

1. Randy D. Down & Jay H. Lehr, "Environmental Instrumentation & Analysis Handbook", Wiley-Blackwell (7 October 2004), ISBN-13: 978-0471463542.

MOOC / NPTEL/YouTube Links:

1. NPTEL Course: Environmental Engineering
   https://onlinecourses.swayam2.ac.in/ntr25_ed57/preview
2. NPTEL Course: Environmental Quality Monitoring & Analysis
   https://onlinecourses.nptel.ac.in/noc25_ch24/preview

(Dr.C.B. Kadu)
BoS Coordinator
Instrumentation Engineering