Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- IV

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Instrumentation Engineering (Sandwich Pattern) **Term / Semester - IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19301	Process Control Systems	3	2	--	5	5	60	20	20	50*	--	--	150
IS19304	Instrumentation Circuit Design	3	4	--	7	7	60	20	20	50*	--	--	150
IS19306	Unit operations & instrumentation	3	--	2	5	5	60	20	20	--	25*	--	125
IS19307	Microcontrollers	3	4	--	7	7	--	--	--	50*	--	25	75
	Elective-I Group												
IS19401	Analytical Instrumentation	3	2	--	5	5	60	20	20	--	25*	25	150
IS19402	Power Plant Instrumentation												
IS19403	Building Automation												
HU19102	Environmental Studies	--	2	--	2	2	--	--	--	--	25	25	50
IS19407	Latex programming (Spoken Tutorial)	--	4 #	--	4 #	4	--	--	--	--	--	--	--
	Total	**15**	**18**	**02**	**35**	**35**	**240**	**80**	**80**	**150**	**75**	**75**	**700**
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

* Indicates assessment by External Examiner else internal assessment, # indicates Self, on- line learning Mode, @ indicates on line examination.

Note: Duration of Examination--TS1&TS2 -1 hour , TH- 2:30 hours, PR/OR – 3 hours per batch , SCA- Library - 1 hour, Sports- 2 hours, Creative Activity-2 hours

Self, on- line learning Mode through MOOCS /Spoken Tutorials / NPTEL / SWAYAM / FOSSEE etc.

Coordinator, Curriculum Development, Department of Instrumentation Engg. | **In-Charge Curriculum Development Cell** | **Head of Departments Department of Instrumentation Engg.** | **Principal**

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19301**				Course Title: **Process Control System**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**00**	**05**	**60**	**20**	**20**	**50***	-	**-**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid-term and second skill test at the end of the term

Rationale:

Process control in continuous production processes is a combination of control engineering and chemical engineering disciplines that uses industrial control systems to achieve a production level of consistency, economy and safety which could not be achieved purely by human manual control. It is implemented widely in industries such as oil refining, pulp and paper manufacturing, chemical processing and power generating plants. Process control technology allows manufacturers to keep their operations running within specified limits and to set more precise limits to maximize profitability, ensure quality and prioritize safety.

Course Outcomes: Student should be able to

CO1	Identify different elements and variables for the given control system
CO2	Use different control modes to control the given process
CO3	Apply of given control system in industrial application
CO4	Prepare project document for given process/project
CO5	Understand hazardous area classification and intrinsic safety in industry

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Basic Process Control System:** 1.1 Process- Definition, types-continuous and batch, and their examples. 1.2 Process Control System– Definition, it's importance in Process industries 1.3 Elements of Process Control System- Sensor/Transducer/ Transmitter, Controller, Final Control Element, and other instruments that support a process control loop – Recorders, Indicators, Alarms, and Interlocks. 1.4 Process Control Terminology- Controlled variable/ Measured Variable, Set-point, Deviation, Manipulated Variable, Disturbance/Load Variables 1.5 Familiarization of Basic Process Control System- Feedback control system concepts its advantages , limitations, and practical applications. **Course Outcome: CO1 Teaching Hours :06 hrs Marks: 8(R- 4, U-4, A-0)**

2	**Modes of PID/Feedback Controllers and Tuning:** 2.1 Modes of feedback controller - ON- OFF, Proportional(P), Integral(I), Derivative Proportional- Integral (PI) , Proportional-Derivative (PD), three term controllers (PID). 2.2 Control mode selection criteria for different processes. 2.3 Electronic and pneumatic type PID controllers and their comparison. 2.4 PID controller tuning- definition, tuning criteria. 2.5 PID controller tuning methods-Ziegler-Nichols open loop response and closed loop response methods. **Course Outcome: CO2 Teaching Hours : 09 hrs Marks:12 (R- 2 , U-4 , A- 6)**
3	**Advanced Process Control Systems** 3.1 Cascade control systems 3.2 Feed-forward control systems 3.3 Ratio control systems- using multiplier and divider, 3.4 Split-range control systems 3.5 Override control systems (Basic concepts, block diagram, industrial example, operation, advantages, disadvantages and applications.) **Course Outcome: CO3 Teaching Hours : 09 Marks: 12 (R- 2 , U- 4 A- 6)**
4	**Process Control based Project and its Documentation** 4.1 Instrumentation Symbols and Identification Standards: Outline of Identification & Instrumentation Symbols -Instrument line symbols, General instrument or function symbols, Control valve body symbols, Primary element symbols. 4.2 Process control loops – temperature, flow, level, pressure using ISA symbols 4.3 Project , typical life cycle of project, Role of process control/ instrumentation engineer in setting up a process control-based project. 4.4 Front end and detailed engineering design documents- Process Flow Diagram (PFD), Piping and Instrumentation Diagrams (P&IDs), Instrument index, Loop diagrams, Instrument specification sheets, hookup diagram, bill of materials . 4.5 Pre startup safety review (PSSR), Loop checking and commissioning - procedure, precautions. 4.6 Cable scheduling, Cable trays **Course Outcome: CO4 Teaching Hours :17 hrs Marks: 22 (R-4 , U- 8 , A-10)**
5	**Safety in Process Control Systems:** 5.1 Hazardous Area & Material classification as per NEC/IEC Standards. Ingress protection, 5.2 Protection techniques used to reduce explosion hazards. 5.3 Intrinsic Safety: Definition, Intrinsically Safe (IS) barrier systems. 5.4 Emergency shutdown(ESD) - concept only **Course Outcome: CO5 Teaching Hours : 04 hrs Marks: 06 (R- 2 , U- 2 , A- 2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to Basic Process Control System**	2	6	0	08
2	**Modes of PID/Feedback Controllers and Tuning**	2	4	6	12
3	**Advanced Process Control Systems**	2	4	6	12

4	**Process Control based Project and its Documentation**	4	8	10	22
5	**Safety in Process Control Systems**	2	2	2	06
	Total	**12**	**24**	**24**	**60**

List of experiments: Total 10-12 experiments(or turns) out of 15-16 experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify the process variables- CV(PV), MV, SP, DVs for given process	02
2	2	CO2	Implement the on-off controller for controlling given process to determine its benefits and limitations.	02
3	3	CO3	Implement the feedback control system for controlling given process to determine its benefits and limitations.	02
4	4	CO4	Draw ISA/ P&ID symbols for given field instruments/control room instruments.	02
5	5	CO5	Identify hazardous area in process control laboratory and suggest protection method	02
6	6	CO2	Implement the P- controller for controlling given process to determine its benefits and limitations.	02
7	1	CO2	Implement the PI- controller for controlling given process to determine its benefits and limitations.	02
8	2	CO2	Implement the PID- controller for controlling given process to determine its benefits and limitations.	02
9	3	CO3	Implement the cascade control system for controlling given process to determine its benefits and limitations.	02
10	4	CO3	Implement the ratio control system for controlling given process to determine its benefits and limitations.	02
11	5	CO4	Develop Process Flow Diagram (PFD) and it's subsequent Piping & Instrumentation Diagram (P &ID) for given laboratory/industrial process control application.	02
12	6	CO4	Develop Piping & Instrumentation Diagram (P &ID) and prepare instrument index for given laboratory/industrial process control application.	02
13	5	CO4	Develop loop diagram for given process control loop/system.	02
14	6	CO4	Develop specification sheet for given process equipment.	02
15	5	CO4	Develop installation hookup of DP transmitter for liquid level measurement	02
			Total	**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Chemical process control: An introduction to theory and practice	Stephanopoulos, G. Prentice-Hall, New Delhi. PTR (1984)	9780131286290
2	Process control & Instrumentation Technology	C.D. Johnson, Published by Wiley	9780471057895

3	Instrument Engineers Handbook Vol .-II Process Control	Bela G. Liptak., Published by Chilton, Philadelphia (1969)	9780801955198
4	Applied Instrumentation Vol 1-4	Andrew, William G., Published by DA Information Services (1982)	9780872013841

E-References:

1. https://www.omega.co.uk/prodinfo/pid-controllers.html
2. http://instrumentationportal.com/
3. http://scholar.vimaru.edu.vn/sites/default/files/diemphd/files/isa_5-1_2009_0.pdf
4. https://www.academia.edu/29216379/P_and_ID_SYMBOLS_P_and_ID_SYMBOLS_ISA_Symbols_and_Loop_Diagrams
5. http://www.lesman.com/train/webinars/Webinar-Slides-Control-101.pdf

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1		2	2				3	1	1
CO2	1		3	3			3	3	1
CO3		2	3	3			3	3	2
CO4				3		3	3	3	1
CO5		1		2	3		3	3	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Sandeep Yadav	Instrumentation Engineer	JSW steel, Pen
2	Mr. Sanjay Rajput	Lecturer in Instrumentation Engg.	Govt. Polytechnic Jintur
3	Mr. S.G. Thube	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. U. B Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
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Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19304**				Course Title: **Instrumentation Circuits Design**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**4**	**-**	**7**	**60**	**20**	**20**	**50***	-	**-**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Operational amplifier is most adaptable IC used widely in Electronic field, Biomedical field and Industry. Students should develop skills to build, test, design circuits based on op-amp and understand the working of various analog and digital signal conditioning circuits using op-amp for industrial, consumer applications.

Course Outcomes: Student should be able to

CO1	Identify the IC741 structure and their use
CO2	Use various linear & nonlinear configuration of op-amp for different applications
CO3	Design various signal conditioning circuits using linear op-amp
CO4	Understand different types of filters and their frequency response
CO5	Apply various IC's to build circuit for specific applications

Course Content Details:

Unit No	Topics / Sub-topics
1	**Fundamental of operation amplifier(op-amp)** 1.1 Operational amplifier definition, symbol, pin diagram of Op-amp IC741 and OP-07. 1.2 Block Diagram of Op-amp and function of each stage. 1.3 Ideal Op-amp electrical characteristic and Transfer characteristics. 1.4 Op-amp Parameter: Input offset voltage, input offset current, Input bias current, offset voltage adjustment range, Common mode rejection ratio (CMRR), supply voltage rejection ratio(SVRR), Slew rate, Differential Input resistance, Input capacitance, Input voltage range, Large Signal voltage gain, output voltage swing, Output resistance, Output short circuit current, Supply current, Gain bandwidth product. 1.5 Virtual Short and virtual ground Concept. 1.6 open loop configurations of Op-amp. **Course Outcome: CO1 Teaching Hours : 07 hrs Marks: 08 (R- 4, U-4, A-0)**

2	**Linear& Non-Linear Applications of Op-amp** 2.1 Linear applications of Op-amp 2.1.1 Close loop configuration: Inverting amplifier Non-Inverting amplifier and Unity gain amplifier. 2.1.2 Arithmetic Operation: Adder/summing/scaling/ averaging amplifier, Subtractor/differential amplifier, Integrator, Differentiator, Multiplier and Divider 2.1.3 Voltage to current Converter with floating load. 2.1.4 Current to voltage converter. 2.1.5 Sample and hold circuit. 2.1.6 Clamping Circuit. 2.2 Non-Linear applications of Op-amp 2.2.1 Comparator: Inverting and Noninverting. 2.2.2 Comparator applications: Zero crossing detector, Square wave generator, Schmitt trigger circuit. (circuit Diagram, working, output equation & waveform) **Course Outcome: CO2 Teaching Hours :12hrs Marks:16(R- 2, U-8, A-6)**
3	**Instrumentation amplifier using Op-amp** 3.1 Two & Three op-amp Instrumentation amplifier : circuit diagram and voltage output equation. 3.2 Advantages and disadvantages of Instrumentation amplifier 3.3 IC LM-324 pin configuration, specification and application 3.4 Applications of Instrumentation amplifier: 3.4.1 Sensor signal conditioning – design considerations and applications for RTD, thermocouple, strain gauge, Load cell 3.4.2 Optical sensor signal conditioning – photo-conductor, photovoltaic. **Course Outcome:CO3 Teaching Hour: 10hrs Marks:12 (R- 2, U-4, A-6)**
4	**Active filters** 4.1 Advantages of active filters over passive filters. 4.2 Filter and its Classification. 4.3 Filter Characteristic terms: order of filter, cut off frequency, pass band, stop band, centre frequency, roll off rate, Bandwidth, Q factor. 4.4 Types of filters : 4.4.1 Low pass (first order Butterworth) 4.4.2 High pass (first order Butterworth) 4.4.3 Band pass filter (first order):wide &Narrow 4.4.4 Band reject filters (first order): wide & Narrow 4.4.5 All pass filters (Circuit diagram, circuit operation, frequency response, Applications) **Course Outcome: CO4 Teaching Hours : 8hrs Marks: 12 (R- 2, U-4, A-6)**
5	**Specialized IC Applications** 5.1 IC555 timer: Need of Timer, features, block diagram and operation, pin Diagram and function 5.2 IC555 timer as monostable multivibrator(circuit operation, output wave form & output equation, applications) 5.3 Application: frequency Divider (circuit diagram & operation)

	5.4 IC555 timer as astable multivibrator (circuit, operation, output wave form & output equation, applications) 5.5 Application: Square Wave Generator (circuit diagram & operation) **Course Outcome: CO5 Teaching Hours:8 hrs Marks:12 (R- 2, U-4, A-6)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Fundamental of operation amplifier(op-amp)**	4	4	0	8
2	**Linear & Non-Linear Applications of Op-amp**	2	8	6	16
3	**Instrumentation amplifier using Op-amp**	2	4	6	12
4	**Active filters**	2	4	6	12
5	**Specialized IC Applications**	2	4	6	12
	Total	**12**	**24**	**24**	**60**

List of experiments: Total 10-12 experiments(or turns) out of experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Test and measure parameters of OP-Amp(input offset voltage, input offset current, input bias current & slew rate)	2
2	2	CO2	Build and test the Inverting & Non- Inverting amplifier usingIC741 Op-Amp & to find its output voltage .	2
3	3	CO3	Built & measure the Gain of Instrumentation amplifier circuit.	2
4	2	CO2	Build and test the output of Integrator & differentiator circuit using IC741	2
5	4	CO4	To observe the response of first order low pass Butterworth filter using OP- Amp	2
6	5	CO5	Built and test Monostable multivibrator Using IC555 timer and determine time cycle.	2
7	3	CO3	To design and test signal conditioning circuit for RTD using instrumentation amplifier	4
8	3	CO3	To design and test signal conditioning circuit for thermocouple using instrumentation amplifier	4
9	3	CO3	To design and test signal conditioning circuit for Strain gauge.	4
10	3	CO3	To design and test signal conditioning circuit for photo diode/ photoconductors	4
11	2	CO2	Build and test the output of adder/scaler/averaging and subtractor circuit using IC741	4

12	5	CO4	Built and test astable multivibrator Using IC555 timer and determine time cycle.	2
13	2	CO2	Build and test the output of V to I converter using IC741	2
14	4	CO4	To observe the response of first order high pass Butterworth filter using OP- Amp	2
15	4	CO4	To observe the response of first order band pass filter using OP- Amp	2
16	4	CO4	To observe the response of first order band reject filter using OP- Amp	2
17	3	CO3	Design and test signal conditioning circuit for Load cell	4
18	5	CO5	Design and test Frequency Divider circuit as an application of Monostable multivibrator	2
19	2	CO2	Build and test the output of I to V converter using IC741	2
20	5	CO5	Design and test square wave generator circuit as an application of astable multivibrator	2
21	3	CO3	Build and test Instrumentation amplifier circuit using IC LM324	2
22	2	CO2	Build and test the output of Comparator using IC741	2
23	all	all	Mini project	4
			Total	**60**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Op-Amp & Linear Integrated circuits	Ramakant A. Gayakwad, Third edition, Prentice Hall of India, 2011	9788120320581
2	Operational amplifiers with Linear integrated circuits	William Stanley, Pearson Education India, 2002	9788131708453
3	Integrated Circuits	K. R. Botkar, Khanna Publication, 1987	9788174092083
4	Linear Integrated Circuit	Roy Choudhary, D. Jain, New age International Publisher, New Delhi, 2003	9788122414707
5	Operational amplifier and Linear IC's	Bell, David A., Oxford University Press. New Delhi, 2011	9780195696134
6	Design with Operational Amplifier & Analog Integrated Circuit	Franco, Sergio, McGraw-Hill Education, New Delhi, 2014	9780078028168
7	Operational amplifier & Linear Integrated circuits	Coughlin & Dirscoll Fourth Edition, Prentice Hall of India	9780136377856
8	Application and Design with Analog Integrated Circuit	J. Michael Jacob Second Edition, Reston Publishing co., 1982	9780835902458

9	Process Control Instrumentation Technology	C.D. Johnson Seventh Edition, Eastern Economy Edition, 1988	9780471637349
10	Electronic Lab Manual	Navas K. A. PHI Learning, New Delhi, 2014	9788120351424

E-References:

1. https://www.studyelectronics.in
2. https://www.electronicsforum.com
3. www.electronicshub.org
4. www.engineersgarage.com
5. https://www.electronics-tutorials
6. https://www.electrical4u.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	2	-	1	1	-
CO2	2		3	2	1	-	3	2	3
CO3	2	2	3	1	2	2	3	3	2
CO4	2	2	3	2	2	-	2	2	2
CO5	2	2	3	1	1	-	2	3	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Smt. R. B. Shirsat	Engineering Assistant	ONGC Ltd.
2	Mr. R. D. Moon	Lecturer in Electronics	Govt. Polytechnic Vikramgad
3	Mr. F. S. Bagwan	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Smt. K. U. Waghmare	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
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Head of Department
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I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:**IS19306**				Course Title: **Unit Operations and Instrumentation**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**--**	**02**	**05**	**60**	**20**	**20**	**--**	**25***	**--**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Instrumentation diploma holders are expected to work in process industries such as petrochemical, power, chemical and fertilizer industries. Fundamental knowledge of different unit operations used in the process industries is essential. This course is introduced with the view that the students will be familiar with various processes and process equipment and instrumentation required for the unit operations.

Course Outcomes: Student should be able to

CO1	Identify various unit operations and processes in industries
CO2	Demonstrate operation of Boiler and Heat Exchanger equipment and its instrumentation and control
CO3	Explain the operation of Distillation equipment and its control schemes
CO4	Describe Evaporation and Drying equipment and associated instrumentation
CO5	Explain Crystallization equipment and associated controls

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Unit Operations** 1.1 Basic concept of unit operation and unit process. 1.2 Batch and continuous process. 1.3 Endothermic and Exothermic reaction. 1.4 Reversible and Irreversible process. 1.5 Applications of the various units in process industries like: Thermal power plant, Oil refinery (process flow diagram and operation) **Course Outcome: CO1 Teaching Hours : 08 hrs Marks: 12 (R- 2, U-4, A-6)**
2	**Heat Exchangers and Boilers** 2.1 Basic concept & flow sheet symbol. 2.2 Types of heat exchange equipment. 2.3 Shell and tube heat exchanger : diagram, construction, operation, controls (Feedback, cascade, feed forward control)

	2.4 Basic concept of boiler, flow sheet symbol & types: Water tube boiler Vs. Fire tube boiler. 2.5 Water tube boiler : diagram, construction and operation. 2.6 Boiler controls: safety interlocks, Burner Control, Steam Temperature Control. 2.7 Drum level control: swelling and shrinking phenomenon, single element control, two element control, and three element control **Course Outcome: CO2 Teaching Hours : 14 hrs Marks: 16 (R- 4, U-6, A-6)**
3	**Distillation** 3.1 Definition, basic concept of distillation process , flow sheet symbol 3.2 Methods of distillation – flash distillation, fractionating column distillation (Equipment setup, diagram & operation) 3.3 Different controls for distillation. 3.4 Applications. **Course Outcome: CO3 Teaching Hours : 07 hrs Marks: 12 (R- 2, U-4, A-6)**
4	**Evaporation and Drying** 4.1 Definition, evaporation process, Capacity and economy of evaporator, flow sheet symbol. 4.2 Single & multiple effect evaporators : diagram & operation 4.3 Evaporator types: Natural vs. Forced circulation evaporators, Climbing film evaporator, Agitated film evaporator (diagrams and operation) 4.4 Methods of increasing economy, Vapor recompression operation. 4.5 Different controls for evaporation unit. 4.6 Introduction of Dryers. 4.7 Factors on which rate of drying depends. 4.8 Types of dryers: Tray dryer, rotary dryer, drum dryers: diagram, operation & advantages & disadvantages. 4.9 Dryer Controls. **Course Outcome: CO4 Teaching Hours :10 hrs Marks: 12 (R-2, U-4, A-6)**
5	**Crystallization** 5.1 Definition. 5.2 Magma, crystallization process, importance of crystal size, 5.3 Crystallizer types: 1.Continuous crystallizer 2. Draft Tube Baffle (DTB) crystallizer: Diagram, operations, advantages & disadvantages. 5.4 Crystallizer controls **Course Outcome: CO5 Teaching Hours :06 hrs Marks: 08 (R- 2, U-4, A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to Unit Operations**	2	4	6	12
2	**Heat Exchangers and Boilers**	4	6	6	16
3	**Distillation**	2	4	6	12
4	**Evaporation and Drying**	2	4	6	12
5	**Crystallization**	2	4	2	08
	Total	**12**	**22**	**26**	**60**

List of assignments: Total 10 drawing assignments (free hand sketches of following assignments on half empirical sheet) out of 13 assignments

Sr. No.	Unit No	COs	Title of the assignment	Hours
1	1	CO1	ISA symbols of various units and process equipment.	2
2	2	CO2	Different types Heat Exchanger.	2
3	2	CO2	Different types of Boiler.	2
4	3	CO3	Distillation column setup	2
5	4	CO4	Evaporators and its controls.	2
6	5	CO5	Crystallizers and its controls.	2
7	1	CO1	Process flow diagram of Thermal power plant.	2
8	1	CO1	Process flow diagram of oil refinery.	2
9	2	CO2	Heat Exchanger control schemes.	2
10	2	CO2	Boiler controls.	2
11	3	CO3	Distillation column controls	2
12	4	CO4	Dryers and its controls.	2
13	All	All	Industry expert lecture	2
14	All	All	Industrial Visit Report	4
				30

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining assignments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Outline of chemical Technology	Gopala Rao & Sittiney, East West Press, 3rd edition, 1997	978-8185938790
2	Unit operations of chemical Engineering	MCcabe & Smith, McGraw Hill,7th edition,2004	978-0072848236
3	Elementary Principles of chemical processes	Bullard, Lisa G. Rousseau, Ronald W. Felder, Richard M. John Willey and Sons Publ.,4th edition, 2015	9781118431221
4	Chemical Engineer's Handbook	**Green, Don, Perry, Robert,** McGraw Hill publ.,8th edition,2007	9780071422949
5	Unit operations -Vol 1 & 2	K. A. Gawane, Nirali Prakashan, 2nd edition,2014	9788196396114 9788196396121
6	Applied Instrumentation Vol 1-4	W.G Andrew, H.B Williams, Gulf Publishers,3rd edition,1993	978-0872010475

7	Instrument Engineers Handbook Vol . –II Proecss Control	Bela G. Liptak.Taylor and Fransis pub ISA,4th edition,2013	9780750622547

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2. https://nptel.ac.in/courses/112/107/112107216/
3. https://nptel.ac.in/courses/103/103/103103035/

CO Vs PO and CO Vs PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	1	1	-	1	2	1	1
CO2	2	3	3	1	-	1	2	2	2
CO3	2	3	3	1	-	1	2	2	2
CO4	1	3	3	1	-	1	2	2	2
CO5	1	3	3	1	-	1	2	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Sagar Panchal	Senior Engineer	VVF Ltd. Taloja
2	Mr. S. R. Shiledar	Assistant Professor	G. C. O. E. Jalgaon
3	Mr. U. B. Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. K. U. Dawane	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

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code**: IS19307**				Course Title: **Microcontrollers**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**4**	**--**	**7**	**--**	**--**	**--**	**50***	**--**	**25**	**75**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Microcontroller is the key device in automation. It is being used in domestic, commercial, industrial and consumer goods from low end to high end applications. Microcontroller enhancing the pace of technology. Diploma engineers shall deal with various Microcontroller based systems and maintain them. This course intends to develop skills to maintain and build the Microcontroller based systems.

Course Outcomes: Student should be able to

CO1	Distinguish microprocessor and Microcontroller based systems
CO2	Interpret the functions of different internal parts of microcontroller 8051
CO3	Develop simple ‘c’ language programs for arithmetic and logical operations
CO4	Develop simple ‘c’ language programs for timer, counter and serial data transfer
CO5	Construct simple application circuits using input/output devices

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basics of Microprocessor and Microcontroller** 1.1 Basic concept of microprocessor & microcontroller. 1.2 Block Diagram of Microprocessor based system. 1.3 Difference between microprocessor & microcontroller. 1.4 Derivatives of microcontroller 8051. [from manufacturers Intel, Atmel, NXP, Microchip] 1.5 Specification of 8051 microcontroller. 1.6 Advantages, Disadvantages and Applications of microcontroller. **Course Outcome: CO1 Teaching Hours : 04 hrs**
2	**Microcontroller 8051 Architecture** 2.1 Architecture of 8051 microcontroller 2.2 Pin diagram of 8051 microcontroller and function of each pin 2.3 Boolean Processor

	2.4 Input/ Output Ports, circuits & their alternate functions 2.5 Internal memory organization[RAM & ROM] 2.6 Stack memory and stack pointer 2.7 Flag and PSW register 2.8 Timers & Counters–Circuit diagram and working 2.9 Interrupts-Types, vector addresses and priority 2.10 Serial data input/ Output **Course Outcome: CO2 Teaching Hours : 08 hrs**
3	**Embedded 'c' and Programming** 3.1 Software development tools: editor, assembler, compiler, cross compiler, linker, locator 3.2 Data types, Constants and Variables, Operators 3.3 Looping: for, while, do-while 3.4 Decision Control: if-else, nesting of if 3.5 Functions 3.6 Arrays 3.7 Programs for simple arithmetic & logical problems **Course Outcome: CO3 Teaching Hours : 11 hrs**
4	**Timers, Interrupts, Serial Communication** 4.1 Timers/Counters: 4.1.1 TMOD, TCON, TH, TL registers 4.1.2 Four modes of operation 4.2 Interrupts: IE, IP registers 4.3 Serial Communication: 4.3.1 SCON, SBUF, PCON registers 4.3.2 Modes of serial communication 4.4 Simple programs based on timer, counter and serial data transfer **Course Outcome: CO4 Teaching Hours : 10 hrs**
5	**Memory and I/O Interfacing** 5.1 External program and data memory interfacing: RAM, ROM 5.2 I/O interfacing : switch, LED, 7 segment display, LCD, relay, 4x4 matrix keyboard, DC motor, stepper motor, ADC and DAC 5.3 Simple programs for I/O control **Course Outcome: CO5 Teaching Hours : 12 hrs**

Suggested Specifications Table (Theory):

----------NA----------

List of experiments: Total 15-20 experiments (or turns) out of 25 experiments (or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify different microprocessor and Microcontroller based systems in your laboratories.	2
2	2	CO2	Understand the keil software, different windows [edit, project, output, memory, I/O ports etc.], functions and different assembler directives.	2

3	3	CO3	Write an ALP to perform simple arithmetic operations like addition, subtraction, multiplication and division.	2
4	4	CO4	Write an ALP to generate different time delays in operation [1ms to 50ms] using T0 and T1 timers.	2
5	5	CO5	Construct circuit to interface switch and LED to 8051 Microcontroller. Write an ALP to control LED On /OFF using switch.	2
6	1	CO1	Make survey of different derivatives of 8051 microcontroller from Intel, Atmel, NXP and Microchip and prepare comparative sheet.	2
7	2	CO2	Identify different pins of microcontroller 8051 on given development board and measure the voltage on different pins.	2
8	3	CO3	Write an ALP to perform simple logical operations like ANDing, ORing, XORing and NOT.	2
9	4	CO4	Write an ALP to count frequency of external pulses using counters C0 & C1.	2
10	5	CO5	Construct circuit to interface LCD to 8051 Microcontroller. Write an ALP to scrolling and steady display.	2
11	3	CO3	Write an ALP to perform memory block transfer source to destination locations in internal data memory.	2
12	4	CO4	Write an ALP to transfer data of various length serially over serial port.	2
13	5	CO5	Construct circuit to interface relay to 8051 microcontroller. Write an ALP to control AC bulb ON/OFF using relay.	2
14	3	CO3	Write an ALP to find smallest and largest nos. located in internal data memory.	2
15	4	CO4	Write an ALP to transfer data of various length serially over serial port.	2
16	5	CO5	Construct circuit to interface relay to 8051 microcontroller. Write an ALP to control AC bulb ON/OFF using relay.	2
17	3	CO3	Write an ALP to arrange nos. in ascending/ descending order located in internal data memory.	2
18	4	CO4	Write an ALP to receive data of various length serially over serial port.	2
19	5	CO5	Construct circuit to interface ADC to 8051 microcontroller. Write an ALP to read potentiometer voltage through ADC.	2
20	3	CO3	Write an ALP to arrange nos. in ascending/ descending order located in internal data memory.	2
21	5	CO5	Construct circuit to interface DAC to 8051 microcontroller. Write an ALP to generate square/ triangular wave.	4
22	5	CO5	Construct circuit to interface 4x4 matrix keypad to 8051 microcontroller. Write an ALP to read keys and display on LCD.	4
23	5	CO5	Construct circuit to interface DC motor to 8051 microcontroller. Write an ALP to control speed of DC motor.	4
24	5	CO5	Construct circuit to interface stepper motor to 8051 microcontroller. Write an ALP to control speed, direction, step angle of stepper motor.	4
25	5	CO5	Microproject on mentioned input/output based applications.	4
Total				**60**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	The 8051 Microcontroller: Architecture, programming and applications	Kenneth J. Ayala, Cengage Learning, 3rd edition, 2005	978-1401861582
2	The 8051Microcontroller and Embedded System using assembly and C	Muhammad Ali Mazidi, Janice Gillispe Mazidi, Rlin D. McKinlay, Pearson/ Prentice Hall New Delhi, 2nd edition, 2008	978-8131710265
3	Microcontroller Theory and application	Ajay V. Deshmukh, McGrawHill New Delhi, 1st edition, 2011	978-0070585959
4	Microprocessors and Microcontrollers: Architecture, Programming and System Design	Krishna Kant, PHI New Delhi, kindle edition, 2016	978-8120331914

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2. http://www.circuitstoday.com/8051-microcontroller
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4. https://www.intorobotics.com/8051-microcontroller-programming-tutorials-simulators-compilers-and-programmers/
5. http://www.8052.com/tut8051.phtml
6. http://electrofriends.com/articles/electronics/microcontroller-electronics-articles/8051-8951/80518951-microcontroller-instruction-set/
7. www.edsim51.com
8. www.faqs.org/microcontroller

CO Vs PO and CO Vs PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1							1	
CO2	1	1		1				1	
CO3	1	3	2	1	2		1	1	2
CO4	1	3	2	1	2		1	1	2
CO5	1	3	3	2	3	2	2	1	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
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3	Mr. U.B. Shinde	Lecturer in Instrumentation	Govt. Polytechnic, Mumbai
4	Mr. F.S. Bagwan	Lecturer in Instrumentation	Govt. Polytechnic, Mumbai

Coordinator,
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Head of Department,
Department of Instrumentation Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19401**				Course Title: **Analytical Instrumentation**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**		**5**	**60**	**20**	**20**		**25***	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid-term and second skill test at the end of the term

Rationale:

Analytical Instrumentation takes extensive use in area of medical field, drugs and pathological laboratories, pharmaceutical, dairy, chemical industries, water treatment etc. This course aids students to obtain knowledge and skills to select, understand working, operate and maintain analytical instruments for relevant industry application. This course tries to build these qualities in students.

Course Outcomes: Student should be able to

CO1	Identify analytical instruments for various applications
CO2	Demonstrate different types of absorption Spectroscopy
CO3	Demonstrate the analytical instruments based on separation techniques
CO4	Select relevant instrument for specified industrial gases
CO5	Use instrument for pH and conductivity measurement

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to analytical instrumentation** 1.1 Analytical Instrumentation: - Definition, Block diagram of analytical instrument and each element explanation 1.2 Compare Classical analytical techniques with instrumental technique 1.3 Classification: -Spectral, Electro-analytical and Separation methods(introduction to each method) 1.4 Elements of optical Radiation sources:-Introduction to sunlight, incandescent, fluorescent, LASER optical filter, Monochromator-prism, Grating. **Course Outcome: CO1 Teaching Hours :8 hrs Marks: 10(R- 4, U-6, A-0)**
2	**Absorption spectroscopy** 2.1 Fundamental of spectroscopy: - Electromagnetic spectrum, Interaction of radiation with matter, Beer Lambert's law (statement) 2.2 Colorimetric Methods: Single and double beam colorimeter. applications 2.3 UV-VIS spectrophotometer: - single beam, double beam spectrophotometer using prism,

	grating, applications 2.4 Infrared spectrometer 2.5 NMR spectroscopy: principle, nuclear spin, nuclear energy level resonance condition, block diagram, constructional details and working of NMR spectrometer, applications 2.6 Flame Photometer: principle, Block Diagram, construction & working of each components of Flame Photometer **Course Outcome: CO2 Teaching Hours: 12hrs Marks:16 (R- 4, U- 6, A-6)**
3	**Analytical Instruments for separation technique** 3.1 Chromatography: - Principle and classification of chromatography 3.2 Gas chromatographic system: principle, diagram, basic components of GC, working applications 3.3 Liquid chromatographic system: principle, diagram, basic components of LC, working applications 3.4 Mass spectrometry: -Basic principle of mass spectrometer, components and types of mass 3.5 spectrometer(magnetic deflection type, time of flight, radio frequency type diagram & working 3.6 GCMS system: -diagram, working, application **Course Outcome: CO3 Teaching Hours:12 hrs Marks:16 (R- 2, U- 8, A- 6)**
4	**Gas analyzer** 4.1 Basic concept, types 4.2 Paramagnetic oxygen analyzer: 4.3 Infrared gas analyzer 4.4 Thermal conductivity analyzer 4.5 (RVP) Reid vapor pressure analyzer 4.6 NOx, Sox gas Analyzer (Principle, working, diagram & applications of each type) **Course Outcome: CO4 Teaching Hours:10 hrs Marks:10 (R- 2, U- 6, A- 2)**
5	**Environmental pollution monitoring instruments** 5.1 Types and concentration of various Gas pollutant 5.2 SO2 measurement using conductivity method 5.3 Nitrogen oxide measurement using Chemiluminescence 5.4 Ozone measurement using conductivity meter 5.5 pH measurement using pH meter (diagram & working) **Course Outcome: CO5 Teaching Hours:06 hrs Marks:08 (R-2, U- 4, A- 2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to analytical instrumentation**	4	6	-	10
2	**Absorption spectroscopy**	4	6	6	16
3	**Analytical Instruments for separation technique**	2	8	6	16

4	**Gas analyzer**	2	6	2	10
5	**Environmental pollution monitoring instruments**	2	4	2	8
	Total	**14**	**30**	**16**	**60**

List of experiment: Total 10-12 experiments(or turns) out of 15 experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify the elements of analytical instruments in Laboratory	2
2	1	CO2	To measure absorbance and transmittance of a given sample using spectrophotometer	2
3	2	CO3	Use Video to demonstrate the working of gas chromatograph.	2
4	2	CO4	To demonstrate the working of infrared gas analyzer.	2
5	5	CO5	Use pH meter to determine pH of a given solution	2
6	5	CO2	Use Video to demonstrate the Flame photometer to measure contents of a given sample	2
7	1	CO2	Use Video to demonstrate working of NMR spectroscopy.	2
8	2	CO3	Use Video to demonstrate the Mass spectrometer for separation of sample content	2
9	3	CO1	Demonstrate the functioning of different optical sources	2
10	4	CO5	Use video for measurement SO2 using conductivity method	2
11	5	CO2	To measure absorbance and transmittance of a given sample using colorimeter	2
12	6	CO2	Demonstrate the working of Infrared Spectrometer	2
13	4	CO4	To demonstrate the working of Thermal conductivity analyzer	2
14	4	CO4	To demonstrate the working of Paramagnetic Oxygen Analyzer.	2
15	3	CO3	Use Video to demonstrate the working of GCMS System	2
			Total	**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Handbook of Analytical Instruments	R.S. Khandpur, Tata McGraw–Hill Publications 2006	978007148746
2	Instrumental method of analysis	Willard Merrit Dean, CBS Publishers1988	9780534290153
3	Introduction to instrumental analysis	Braun Robert D., McGraw Hill Education, New Delhi	978007100472

4	Principle of Instrumental Analysis	Skoog , holler, Nieman, Saunders college publishing,1998.	9781305577213
5	Instrumental Method of Chemical Analysis	Ewing E.W. McGraw Hill Education, New Delhi1969	9780070198531
6	Analytical instrumentation instrument Engineers Hand book	B.G. Liptak, CRC Press, 1994	9780801983979

E-References:

1. https://www.slideshare.net
2. https://nptel.ac.in
3. https://instrumentationtools.com
4. www.youtube.com
5 https://vlab.amrita.edu

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	-	2	1	-	2	1	1
CO2	2	1	-	3	2	-	1	2	2
CO3	2	3	-	2	3		2	2	3
CO4	2	1	-	2	2	1	3	3	2
CO5	2	1	1	3	2	-	2	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Smt. R. B. Shirsat	Engineering Assistant	ONGC Ltd.
2	Mr. C. S. Tamkhane	Lecturer in Instrumentation Engg.	Govt. Polytechnic Pen
3	Mr. K. U. Dawane	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mrs K.U. Waghmare	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
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Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19402**				Course Title: **Power Plant Instrumentation**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

The demand of power generation is increasing due to living standard, increasing population and industrialisation. The role of instrumentation engineer is to design, develop, install, manage and maintain equipment which are used to monitor and control systems, machinery and processes in power plant, to make sure that these systems and processes operate effectively, efficiently, safely and power generation without any type of pollution. The course is designed to familiarise students to the layouts and operations with the instrumentation available in power generation plant.

Course Outcomes: Student should be able to

CO1	Classify types of power plants
CO2	Demonstrate layout, working, site selection, types of boilers of thermal power plants
CO3	Describe site selection, classification, layout and components for Hydro Electric Power Plants
CO4	Discuss schematics, types of reactors in nuclear power plants with safety measures
CO5	Explain the non-conventional types of power plants

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Power plant:** 1.1 Introduction to power generation 1.2 Need of Power Generation 1.3 Site selection of Power plant 1.4 Classification of power plant **Course Outcome: CO1 Teaching Hours :08hrs Marks:10 (R-4, U-4, A- 2)**
2	**Thermal Power Plant:** 2.1 Method of power generation 2.2 General Layout, working, site selection of Thermal power plant. 2.3 Coal classification, coal handling & storage and feeding. 2.4 Steam turbines, Gas turbines, condenser, feed water Treatment, Ash handling system. 2.5 Types of boilers, High pressure boiler and their controls. 2.6 Types of Pumps and Fans.

	2.7 Fire and gas detection system 2.8 Role of Instrumentation in thermal power plant. **Course Outcome: CO2 Teaching Hours :10hrs Marks:14 (R-2, U-6, A- 6)**
3.	**Hydroelectric Power Plant** 3.1 Site selection, layout of hydro power plant. 3.2 Classification of Hydropower plants. 3.3 Components: Reservoirs, dams, spillways, conduits, surge tank, prime overs, draft tubes, water turbine diagrams (brief introductions) 3.4 Role of Instrumentation in Hydro power plant. **Course Outcome: CO3 Teaching Hours :10hrs Marks:14 (R-2, U-6, A- 6)**
4	**Nuclear Power Plant** 4.1 Concept of energy generation from nuclear fission, control of chain reaction. 4.2 Schematics of Nuclear power plant. 4.3 Types of reactors, reactor control, safety measures. **Course Outcome: CO4 Teaching Hours :09hrs Marks:12 (R-2, U-4, A- 6)**
5.	**Non-conventional power generation**: Brief introduction of following 5.1 Wind power plant 5.2 Solar power plant 5.3 Tidal Power plant 5.4 Role of Instrumentation in solar power plant. **Course Outcome: CO5 Teaching Hours :08hrs Marks:10 (R-2, U-4, A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to Power Plant**	4	4	2	10
2	**Thermal Power Plant**	2	6	6	14
3	**Hydroelectric Power Plant**	2	6	6	14
4	**Nuclear Power Plant**	2	4	6	12
5	**Non-conventional power generation**	2	4	4	10
Total		**12**	**24**	**24**	**60**

List of experiments: Total 10 experiments(or turns) out of 15 experiments(or turns)
To draw separate sheet for each of the following:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Prepare a comparison chart for power plants based on their types, location, selection	2
2	2	CO2	Detailed layout of thermal power plant	2
3	3	CO3	Detailed layout of Hydraulic power plant	2
4	4	CO4	Detailed layout of Nuclear power plant	2
5	5	CO5	General layout of wind power plant	2
6	2	CO2	Sketches of High-pressure boilers	2
7	4	CO4	Sketches of types reactors of nuclear power plants	2
8	2	CO2	Sketches of cooling water system using water softening.	2
9	2	CO2	Sketches of coal and ash handling systems	2
10	2	CO2	Sketches of Types of Pumps and Fans	2
11	2	CO2	Sketches of steam turbines	2
12	5	CO5	General layout of solar power plant	2
13	5	CO5	General layout of Tidal power plant	2
14	2	CO2	Collect information and technical details for thermal power plant	2
15	1	CO1	Report on any one Power plant visits	2
Total				**30**

Note: Experiments No. 1 to 5 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Power Plant Engineering	Domkundwarand Arora Domkundwar Dhanpat Rai & Co.(P) Limited; Eighth edition (2016)	978-8177001952
2	Non-conventional energy resources	B. H. Khan, McGraw Hill Education India Private Limited; Third edition (1 July 2017)	978-9352601882
3	Solar Energy	S. P. Sukhatme McGraw Hill Education; Fourth edition (2017)	978-9352607112
4	Boiler Control Systems Engineering	G.F. Gilman International Society of Automation 2 edition (20 August 2012)	978-1936007202
5	Power Plant Engineering	P.K.Nag McGraw Hill Education; Fourth edition (1 July 2017)	978-9339204044

6	A Textbook of Power Plant Engineering	R. K. Rajput Laxmi Publications Pvt Ltd; 5th edition (2007)	978-8131802557

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2. https://www.slideshare.net/shilpashukla5099/thermal-plant-instrumentation-and-control
3. https://letslearn235216893.wordpress.com/2020/01/10/power-plant-instrumentation/
4. https://www.scribd.com/presentation/70636397/Power-Plant-Instrumentation
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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	-	-	2	1	1
CO2	3	-	3	-	3	-	3	3	3
CO3	3	-	3	-	3	-	3	3	3
CO4	3	-	2	-	3	-	3	3	3
CO5	3	-	3	-	3	-	3	3	3

Industry Consultation Committee:

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3	Mr. K.U. Dawane	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
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Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:**IS19403**				Course Title: **Building Automation**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**--**	**05**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Knowledge of building environments is fundamental to the design, operation and maintenance of today's complex buildings. Building management system plays a vital role in commercial buildings, Government offices, Hospitals, Pharmaceutical industries, Hotel industries, Clubs, Casinos, Air Ports, etc. As major role of instrumentation engineer is involved in this field, the knowledge of Building Management System is essential for instrumentation students. This course will help the students to understand the various aspects of different systems seen in well-structured building.

Course Outcomes: Student should be able to

CO1	Identify various components of Building management system.
CO2	Demonstrate the use of psychrometric chart and the functioning of different types of HVAC equipment and systems.
CO3	Explain the operation of various equipment and subsystems in BMS.
CO4	Understand DDC fundamentals of BMS.
CO5	Describe the advanced features used for effective facility control.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction:** 1.1 Concept of Building Automation. 1.2 Components of Building management system (BMS). 1.3 Features of Building management system. 1.4 Benefits of Building management system. **Course Outcome: CO1 Teaching Hours : 3 hrs Marks: 08 (R- 2, U-6, A-0)**
2	**HVAC systems:** 2.1 Air Properties definitions 2.1.1 Dry bulb temperature, 2.1.2 Wet bulb temperature,

	2.1.3 Relative humidity, 2.2.4 Humidity ratio, 2.1.6 Dew Point temperature, 2.1.7 Enthalpy, 2.1.8 Specific Volume. 2.2 Introduction to the Psychrometric Chart, 2.2.1 Construction of Psychometric chart, 2.2.2 Examining the psychrometric chart, 2.2.3 Sketching the eight HVAC processes on the psychrometrics chart, 2.3 The basic central system 2.3.1 Components of air conditioning systems. 2.3.2 Classification of HVAC systems: All Air system, All water system, Air – water system, (Diagram, operation, advantages and disadvantages) 2.3.3 HVAC Zones and Rooms. 2.4 Components of HVAC.(Diagram and operation of each) 2.4.1 Boiler, 2.4.2 Chiller, 2.4.3 Air-handling unit (AHU), 2.4.4 Air terminal unit (ATU), 2.4.5 Variable air volume equipment (VAV) 2.5 HVAC sequence of operation. 2.6 Maintenance. 2.7 HVAC Controls. **Course Outcome: CO2 Teaching Hours : 16 hrs Marks: 14 (R- 04, U-04,A-06)**
3	**BMS Subsystems:** 3.1 **Fire Alarm Systems (FAS)** 3.1.1 Overview FAS systems. 3.1.2 Block diagram of FAS. 3.1.3 FAS Components: Fire and smoke detectors, smart sensors, Fire Alarm Control Panel, Annunciator panel, Suppression systems, Notification devices. 3.1.4 Applications. 3.2 **CCTV Systems** 3.2.1 Overview of CCTV system. 3.2.2 Block diagram of CCTV System. 3.2.3 Types of CCTV Camera. 3.2.4 Video Management System DVM features , DVR Vs. NVR. 3.2.5 Applications. 3.3 **Access Control Systems** 3.3.1 Overview of Access Control System. 3.3.2 Block diagram of Access Control System. 3.3.3 Component of Access Control System. 3.3.4 Features. 3.3.5 Applications. **Course Outcome: CO3 Teaching Hours :12hrs Marks:14(R- 04, U- 04, A- 06)**

4	**DDC Fundamentals in BMS.** 4.1 Roll of microprocessor in BMS 4.2 Evolution of DDC 4.3 Block diagram of DDC 4.4 Controller configurations. 4.5 Types of Controllers 4.6 Controller Software: Operating Software, Application software, Energy Management software 4.7 Typical DDC Operators: Sequence, Reversing, Ratio, Analog controlled digital output, Digital controlled analog output, Analog controlled analog output, Maximum input, Minimum input , Delay, Ramp. **Course Outcome: CO4 Teaching Hours :08hrs Marks:12 (R-02,U- 04, A- 06)**
5	**Advance Technology for effective facility Control** 5.1 Features for optimal Control: 5.1.1 Optimal START / Optimal STOP (Optimal Run time) 5.1.2 Load Rolling 5.1.3 Demand Limiting 5.1.4 Economizer switchover 5.1.5 Supply air reset (SAR) 5.1.6 Supply Water Reset (Chilled water or Hot Water) 5.1.7 Condenser water reset 5.1.8 Chiller sequencing 5.2 Information Management Features : 5.2.1 Summaries 5.2.2 Password 5.2.3 Alarm Report 5.2.4 Time Scheduling 5.2.5 Trending 5.2.6 Totalization 5.2.7 Graphics **Course Outcome: CO5 Teaching Hours : 06hrs Marks: 12 (R-02 , U-04, A-06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction**	2	6	0	08
2	**HVAC systems**	4	4	6	14
3	**BMS Subsystems**	4	4	6	14
4	**DDC Fundamentals in BMS.**	2	4	6	12
5	**Advance Technology for effective facility Control**	2	4	6	12
	Total	**14**	**22**	**24**	**60**

List of assignments: Total 10-12 assignments (or turns) out of 15 assignments (or turns)

Sr. No.	Unit No	COs	Title of the Assignment	Hours
1	1	CO1	Architecture and components of BMS.	2
2	2	CO2	Heating, Ventilation and Air-conditioning systems (HVAC)	2
3	3	CO3	Closed-circuit television (CCTV) systems (connections of camera/DVR/NVR, installation of IP based camera.)	2
4	4	CO4	BMS Control Panels and Alarm Monitors.	2
5	5	CO5	Features for optimal Control.	2
6	2	CO2	Types of HVAC system.	2
7	2	CO2	Sensors used and maintenance of HVAC System.	2
8	3	CO3	Access control system: Access control deployment at a typical door.	2
9	3	CO3	Fire alarm systems.	2
10	3	CO3	Types of Fire/smoke detectors	2
11	3	CO3	Troubleshoot the faults in the given CCTV system.	2
12	4	CO4	Typical DDC Operators in BMS.	2
13	4	CO4	Energy Management system.	2
14	5	CO5	Information Management Features for effective facility Control.	2
15	All	All	**ACTIVE LEARNING ASSIGNMENTS**: Preparation of power-point slides, by students , which may include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will allocate chapters/ parts of chapters to groups of students	2
		Total		**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Smart Buildings	Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier, 2nd ed., 2010.	9781856176538
2	Understanding Building Automation system	Reinhold A. Carlson, Robert A. Di Giandomenico, R.S. Means Company, 1 edition, 1991	9780876292112
3	Building Environment: HVAC Systems	Alan J. Zajac, Johnson Controls, Inc.,1st editon,1997	9780925669001

4	HVAC Controls and Systems	John I. , Levenhagen Donald H.,Spethmann, McGraw-Hill Pub.,1st edition,1992	9780070375093
5	Intelligent Building Systems	by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012.	9781461550198
6	Instrument Engineers Handbook Vol . –II Process Control	Bela G. Liptak.Taylor and Fransis Pub., ISA,4th edition,2013	9780750622547
7	"Basics of Air Conditioning"	Indian Society of Heating, Refrigerating & Air Conditioning, ISHRAE Pub.	--

E-References:

1. https://www.ishrae.in/
2. http://www.controlservices.com/learning_automation.htm
3. https://www.johnsoncontrols.com/

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	2	2	-	1	2	1	1
CO2	2	2	3	3	-	1	2	3	1
CO3	1	2	3	3	1	1	2	2	2
CO4	1	2	2	1	-	1	2	1	2
CO5	1	1	2	1	-	1	1	1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Shrikant Patil	Senior Engineer	Cosmos Integration Solutions Pvt. Ltd. Mumbai
2	Mr. S.R. Shiledar	Assistant Professor	Govt. College of Engineering Jalgaon
3	Mr. F. S. Bagwan	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. K. U. Dawane	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

Principal

Programme : **Diploma in CE/EE/EC/CO/IT/IS/LG/LT (Sandwich pattern)**										
Course Code: **HU19102**				Course Title: **Environmental Studies**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**02**	**--**	**02**	**--**	**--**	**--**	**--**	**25**	**25**	**50**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

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. Solve various engineering problems applying ecosystem to produce eco – friendly products. Use relevant air and noise control method to solve domestic and industrial problems. Use relevant water and soil control method to solve domestic and industrial problems. To recognize relevant energy sources required for domestic and industrial problems. Solve local solid and e-waste problems.

Course Outcomes: Student should be able to

CO1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
CO2	Understand the suitable air, extent of noise pollution, and control measures and acts.
CO3	Understand the water and soil pollution, and control measures and acts.
CO4	Understand different renewable energy resources and efficient process of harvesting.
CO5	Understand Solid Waste Management & E Waste Management, ISO 14000, 45001 & Environmental Management.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Ecosystem** 1.1 Structure of ecosystem, biotic & Abiotic components 1.2 Food chain and food web 1.3 Aquatic (Lentic and Lotic) and terrestrial ecosystem 1.4 Carbon, Nitrogen, Sulphur, Phosphorus cycle 1.5 Global warming -Causes, effects, process, Green House Effect, Ozone depletion **Course Outcome: CO1 Teaching Hours : 6 hrs Marks: 03 (R- NA, U-NA, A- NA)**
2	**Air and Noise Pollution** 2.1 Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler) 2.2 Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone

	separator, Electrostatic Precipitator) 2.3 Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler 2.4 Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution **Course Outcome: CO2 Teaching Hours : 6 hrs Marks: 05 (R- NA, U-NA, A- NA)**
3	**Water and Soil Pollution** 3.1 Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition 3.2 Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis) 3.3 Causes, Effects and Preventive measures of Soil Pollution : Causes – Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-waste 3.4 Mangroves : Importance, benefits. **Course Outcome:CO3 Teaching Hours : 6 hrs Marks: 05 (R- NA, U-NA, A- NA)**
4	**Renewable sources of Energy** 4.1 Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills. 4.2 Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas 4.3 Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy 4.4 New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion) Concept, origin and power plants of geothermal energy **Course Outcome:CO4 Teaching Hours : 6 hrs Marks:05 (R- NA, U-NA, A- NA)**
5	**Solid Waste Management OR E- Waste Management, ISO 14000 & Environmental Management** **For Civil Engineering :** 5.1 Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste. 5.2 Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste 5.3 Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. 5.4 Concept of Carbon Credit, Carbon Footprint. 5.5 Environmental management in fabrication industry. 5.6 ISO14000: Implementation in industries, Benefits, ISO 45001:2018 5.7 Role of MPCB in factory permit. 5.8 Green pro IGBC certification, its benefits **OR** **For Computer Engineering & Information Technology :** 5.1 E-Waste Electronic products which have become unwanted, non-working, obsolete 5.2 E-Waste Management Services 5.3 Separation of E-Waste from other waste

	5.4 Categorization of E-Waste into old working equipments, old computers, non-working components 5.5 Authorized Recycling Facilities 5.6 Refurbishing **OR** **For Electrical Engineering :** 5.1 Various e-waste sources, their constituents, and health impacts 5.2 e-Waste Problem in India 5.3 Initiatives on building awareness in e-waste management. 5.4 Current Status of e-Waste Management & Environmental (Protection) Act 1986 5.5 Development of waste recycling technologies. 5.6 Opportunities of e-Waste Management in India 5.7 e-Waste Management techniques **OR** **For Electronics Engineering & Instrumentation Engineering :** 5.1 Solid waste generation- Sources and characteristics of : E- waste, biomedical waste. 5.2 Toxicity due to hazardous substances in E waste and their impact 5.3 Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste 5.4 Domestic E waste disposal and E waste management 5.5 Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. 5.6 Concept of Carbon Credit, Carbon Footprint. **OR** **For Leather Technology/ Leather Goods & Footware Technology :** 5.1 Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste. 5.2 Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste 5.3 Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. 5.4 Concept of Carbon Credit, Carbon Footprint. 5.5 Environmental management in fabrication industry. 5.6 ISO14000: Implementation in industries, Benefits. 5.7 Solid waste management in leather and footwear industries **Course Outcome:CO5 Teaching Hours : 6 hrs Marks:07(R- NA, U-NA, A- NA)**

Note : Chapter 5 should be teach as per department mentioned.

List of tutorials:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1,2,3, 4,5	CO1,CO2, CO3,CO4, CO5	Prepare a write up on each unit (altogether 5 in number) that summarizes the whole unit and presents important points on it.	14
2	2,3	CO2,CO3	Visit to a local polluted site : Urban/Rural/Industrial/Agricultural and prepare a report	4

			based on visit.	
3	4	CO4	Visit to biomass plant and prepare a report based on visit.	6
4	5	CO5	Visit to municipal solid waste management organization **or** an authorized e-waste recycling plant and prepare a report based on visit.	6
Total				**30**

References/ 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: 978-93-86173-09-6
2	Understanding Chemistry	C.N.Rao Universities Press(India) Pvt. Ltd. 2011	ISBN:13-9788173712500
3	Waste water treatment for pollution control and reuse	Arceivala, Soli Asolekar, Shyam Mc-Graw Hill Education India Pvt. Ltd. New york, 2007	ISBN:978-07-062099
4	Elements of Environmental Pollution control	O.P.Gupta Khanna Publishing House, New Delhi	ISBN:13-9789382609667

E-References:

1) www.eco-prayer.org
2) www.teriin.org
3) www.cpcp.nic.in
4) www.cpcp.gov.in
5) www.indiaenvironmentportal.org.in
6) www.whatis.techtarget.com
7) www.sustainabledevelopment.un.org
8) www.conserve-energy-future.com
9) http://www.nationallibrary.gov.in

CO Vs PO and CO Vs PSO Mapping (Civil Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	1
CO2	3	3	2	2	3	3	3	--	1	1
CO3	3	3	2	2	3	3	3	--	1	1
CO4	3	3	2	2	3	3	3	--	1	1
CO5	3	3	2	2	3	3	3	--	1	1

CO Vs PO and CO Vs PSO Mapping (Electrical Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	3
CO2	3	3	2	2	3	3	3	--	--	2
CO3	3	3	2	2	3	3	3	--	--	2
CO4	3	3	2	2	3	3	3	--	--	2
CO5	3	3	2	2	3	3	3	--	--	2

CO Vs PO and CO Vs PSO Mapping (Electronics Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	2
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	2
CO5	3	3	2	2	3	3	3	--	--	1

CO Vs PO and CO Vs PSO Mapping (Instrumentation Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	2	1	3	3	3	--	--
CO2	3	3	2	2	3	3	3	--	--
CO3	3	3	2	2	3	3	3	--	--
CO4	3	3	2	2	3	3	3	--	--
CO5	3	3	2	2	3	3	3	--	--

CO Vs PO and CO Vs PSO Mapping (Computer Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	--
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	--
CO5	3	3	2	2	3	3	3	--	--	--

CO Vs PO and CO Vs PSO Mapping (Information Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	3	--
CO2	3	3	2	2	3	3	3	--	2	--
CO3	3	3	2	2	3	3	3	--	2	--
CO4	3	3	2	2	3	3	3	--	2	--
CO5	3	3	2	2	3	3	3	--	3	--

CO Vs PO and CO Vs PSO Mapping (Leather Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	1
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	--
CO5	3	3	2	2	3	3	3	--	--	--

CO Vs PO and CO Vs PSO Mapping (Leather Goods & Footware Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	3	--	--	1
CO2	3	3	2	2	3	3	3	--	--	--
CO3	3	3	2	2	3	3	3	--	--	--
CO4	3	3	2	2	3	3	3	--	--	--
CO5	3	3	2	2	3	3	3	--	--	--

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Rohan Deokar	Deputy Engineer	MMRDA
2	Mr. Sanjay Kulkarni	Surveyor and Consultant	SRKulkarni Pvt.Firm
3	Mr. K.V. Kelgandre	Sr. Lecturer in Civil Engg.	K.J. Somaiya Polytechnic
4	Ms. S. M. Male	Lecturer in Civil Engg.	Govt. Polytechnic Mumbai

Coordinator,
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Department of Civil Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:IS19407				Course Title: LaTex						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4#**	**--**	**4**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Course Content Details:

Topics / Sub-topics
1. LaTeX on Windows using TeXworks Outline: Installing MikTeX on Windows Writing basic LaTeX document using TeXworks editor Configuring MikTeX to download missing packages
2. Report Writing Outline: Report Writing report style having chapter, section and subsection article style having section, subsection and subsubsection Automatic generation of table of contents toc file.
3. Letter Writing Outline: Letter Writing Letter document class From address Automatic generation and format of date Starting a new line with double slash To address Starting a new paragraph with a blank line itemize environment for bullet, enumerate environment for numbered points, Closing statement Signature Carbon copy .
4. Mathematical Typesetting Outline: Mathematical Typesetting $ sign to begin and end mathematical expressions Creating alpha, beta, gamma and delta Space being used as a terminator of symbols Creating spaces in mathematical formulae, Difference in font of text and formula Difference in the minus sign in text and in formula, frac command to create fractions. Subscripts and superscripts. Use of braces {} to demarcate arguments Not equal to, greater than or equal to, less than or equal to, much less than Right arrow, left arrow, left right arrow, up arrow Integral sign, limits of an integral Matrices of different rows and columns
5. Equations Outline: Equations Creating an equation Writing multiple equations Aligning multiple equations amsmath package $ mode align environment intertext command Unnumbered align* environment.
6. Numbering Equations Outline: Numbering Equations amsmath numbering equations align environment no number command labelling equations with the label command cross referencing equations with the ref command.
7. Tables and Figures Outline: Tables and Figures Creating tables and figures in LaTeX
8. Beamer

Outline: Beamer Creating a presentation using Beamer

9. **Bibliography**
   Outline: Bibliography Creating Bibliography in LaTeX
10. **Feedback diagram with Maths**
    Outline: Feedback diagram with Maths Open the .fig file saved in the feedback control tutorial Put G(z) = \frac z{z-1}$ in the second block diagram Choose the special flag..
11. **New command in LaTeX**
    Outline: What is a command? Different types of commands with examples Defining a new command Defining short commands for long repeated input. Commands with parameter Passing parameter.
12. **New environment in LaTeX**
    Outline: What is an environment? Defining a new environment Defining environments with parameters Renew environment Redefining an existing environment to the required output
13. **Writing Style Files in LaTeX**
    Outline: Writing Style Files in LaTeX About LaTeX Styles files. Writing a Style file for LaTeX. Importing a Style file in LaTeX. Defining a standard Style file for LaTeX. New command .
14. **Indic Language Typesetting in LaTeX**
    Outline: Indic Language Typesetting in LateX Typeset a document in Indic language using XeLaTeX. Indic language fonts bundle. Installing Indic language Fonts. Installing Nirmala UI Font.

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Head of Department
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I/C, Curriculum Development Cell

Principal