Government Polytechnic, Mumbai

(Academically Autonomous Institute, Government of Maharashtra)

Programme: Diploma in Instrumentation Engineering (E&C) (Sandwich Pattern)

Learning and Assessment Scheme (P-23) **With Effect from Academic Year : 2023-24**

Duration of Programme : 6 Semester **Duration : 16 WEEKS**

Semester : Third **Scheme : P-23**

Sr. No.	Course Code	Course Title	Course Type	Total IKS Hrs. For Sem.	Learning Scheme					Credits	Assessment Scheme														
					Actual Contact Hrs./Week			Self-Learning (Term Work + Assignments) Hrs./Week	Notional Learning Hrs./Week		Paper Duration (Hrs.)	Theory					Based on LL & TL Practical					Based On Self-Learning		Total Marks
												FA-TH		SA-TH	Total		FA-PR		SA-PR			SLA		
												T1	T2	Max	Max	Min	Max	Min	Max		Min	Max	Min	
					CL	TL	LL	SLH	NLH			Max	Max						PR	OR				
1	IS23104	Industrial Measurements	DSC	--	3	--	2	1	6	3	2:30	20	20	60	100	40	25	10	25#	--	10	25	10	175
2	IS23105	Analog Electronics	DSC	--	3	--	2	1	6	3	2:30	20	20	60	100	40	25	10	25@	--	10	25	10	175
3	IS23106	Control System and its Applications	DSC	--	3	--	2	1	6	3	2:30	20	20	60	100	40	25	10	25#	---	10	25	10	175
4	IS23501	Digital Techniques	AEC	--	3	--	4	1	8	4	2:30	20	20	60	100	40	25	10	25#	--	10	25	10	175
5	IS23604	C Programming	SEC	--	2	--	4	--	6	3	--	--	--	--	--	--	50	20	50@	--	20	--	--	100
6	IS23605	Professional software	SEC	--	--	--	2	--	2	1	--	--	--	--	--	--	25	10	25#	--	10	--	--	50
7	SL23602	Latex programming (Spoken tutorial)	SEC	--	--	--	--	4	4	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	UV23302	Universal Human Values-II	VEC	4	1	--	--	1	2	1	--	--	--	--	--	--	--	--	--	--	--	50	20	50
				4	**15**	**--**	**16**	**9**	**40**	**20**	**10**	**80**	**80**	**240**	**400**	**160**	**175**	**70**	**175**	**--**	**70**	**150**	**60**	**900**

Abbreviations: CL-Classroom Learning, TL-Tutorial Learning, LL- Laboratory Learning, FA-Formative Assessment, SA-Summative Assessment, IKS-Indian Knowledge System, SLA - Self Learning Assessment

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

Note:

1. FA-TH represents addition of two-20 marks class tests conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course, then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+TL+LL+SL) hours X 16 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. *Self-learning hours shall not be reflected in the Time Table.

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

Department Coordinator, Curriculum Development, Dept. of Instrumentation Engineering

Head of Department, Dept. of Instrumentation Engineering

In-Charge Curriculum Development Cell

Principal, Government Polytechnic Mumbai

Programme: Diploma Instrumentation Engineering (E&C) (Sandwich Pattern)													
Course Code: IS23104					**Course Title: Industrial Measurements**								
Compulsory/Optional: Compulsory													
Learning Scheme and Credits						**Assessment Scheme**							
						FA-TH		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA-**		**SLA**	**Total**
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**T1**	**T2**			**PR**	**OR**		
3	--	2	1	6	3	20	20	60	25	25#	--	25	175

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

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

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

Note:

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

I. Rationale:

Instrumentation diploma engineers must be conversant with the details of measurement of process variables. In any process industry, the major process variables involved are temperature, pressure, flow, level and displacement. The diploma engineer should be able to select proper instrument for the measurement of the various parameters and maintain these instruments. This course mainly deals with study of these important transducers and their applications in measurement systems.

II. Industry/Employer Expected Outcome:

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

1. Understand the significance of measurement of important parameters in process industries.
2. Demonstrate the construction and working of different transducers used in industrial measurements.

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

CO1	Demonstrate the operation of given displacement transducers.
CO2	Demonstrate the operation of given pressure transducers.
CO3	Demonstrate the operation of given level transducers.
CO4	Demonstrate the operation of given flow transducers.
CO5	Demonstrate the operation of given temperature transducers.

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics/Sub-topics
1	**TLO1.1** Define and identify types of displacement and the units. **TLO1.2** Demonstrate the working of Resistive Displacement Transducers **TLO1.3** Demonstrate the working of Inductive Displacement transducers **TLO1.4** Explain the concept Capacitive Transducers used in industries for displacement measurements **TLO1.5** Prepare the general specifications of displacement transducer **TLO1.6** Understand the selection criteria for displacement transducers	**Unit-I Displacement Measurement** 1.1 Displacement – Definition, types & Units. 1.2 Resistive Displacement Transducers: Potentiometer, Strain gauge, types, Effect of temperature on strain gauge measurement, Simple Numerical on strain gauge factor. 1.3 Inductive Displacement transducers- Inductance principle, classification of inductive Transducers: Linear variable differential transformer, rotary variable differential transformer. 1.4 Capacitive Transducers- Capacitance principle, Concept & variable capacitance due tochange in dielectric media, area of the plate, distance between the plates. 1.5 General specifications of displacement transducer. 1.6 Selection criteria for displacement transducers. (Diagram, construction, working, range, advantages, disadvantages and applications.)
CourseOutcome:CO1	**TeachingHours:09 hrs.**	**Marks: 12**
2	**TLO2.1** Define pressure and types **TLO2.2** Understand the working of different manometers **TLO2.3** Demonstrate the working of Elastic pressure sensors/ pressure gauges **TLO2.4** Understand the working of transducers used for vacuum measurement **TLO2.5** Explain the operation of different electronic pressure sensors, transmitters **TLO2.6** Prepare the general specifications of pressure transducer **TLO2.7** Demonstrate the procedure for calibration of pressure gauge using dead weight tester	**Unit-II Pressure Measurement** 2.1 Definition, different types of pressure. 2.2 Manometers: U-tube-type, well -type, inclined manometers, and barometer. 2.3 Elastic pressure sensors/ pressure gauges: Bourdon tubes, bellows, diaphragms. 2.4 Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, Pirani gauge, Thermocouple gauge. 2.5 Electric pressure sensors: Resistive type: Diaphragm with strain gauge, Inductive-type : Bourdon tube with LVDT, Capacitive type and piezo electric-type pressure sensors 2.6 General specifications of pressure transducer. 2.7 Selection criteria of pressure transducer. 2.8 Calibration of pressure gauge using dead weight tester (Diagram, construction, operation, ranges, advantages, disadvantages and application of above pressure transducers.)

Course Outcome: CO2	**TeachingHours:09 hrs.**	**Marks: 12**
3	**TLO3.1** State the types of level sensors and transducers **TLO3.2** Understand the working principle of Sight-type Instruments **TLO3.3** Understand the working principle of pressure type level transducer. **TLO3.4** Explain the working of Electrical instruments used for level measurement. **TLO3.5** Differentiate between Sonic- type and Radiation-type level instruments **TLO3.6** Prepare the general specifications of level transducer **TLO3.7** Discuss the selection criteria for level transducers.	**Unit-III Level Measurement** 3.1 Classification of level measuring methods 3.2 Sight-type Instruments: Glass gauges, displacers, tape float 3.3 Pressure-type Instruments: Differential pressure, bubblers, and Diaphragm. 3.4 Electrical- Instruments: Capacitance probes, resistance tapes, and conductivityprobes. 3.5 Sonic- type Instruments: Ultrasonic –type level measurement 3.6 Radiation-type Instruments: Nuclear type, Radar (microwave) type. 3.7 General specifications of level transducers. 3.8 Selection criteria for Level transducer. (Diagram, construction, operation, ranges advantages, disadvantages & applicationsof above transducers.)
Course Outcome: CO3	**TeachingHours:06 hrs.**	**Marks: 10**
4	**TLO4.1** Define the Bernoulli's principle, Reynolds's number and flow types **TLO4.2** Classify the flow meters used in industries **TLO4.3** Explain construction and working of given flow meter **TLO4.4** Prepare the general specifications of given flowmeter **TLO4.5** Discuss the selection criteria for flow transducers	**Unit-IV Flow measurement** 4.1 Flow principles: Bernoulli's principle, Reynolds's number and flow types. 4.2 Flow-meters classification 4.3 Variable head flow meters: Orifice plates, venturi meter, flow nozzle, pitot tubes. 4.4 Variable area flow meter: Rotameter. 4.5 Electrical flow meters: Turbine-type, magnetic –type, vortex shedding type,ultrasonic type flow meters. 4.6 Positive-Displacement Flow meters: Rotary-vane and Nutating-disk type flowmeters. 4.7 Coriolis Mass flow meters. 4.8 General specifications of flow transducers. 4.9 Selection criteria for flow transducers. (Diagram, construction, operation, ranges, advantages, disadvantages & applicationsof above transducers.)
Course Outcome: CO4	**Teaching Hours: 09 hrs.**	**Marks:12**
5	**TLO5.1** Convert the temperature reading into various units **TLO5.2** Classify the temperature transducers **TLO5.3** Explain the construction and working of various thermometers **TLO5.4** Explain the construction and working of electrical transducers of temperature measurement	**Unit-V Temperature Measurement** 5.1 Temperature and its units, temperature scales and conversion 5.2 Classification of temperature Measuring transducers: a. Filled system thermometers, b. Bimetallic strip thermometers 5.3 Electrical methods: a. Resistance Temperature Detectors (RTDs), RTD measurement circuits: 2 wire, 3wire and 4-wire compensation circuits, characteristics

	TLO5.5 Differentiate between pyrometers and other temperature transducers **TLO5.6** Prepare the typical specifications for given temperature transducer **TLO5.7** Discuss the selection criteria for flow transducers	b. Thermistors, types, characteristics c. Thermocouples: Principle, thermocouple effects and laws,cold junction compensation, Thermocouple tables, characteristics 5.4 Pyrometers: a. Radiation method, b. Optical method. 5.5 Integrated-Circuit Temperature Sensors. 5.6 General specifications for temperature transducers. 5.7 Selection criteria of temperature transducer. (Working Principle, construction, materials, ranges, Advantages, disadvantage and applications.)
Course Outcome: CO5	**Teaching Hours: 12 hrs.**	**Marks:14**

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

Sr. No	Practical/ Tutorial/ Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles / Tutorial Titles	Number of Hrs.	Relevant COs
1	**LLO1.1** Demonstrate the use of potentiometer for displacement measurement.	Use the potentiometer to measure the linear/ angular displacement	02	CO1
2	**LLO2.1** Measure linear displacement using LVDT.	Use the LVDT to measure linear displacement.	02	CO1
3	**LLO3.1** Measure angular displacement using RVDT.	Use the RVDT to measure angular displacement.	02	CO1
4	**LLO4.1** Measure pressure using the given pressure gauge.	To measure pressure using the given Bourdon tube– C type/ Helical type/ Spiral type	02	CO2
5	**LLO5.1** Measure Pressure using the given manometer.	To measure Pressure using the well/ U-tube /inclined tube manometers	02	CO2
6	**LLO6.1** Measure weights using strain gauge.	Use the strain gauge to measure weights.	02	CO2
7	**LLO7.1** Demonstrate the pressure measurement using given electronic pressure instrument.	To measure the pressure using given electronic pressure sensor/instrument.	02	CO2
8	**LLO8.1** Demonstrate the working of dead weight tester	To calibrate the given pressure gauge by using dead weight tester.	02	CO2
9	**LLO9.1** Demonstrate the working of capacitive level transducer.	To measure water level using the capacitive level transducers.	02	CO3
10	**LLO10.1** Measure water level using the Bubbler method.	To measure water level using the Bubbler method.	02	CO3
11	**LLO11.1** Measure water level using the given sight type instrument.	To measure water level using the given sight type instrument.	02	CO3
12	**LLO12.1** Measure level using the given DP transmitter.	To measure level using the given DP transmitter.	02	CO3
13	**LLO13.1** Measure flow rate using orifice meter/venturi meter	To measure flow rate using orifice meter/venturi meter.	02	CO4
14	**LLO14.1** Measure Flow rate using Rotameter.	To measure flow rate using Rotameter.	02	CO4

15	**LLO15.1** Observe the characteristics of thermocouple.	To plot the characteristics of the given thermocouples (Temp. Vs. Voltage) J – type/ K type.	02	CO4
16	**LLO16.1** Observe the characteristics of PT-100	To plot the characteristics of PT-100 (Temp. Vs. Resistance)	02	CO5
17	**LLO17.1** Plot the characteristics of the given thermocouples	To plot the characteristics of the given thermocouples (Temp. Vs. Voltage) T - type/ S-type/ R - type.	02	CO5
18	**LLO18.1** Plot the characteristics of a thermistor	To plot the characteristics of a thermistor (Temp. Vs. Resistance**)**	02	CO5
19	**LLO19.1** Calibrate the given temperature transducers.	To calibrate the given temperature transducers.	02	CO5
20	**LLO20.1** Demonstrate the water level measurement using the Sonic type instrument.	To observe the water level using the Sonic type instrument.	02	CO3
		Total	**30**	

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

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

Assignments:

Assignment 1:

i. Classify the displacement transducers.
ii. List the resistive displacement transducers and illustrate any one with neat sketch.
iii. List the inductive displacement transducers and illustrate any one with neat sketch.
iv. Explain the concept of variable capacitance due to change in dielectric media, area of the plate, distance between the plates.
v. Illustrate the displacement measurement using capacitive transducer.
vi. Make a survey of displacement transducers used in thermal power plant.

Assignment 2:

i. Classify the pressure transducers.
ii. List the non-electrical type pressure transducers and illustrate working of any one with neat sketch.
iii. List the electrical type pressure transducers and illustrate working of any one with neat sketch.
iv. List the transducers used for measurement of vacuum and explain working of any one with neat sketch.
v. Make a survey of pressure transducers used in nuclear power plant.

Assignment 3:

i. Classify the level transducers.
ii. List the sight type level transducers and illustrate working of any one with neat sketch.
iii. List the Pressure-type level transducers and illustrate working of any one with neat sketch.
iv. List the Electrical -type level transducers and illustrate working of any one with neat sketch.
v. List the sonic -type level transducers and illustrate working of any one with neat sketch.
vi. List the radiation -type level transducers and illustrate working of any one with neat sketch.
vii. Make a survey of level transducers used in typical oil and gas refinery.

Assignment 4:

i. Classify the flow transducers.
ii. List the Variable head flow meters and illustrate working of any one with neat sketch.
iii. List the Variable area flow meters and illustrate working of any one with neat sketch.
iv. List the Electrical -type flowmeters and illustrate working of any one with neat sketch.

v. List the Positive-Displacement Flow meters and illustrate working of any one with neat sketch.
vi. Illustrate working of Coriolis Mass flowmeter with neat sketch.
vii. Make a survey of flow transducers used in typical chemical and fertilizer industry.

Assignment 5:

i. Classify the temperature transducers.
ii. List the filled system thermometers and illustrate working of any one with neat sketch.
iii. List the Variable area flow meters and illustrate working of any one with neat sketch.
iv. List the Electrical -type temperature transducers and illustrate working of any one with neat sketch.
v. List the Pyrometers and illustrate working of any one with neat sketch.
vi. Illustrate working of bimetallic strip thermometer with neat sketch.
vii. Make a survey of temperature transducers used in typical distillery industry

Micro-Project:

i. Prepare model/circuit to measure small displacement.
ii. Prepare model/circuit to measure air pressure in a vessel or tank.
iii. Prepare model/circuit to measure water level in a small drum.
iv. Prepare model/circuit to measure flow of water flowing through the small pipe.
v. Prepare model/circuit to measure water temperature in a small water heater.

Activities:

i. Arrange an industrial visit for actual experience of various measurement systems and transducers.
ii. Visit and prepare typical specifications of various transducers

VII. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Displacement Measurement	4	4	4	12
2	Pressure Measurement	4	4	4	12
3	Level Measurement	4	4	2	10
4	Flow Measurement	4	4	4	12
5	Temperature Measurement	4	6	4	14
Total Marks		**20**	**22**	**18**	**60**

VIII. Assessment Methodologies/Tools:

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- Rubrics for assessment based on laboratory process and product related performance indicators. (25 Marks)
- End of the term theory examination. (60 Marks)

IX. Suggested COs-Pos Matrix Form

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

X. Suggested Learning Materials/Books

Sr. No.	Title	Author, Publication, Edition and Year of Publication	ISBN NO.
1	Measurement and Control Basics	Thomas A. Hughes, ISA Press, 5th Revised edition,2015	978-0876640142
2	Instrumentation Measurement and Analysis	B.C. Nakra, K.K. Chaudhari, Tata McGraw Hill,4th edition, 2016	97-89385880629
3	Transducers and Instrumentation	D.V.S. Murthy, Prentice Hall India, 2 editions,2008	978-8120335691
4	Instrumentation Devices and Systems	C.S. Rangan, V.S.V. Mani, G.R. Sarma, Tata McGraw Hill, 2nd edition,2001	978-0074633502
5	Industrial Instrumentation and control	S.K. Singh, Tata McGraw Hill,2 edition,2003	978-0074519141
6	A Course in Electrical and Electronics Measurement and Instrumentation	A. K. Sawhney, Dhanpat Rai& Co,19th edition,2011	978-8177001006
7	Principles of Industrial Instrumentation	D. Patranabis Tata McGraw Hill,2 edition,2001	978-0074623343

8	Instrument Engineers Handbook Vol. Process Measurement	Bela G. Liptak Chilton Book Co U.S.A ,5th edition.2016	978-1498727648

XI. Learning Websites & Portals

Sr. No.	Link/Portal	Description
1	https://nptel.ac.in/courses/103/105/103105130/	All units
2	https://nptel.ac.in/courses/108105063	All units
3	https://instrumentationtools.com/category/pressure-measurement/	unit 2
4	https://instrumentationtools.com/category/level-measurement/	unit 3
5	https://instrumentationtools.com/category/flow-measurement/	unit 4
6	https://instrumentationtools.com/category/temperature-measurement/	unit 5

XII.Academic Consultation Committee/ Industry Consultation Committee:

Sr. No.	Name	Designation	Institute/Organization
1	Mr. Abinav Sharma	Deputy Engineer	Toyo Engineering India Pvt. Ltd, Mumbai
2	Mrs. Rupali Thakre	Lecturer in Instrumentation	Government Polytechnic, Pen
3	Mrs. Kavita Waghmare	Lecturer in Instrumentation	Government Polytechnic, Mumbai
4	Mr. Kishor Dawane	Lecturer in Instrumentation	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme: Diploma in Instrumentation Engineering (E&C) (Sandwich Pattern)													
Course Code: IS23105					**Course Title: Analog Electronics**								
Compulsory / Optional: Compulsory													
Learning Scheme and Credits						**Assessment Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA-**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
3	--	2	1	6	3	20	20	60	25	25@	--	25	175

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

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

I. Rationale:

Instrumentation engineers deal with field data acquisition and control of parameters in industries. Data/signals are acquired in control room from various sensors/ transducers and conditioned to required level and form. Based on this signal information, the parameters are controlled. Electronics and power circuits play vital role in processing signals and controlling the parameters. This course deals with the maintenance of such electronics and power circuitries in industries.

II. Industry / Employer Expected Outcome:

The aim of this course is to attain the following industry/ employer expected outcome through various teaching learning experiences: “Maintain analog and power electronic circuits”.

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

CO1	Use different types of amplifiers in low power electronic circuits
CO2	Build and test different oscillators in low power electronic circuits
CO3	Use different power semiconductor devices in high power electronic circuits
CO4	Use different types of power converters in high power electronic circuits
CO5	Maintain and troubleshoot different high power control circuits

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's) aligned to CO's	Topics / Sub-topics
1	**TLO1.1** Describe different types of voltage amplifiers. **TLO1.2** State the principle of negative feedback. **TLO1.3** List merits of negative feedback. **TLO1.4** Explain voltage series feedback amplifier. **TLO1.5** Explain current series feedback amplifier. **TLO1.6** Classify power amplifiers	**Unit-I Amplifiers** 1.1 Voltage amplifiers 1.1.1 Direct coupled 1.1.2 R-C coupled 1.1.3 Transformer coupled (Circuit, operation and frequency response) 1.2 Negative feedback amplifiers 1.2.1 Principle of negative feedback 1.2.2 Advantages of negative feedback 1.2.3 Voltage series feedback amplifier circuit and operation 1.2.4 Current series feedback amplifier circuit and operation 1.3 Power amplifiers 1.3.1 Classification 1.3.2 Nonlinear distortion and efficiency of conversion 1.3.3 Push-pull amplifier
Course Outcome: CO1	**Teaching Hours: 10 hrs.**	**Marks: 12**
2	**TLO2.1** Justify the use of positive feedback in oscillator **TLO2.2** State the Barkhausen criterion **TLO2.3** Explain the working principle of different types of oscillators **TLO2.4** Draw the circuit diagram of different oscillators **TLO2.5** Describe the operation of different types of oscillators **TLO2.6** Write output frequency equation of different oscillators	**Unit-II Oscillators** 2.1 Barkhausen criterion 2.2 RC phase shift oscillator 2.3 Wein bridge oscillator 2.4 Hartley oscillator 2.5 Colpitts oscillator 2.6 Crystal oscillator 2.7 UJT relaxation oscillator (Circuit, principle, operation, equation for output frequency no derivation)
Course Outcome: CO2	**Teaching Hours: 08 hrs.**	**Marks: 12**
3	**TLO3.1** Classify Thyristor family **TLO3.2** Draw the symbols and V-I characteristics of various power semiconductor devices **TLO3.3** Explain the working principle of different power semiconductor devices **TLO3.4** List the turn-on and turn-off methods of SCR **TLO3.5** State the need of SCR protection **TLO3.6** Prepare specification of SCR	**Unit-III Power Semiconductor Devices** 3.1 Classification of Thyristor family 3.2 SCR (Thyristor) 3.2.1 Symbol, construction, principle of operation, V-I characteristic 3.2.2 Turn-on methods: R and RC triggering 3.2.3 Turn-off (commutation) method: Natural commutation 3.2.4 Need of SCR protection- Overvoltage and over current protection, Snubber circuit, free-wheeling diode, and Thermistor heat sink 3.2.5 Specification of SCR- Voltage, current, Power,

		temperature, dv/dt and di/dt 3.3 DIAC, TRIAC, IGBT, MOSFET 3.3.1 Symbol, construction, operation and V-I characteristic of DIAC and TRIAC 3.3.2 Symbol, construction, operation and V-I characteristic of IGBT and MOSFET
Course Outcome: CO3	**Teaching Hours: 10 hrs.**	**Marks: 12**
4	**TLO4.1** Describe the principle of operation of controlled rectifiers **TLO4.2** Draw the circuit diagram and waveforms of controlled rectifiers **TLO4.3** Explain the principle of operation of chopper **TLO4.4** Draw the circuit diagram and waveforms of chopper **TLO4.5** State the principle of operation of inverter **TLO4.6** Draw the circuit diagram and waveforms of inverter	**Unit-IV Power Converters** 4.1 Single phase full wave-controlled rectifier 4.2 Chopper 4.2.1 Principle of operation 4.2.2 Control strategy: static and variable frequency system 4.2.3 First quadrant chopper 4.3 Inverter 4.3.1 Single phase bridge inverter 4.3.2 Sinusoidal PWM inverter (Principle of operation, circuit diagram and waveforms)
Course Outcome: CO4	**Teaching Hours: 09 hrs**	**Marks: 12**
5	**TLO5.1** Explain the use of solid-state relays in power control circuits **TLO5.2** Use TRIAC to implement temperature control system **TLO5.3** Use TRIAC to actuate control valve **TLO5.4** Use SCR to implement liquid level control **TLO5.5** Use 1-Ø full control converter to control of DC series motor **TLO5.6** Use suitable power devices/circuits to control speed of 3-Ø induction motor	**Unit-V Thyristor Applications** 5.1 Solid state relays 5.1.1 DC SSR 5.1.2 AC SSR 5.2 Triac based temperature control 5.3 Liquid level control using SCR 5.4 Triac based control for actuation of valves 5.5 Speed control of DC series motor with 1-Ø full control converter 5.6 Speed control of 3-Ø induction motor by v-f method (Circuit diagram, construction, operation and application only)
Course Outcome: CO5	**Teaching Hours: 08 hrs**	**Marks: 12**

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

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of Hrs.	Relevant COs
1	**LLO1.1** Build and test RC-coupled amplifier **LLO1.2** Plot frequency response of RC-coupled amplifier	RC-coupled amplifier	02	CO1
2	**LLO2.1** Build and test RC phase- shift/ Wein bridge oscillator **LLO2.2** Plot frequency response of RC-coupled amplifier.	RC phase- shift/ Wein bridge oscillator	02	CO2

3	**LLO3.1** Plot the V-I characteristic of SCR **LLO3.2** Measure breakdown voltage, latching & holding current of SCR	V-I characteristics of SCR	02	CO3
4	**LLO4.1** Build and test single phase full wave-controlled rectifier **LLO4.2** Plot its output waveforms	Single phase full wave-controlled rectifier	02	CO4
5	**LLO5.1** Build and test solid state relay to control high power devices	Solid state relay	02	CO5
6	**LLO6.1** Build and test transformer-coupled amplifier **LLO6.2** Plot frequency response of transformer coupled amplifier	Transformer -coupled amplifier	02	CO1
7	**LLO7.1** Build and test Hartley/Colpitts oscillator **LLO7.2** Plot its frequency response	Hartley/Colpitts oscillator	02	CO2
8	**LLO8.1** Plot the V-I characteristic of DIAC **LLO8.2** Measure breakdown voltage, latching & holding current of DIAC	V-I characteristic of DIAC	02	CO3
9	**LLO9.1** Build and test First quadrant chopper **LLO9.2** Plot its output waveforms	First quadrant chopper	02	CO4
10	**LLO10.1** Build and test D.C motor speed control using chopper	D.C motor speed control using chopper	02	CO5
11	**LLO11.1** Build and test Push-pull amplifier **LLO11.2** Calculate its efficiency	Push pull amplifier	02	CO1
12	**LLO12.1** Build and test UJT relaxation oscillator **LLO12.2** Plot frequency response of UJT relaxation oscillator	UJT relaxation oscillator	02	CO2
13	**LLO13.1** Plot the V-I characteristic of TRIAC. Measure breakdown voltage, latching & holding current of TRIAC	V-I characteristic of TRIAC	02	CO3
14	**LLO14.1** Build and test single-phase bridge inverter **LLO14.2** Plot its output waveforms	Single-phase bridge inverter.	02	CO4
15	**LLO15.1** Build and test TRIAC based temperature control circuit	TRIAC based temperature control circuit	02	CO5
16	**LLO16.1** Build and test Voltage series or current series amplifier **LLO16.2** Plot its frequency response	Voltage series or current series amplifier	02	CO1
17	**LLO17.1** Build and test Crystal oscillator **LLO17.2** Plot its frequency response	Crystal oscillator	02	CO2
18	**LLO18.1** Plot the V-I characteristic of IGBT /MOSFET **LLO18.2** Measure breakdown voltage, latching & holding current of IGBT/ MOSFET	IGBT / MOFET	02	CO3
19	**LLO19.1** Build and test three phase full wave-controlled rectifier **LLO19.2** Plot its output waveforms	Single phase full wave-controlled rectifier	02	CO4
20	**LLO20.1** Build and test Liquid level control using SCR OR TRIAC based control for actuation of valve	Liquid level control using SCR OR TRIAC based control for actuation of valves	02	CO5
		Total Hours	**24**	

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

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

Micro Project:

i. Prepare model/circuit of Thyristors-SCR/DIAC/TRIAC/IGBT/MOSFET.
ii. Build and test circuit of power converters- rectifier/ chopper/inverter
iii. Build and test circuit of thyristor applications
iv. Build and test circuit of any one oscillator mentioned in curriculum
v. Build and test circuit of any one negative feedback or power amplifier.

Assignments:

i. Assignment on unit 1- Amplifiers
ii. Assignment on unit 2- Oscillators
iii. Assignment on unit 3- Power semiconductor devices
iv. Assignment on unit 4- Power converters
v. Assignment on unit 5- Thyristor applications

Activities:

i. Access websites for collecting s specification of thyristors- SCR/DIAC/TRAIC/IGBT/MOSFET using datasheet
ii. Present seminar on any one topic related to the course
iii. Develop a small circuit/ mini project to provide solution to industry/society problem
iv. Explore details of power amplifiers/ SCRs with the help of datasheet
v. Circuit simulation using Software like Electronic work Bench/ MultiSIM / Circuit Maker.
vi. Computer based tutorial (CBT) describing operation of SCR/DIAC/TRIAC with the help of animations or video films

VII. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Amplifiers	4	4	4	12
2	Oscillators	2	6	4	12
3	Power Devices	4	6	2	12
4	Power Converters	2	4	6	12
5	Thyristor Applications	2	2	8	12
	Total Marks	**14**	**22**	**24**	**60**

VIII. Assessment Methodologies/Tools:

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- Rubrics for assessment based on laboratory process and product related performance indicators. (25 Marks)
- End of the term theory examination. (60 Marks)

IX. Suggested COs - POs Matrix Form

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

X. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publication, Edition and Year of Publication	ISBN NO.
1	Electronic devices and Circuit Theory	Boylestad Robert, Louis Nashelsky Pearson Education, 11th edition, 2015	978-9332542600
2	Electronic devices & Circuits: An Introduction	Allen Mottershed, PRENTICEHALL, 1st edition, 1979	978-8120301245
3	Electronic devices and Circuit Theory	Milman & C. C. Halkias, McGraw Hill Education, 1st edition, 1967	978-81203012450
4	Integrated Electronics	J. Milman, C. C. Halkias & Chetan Parikh, McGraw Hill Education; 2nd edition, 2017	978-0070151420
5	A Textbook of Electronic Devices and Circuits	R. S. Sedha, S. Chand Publications, 2nd edition, 2008	978-8121928687
6	Power Electronics	P. S. Bimbhra, Khanna publishers, 6th edition, 1990	978-8174092793
7	Power Electronics Circuits Devices and Applications	Muhammad H. Rashid, Pearson Education, 4th edition, 2017	978-9332584587

8	Power Electronics	Singh M D and Khanchandani K.B., Tata McGraw Hill Publication, New Delhi, 2nd edition, 2017	978-0070583894

XI. Learning Websites & Portals

Sr. No.	Link / Portal	Description
1	https://nptel.ac.in/content/storage2/courses/	---
2	https://nptel.ac.in/courses/108/105/108105066/	Power Electronic
3	https://vivadifferences.com/	---
4	https://www.tutorialspoint.com/	All unit
5	http://www.electronicshub.org/	All unit
6	http://electrofriends.com//	All unit
7	https://www.electrical4u.com/concept-of-power-electronics/	All unit
8	https://www.polytechnichub.com	All unit

XII. Academic Consultation Committee/Industry Consultation Committee:

Sr. No.	Name	Designation	Institute/Organization
1	Mr. Nilesh Singh	Technical Support Engineer	Potence Controls Pvt Ltd.
2	Dr. D. S. Marathe	HOD EXTC dept.	A.C. Patil College of Engineering, Kharghar
3	Mr. M. K. Kulkarni	Lecturer in Instrumentation	Govt. Polytechnic, Mumbai
4	Mr. Shivaji G. Thube	Lecturer in Instrumentation	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Program: Diploma in Instrumentation (E&C) (Sandwich Pattern)													
Course Code : IS23106					**Course Title : Control System and its Applications**								
Compulsory/Optional: Compulsory													
Learning Scheme and Credits						**Assessment Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2:30 Hrs.)**	**FA- PR**	**SA-PR**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
03	--	02	01	06	03	20	20	60	25	25#	---	25	175

Total IKS Hrs. for course: -- hrs.

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

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

Note:

1. FA-TH represents addition of two class tests 20 marks each conducted during the term.
2. FA-PR represents tutorial/practical term work of 25 Marks.
3. SA-TH represents the end term theory examination of 60 Marks.
4. SA-PR/OR represents the end term Practical examination of 25 Marks

I. Rationale

The modern small, medium and large-scale industries adopting automation to improve quality and cost effectiveness of product. The Instrumentation Engineer have key role in Automation of various industries such as Power Generation, Chemical Fertilizer, Refineries, Sugar, Steel, Aeronautics and Health Care etc. This course will help the students to acquire the knowledge and skill of Principle of Control system and its application in Industrial Automation.

II. Industry/Employer Expected Outcome:

The industry/ Employer is expecting the automation of various process/system (Mechanical, Electrical and Electronics) efficiently by controller and peripheral devices.

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

CO1	Identify the type of Control Systems
CO2	Modeling of different physical systems
CO3	Analyze the different types of system to different standard test signal
CO4	Understand stability of control system and different methods
CO5	Use of motors (AC, DC and Stepper) in motion control system

IV. Course Content Details :

Unit No.	Theory Learning Outcomes (TLO's) aligned to CO's	Topics/Sub-topics
1	**TLO1.1** Classify the given type(s) of control system. **TLO1.2** Justify the effect of feedback on control system. **TLO1.3** Identify the types of system. **TLO1.4** Determine the Transfer Function of the given electrical circuits. **TLO1.5** Represent simple physical systems in terms of block diagrams having various inputs and outputs and determine their transfer function.	**Unit-I Fundamentals of control systems:** 1.1 Introduction to Control system 1.2 Feedback and its effect: Effect of feedback on overall gain, stability, sensitivity and external disturbance or noise 1.3 Types of feedback Control Systems: Linear versus Nonlinear and Time invariant versus time invariant systems. 1.4 Complex variable concept: Complex variable, function of complex variable, analytic function, singularities, poles and zeros of functions. 1.5 Differential equation: Linear ordinary differential equations 1.6 Laplace transform and its Inverse: Definition of Laplace transform Inverse of Laplace transform and important theorems (Multiplication by constant, sum and difference, differentiation, Integration, shift in time, initial and final value theorem. Inverse by Partial fraction method) 1.7 Applications of Laplace transform to find the solution of linear ordinary differential equation. (No detail derivation and only simple Numerical need to study)
Course Outcome : CO1	**Teaching Hours : 10 hrs.**	**Marks : 14**
2	**TLO2.1** Represent the control system in block diagram **TLO2.2** Use Block diagram reduction rules **TLO2.3** Use the differential equation to model the electrical and mechanical systems **TLO2.4** Understand the role of sensors in control systems	**Unit II Models of Industrial Control Devices and Systems** 2.1 Introduction 2.2 Impulse response and Transfer function of Linear System: Impulse response, Transfer function (SISO and MIMO) 2.3 Block diagrams: Block diagram of Control system and its manipulations. 2.4 Equation of Electrical system 2.5 Modeling of Mechanical system Elements: Translation motion, rotational motion, conversion between translation and rotational motions, gear trains, Levers and timing belts, Backlash and Dead Zone 2.6 Equation of Mechanical System 2.7 Sensors and Encoders in control system: 2.8 Tachometers and Incremental Encoder (No detail derivation and only simple Numerical need to study)
Course Outcome : CO2	**Teaching Hours : 10 hrs.**	**Marks : 14**

3	**TLO3.1** Represent the given standard test input mathematically and graphically **TLO3.2** Determine the transient and steady state response of the given control system for different standard test signal. **TLO3.3** Determine different time response specifications of a second order system for unit step input **TLO3.4** Determine steady state error for a given control system	**Unit-III Time domain Analysis of Control System** 3.1 Introduction: time response of system 3.2 Standard test signal: Step Signal, Ramp Signal, Parabolic Signal, Impulse Signal 3.3 Time response of first order system: unit step and unit ramp 3.4 Time Response of second order system: Unit step 3.5 Steady state error and Error constants: types of feedback control system-type0, type1 and type2 (No detail derivation and only simple Numerical need to study)
Course Outcome : CO3	**Teaching Hours : 08 hrs.**	**Marks : 12**
4	**TLO4.1** Define notion of stability **TLO4.2** Understand necessary and sufficient conditions of stability of control system. **TLO4.3** Types of stability criteria of control system	**Unit-IV Stability of Linear Control system** 4.1 Concept of stability 4.2 Necessary conditions of stability 4.3 Hurwitz Stability Criterion 4.4 Routh's stability criterion (No detail derivation and only simple Numerical need to study)
Course Outcome : CO4	**Teaching Hours : 07 hrs.**	**Marks : 06**
5	**TLO5.1** Understand principle, model and classification of DC motor. **TLO5.2** Study torque speed characteristics of DC motor. **TLO5.3** Explain the speed control of DC by two methods with different components. **TLO5.4** Study motion control application such as robotic and sun seeker system with different components.	**Unit-V Motors & its application in Control system** 5.1 Basic operational principles of DC motors 5.2 Basic Classification of PM DC Motors 5.3 Model of PM DC Motors 5.4 Torque speed curves of a DC motors 5.5 DC motor Position and Speed Control: DC Servomotors, Armature controlled DC motors, Field Controlled dc motor, electronic amplifier, DC Tacho-generator, Speed control system, geared drive, a position control system. 5.6 AC Control system: AC servomotor; A carrier control system 5.7 Robotic Control system 5.8 Sun Seeker System: Coordinate System, Error discriminator, Op-amp, Servo amplifier, tachometer and DC motor. (No detail derivation and only simple Numerical need to study)
Course Outcome : CO5	**Teaching Hours : 10 hrs.**	**Marks : 14**

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

Sr. No.	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles / Tutorial Titles	Number of Hrs.	Relevant COs

1	**LLO1.1** Understand & classify the available control system in laboratories.	To Classify the control system available in laboratory	2	CO1
2	**LLO2.1** Find out the transfer function to given closed loop control system in block diagram form	To determine the transfer function for given closed loop system in block diagram representation	2	CO2
3	**LLO3.1** Find out the peak overshoot and peak time to unit step response of given transfer function	To plot the unit step response of given transfer function to find the peak overshoot and peak time using open-source software.	2	CO3
4	**LLO4.1** Understand the concept of control system stability and simulate analysis of stability of linear time invariant system.	To find the simulation of stability analysis of Linear Time invariant system.	2	CO4
5	**LLO5.1** Understand explain the torque speed characteristics of AC and DC servo motors.	To study speed - torque characteristics of AC and DC servo motor	2	CO5
6	**LLO6.1** Simulate the unity and non-unity feedback transfer function by open-source software.	To simulate unity and non-unity feedback transfer function	2	CO1
7	**LLO7.1** Explain the open and close loop control system	To study basics of open loop and closed loop control system	2	CO1
8	**LLO8.1** Find the poles and zeros of given transfer function and plot on coordinates system/graph paper	To Plot the Pole Zero configuration in S- Plane for given transfer function	2	CO1
9	**LLO9.1** List out and explain any one open-source software available to use/implement the control system concept.	To use open-source software for control system application	2	CO1
10	**LLO10.1** Find and explain thetype0, type1 and type 2 control system from given first order control system	To study the behavior of first order type0, type1 and type2 control system	2	CO2
11	**LLO11.1** Find and explain the type0, type1 and type 2 control system from given Second order control system	To study the behavior of second order type0, type1 and type2 control system	2	CO2
12	**LLO12.1** Find out the rise time and delay time to unit step response of given transfer function	To plot step response to find the rise time and time delay of control system.	2	CO3
13	**LLO13.1** Find out the steady state error of given transfer function.	To determine the steady state errors of given transfer function	2	CO3
14	**LLO14.1** Explain the simulation of second order transfer using open-source software/ MATLAB SIMULINK	To simulate the transfer of second order system using SIMULINK MATLAB.	2	CO3
15	**LLO15.1** Understand the simulation by open software and implement to DC motor characteristics.	To simulate the DC motor Characteristics using MATLAB	2	CO5
16	**LLO16.1** Explain the AC motor speed – torque characteristics.	To obtain the torque - speed Characteristics of AC machine	2	CO5

17	**LLO17.1** Determine the transfer function of DC machine	To obtain the transfer function of DC machine.	2	CO5
		Total	**30**	

Note: Experiments Sr. No. 01 to 05 is compulsory and should map all units and Cos, remaining 07 experiments are to be performing on the importance of topic. Conduct the 6-experiment based on hardware and 6 on software. Also, consider an availability of hardware equipment & software in laboratory to conduct the experiments.

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

Micro Project:

i. Night vision Spy Robot
ii. Human detection robot using IR sensor
iii. Rescue Robot and pipeline inspection using Zigbee
iv. Mobile Robot Navigation system
v. Bluetooth Control robot
vi. Land survey robot
vii. GPS guided mobile robot
viii. Pick and place robot vehicle
ix. Automatic Human follower trolley using Raspberry pi
x. Smart Shopping trolley

Assignments on every topic & units.

i. Explain different types of control systems and Feedback Characteristics?
ii. Compare open & closed loop systems
iii. Define SISO and MIMO
iv. List the advantages and disadvantages of open loop system
v. List the advantages and disadvantages of closed loop system.
vi. Explain the transient and steady state response.
vii. Define the error constant.
viii. Define different standard test signal.
ix. Define system type of a LTI system
x. Explain the position control of servomechanism.
xi. State the two notions of Stability of control system.
xii. Explain the necessary and sufficient condition of stability
xiii. Explain Hurwitz stability criteria of control system
xiv. Explain the Routh stability Criteria of control system.
xv. Explain the relative stability of control system.
xvi. State the advantages of DC Motors for control system applications.
xvii. List the sources of non-linearity's in a DC Motor.
xviii. List the effects of Inductance & inertia in DC Motor.
xix. Define the Electrical and Mechanical time constant of DC motor.
xx. Define tachometer? Explain how is it used in control system.
xxi. Find the transfer function of pure time delay Td.
xxii. Explain the effect of back emf on performance of control system.

VII. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Fundamentals of control systems	4	4	6	14
2	Models of Industrial Control Devices and Systems	2	6	6	14
3	Time domain and Frequency domain analysis of Control System	2	4	6	12
4	Stability of Linear Control system	2	2	2	06
5	Motors & its application in Control system	4	4	6	14
	Total	**14**	**20**	**26**	**60**

VIII. Assessment Methodologies / Tools

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- Rubrics for assessment based on laboratory process and product related performance indicators. (25 Marks)
- End of the term theory examination. (60 Marks)

IX. Suggested COs-POs Matrix Form

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

X. Suggested Learning Materials/Books

Sr. No	Author	Title	ISBN NO.

1	I.J. Nagrath and M. Gopal	Control System Engineering (Sixth edition), New Age International	978-9386070111
2	Benjamin C. Kuo	Automatic Control Systems (Seventh edition), John Wiley and Sons	978-0471366089
3	M Gopal	Control Systems (Third edition), New Age International	978-0070668799
4	Norman S Nise	Control System Engineering (Seventh Edition), John Wiley and Sons	978-8126510979
5	Katsuhiko Ogata	Modern Control Engineering (Fifth Edition), Prentice Hall, 2010	978-0136156734

XI. Learning Websites & Portals

Sr. No.	Link/Portal	Description
1	https://www.electronicsforu.com/technology-trends/learn-electronics/control-system	Control System, definition and Applications
4	https://www.tutorialspoint.com/control_systems/control_systems_introduction	Basics of control system
5	https://www.studocu.com/in/document/dr-apj-abdul-kalam-technical- university/control-system/assignment-control-system/39635509	Short Questions and Answer on Basic of Control system
6	https://www.matlabsolutions.com/control-systems.php	MATLAB Based Assignment and Application List of Control and Automation
7	https://onlinecourses.nptel.ac.in/noc24_de18/preview	A course on Control system By Prof. Dr C.S. Shankar Ram, IIT Madras

XII. Academic Consultation Committee/Industry Consultation Committee:

Sr.No	Name	Designation	Institute/Organization
1	Mr. Neeraj Gangarde	Director/Co-founder	Ecosys Efficiencies Pvt Ltd, Andheri Mumbai
2	Mrs. Urvi Sawant	Lecturer, Electrical Engineering.	Shri Bhagubhai Mafatlal Polytechnic, Vile Parle , Mumbai
3	Mr. F. S. Bagwan	Lecturer in Instrumentation Engineering.	Government Polytechnic Mumbai
4	Dr. B.B. Sul	Head of Department Instrumentation Engineering.	Government Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Diploma in Instrumentation Engineering(E&C) (Sandwich Pattern)													
Course Code: IS23501					**Course Title: Digital Techniques**								
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA-**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
3	--	4	1	8	4	20	20	60	25	25#	--	25	175

Total IKS Hrs. for course: -- Hrs.

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

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

Note:

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

I. Rationale:

Digital Techniques is most part of modern industrial devices and this course forms the foundation of computers. Students will become familiar with various digital devices and circuits that are used in microprocessor, microcontroller, computers and other digital systems. It will enable the students to assemble, design, and test logic gates and circuits, combinational & sequential logic circuits, etc. to possess the basic skills of digital techniques to maintain various digitally controlled systems used in industry. This course covers the number systems, analog to digital and digital to analog converters which are important parts of digital systems.

II. Industry / Employer Expected Outcome:

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

1. Understand the basic logic gates and numbering system.
2. Simplify the design and test digital logic circuits using different theorems.

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

CO1	Understand the number system, codes and their conversion methods.

CO2	Make use of Boolean expressions to realize logic circuits using different logic gates.
CO3	Realize the different types of combinational circuits using logic gates
CO4	Design sequential circuits using flip flop.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's) aligned to CO's	Topics / Sub-topics
1	**TLO1.1** Understand and convert different number system **TLO1.2** Perform binary Arithmetic operation on the given binary number. **TLO1.3** Convert the given coded number into other specific code. **TLO1.4** Add and subtract two decimal number into BCD code.	**Unit-I Number Systems and codes** 1.1 Number system: Concept of base of number system Decimal, Binary, Octal, Hexadecimal number system. 1.2 Conversion of one number system to another number system (fractional point numbers). 1.3 Binary addition and subtraction 1.4 Compliments: 1's and 2's compliments, Binary subtraction using 1's and 2's complement 1.5 Type of codes: BCD code, Excess 3 code, Gray code 1.6 Binary to Gray and Gray to Binary code conversion.
Course Outcome: CO1	**Teaching Hours: 08 hrs.**	**Marks: 12**
2	**TLO2.1** Draw and explain functionality of give Logic Gate ate with the help of its truth table **TLO2.2** Implement basic gates and other gates from Universal Gates **TLO2.3** Understand the characteristics of Logic Families **TLO2.4** State the De' Morgan's theorem and laws of Boolean algebra **TLO2.5** Simplify given expression using Boolean algebra. **TLO2.6** Develop logic circuits in standard SOP/POS form for given example. **TLO2.7** Simplify given expression using Boolean algebra and K-map	**Unit-II Logic Gates and Boolean algebra** 2.1 Logic Gates: Symbol, Truth Table and logical expression of basic Gates (AND, OR, NOT), universal gate (NAND, NOR) and Special Purpose Gates - (EX-OR, EX-NOR) 2.2 NAND and NOR as a universal gate. 2.3 Characteristics of logic gates: Propagation delay, power dissipation, fan in, fan out, Noise Margin. 2.4 Boolean Algebra: Laws of Boolean algebra, Duality theorem, De Morgan's theorems, Simplification and realization of Boolean expression using Boolean laws and De Morgan's theorems 2.5 Standard Boolean representation: Concept of SOP & POS, Minterm & Maxterm. 2.6 Introduction to K-map: Karnaugh map (K-map) representation of logic function, Simplification of K-map for 2, 3 and 4 variables with don't care condition, Realization of reduced expression using logic gates.
Course Outcome: CO2	**Teaching Hours: 14 hrs.**	**Marks: 18**

3	**TLO3.1** Define combinational logic circuit. **TLO3.2** Develop adder and subtractor circuit **TLO3.3** Use IC7483 to design the adder and subtractor **TLO3.4** Convert given numbers from binary to Gray and Gray to binary codes. **TLO3.5** Draw the MUX/DEMUX tree for the given number of inputs. **TLO3.6** List IC numbers of given combinational circuits	**Unit-III Combinational Logic Circuits** 3.1 Arithmetic Circuits: Half adder, full adder, half subtractor and full subtractor using K-map and realization using gates. 3.2 Code Converter: binary to gray and gray to binary convertor using K-map and realization using gates. 3.3 4-bit parallel binary adder (IC7483) 3.4 Comparator: 1 bit, 2 bit (design using K-map and realization using logic gates). 3.5 Multiplexer: Necessity of multiplexing, types (2:1, 4:1, 8:1), multiplexer tree, application 3.6 Demultiplexer: Necessity of demultiplexing, types (1:2, 1:4, 1:8), application 3.7 3 to 8 line decoder and 8 to 3 line encoder 3.8 BCD to seven segment decoder / driver(IC 7447)
Course Outcome: CO3	**Teaching Hours:11 hrs.**	**Marks: 14**
4	**TLO4.1** Differentiate between combinational and sequential circuits. **TLO4.2** Explain the truth tables of the given Flip flops **TLO4.3** Use Flip flop to construct the counter **TLO4.4** Use Flip flop to construct the ring counter. **TLO4.5** Explain the function of ripple counter (implemented using K-map) with the help of truth table. **TLO4.6** Classify the type of shift register in digital instruments.	**Unit-IV Sequential circuits** 4.1 Difference between combinational and sequential circuits 4.2 Flip flops: S-R flip-flop using NAND gates, clocked SR flip- flop with preset & clear, clocked J-K flip-flop with preset& clear, Master slave J-K flip-flop, D&T flip flops.(truth table, symbol and operation of all FFs) 4.3 Counters: basic concept of counters, classification (synchronous and asynchronous counter), concept of Up and Down counter. 4.4 Asynchronous counters- Ripple counter, Ring counter (circuit diagram, operation and its waveforms) 4.5 Synchronous counter- Implementation of 3-bit synchronous counter using k-map with waveforms. 4.6 Shift Registers: Definition, classification, Basic concept of SISO, SIPO, PISO, PIPO
Course Outcome: CO4	**Teaching Hours: 12 hrs.**	**Marks: 16**

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

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of Hrs.	Relevan COs
1	**LLO1.1** Convert of one number into another number	To convert the given numbers of number system into another number system.	02	CO1
2	**LLO2.1** Build/ test the functionality of gates using ICS	To verify Truth Table of basic gate AND, OR, NOT, NAND, NOR, Ex-OR & Ex-NOR gates using ICS.	02	CO2

3	**LLO3.1** Simplify the Boolean equation	To implement the given simple Boolean equation using logic gates and verify its output.	02	CO2
4	**LLO4.1** Design basic gates using Universal gate	To implement the basic logic gates using universal logic gate (NAND).	02	CO2
5	**LLO5.1** Verify the truth table SR FF	To verify truth table of SR FF using ICs.	02	CO4
6	**LLO6.1** Verify truth table of Half Adder and Subtractor	To construct Half Adder and Half subtractor & verify the Truth Table	02	CO3
7	**LLO7.1** Verify De Morgan's theorem.	To implement and verify truth table of De Morgan's theorem.	02	CO2
8	**LLO8.1** Design D and T Flip Flop using IC.	To verify truth table of D and T FF using ICs.	02	CO4
9	**LLO9.1** Verify truth table of Full Adder	To construct Full Adder and verify the Truth Table	02	CO3
10	**LLO10.1** Convert the given number into another form using K map technique	Design binary to gray convertor using K-map reduction techniques, realize it with using gates and verify the truth table	02	CO3
11	**LLO11.1** Implement Basic gates using Universal gate.	To implement basic logic gates using universal logic gate (NOR).	02	CO2
12	**LLO12.1** Design JK Flip Flop using IC.	To verify truth table of JK FF using ICs.	02	CO4
13	**LLO13.1** Verify truth table of Subtractor	To construct Full subtractor & verify the Truth table	02	CO3
14	**LLO14.1** Convert the given number into another form using K map technique	Design gray to binary convertor using K-map reduction techniques, realize it with using gates and verify the truth table.	02	CO3
15	**LLO15.1** Verify truth table8:1 multiplexer using IC 74151.	To verify truth table of 8:1 multiplexer using IC 74151.	02	CO3
16	**LLO16.1** Verify truth table of 3 line to 8 line decoder	To verify truth table of 3 line to 8 line decoder using IC.	02	CO3
17	**LLO17.1** Design and Verify 1- Bit comparator	Design 1-Bit comparator using k-map reduction technique. Realize it with using gates and verify the truth table.	02	CO3
18	**LLO18.1** To design adder and subtractor circuit by IC7483	To design adder and subtractor circuit by using 4 bit parallel binary adder IC (IC7483)	02	CO3
19	**LLO19.1** Verify truth table of comparator	To verify the truth table of Comparator (IC7485).	02	CO3
20	**LLO20.1** Verify truth table of 4:1 multiplexer	To verify truth table of 4:1 multiplexer using logic gates	02	CO3
21	**LLO21.1** Verify truth table of 1:4 demultiplexer	To verify truth table of 1:4 demultiplexer using logic gates	02	CO3
22	**LLO22.1** Demonstrate the operation of 3bit ripple counter.	To construct 3bit ripple counter using Flip Flop and verify its operation	02	CO4
23	**LLO23.1** Construct and test MOD-6 asynchronous counter	To construct and test MOD-6 asynchronous counter using IC 7490.	02	CO4
24	**LLO24.1** Implement a circuit to convert BCD to seven segment display	To implement a circuit to convert BCD to seven segment display using decoder / driver IC. (IC 7447)	02	CO3

25	**LLO25.1** Verify truth table of Duality theorem	Implement and verify truth table of Duality theorem	02	CO2
26	**LLO26.1** Develop temperature measurement using gate	Build/ Test AND, OR, NOT, EX-OR Logic circuits for temperature.	02	CO2
27	**LLO27.1** Develop temperature measurement using gate	Build/ Test NAND, NOR Logic for temperature measurement.	02	CO2
28	**LLO28.1** Develop level measurement loop using gate	Build/ Test NAND, NOR Logic for level measurement	02	CO2
29	**LLO29.1** Develop level measurement loop using gate	Build/ Test AND, OR, NOT, EX-OR Logic for level measurement.	02	CO2
30	**LLO30.1** Demonstrate the operation of 3bit ring counter.	To construct 3bit ring counter using Flip Flop and verify its operation	02	CO4
		Total	**60**	

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

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

1. Assignments:

Assignment 1:

i. Classify different number systems.
ii. Convert given number system into another code system (each type min 1example)
iii. Perform arithmetic operation of binary number.
iv. Subtract given binary number using 1's and 2's compliments
v. Explain Different types of code.
vi. Perform BCD addition and Subtraction.
vii. Make a survey of Digital techniques used in industry as well as daily life

Assignment 2:

i. Define characteristics of logic gates.
ii. Draw symbol and truth table of logic gates.
iii. Name universal gate and explain why it is called universal gate.
iv. State the concept of Duality Theorem and De Morgan's theorems.
v. State the laws of Boolean algebra.
vi. Develop circuit for standard SOP/POS form for given expression.
vii. Realize the given expression using K-map.
viii. Make survey for logic gates used in instrumentation field.

Assignment 3:

i. Define combinational logic circuits.
ii. Design adder and subtractor using K-map.
iii. Develop circuit of 2-bit comparator using K-map and realize using logic gate.
iv. Explain working of multiplexer and demultiplexer.
v. State the function of encoder and decoder with neat sketch.
vi. Convert Binary to gray using K-map and realize using logic gate.
vii. Make a survey of encoder, decoder and seven segment drivers used in Automation Industry.

Assignment 4:

i. Difference between i) combinational and sequential circuits ii) Latch & Flip Flop.

ii. Design S-R flip-flop using NAND gates and explain operation with truth table.
iii. List different types of flip flop and illustrate working of JK flip flop.
iv. Classify counter. Explain concept of up and Down counter with the help of diagram.
v. Explain the operation of Ripple counter and draw waveform.
vi. Implement 3-bit synchronous counter using K-map with waveforms.
vii. Give classification of shift register and illustrate working of any one.
viii. Make survey of sequential circuits used in embedded system.

2. Micro Project:

i. Implement 16:1 MUX using /8:14:1 MUX.
ii. Built Circuit for LED Display bar.
iii. Alarm system design using logic gate.
iv. Develop 1:8 MUX using 1:4/1:2 DE-MUX.
v. Light detector using JK/SR flip flop.
vi. To develop a micro project based on applications of Combinational circuits.
vii. To develop a micro project based on applications of sequential circuits

3. Activities:

i. Organize seminar on specific topic in the group of students and present in the class.
ii. Prepare model charts of logic gates and truth table.
iii. Organize expert lecture for digital techniques applications in industry.

VI. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Number System	4	6	2	12
2	Logic gates and logic families	4	8	6	18
3	Combinational Logic Circuits	4	4	6	14
4	Sequential Logic Circuit	4	6	6	16
Total Marks		**16**	**24**	**20**	**60**

VII. Assessment Methodologies/Tools:

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- Rubrics for assessment based on laboratory process and product related performance indicators. (25 Marks)
- End of the term theory examination. (60 Marks)

VIII. Suggested COs - POs Matrix Form

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

IX. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publication, Edition and Year of Publication	ISBN NO.
1	Modern Digital Electronics	R. P. Jain, Tata McGraw Hill, Education 4th edition (2009)	978-0070669116
2	Principles of Digital Electronics	Donald P. leach , Malvino A. P. and Goutam Saha,Tata McGraw Hill, Education 6th edition (2008)	978-0070601758
3	Fundamentals of Digital Circuits	Kumar A. Anand, PHI learning private ltd.4th Revised edition (2016)	978-8120352681
4	Digital Electronics	G.K. Kharate, Oxford; Reprint edition (2010)	978-0198061830
5	Digital electronics: Principles, devices and applications	Maini A. K. John Willy and Sons, Latest edition	978-0470032145
6	Digital Design	Mano, M. Morris Pearson, New Delhi, Latest edition	978-8131714508

X. Websites & Portals

Sr. No.	Link / Portal	Description
1	https://www.tutorialspoint.com/digital_electronics/index.asp	Unit 4
2	https://www.udemy.com/course/basics-of-digital-techniques/	Unit 1

3	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/	Unit 2 & unit 3
4	www.youtube.com "enter the name of topic"	All units
5	https://studytronics.weebly.com/digital-electronics.html	Unit 2
6	www.nptel.com	All units
7	https://www.build-electronic-circuits.com	To build the circuit.
8	https://onlinecourses.nptel.ac.in/noc19_ee51/preview	Digital circuits
9	www.tinkercad.com	One can build and simulate the circuit
10	https://de-iitr.vlabs.ac.in/	Virtual Labs for digital systems

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No.	Name	Designation	Institute/Organization
1	Ms. Srushti Pawar	Chief Executive Officer	PNT Academy Dombivali
2	Ms. S.R. Nagargoje	Lecturer in Electronics	Government Polytechnic, Thane
3	Mr. K. U. Dawane	Lecturer in Instrumentation	Government Polytechnic, Mumbai
4	Ms. K. U. Waghmare	Lecturer in Instrumentation	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme: Diploma in Instrumentation Engineering (E&C) (Sandwich Pattern)													
Course Code: IS23604					**Course Title: C Programming**								
Compulsory / Optional: Compulsory													
Learning Scheme and Credits						**Assessment Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA-**		**SLA**	**Total**
										PR	**OR**		
2	--	4	--	6	3	--	--	--	50	50@	--	--	100

Total IKS Hrs. for course: -- Hrs.

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

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

Note:

1. FA-PR represents tutorial/practical term work of 50 Marks.
2. SA-PR represents the end term Practical examination of 50 Marks

I. Rationale:

'C' programming language helps to build a strong foundation for computer programming. This course will help to solve beginner level problems such as mathematical operations, string processing, data structure and data structure related processing, with the help of basic concepts, control flow structures, and principles of C. This course is basically designed to create a base to develop foundation skills of procedure - oriented programming.

II. Industry / Employer Expected Outcome:

The aim of this course is to help the student to achieve the following industry identified outcome through various learning experiences: "Develop 'C' programs that address issues with processing strings, mathematic operations, and data structures."

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

CO1	Develop C program using input - output functions and arithmetic expressions
CO2	Develop C program involving branching and looping statements
CO3	Implement Arrays and structures using C programs
CO4	Develop C program using user-defined functions
CO5	Write C program using pointer

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's) aligned to CO's	Topics / Sub-topics
1	**TLO1.1** Write algorithm forgiven problem statement **TLO1.2** Identify the givenbuilding blocks of a C Program **TLO1.3** Use basic constructs like constants, variables, datatypes for developing C program **TLO1.4** Write C programs using printf() and scanf() functions **TLO1.5** Write C programsusing arithmetic operators,bitwise operators	**Unit-I Basics of C Programming** 1.1 Fundamentals of algorithms: Notion of algorithm, Notations used for assignment statements and basic control structures 1.2 Introduction to 'C': General structure of 'C'program, Header file, 'main ()' function 1.3 Fundamental constructs of 'C': Character set, tokens, keywords, Identifiers, Constants - number constants, character constants, string constants, Variables. Data types in 'C': Declaring variables, datatype conversion 1.4 Basic Input and Output functions: input and output statements using printf(), scanf() functions 1.5 Assignments and expressions: simple assignment statements, arithmetic operators, shift operators, bitwise operators, size of operator
Course Outcome: CO1		**Teaching Hours: 05hrs**
2	**TLO2.1** Write a 'C' programusing decision making statements **TLO2.2** Use loop statements in C program to solve iterativeproblems **TLO2.3** Use appropriate statement to alter the programflow in the loop	**Unit-II Decision making and Looping** 2.1 Conditional statements: Relational operators, logical operators, if statement, if-else statements,nested if-else statements, if-else ladder, switch statement 2.2 Looping statements : 2.1 while loop, do… whileloop, for loop 2.3 Branching Statements: goto statement, use of'break' and 'continue' statements
Course Outcome: CO2		**Teaching Hours: 06hrs**
3	**TLO3.1** Write a C Program to perform operations on one dimensional array **TLO3.2** Declare, initialize, and access elements of two dimensional array **TLO3.3** Declare ,initialize and access data using Structure **TLO3.4** Explain typedef and enum	**Unit-III Arrays and Structures** 3.1 Characteristics of an array, One dimension and two dimensional arrays, concept of multi-dimensional arrays 3.2 Array declaration and Initialization 3.3 Operations on Arrays 3.4 Character and String input/output and String related operations 3.5 Introduction and Features of Structures, Declaration and Initialization of Structures, array ofstructures 3.6 Type def, Enumerated Data Type
Course Outcome: CO3		**Teaching Hours: 06hrs**

4	**TLO4.1** Explain need of Functions in C program **TLO4.2** Write C Program involving C library functions **TLO4.3** Write user defined functions for given problem inC program **TLO4.4** Write C Program for calling function by 'value' and calling function by 'reference' **TLO4.5** Implement recursive functions in C Program	**Unit-IV Functions** 4.1 Concept and need of functions 4.2 Library functions: Math functions, String handling functions, other miscellaneous functions such as getchar(), putchar(), malloc(), calloc() 4.3 Writing User defined functions - function definition, functions declaration, function call, scope ofvariables - local variables, global variables 4.4 Function parameters: Parameter passing- call by value & call by reference, function return values, function return types ,declaring function return types,The 'return' statement 4.5 Recursive functions
Course Outcome: CO4		**Teaching Hours: 07hrs**
5	**TLO5.1** Declare and Define Pointer Variable **TLO5.2** Write C program to print the address and values of pointer variables **TLO5.3** Write C program to perform arithmetic operations using pointers **TLO5.4** Write C Program to perform operations on Arrays using Pointers **TLO5.5** Explain string related operations usingpointer **TLO5.6** Access individual variable of structure using Pointer	**Unit-V Object Oriented Programming** 5.1 Introduction to Pointers : Definition, use of pointers, '*' and '&' operators, declaring, initializing, accessing pointers 5.2 Pointer arithmetic 5.3 Pointer to array 5.4 Pointer and Text string 5.5 Function handling using pointers 5.6 Pointers to structure
Course Outcome: CO5		**Teaching Hours: 06hrs**

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

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of Hrs.	Relevant COs
1	**LLO1.1** Write logical steps for given program flow **LLO1.2** Write the standard English like statements for programming flow of givenproblem statement	Install and study the C programming environment	2	CO1
2	**LLO2.1** Write Simple C program using constant andvariables **LLO2.2** Use the arithmeticoperators for developing C Program	Implement C programs using Constants and Variables	2	CO1
3	**LLO3.1** Use Arithmetic operators in C Program	Implement C programs using arithmetic operators to solve given arithmetic operations	2	CO1

<table>
<tr><td>4</td><td>LLO4.1 Write code for typecasting in C</td><td>Implement C programs using implicit and Explicit datatype conversion</td><td>2</td><td>CO1</td></tr>
<tr><td>5</td><td>LLO5.1 Write C code for displaying formatted output with comments wherever applicable</td><td>Write well commented C programs using formatted Input/Output statements
e.g. Sample Output:<table><tr><td>Name</td><td>First Name, Middle Name, Last name</td></tr><tr><td>Roll No</td><td>XXXX</td></tr><tr><td>Percentage</td><td>upto 2 decimal place</td></tr><tr><td>Date of Birth</td><td>DD/MM/YYYY</td></tr><tr><td>Branch,College</td><td>XXXXXXXXXX</td></tr></table></td><td>2</td><td>CO1</td></tr>
<tr><td>6</td><td>LLO6.1 Use Relational and logical operators in C to solve given problem
LLO6.2 Write C program using Relational and logical operators for solving given problem</td><td>Implement minimum two C programs usingRelational and conditional operator</td><td>2</td><td>CO1, CO2</td></tr>
<tr><td>7</td><td>LLO7.1 Use logical operators in given expressions</td><td>Implement minimum two C programs using LogicalOperators</td><td>2</td><td>CO1, CO2</td></tr>
<tr><td>8</td><td>LLO8.1 Write expressions using bitwise operators in given problem statement</td><td>Implement minimum two C programs using BitwiseOperators</td><td>2</td><td>CO1, CO2</td></tr>
<tr><td>9</td><td>LLO9.1 Write the syntax for various if statements
LLO9.2 Write C program forany problem using If statements</td><td>Implement minimum two C programs using simple If statement and if, else statement</td><td>2</td><td>CO2</td></tr>
<tr><td>10</td><td>LLO10.1 Write syntax of if.. else statements</td><td>Implement minimum two C programs using nested If -else statement and nesting e.g.- Write and Execute the C program to print thegrades of students based on percentage</td><td>4</td><td>CO2</td></tr>
<tr><td>11</td><td>LLO11.1 Write syntax of Switch statement to solving given problem</td><td>Develop C program using Switch statements</td><td>2</td><td>CO2</td></tr>
<tr><td>12</td><td>LLO12.1 Write C program using Switch statement</td><td>Write a C program to print English Calendar monthsas per given number(eg: If input is 4 then print “April”) using Switch statement</td><td>2</td><td>CO2</td></tr>
<tr><td>13</td><td>LLO13.1 Implement iterative solution to problem using while and do - - while loop</td><td>Implement minimum two C programs using 'while' loop and 'do...while' loop statements</td><td>2</td><td>CO2</td></tr>
<tr><td>14</td><td>LLO14.1 Write the syntax forstatement
LLO14.2 Write C code for solving given problem usingfor loop</td><td>Implement C programs using for loop statement (e.g.-Write a C Program to print numbers from 1 to 100)</td><td>2</td><td>CO1, CO2</td></tr>
<tr><td>15</td><td>LLO15.1 Write syntax for while and do ... while loop
LLO15.2 Write syntax for 'for'loop</td><td>Print various patterns using loops. e.g. - Write C Program to print following or similar pattern
*
**
***</td><td>02</td><td>CO2</td></tr>
</table>

		*****		
16	**LLO16.1** Declare andinitialize the Array **LLO16.2** Write C program for implementation of one-dimensional array	Implement C programs using One Dimensional Array.(e.g.-Write C program to input 5 numbers using array and display sum of it)	2	CO2, CO3
17	**LLO17.1** Declare and initialize two-dimensional array **LLO17.2** Write C program for implementation of two-dimensional array	Implement C programs using Two-Dimensional Array. (e.g.-Write C program to calculate addition oftwo 3X3 matrices.)	4	CO3
18	**LLO18.1** Declare character array as Strings in C **LLO18.2** Write C programs for print string operations without using string handlingfunctions	Write C program to perform following operations without using standard string functions. i) CalculateLength of given string ii) Print reverse of given string	2	CO3
19	**LLO19.1** Declare ,define and access structure variables	Implement 'Structure' in C (e.g. - Add and Subtract complex numbers using structure)	4	CO3
20	**LLO20.1** Write C programsusing Array of Structure	Implement ' Array of Structure' in C (e.g.-Accept and Display 10 Employee information using structure)	2	CO3
21	**LLO21.1** Use built-in libraryfunctions in C programs	Develop C program using in-built mathematicaland string functions	2	CO4
22	**LLO22.1** Write C programs using user defined functions	Write C program to demonstrate User definedFunctions	4	CO4
23	**LLO23.1** Write Recursivefunctions in C	Implement recursive functions in C program	2	CO4
24	**LLO24.1** Declare and initialize pointer variables **LLO24.2** Write C program to access variables using pointers	Write C Program to print addresses and values of variables using Pointer. (e.g.-Write C program to access and display address of variables.)	2	CO5
25	**LLO25.1** Perform arithmetic operations using pointers	Implement C Programs to perform arithmeticoperations using Pointer	2	CO5
		Total Hours	**60**	

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

VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self-Learning):---- NOT APPLICABLE----

VII. Specification Table: ----NOT APPLICABLE-----

VIII. Assessment Methodologies/Tools:

Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on attendance, process and product related performance indicators. (50 Marks)

Summative Assessment (Assessment of Learning)

- Rubrics for assessment based on laboratory process and product related performance indicators. (50 Marks)

IX. Suggested COs - POs Matrix Form

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

X. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publication, Edition and Year of Publication	ISBN NO.
1	Programming in ANSI 'C'	E. Balaguruswamy, McGraw Hill Publications	978-9353165130
2	Let us 'C'	Yashwant Kanetkar, BPB Publication	978-8183331630
3	Head First C	David Griffiths, Dawn Griffiths, O'Reilly Media, Inc.	978-1449345013

XI. Learning Websites & Portals

Sr. No.	Link / Portal	Description
1	https://nptel.ac.in/courses/106104128	C Programming
2	https://jsommers.github.io/cbook/control.html	Control structures, flow control statements inC

3	https://www.learn-c.org/en/Functions	Functions
4	https://www.simplilearn.com/tutorials/c-tutorial/pointers-in -	Pointers
5	https://www.w3schools.com/c/	C Programming
6	https://www.javatpoint.com/c-programming-language-tutorial	C Programming tutorial
7	https://www.programiz.com/c-programming	C Programming
8	https://www.programiz.com/c-programming/online-compiler/	online C compiler

XII. Academic Consultation Committee/Industry Consultation Committee:

Sr. No.	Name	Designation	Institute/Organization
1	Mr. Pratik Tirodkar	Chief executive officer	PNT Robotics & Automation Solutions Dombivali
2	Mr. Badshah Mulla	Lecturer in Computer	Government Polytechnic, Miraj
3	Dr. B. B. Sul	Head of Department, Instrumentation Engg.	Government Polytechnic, Mumbai
4	Mr. Firoz S. Bagwan	Lecturer in Instrumentation	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme: Diploma in Instrumentation Engineering (E&C) (Sandwich Pattern)													
Course Code: IS23605					**Course Title: Professional Software**								
Compulsory/Optional: Compulsory													
Learning Scheme and Credits						**Assessment Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2.30 Hrs.)**	**FA- PR**	**SA-**		**SLA**	**Total**
										PR	**OR**		
--	--	02	--	02	01	--	--	--	25	25#	--	--	50

Total IKS Hrs. for course: --

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

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

Note:

1. FA-PR represents tutorial/practical term work of 25 Marks.
2. SA-PR represents end term oral examination of 25 Marks.

I. Rationale

Professional software is a course that introduces students to fundamental programming logic and concepts that are implemented in the context of engineering applications using LabVIEW. LabVIEW, a graphical (dataflow) programming, has been used by millions of engineers and scientists for industrial applications and advanced research for over 20 years because of its ability to interact with a variety of data acquisition and control hardware.

II. Industry/Employer Expected Outcome

The aim of this course is to help the student to achieve the following industry identified outcome through various learning experiences: "Use LabVIEW software to develop an application".

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

CO1	Use and explore LabVIEW software
CO2	Develop customized virtual instruments using LabVIEW.
CO3	Simulate and test basic electrical circuits using LabVIEW.
CO4	Apply the knowledge of LabVIEW programming techniques for solving Instrumentation engineering problems.

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics/ Sub-topics

1	**TLO1.1** Define LabView **TLO1.2** Describe the need of LabVIEW &benefits of LabView **TLO1.3** List benefits of LabView **TLO1.4** Explanations of Controls Palette **TLO1.5** Explanations Block Diagram and its working **TLO1.6** Describe the Programming and Execution methods	**Unit-I Introduction to LabVIEW** 1.1 LabVIEW Environment: Definition, Necessity of LabVIEW, LabVIEW benefits 1.2 Front panel designing and working environment Definitions of Control and Indicators, Explanations of Controls Palette Explanations Block Diagram and its working Terminals Functional Platte 1.3 Programming and Execution methods.
Course Outcome: CO1		
2	**TLO2.1** Use of numerical function. **TLO2.2** Design Boolean equation. **TLO2.3** Creating sub VI. **TLO2.4** Plot data. **TLO2.5** Develop basic program in LabVIEW.	**Unit –II Basic Programming:** 2.1 Use of Numerical functions, Designing of Boolean operations, Comparator applications. 2.2 Creating sub-VIs from section of a VI, opening and editing sub-VIs, placing sub–VIs on block diagrams, saving sub–VIs. 2.3 Plotting data. 2.4 Exercises in basic programming.
Course Outcome: CO2		
3	**TLO3.1** Introduction to For loops use Shift registers, while loop designing Flat Sequences **TLO3.2** Describe Case Structure & Event Structure. **TLO3.3** Describe the string functions, arrays and clustering in VI. **TLO3.4** Use the system files. **TLO3.5** Report Generations in various files **TLO3.6** Develop the given application	**Unit-III Programming Loops, Structures, String, Arrays and Clusters** 3.1 Introduction to For loops, use Shift registers, while loop designing Flat Sequences 3.2 Case Structure: Definition and designing method Event Structure: Definition and designing method. 3.3 Working with string functions, arrays and clustering in VI 3.4 Acquire and use the system files based on File I/O functions Report Generations in various files such as MS excel, TDMS, LVM file 3.5 Develop Applications
CourseOutcome:CO3		
4	**TLO4.1** Explain data Configuration. **TLO4.2** Understand data acquisition cards. **TLO4.3** Acquiring and analyzing real time data. **TLO4.4** Develop different applications using LabVIEW.	**Unit-IV Application Development Using LabVIEW** 4.1 Data Configuration, Acquisition cards, Acquiring the real time digital data to the LabVIEW User interface. Acquiring of real time analog sensor values. 4.2 Develop different applications using LabVIEW
CourseOutcome:CO4		

IV. Laboratory Learning Outcome and Aligned Practical/ Tutorial Experiences

Sr No	Practical/Tutorial/ Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO1.1** Exploring a LabVIEW Project **LLO1.2** Explain Parts of a VI **LLO1.3** Understanding Dataflow	Explore an existing LabVIEW project and parts of a VI.	2	CO1
2	**LLO2.1** Use of numerical function. **LLO2.2** Develop program using LabVIEW **LLO2.3** Simulate and troubleshoot program.	To develop a VI (LabView program) to simulate a Simple Calculator.	2	CO2
3	**LLO3.1** Use of Boolean function. **LLO3.2** Develop program using LabVIEW **LLO3.3** Simulate and troubleshoot program	To develop a VI (LabView program) to simulate Logic gates	2	CO2
4	**LLO4.1** Use of For loop function. **LLO4.2** Develop program using LabVIEW. **LLO4.3** Simulate and troubleshoot program	To develop a VI (LabView program) to simulate and test for loop	2	CO3
5	**LLO5.1** Use of While loop function. **LLO5.2** Develop program using LabVIEW. **LLO5.3** Simulate and troubleshoot program	To develop a VI (LabView program) to simulate and test While loop	2	CO3
6	**LLO6.1** Use of array function **LLO6.2** Develop program using LabVIEW **LLO6.3** Simulate and troubleshoot program.	To Develop a VI for addition of Array	2	CO3
7	**LLO7.1** Use of Cluster function **LLO7.2** Develop program using LabVIEW **LLO7.3** Simulate and troubleshoot program.	To create VI student database, cluster function.	2	CO3
8	**LLO8.1** Use of Case Structure function **LLO8.2** Develop program using LabVIEW **LLO8.3** Simulate and troubleshoot program.	To develop a VI to simulate given case structure application	2	CO2,CO3
9	**LLO9.1** Use of Sub VI function **LLO9.2** Develop program using LabVIEW **LLO9.3** Simulate and troubleshoot program.	To develop a Sub VI to simulate given case structure application	2	CO2,CO3
10	**LLO10.1** Develop program using LabVIEW. **LLO10.2** Simulate and troubleshoot Program.	To develop a VI to simulate automatic temperature control system for house. Program requirements – Automatic Mode. • Regulate house air temperature • AC is ON when temperature is greater than 80°F • Heater is ON when temperature is less than 60°F • Both OFF when the temperature is between 60°F & 80°F.	2	CO2,CO3
11	**LLO11.1** Develop program using LabVIEW. **LLO11.2** Simulate and troubleshoot program.	To develop a VI for creating function generator for Sinusoidal/triangular/square signal	2	CO4

		with variable amplitude, frequency and phase.		
12	**LLO12.1** Develop program using LabVIEW. **LLO12.2** Simulate and troubleshoot program	To develop a VI and run it to measure current, voltage, capacitance, resistance and inductance using DAQ cards / ELVIS board.	2	CO4
13	**LLO13.1** Develop program using LabVIEW. **LLO13.2** Simulate and troubleshoot program.	To develop a VI to measure Measurement of AC/ DC voltage using DAQ cards/ELVIS board.	2	CO2,CO3, CO4
14	**LLO14.1** Develop program using LabVIEW. **LLO14.2** Simulate and troubleshoot program.	To create VI to simulate traffic light control using Sequence structure.	2	CO2,CO3, CO4
15	**LLO15.1** Develop program using LabVIEW. **LLO15.2** Simulate and troubleshoot program.	Applications of LabVIEW in process control—tank level/temperature control.	2	CO2,CO3, CO4

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

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

1. Write a report on LabVIEW Best Practices.
2. Write a report on Debugging and Troubleshooting of LabVIEW project.
3. Write a report on Data Groups in LabVIEW.
4. Write a report on Writing and Reading Data to File in LabVIEW.
5. Prepare a chart to display different parts of VI.
6. Writer report on creating Sub VI.
7. Writer report on Loops & structures in LabVIEW.
8. Writer report on string, Cluster & array in LabVIEW.
9. Writer report on different files generated in LabVIEW.

VI. Specification Table: Not Applicable

VII. Assessment Methodologies/Tools:

Formative assessment (Assessment for Learning)
Rubrics for continuous assessment on process and product related performance indicators (25marks).
Note: Rubric - Each Practical Carries.

1) 02 Marks for present, 00 Marks for Absent & 01 Marks for extra practical.
2) 04 Marks for Discipline & involvement in the practical.
3) 04 Marks for Accuracy for result & Neat clean presentation.

Summative Assessment (Assessment of Learning)
End term examination, Viva-voce, Laboratory performance (25marks)

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

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

IX. Suggested Learning Materials/Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN No.
1	Learning with Lab-view	Robert H. Bishop Pearson. 1st edition 2014	978-0134022123
2	LabVIEW for Everyone	Jeffrey Travis and Jim Kring Prentice Hall; 3rd edition 2006	978-0131856721
3	LabVIEW programming, data acquisition and analysis	Beyon Jeffery Y Prentice Hall (30 August 2000)	978-0130303677
4	"Virtual Instrumentation using LabVIEW"	Sanjay Gupta McGraw Hill Education; 2nd edition (1 July 2017)	978-0070700284
5	Virtual instrumentation using LabVIEW	Jovitha Jerome Prentice Hall India Learning Private Limited (1 January 2010)	978-8120340305
6	LabVIEW user's manual.	National Instruments	---

X. Learning Websites & Portals

Sr. No	Link/Portal	Description
1	https://learn.ni.com/learn/article/labview-tutorial	All unit
2	https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_basic.php	All unit

3	https://mindmajix.com/labview-tutorial	All unit
4	https://neurophysics.ucsd.edu/Manuals/National%20Instruments/LV_Fundamentals.pdf	All unit
5	https://medium.com/@labviewdevacademy/labview-tutorial-4d91a10d3dac	All unit
6	https://www.halvorsen.blog/documents/programming/labview/labview_basics.php	All unit

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Avinash Mane.	Prolific System Tech	Automation Trainer
2	Mr. Saurabh Kharjule	Lecturer Instrumentation Engg.	Government Polytechnic, Ratnagiri
3	Mr. S.G. Thube	Lecturer Instrumentation Engg.	Government Polytechnic, Mumbai
4	Mr. U.B. Shinde	Lecturer Instrumentation Engg.	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

Incharge,
Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme : Diploma in ME/CE/EE/CO/IF/IS/EC/RT/LT/LG (Sandwich Pattern), AIML	
Course Code: UV23302	**Course Title : Universal Human Values-II**
Compulsory / Optional: Compulsory	

Learning Scheme and Credits						**Assessment Scheme**						
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (3Hrs.)**	**FA- PR**	**SA**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
01	--	--	01	02	01	--		--	--	--	--	50	50

Total IKS Hrs. for course: 04 Hrs.

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

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

Note:

1. SLA represents self-learning Assessment of 25 Marks.

I. Rationale

Universal Human Values-I course helped students to discover themselves and comfortably connect with their peers. Students experienced living in harmony with nature by visiting a nature park and participating in activities like tree plantation, beach cleaning and institute cleaning.

The Universal Human Values-II course is more focused on helping students to create health consciousness and experience living in harmony with their bodies. It will help to create a holistic perspective based on self-exploration about themselves, family, society and nature. Patriotic values will be imbibed by learning about the constitution of India.

Through experiential learning, an ideal personality will be developed to excel in the field of work. It is the journey of thought process from 'my family' to 'world family'. In essence, it promotes human values, inculcates ethics and develops the best citizens.

II. Industry / Employer Expected Outcome

To demonstrate value-based behavior at the workplace.

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

CO1	Understand and appreciate duties and civic responsibilities.
CO2	Develop health consciousness.

CO3	Develop respect and recognition for others' work.
CO4	Understand the importance of living in harmony with nature and society.
CO5	Internalize lessons from great souls who exemplified nobility, courage and righteousness.
CO6	Develop holistic well-being through balancing individual needs with common good.

IV. Course Content Details:

Sr. No	CO	Activity	Related Value/s	Methodology of Implementation	Student's Role	Mentor's role	Resources Required
1	CO1 CO3	Read preamble of constitution and list down duties and responsibilities of a citizen	Patriotism Integrity Loyalty Harmony Righteousness	Read preamble of constitution of India from internet website	Brainstorm to understand the importance of preamble.	Motivate students to present different stories related to Indian constitution	https://www.constitutionofindia.net/constitution_of_india/preamble
2	CO6	Prepare your own SWOT Analysis	Self-exploration, Honesty	Analysis and report writing	Thoughtfully analyze self	Explain process of SWOT analysis	Case studies
3	CO2	Student will prepare a diet chart, analyze food consumption habit-List food consumed during last 3 days and identify its nutritional effects on body	Health consciousness	Balanced diet chart preparation	Find out the ways to maintain balanced diet chart	Provide information resources	Internet websites, Professional dietician

4	CO3 CO5	Identify 5 personalities from the areas like sports, defense, politics, businesses and social work who have demonstrated great spirit of integrity in their life and write a report. e.g. **Rajendra Singh**- Water man of India, **Dr. A P J Abdul kalam**- scientist and former president of India. **Mohammed Yunus**- Bangladeshi social entrepreneur, **Kapil Dev**- Cricketer of the century. **David Packard**- Chairman of Hewlett- Packard (HP)	Integrity, respect	Information collection and analysis	Identify personalities and study their extra-ordinary work	Guide students to identify various dimensions of the personality	Internet websites, Institute Library
5	CO4 CO6	Study the Sustainable Development Goals of the United Nations for peace and prosperity of people and the planet, now and into the future by visiting the following website: https://sdgs.un.org/goals	Social Gratitude, Empathy, Compassion, Accountability	Visit the website, study history and List 17 sdgs	Study the sdgs in detail (assigned to your group by mentor), prepare presentation	Assign 17 sdgs to different groups of students	Local NGOs working for UN

6	CO2 CO6	Understanding Eight limbs (Ashtanga) of Yoga for gaining the best mental health. **IKS hours**- Cultural and spiritual history of India- eight-fold path of yoga.	Health consciousness Social gratitude	Arrange the session of a meditation expert to understand the philosophy of Yoga.	Students will need to understand and practice the principles of the eight limbs of yoga. Practice it daily for the best physical and mental health.	Mentors will need to provide guidance on understanding and practicing the principles of the eight limbs of yoga and provide feedback on students' progress.	Resources such as yoga mats or printed materials on the eight limbs of yoga may be required.
7	CO5	1.Seven blunders told by Mahatma Gandhi and practice them as an ethic in your daily life to be a moral citizen. 2. Swami Vivekananda and his philosophy 3.Bharatratna Dr Babasaheb Ambedkar and his philosophy, teachings Any other social reformer **IKS hours**- Cultural history of India- Religious and Civic philosophies.	Character Humanity Sacrifice Honesty Accountability Patriotism	Select anyone topic. Prepare Group presentations on selected topics.	Students will need to prepare and present a group presentation on a selected topic.	Mentors will need to provide guidance on preparing and presenting a group presentation and provide feedback on students' presentations.	
8	CO3 CO6	Visit websites of reputed industries and study their Corporate Social Responsibility (CSR) activities. Also arrange an interview of a successful entrepreneur.	Social Gratitude Accountability	Visit CSR section of the website of selected industry	Students will need to research and report on the CSR activities of a selected industry.	Mentors will need to provide guidance on researching and reporting on CSR activities and provide feedback on students' reports.	Access to the internet or relevant industry publications may be required.

9	CO3	Analyze behavior pattern of self and group member while performing any group activity	Harmony in behavior	List different group activities, select anyone from the list and perform it.	Students will need to analyze their own behavior and that of their group members during a group activity and record their observations.	Mentors will need to provide guidance on observing and recording behavior patterns and provide feedback on students' observations.	Guidelines for observing and recording behavior patterns may be necessary.
10	CO5	Read and create abstract of biography like, 1. Ek Hota Carver 2.Biography of a yogi 3. JRD Tata 4. Mahatma Gandhi 5. Pant pratinidhi 6. Shriman Yogi	Righteousness	Visit library, find out books, read and prepare the report	Students will need to select a biography to read and create an abstract that summarizes the key ideas and messages in the biography.	Mentors will need to provide guidance and support to help students select an appropriate biography and create a well-written abstract.	Access to a library or online resources to select a biography to read and create an abstract.
11	CO1 CO3 CO4	NDRF one day training OR Police Mitra training OR Red cross training OR Fire safety training OR Self-defense training for Girls OR CPR training	Accountability Empathy	Plan training with the help of related agencies	Students will need to attend a one-day training session.	Mentors will need to provide guidance on attending the selected training session and ensuring safety.	Access to training facilities and materials may be necessary.

V. Methodology:

1. The course teacher will be the mentor.
2. In consultation and under supervision of a mentor, the student/ Group of students has to complete the activity.
3. The mentor will work as a facilitator/ advisor.
4. The strategies to learn the course is "Self- Exploratory" and "Experiential Learning"
5. The onus of responsibility for completing the activities is with students.
6. **Out of eleven activities the student has to complete at least five no. of activities throughout the term. Activity number two is compulsory.**

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

During self-learning hours students have to register online **(https://www.mahayouthnet.in/)** for the following "Youth Leadership for Climate Action" self-paced online courses. After completion of these courses' students will appear for the online exam of these courses and earn a certificate of completion. Students will submit these 4 certificates to the mentor.

Sr. No.	Unit	Marks
1	Living with Climate Change	10
2	Water Management and Climate Action	
3	Energy Management and Climate Action	05
4	Waste Management and Climate Action	05
5	Bio-cultural diversity Conservation and Climate Action	05
6	The student has to complete at least **five** no. of activities out of the 11 activities mentioned in the course content details throughout the term and submit the reports. Each activity carries 05 marks.	25
	Total	50

Note: 1. Unit 1 and Unit 2 are presented together and carry one certificate.
2. Unit 3,4, and 5 are individual units.

VII. Assessment methodologies/Tools:

Formative Assessment (Assessment for Learning)
The student has to complete at least **five** no. of activities throughout the term. Each activity carries 05 marks.

Criterion No.	Criterion	Max. Marks	Not Satisfactory	Good	Excellent
1	Attendance	01	0	1	1
2	Knowledge	02	0	1	2
3	Presentation / Performance	02	0	1	2
	Total	05			

VIII. Suggested CO-PO Matrix form:

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools, Experimentation and Testing**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO - 1**	**PSO - 2**
CO1	--	--	--	--	--	--	3	1	--
CO2	--	1	1	--	--	--	1	--	--
CO3	--	1	--	--	--	--	2	1	--
CO4	--	1	1	--	1	--	2	--	--
CO5	--	--	--	--	--	--	3	--	--
CO6	--	1	1	--	--	--	2	1	--
Legends :- High:03, Medium:02,Low:01, No Mapping: -									

IX.References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	A Foundation Course in Human Values and Professional Ethics	R.R. Gaur, R. Sangal, G.P. Bagaria, Excel Books, New Delhi, 2010	978-8174467812
2	Human Values	A.N. Tripathy, New Age International Publishers, 2003	978-8122425895
3	Teacher's Manual - A Foundation Course in Human Values and Professional Ethics	R.R. Gaur, R. Sangal, G.P. Bagaria, Excel Books, New Delhi, 2010	--
4	Science and Humanism, Towards a Unified World View	PL Dhar, RR Gaur, Commonwealth Publications, 1992	978-8171692224
5	Education for values in schools- a framework	NCERT	--
6	Value oriented education	E N Gawande	--

X. E-References:

1) https://youtu.be/kOJu1vj_BVk (The 10 Most Important Human Values)
2) Dr. Prakash Baba Amte- Movie

3) https://youtu.be/QeogOlzG2ls (Value of Education -short film)

E-References for mentors:

1) https://www.edutopia.org/

2) https://sdgs.un.org/goals

3) https://www.mahayouthnet.in/

XI. Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Dr. L.A. Patil	Principal (Retired)	Pratap College, Amalner
2	Dr. Nitin Deshpande	Lead Consultant	Dnyanpeeth Academy, Pune
3	Dr. Chandrakant Shahasane	Founder Trustee	Karnala Charitable Trust, Pune
4	Mr. K. V. Patil	Lecturer, Mechanical Engineering	Government Polytechnic, Mumbai
5	Mrs. P. A. Khande	Lecturer, Electronics Engineering	Government Polytechnic, Mumbai
6	Mrs. Vrushali A. Patil	Lecturer, Computer Engineering	Government Polytechnic, Mumbai
7	Mrs. Sanjana Londhe	Lecturer, Civil Engineering	Government Polytechnic, Mumbai
8	Mrs. Swati Shinde	Lecturer, Instrumentation Engg.	Government Polytechnic, Mumbai

Institute Coordinator,
Curriculum Development
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme: **Diploma in Instrumentation Engineering (E&C) (Sandwich Pattern)**													
Course Code:SL23602						**Course Title: LaTex (Spoken Tutorial)**							
Compulsory / Optional: Compulsory													
Learning Scheme and Credits						**Assessment Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA-**		**SLA**	**Total**
										PR	**OR**		
--	**--**	**--**	**4**	**4**	**2**	**--**	**--**	**--**	**--**	**--**	**--**	**50**	**50**

Total IKS Hrs. for course: 00 Hrs.

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

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

Note:

1. FA-TH represents addition of two class tests (T1, T2) conducted during the term.
2. SLA represents self-learning Assessment of 25 Marks

I. Rationale:

This course designed to assure a basic level of computer applications literacy to include introduction to digital India programme, spoken tutorial. It covers the application software Libre office suite writer and draw, which helps for documentation, word processing, creating and editing spreadsheets, slideshows, diagrams, and drawing purpose etc. The Libre office is free, open-source, and feature-rich word processing solution with cross-platform compatibility and strong community support.

II. Industry / Employer Expected Outcome

To demonstrate LaTex at the workplace.

III. Course outcomes:

CO1	Create professional documents like project reports and presentations using LaTeX.
CO2	Use LaTeX features for bibliographies, tables, figures, and custom layouts.
CO3	Practice solving common LaTeX issues through hands-on exercises.
CO4	Perform efficiently with others on documents using LaTeX's collaborative tools.

IV. Course Content Details:

Unit No	Topics / Sub-topics
1	**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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