Government Polytechnic Mumbai

(An Autonomous institute of Government of Maharashtra)

Curriculum for the programme

Diploma in Instrumentation Engineering

(Sandwich pattern)

P-19 Outcome based Curriculum

(180 credits)

Year of Curriculum Implementation

Ist year:2019-20 **IInd year :2020-21** **IIIrd year :2021-22**

Index for Curriculum Document of P-19

Institute Vision and Mission & Department Vision and Mission

- **Institute Vision and Mission:**

Vision:

" Transform Knowledge into Work ".

Mission:

We are committed

1. Quality education for lifelong learning.
2. Need based educational programmes through different modes.
3. Outcome based curriculum implementation Outcome based curriculum implementation.
4. Development and up gradation of standard laboratory practices
5. Promoting entrepreneurial programmes.

We believe in ethical, safety, environmental friendly practices and teaching learning innovations.

- **Instrumentation Engineering department Vision and Mission:**

Vision :

"Develop competent technicians and practicing engineers to furnish Real-time Automation."

Mission:

We are committed to

1. To provide quality technical education through continuous up-gradation of laboratories, curricula, faculty and industry-institute interaction.
2. To impart technician skills for the professional career.
3. To promote entrepreneurship, interpersonal skills and career advancement opportunities

Programme Outcomes (PO's):

1. Basic and Discipline specific knowledge:

   Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. Problem analysis:

   Identify and analyse well-defined engineering problems using codified standard methods.
3. Design/ development of solutions:

   Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. Engineering Tools, Experimentation and Testing:

   Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
5. Engineering practices for society, sustainability and environment:

   Apply appropriate technology in context of society, sustainability, environment and ethical practices.
6. Project Management:

   Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. Life-long learning:

   Ability to analyse individual needs and engage in updating in the context of technological changes.

Programme Specific Outcomes (PSO's) and Programme Educational Objectives (PEO's)

- **Programme Specific Outcomes (PSO's):**

PSO-1: Students will have an ability to select, install, operate, calibrate and maintain various instruments with utmost safety.

PSO-2: Students will have an ability to develop, configure, implement, operate and troubleshoot computerized control systems for automation

- **Programme Educational Objectives (PEO's)**

PEO-1: Diploma holders will have a technical knowledge base and skill sets to pursue the professional career in the fields related to Instrumentation engineering.

PEO-2: Diploma holders will be entrepreneurs, pursuing career advancement, and adapting technological changes in Instrumentation engineering fields through life-long learning.

PEO-3: Diploma holders will be competent in all forms of communication, work effectively as individuals or in team environments, exhibit ethical attitude and a strong sense of professionalism.

Government Polytechnic Mumbai

Curriculum Philosophy

(P19 Outcome based Curriculum)

Preface

The quality of technical education is dependent on a well-developed curriculum.The curriculum should not focus only on technical contents but it should impart necessary skills that help students to learn how to copewith new challenges. It should prepare them for lifelong learning once they enter the workforce. It is very necessary that the diploma students should be well updated with the latest technological skills and advancements, to meet industrial demands and contribute to nation building. With this thought we have designed outcome based curriculum keeping in view the latest industry trends and market requirements. Outcome based curriculum will be offered to students 2019 onwards. Outcome based curriculum is student centric rather than teacher centric. It is comprising of basic science and engineering having focus on fundamentals, significant discipline level courses and electives. Six month Inplant training is also included in the curriculum to make the student understand industry requirements, have hands on experience and take up project work relative to industry in their final year. These features will allow the students to develop problem solving approach to face the challenges in real life.

In outcome based education, Programme Outcomes, Programme specific outcomes, Course outcomes are defined first and then course contents are designed to achieve these outcomes. During curriculum implementation the teacher will analyze the contents and then develop the learning experiences which will ensure accomplishment of outcome. The industry experts, being main stake holders are actively involved, while designing the curriculum. Outcomes are validated by industry experts, so it will produce industry ready pass outs and increase the employability of students.

Salient features of this curriculum are

- Outcome based curriculum with well defined outcomes for each course
- Incorporation of six month Inplant training
- Built in flexibility to the students in terms of elective courses
- Course on Entrepreneurship and Start-up to encourage entrepreneurial skills
- More weightage for practical's in terms of contact hours to increase skill component
- Student Centered Activity in first, second and third semester to inculcate the habit of physical and mental fitness right at the start

- One MOOCin each semester in order to inculcate self learning capability in students.
- A list of experiments with clear outcomes.

The New Curriculum has been designed to better meet the needs of the industry consideringevolving technological trends and implications for the engineering workforce.This curriculum is also expected to enhance employability skills and develop well trained Diploma Engineers who have theknowledge and the skills to get engineering solutions for real-world problems.

I gratefully acknowledge the time and efforts of all those who contributed to design the curriculum, especially the contributions of chairperson and members of Board of Studies and Programmewise Board of Studies. I acknowledge all the stake holders, aluminies and subject experts.

(Mrs. Swati Deshpande)
Principal
Government Polytechnic Mumbai

Outcome Based Education Philosophy

As the National Board of Accreditation (NBA)is focusing on the adoption of Outcome Based Education (OBE) approach, Government Polytechnic, Mumbai has adopted the OBE approach for design of curriculum P19 to all programmes. NBA adopted Outcome based Model because, OBE is “Student Centric” rather than “Teacher Centric”. OBE focuses on the graduate attributes or outcomes after completing an academic programme. Outcome based approach means knowingwhat you want to achieve and then taking the steps to do so.Starting with a clear picture of what is important for students to be able to do and then organizing the curriculum delivery and assessment to make sure learning happens.

Some Benefits of OBE are

1. Satisfying the need of stake holders
2. More specific and coherent curriculum
3. Student centric

Components of the OBE are

1. Outcome based curriculum: What students should be able to do after learning the curriculum?
2. Outcome based Teaching Learning: Prepare and train the students to achieve the outcomes.
3. Outcome based assessment: Measure what the student has achieved? Indentify which outcome has not attained by the students.
4. Remedial measures: Take the remedial measures so that student can achieve that outcome.

Fig1. Outcome Based Education Philosophy

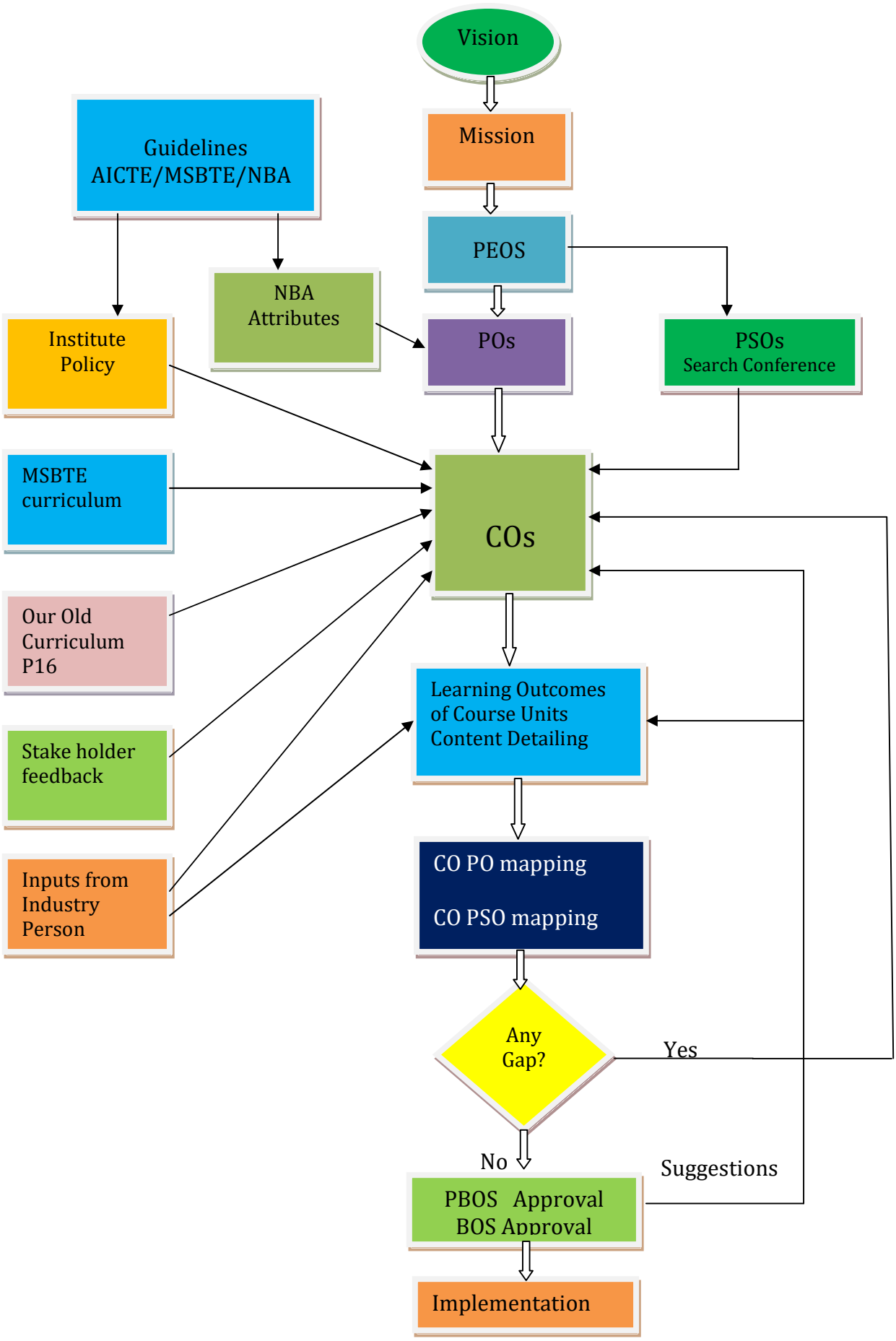

Fig. 2 Curriculum Design Process

Figure 1 shows outcome based education philosophy. Vision and mission statements willbe finalized first, and then each programme will finalize Programme educational objectives (PEOs). Programme outcomes (POs) are given by NBA. Each programme will finalize their Programme Specific Outcomes (PSOs). Then course outcomes (COs) are finalized and then content detailing of each course will be carried out.

Figure 2 shows our curriculum design process/philosophy. Figure is self explanatory. Important steps are given below. Process starts with formulation of vision mission statements of the institute.

1. Formulation of Vision Mission Statements

Vision Mission statements of the institute are finalized using following steps.

- Bottoms up approach
- Involvement all stakeholders
- Discussion, Brain storming sessions among all stake holders
- Gap analysis or SWOT analysis
- Challenges before the institute
- What are the immediate and long term goals

After following these steps vision and mission statements of the institute is finalized as

Institute Vision

Transform Knowledge into Work

Institute Mission

We are committed for

- Quality education for life long learning
- Need based educational programmes through different modes.
- Outcome based curriculum implementation
- Development and up gradation of standard laboratory practices
- Promoting entrepreneurial programmes

We believe in ethical, safety, environmental friendly practices and teaching learning innovations.

Once, the vision mission statements are finalized. Using the same procedure vision mission statements of each programmes are finalized.

2. Programme Educational Objectives (PEOs)

The Programme educational objectives of a diploma program are the statements that describe the expected achievements of diploma holders in their career, and also in particular, what they are expected to perform and achieve during the first few years after diploma. The PEOs, may be guided by global and local needs, vision of the Institution, long term goals etc.For defining the PEOs the faculty members of the program have continuously worked with all Stakeholders: Local Employers, Industry, Students and the Alumni

3. Programme Outcomes (POs)

Programme outcomes are given by NBA. They are

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis:** Identify and analyzewell defined engineering problems using codified standard methods**.**
3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. **Engineering tools experimentation and testing:** Apply modern engineering tools and appropriate technique to conduct standard test and measurements.
5. **Engineering practices for society sustainability and environment:** apply appropriate technology in context of society sustainability environment and ethical practices
6. **Project management:**Use Engineering Management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. **Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes

4. Programme Specific Outcomes (PSOs)

These outcomes are specific to a program in addition to NBA defined POs, namely, Civil, Computer, Electrical, Electronics, Mechanical, Information Technology, Instrumentation, Rubber Technology, Leather Technology, and Leather Goods and Footwear technology.

5. Course Outcomes (COs) and Content detailing

"Statements of observable student actions that serve as evidence of the Knowledge, Skills and Attitudes acquired in a course". Each course is designed to meet (about 4 to 6) Course Outcomes

The Course Outcomes are stated in such a way that they can be actually measured. "Blooms Taxonomy" is used for framing course outcomes.

Course Outcome statementsare broken down into two main components:

- **An action word** that identifies the performance to be demonstrated;
- **Learning statement** that specifies what learning will be demonstrated in the performance;

Once the COs are finalized, content detailing of each course is done as per the course outcomes. For content detailing inputs are taken from stake holders, MSBTE curriculum and industry persons.

6. CO-PO and CO-PSO mapping

When all COs are finalized, COs are mapped with POs and PSOs. During mapping if it is found that particular PO or PSO has not been addressed by any CO, then it is considered as gap. To remove this gap, again COs are modified. This process will repeat till all POs and PSOs are mapped by COs.

7. Approval in PBOS and BOS meetings.

After CO-PO and CO-PSO mapping, content detailing is done. Then the curriculum is kept for approval in Programme wise Board of studies (PBOS) meeting. Each programme has its own PBOS committee whose structure is as follows.

Head of Department concerned	Chairman
Two senior Lecturers	Members
One expert from the neighboring institute	Member

Nominee from the board of technical Education	Member
One expert from the local industry	Member
Departmental Curriculum Coordinator	Member Secretary

Suggestions given by PBOS members are incorporated in the curriculum and then it is put in front of Board of studies (BOS). Structure of BOS is as follows.

Representative from Industry	Chairman
Principal	Member
Head of All departments	Member
Local Experts of all programmes	Member
Nominee from the board of technical Education	Member
In charge CDC	Member Secretary

Suggestions given by BOS members are incorporated in the curriculum and the finalized curriculum is then offered to the students.

8. Institute Policies

As per the guidelines given by All India Council of Technical Education (AICTE), Maharashtra State Board of Technical Education (MSBTE), Directorate of Technical Education (DTE) and NBA, Institute policies about curriculum design are decided in the meeting of all Heads of the departments.

Being an autonomous institute, we revise our curriculum after every 4 to 5 years. Earlier it was revised in 2016. Curriculum 2016 was outcome based curriculum. As per instructions received from AICTE and NBA, Outcome based curriculumshould be offered to students,we have offeredOutcome based curriculumin 2016. In 2019, we have conducted search conference in all departments to identify set of skill components that should be developed in students at the end of the diploma programme. Here we got suggestions from industry experts as well as from stakeholders about incorporation of six month Inplant training in the curriculum itself to give awareness about industry culture to students. So in 2019 we revised our curriculum. It is outcome based with six months Inplant training. We got approval from AICTE also. So now all courses are sandwich pattern. This scheme we name as P19 scheme. In 2019 it will be offered to first year and in subsequent years it will be offered to second year and third year. Once the curriculum frame work is finalized at the institute level, as per the demand of the industry, course

contents can be changed at any level without disturbing the frame work. This is necessary to satisfy the present demand of the industry and remove the curricula gaps as per the advancement in technology.

2019curriculum is of 180 credits (215 teaching hours). As per AICTE norms given in APH 2015-16, contact hours per semester should be 525 hours and number of teaching days should be 75 in a semester (7 hours per day i.e. 35 hours per week). Total weeks for teaching are 15. One week will be for unit test exam. Total term will be of 16 week.

So we decided to design 2019 curriculum with 180 credits.

Definition of Credit:

1 Hr. Lecture (L) per week 1 credit

1 Hr. Tutorial (T) per week 1 credit

2 Hours Practical (P) per week 2 credit

All programmes (Civil Engineering, Computer Engineering, Electrical Engineering, Electronics Engineering, Information Technology, Instrumentation, Mechanical Engineering, Rubber Technology, Leather Technology, Leather Goods and Footwear Technology) have incorporatedsix month Inplant training in their curriculum, wherein students will go for Inplant training in the industries during last semester. 20 credits (40 teaching hours per week) are allotted for Inplant training.

Curriculum Framework

Semester wise Credit distribution and Mark distribution is given below.

Curriculum Frame work for All Programmes

Year	Semester	Credits	Teaching hours	Marks
First	**First**	30	35	600 to 700
	Second	30	35	600 to 700
Second	**Third**	30	35	600 to 700
	Fourth	35	35	700 to 800
Third	**Fifth**	35	35	700 to 800
	Sixth	20	40	200
Total		180	215	3400 to 3900

Apart from technical courses, in first 3 semesters, 5 teaching hours per week are allotted for Student Center Activities. Breakup of these five hours is as follows.

Library – 1 hr

Sports – 2 hrs

Creative arts – 2 hrs

In order to inculcate self learning capability in students MOOC (Massive Open Online Course) in each semester is incorporated in the curriculum of all programmes.

As per AICTE model curriculum 60% weightage is given for external examination and 40% weightage is given for internal examination as far as theory is considered. For all courses in all programmes 60+20+20 pattern of examination is followed. Two internal progressive assessment tests are conducted for theory courses in a semester having maximum marks 20. End semester examination of 60 Marks is conducted at the end of the semester. Addition of two test marks with end semester examination marks will give total marks out of 100.

After test as well as end term examination bitwise analysis of answer book of each student will be done in order to calculate course outcome attainment. From course attainment, PO and PSO attainment will be calculated. If attainment is not satisfactory remedial measures will be taken by respective department.

For courses, those they are having practical's, Term work is kept, where continuous assessment is made compulsory.

In the sixth semester, students are going for Inplant training. Before going into industry at least he/she should learn basic things required for his/her programme. In order to achieve this, a prerequisite of minimum 100 credits is must for registration of Inplant training. A student will be eligible for registration of Inplant training only when he/she completes minimum 100 credits.

Award of Diploma

For the award of diploma in all programmes, all courses of 5th semester and Inplant training will be considered along with weightage from first semester to fourth semester courses as shown in following table.

All courses of fifth semester	700 to 800 Marks
Inplant Training	200 Marks
Consolidated marks of first to fourth semester*	400 marks
Total marks	1300 to 1400 Marks

*Consolidated Marks of first to fourth semester – the total marks of first, second, third and fourth semesters are converted to 100 marks each. These marks are then added (1stSem +2ndSem +3rdSem + 4thsem) as 100+100+100+100 = 400 marks.

Implementation of MOOC:

In each semester all programmes will offer a MOOC. Programme head should see that this MOOC is freely available to all students; it should not be financial bourdon on students. Sufficient number of lectures/sessions should be available for the course which is offered through MOOC. For 1 credit per week one lecture or one session of 45 minutes to 60 minutes should be available.

For MOOC courses online examination is conducted by service provider for example spoken tutorial. Spoken tutorial will issue certificates also. Programme head should collect certificates of all students semester wise and submit to controller of examination.

As exam is conducted by some other agency, marks are not taken into consideration. They will not reflect in the result. But unless and until student complete certification, credits of MOOC will not be awarded to the students. Without completion of 180 credits diploma will not be awarded.

Student can complete MOOC at any time throughout of this tenure of diploma. Course or exam registration of student in any semester will not be blocked due to incompletion of MOOC. Whenever student completes certification, in that term, in the result of term end examination credits will be allotted.

Course Codes:

Entire curriculum of all Programmes is divided into five levels. These levels and their percentage is given below.

Level1- Science and Humanities (10 to 15%)

Level2- Core Technology (25 to 30%)

Level3- Applied Technology (45 to 50%)

Level4- Diversified Courses (5 to 10%)

Level5- Management courses (3 to 5%)

Course Coding Scheme:-

Course Code abbreviations	Definitions
HU	Humanities
SC	Science
MG	Management
CE	Civil
CO	Computer
EC	Electronics
EE	Electrical
IT	Information Technology
IS	Instrumentation
RT	Rubber
LT	Leather Technology
LG	Leather Goods and Footwear

Course codes are formed as:

First two letters are course code abbreviations. Then two digits "19" refers to 2019 curriculum.

Next digit is level number and last two digits are serial number from that level.

For example: HU19101 (Communication Skill)

HU- It belongs to Level 1 Science & humanities

19- 2019 curriculum

1- Level 1

01- Sr. No of Level 1 courses.

180 Credit scheme 2019 level wise distribution of Instrumentation Engineering

Level code	Title of Level	Courses			Credits				Marks
		Compulsory	Optional	Total	L	P	TU	Total	
1	Science and Humanities	6	0	6	16	8	0	24	625
2	Core Technology	11	0	11	24	32	0	56	1475
3	Applied Technology	12	0	12	21	74	2	77	1200
4	Diversified Technology	2	2	4	6	12	0	18	300
5	Management Courses	1	0	1	3		2	5	50
	Total	**32**	**2**	**34**	**70**	**126**	**4**	**180**	**3650**

Legends: L: Lecture P: Practical TU: Tutorial C:Compulsory O: Optional TH: Theory exam TS1 &TS2: Unit test 1&2 PR: Practical exam OR: Oral exam TW: Term work

Level 1 : Science & Humanities

Course Code	Course Title	C	O	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
				L	P	TU	Total		Theory			PR	OR	TW	Total
									TH	TS1	TS2				
HU19101	Communication skill	C		2	2	--	4	4	50	25	25	25*	--	25	150
SC19101	Basic Physics	C		3	2	--	5	5	50	25	25	25*	--	25	150
SC19109	Basic Mathematics	C		4	--	--	4	4	50	25	25	--	--	--	100
SC19110	Engineering Mathematics	C		4	-	--	4	4	50	25	25				100
SC19106	Applied Chemistry	C		3	2	--	5	5				50*		25	75
HU19102	Environmental Studies	C		-	2	--	2	2					25	25	50
	Total			**16**	**8**	**--**	**24**	**24**	**200**	**100**	**100**	**100**	**25**	**100**	**625**

Legends: L: Lecture P: Practical TU: Tutorial C:Compulsory O: Optional TH: Theory exam TS1 &TS2: Unit test 1&2 PR: Practical exam OR: Oral exam TW: Term work

Level 2 : Core Technology Courses

Course Code	Course Title	C	O	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
									Theory			PR	OR	TW	Total
				L	P	TU	Total		TH	TS1	TS2				
IS19201	Principles of measurement	C		3	2	--	5	5	50	25	25	50	--	25	175
WS19201	Workshop Practice	C		--	4	--	4	4	--	--	--	--	--	50	50
IS19202	Instrumentation Workshop Practice	C		--	4	--	4	4	--	--	--	--	--	50	50
IS19204	Electronic Measuring Instruments	C		3	2		5	5	50	25	25	25		25	150
IS19206	Basics of Electronics Engineering	C		3	4		7	7	50	25	25	50		25	175
EE19206	Fundamental of Electrical Engineering	C		3	2		5	5	50	25	25	50		25	175
IS19203	Industrial Measurements	C		3	4		7	7	50	25	25		25*	25	150
IS19208	Applied electronics	C		3	2		5	5	50	25	25	25		25	150
IS19205	Control System Components	C		3	2		5	5	50	25	25		25*	25	150
EE19211	Electrical Machines	C		3	2		5	5	50	25	25	25		25	150
IS19207	Digital Techniques	C			4		4	4				50*		50	100
	Total			**24**	**32**	**--**	**56**	**56**	**400**	**200**	**200**	**275**	**50**	**350**	**1475**

Legends: L: Lecture P: Practical TU: Tutorial C:Compulsory O: Optional TH: Theory exam TS1 &TS2: Unit test 1&2 PR: Practical exam OR: Oral exam TW: Term work

Level 3 : Applied Technology Courses

Course Code	Course Title	C	O	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
									Theory			PR	OR	TW	Total
				L	P	TU	Total		TH	TS1	TS2				
IS19307	Microcontrollers	C		3	4		7	7	50	25	25	25*		25	150
IS19304	Instrumentation Circuit Design	C		3	4		7	7				50*		25	75
IS19301	Process Control Systems	C		3	2		5	5	50	25	25	50*			150
IS19306	Unit operations & instrumentation	C		3		2	5	5	50	25	25		25*		125
IS19303	Industrial Automation	C		3	4		7	7	50	25	25	50*			150
IS19302	Maintenance of Instruments & Systems	C		3	2		5	5	50	25	25		25*		125
IS19305	Biomedical Instrumentation	C		3	2		5	5	50	25	25		25*		125
IS19309	Project	C			4		4	4					50*	50	100
IS19308	Inplant training	C			40		40	20					150*	50	200
IS19309	Libre office suite (Spoken tutorial)	C			4#		4#	4							
IS19310	Inkscape (Spoken tutorial)	C			4#		4#	4							
IS19311	C and CPP (Spoken tutorial)	C			4#		4#	4							
	Total			**21**	**74**	**2**	**97**	**77**	**300**	**150**	**150**	**175**	**275**	**150**	**1200**

Legends: L: Lecture P: Practical TU: Tutorial C:Compulsory O: Optional TH: Theory exam TS1 &TS2: Unit test 1&2 PR: Practical exam OR: Oral exam TW: Term work
#:self online learning mode

Level 4: Diversified Courses

Course Code	Course Title	C	O	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
									Theory			PR	OR	TW	Total
				L	P	TU	Total		TH	TS1	TS2				
Elective-I Group		OPTIONAL 1 (ANY ONE)													
IS19401	Analytical Instrumentation		O	3	2		5	5	50	25	25		25*	25	150
IS19402	Power Plant Instrumentation		O	3	2		5	5	50	25	25		25*	25	150
IS19403	Building Automation		O	3	2		5	5	50	25	25		25*	25	150
Elective-II Group		OPTIONAL 2 (ANY ONE)													
IS19404	Distributed Control Systems		O	3	2		5	5	50	25	25		25*	25	150
IS19405	Agriculture Instrumentation		O	3	2		5	5	50	25	25		25*	25	150
IS19406	Advance Embedded Systems		O	3	2		5	5	50	25	25		25*	25	150
IS19407	Latex programming (Spoken tutorial)	C			4#			4							
IS19408	Scilab (Spoken tutorial)	C			4#			4							
	Total			**6**	**12**		**10**	**18**	**100**	**50**	**50**		**50**	**50**	**300**

Legends: L: Lecture P: Practical TU: Tutorial C:Compulsory O: Optional TH: Theory exam TS1 &TS2: Unit test 1&2 PR: Practical exam OR: Oral exam TW: Term work
#:self online learning mode

Level 5: Management Courses

Course Code	Course Title	C	O	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
									Theory			PR	OR	TW	Total
				L	P	TU	Total		TH	TS1	TS2				
IS19501	Industrial Management & Entrepreneurship			3		2	5	5					25*	25	50
	Total			**3**		**2**	**5**	**5**					**25**	**25**	**50**

Legends: L: Lecture P: Practical TU: Tutorial C:Compulsory O: Optional TH: Theory exam TS1 &TS2: Unit test 1&2 PR: Practical exam OR: Oral exam TW: Term work
#:Self online learning mode

Semester wise Credit and Marks Distribution

Semester-I				**Semester-II**			
Course Code	Course Title	Credits	Marks	Course Code	Course Title	Credits	Marks
HU19101	Communication skill	4	150	SC19110	Engineering Mathematics	4	100
SC19101	Basic Physics	5	150	SC19106	Applied Chemistry	5	150
SC19109	Basic Mathematics	4	100	IS19204	Electronic Measuring Instruments	5	75
IS19201	Principles of measurement	5	175	IS19206	Basics of Electronics Engineering	7	175
IS19309	Libre office suite (Spoken Tutorial)	4#	--	EE19206	Fundamental of Electrical Engineering	5	175
WS19201	Workshop Practice	4	50	IS19310	Inkscape (Spoken Tutorial)	4#	--
IS19202	Instrumentation Workshop Practice	4	50				
Student Centered Activity		--	--	Student Centered Activity		--	--
Total		**30**	**675**	**Total**		**30**	**675**
Semester-III				**Semester-IV**			
Course Code	Course Title	Credits	Marks	Course Code	Course Title	Credits	Marks
IS19203	Industrial Measurements	7	150	IS19307	Microcontrollers	7	75
IS19208	Applied electronics	5	150	IS19304	Instrumentation Circuit Design	7	150
IS19205	Control System Components	5	150	IS19301	Process Control Systems	5	150
EE19211	Electrical Machines	5	150	IS19306	Unit operations & instrumentation	5	125
IS19311	C and CPP (Spoken Tutorial)	4#	--	IS19401 IS19402 IS19403	**Elective-I Group** Analytical Instrumentation Power Plant Instrumentation Building Automation	5	150
IS19207	Digital Techniques	4	100	IS19407	Latex programming (Spoken Tutorial)	4#	--
				HU19102	Environmental Studies	2	50
Student Centered Activity		--	--				
Total		**30**	**700**	**Total**		**35**	**700**
Semester-V				**Semester-VI**			
Course Code	Course Title	Credits	Marks	Course Code	Course Title	Credits	Marks
IS19303	Industrial Automation	7	150	IS19308	Inplant training	20	200
IS19302	Maintenance of Instruments & Systems	5	125				
IS19305	Biomedical Instrumentation	5	125				
IS19501	Industrial Management & Entrepreneurship	5	50				
IS19404 IS19405 IS19406	**Elective-II Group** Distributed Control Systems Agriculture Instrumentation Advance Embedded Systems	5	150				
IS19309	Project	4	100				
IS19408	Scilab (Spoken tutorial)	4#	--				
Total		**35**	**700**	**Total**		**20**	**200**

(Approved copy)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
HU19101	Communication skill	2	2	--	4	4	60	20	20	25*	--	25	150
SC19101	Basic Physics	3	2	--	5	5	60	20	20	25*	--	25	150
SC19109	Basic Mathematics	4	--	--	4	4	60	20	20	--	--	--	100
IS19201	Principles of measurement	3	2	--	5	5	60	20	20	50	--	25	175
IS19309	Libre office suite (Spoken Tutorial)	--	4#	--	4#	4	--	--	--	--	--	--	--
WS19201	Workshop Practice	--	4	--	4	4	--	--	--	--	--	50	50
IS19202	Instrumentation Workshop Practice	--	4	--	4	4	--	--	--	--	--	50	50
	Total	**12**	**18**	**--**	**30**	**30**	**240**	**80**	**80**	**100**	**--**	**175**	**675**
Student Centered Activity (SCA)					**05**								
Total Contact Hours					**35**								

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

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

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

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

Coordinator, Curriculum Development, Department of Instrumentation Engg.

In-Charge Curriculum Development Cell

Head of Departments Department of Instrumentation Engg.

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GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
SC19110	Engineering Mathematics	4	-		4	4	60	20	20				100
SC19106	Applied Chemistry	3	2		5	5	60	20	20	25*		25	150
IS19204	Electronic Measuring Instruments	3	2		5	5				50*		25	75
IS19206	Basics of Electronics Engineering	3	4		7	7	60	20	20	50		25	175
EE19206	Fundamental of Electrical Engineering	3	2		5	5	60	20	20	50		25	175
IS19310	Inkscape (Spoken Tutorial)		4#		4#	4							
	Total	**16**	**14**	**--**	**30**	**30**	**240**	**80**	**80**	**175**	**--**	**100**	**675**
Student Centered Activity (SCA)					**05**								
Total Contact Hours					**35**								

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

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

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

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19203	Industrial Measurements	3	4		7	7	60	20	20		25*	25	150
IS19208	Applied electronics	3	2		5	5	60	20	20	25		25	150
IS19205	Control System Components	3	2		5	5	60	20	20		25*	25	150
EE19211	Electrical Machines	3	2		5	5	60	20	20	25		25	150
IS19311	C and CPP (Spoken Tutorial)		4#		4#	4							
IS19207	Digital Techniques		4		4	4				50*		50	100
	Total	**12**	**18**	**--**	**30**	**30**	**240**	**80**	**80**	**100**	**50**	**150**	**700**
Student Centered Activity (SCA)					**05**								
Total Contact Hours					**35**								

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

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

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

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19307	Microcontrollers	3	4		7	7				50*		25	75
IS19304	Instrumentation Circuit Design	3	4		7	7	60	20	20	50*			150
IS19301	Process Control Systems	3	2		5	5	60	20	20	50*			150
IS19306	Unit operations & instrumentation	3		2	5	5	60	20	20		25*		125
IS19401 IS19402 IS19403	**Elective-I Group** Analytical Instrumentation Power Plant Instrumentation Building Automation	3	2		5	5	60	20	20		25*	25	150
IS19407	Latex programming (Spoken Tutorial)		4#		4#	4							
HU19102	Environmental Studies		2		2	2					25	25	50
	Total	**15**	**18**	**02**	**35**	**35**	**240**	**80**	**80**	**125**	**75**	**100**	**700**
Total Contact Hours					**35**								

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

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

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

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19303	Industrial Automation	3	4		7	7	60	20	20	50*			150
IS19302	Maintenance of Instruments & Systems	3	2		5	5	60	20	20		25*		125
IS19305	Biomedical Instrumentation	3	2		5	5	60	20	20		25*		125
IS19501	Industrial Management & Entrepreneurship	3		2	5	5					25*	25	50
IS19404 IS19405 IS19406	**Elective-II Group** Distributed Control Systems Agriculture Instrumentation Advance Embedded Systems	3	2		5	5	60	20	20		25*	25	150
IS19309	Project		4		4	4					50*	50	100
IS19408	Scilab (Spoken tutorial)		4#		4#	4							
	Total	**15**	**18**	**02**	**35**	**35**	**240**	**80**	**80**	**50**	**150**	**100**	**700**
Total Contact Hours					**35**								

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

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

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19308	Inplant training		40		40	20					100*	100	200
	Total	**--**	**40**	**--**	**40**	**20**					**100**	**100**	**200**
Total Contact Hours					**40**								

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

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Award of Diploma (Courses for award of diploma)

For the award of diploma in Instrumentation Engineering, all courses of 5th semester and inplant training will be considered along with weightage from first semester to fourth semester courses as shown in following table.

Details of Award of Class				**Marks**
Semester-V				
Course Code	Course Title	Credits	Marks	
IS19303	Industrial Automation	7	150	700
IS19302	Maintenance of Instruments & Systems	5	125	
IS19305	Biomedical Instrumentation	5	125	
IS19501	Industrial Management & Entrepreneurship	5	50	
IS19404 IS19405 IS19406	Elective -I group Distributed Control Systems Agriculture Instrumentation Advance Embedded Systems	5	150	
IS19309	Project	4	100	
IS19605	Scilab (Spoken tutorial)	4 #	--	
Semester-VI				
IS19308	Inplant training	20	200	200
Consolidated marks of first to fourth semester* (400 marks.)				
Semester -I		30	675	100
Semester -II		30	675	100
Semester -III		30	700	100
Semester -IV		35	700	100
Total marks		**180**		**1300**

*Consolidated Marks of first to fourth semester – the total marks of first, second, third and fourth semesters are converted to 100 marks each. These marks are then added (1st Sem +2nd Sem +3rd Sem + 4th sem) as 100+100+100+100 = 400 marks.

Direct second Year admitted students Backlogs:

Sr.no.	Entry Qualification	Additional Qualification	Course to be registered
1	HSC Science(PCMB)	NA	No Backlogs
2	HSC Science (PCB)	NA	Basic Mathematics
3	HSC Commerce	NA	Basic Mathematics
4	HSC Vocational	NA	No Backlogs
5	HSC Science(PCMB)	SSC technical	No Backlogs
6	HSC Science (PCB)	SSC technical	Basic Mathematics
7	HSC Commerce	SSC technical	Basic Mathematics
8	HSC Vocational	SSC technical	No Backlogs
9	ITI	HSC Science(PCMB)	No Backlogs
10	ITI	HSC Science (PCB)	Basic Mathematics
11	ITI	HSC Commerce	Basic Mathematics
12	ITI	HSC Vocational	No Backlogs
13	ITI	HSC Arts	Basic Mathematics
14	ITI	MCVC	Basic Mathematics
15	MCVC	HSC Science(PCMB)	No Backlogs
16	MCVC	HSC Science (PCB)	Basic Mathematics
17	MCVC	HSC Arts	Basic Mathematics
18	MCVC	HSC Vocational	No Backlogs

Equivalence Courses for Instrumentation Engineering Programme

The following courses represents the equivalence courses for P-16 to P-19 scheme as follows:

Sem	Sr. No.	P-16 Scheme				P-19 Scheme			
		Course code	**Course Title**	**Mode of Exam**	**Credits**	**Course code**	**Course Title**	**Mode of Exam**	**Credits**
I	1	HU16101	Basics of communication	TH	3	HU19101	Communication Skills	TH	4
	2	SC16104	Engg. Physics	TH, TW	5	SC19101	Basics Physics	TH, PR, TW	5
	3	SC16107	Mathematics -I	TH	4	SC19109	Basic Math	TH	4
	4	EE16201	Fundamental of Electrical Engg.	TH, OR, TW	5	EE19206	Fundamental of Electrical Engg.	TH, PR, TW	5
	5	HU16103	Generic Skill	TW	2	**No equivalence**			
	6	CO16201	Computer Fundamental	Online Exam	4	**No equivalence**			
	7	IS16201	Instrumentation workshop practice	PR, TW	6	IS19202	Instrumentation workshop practices	TW	4
	8	NC16101	Yoga			**No equivalence**			
	9	NC16102	Social Work			**No equivalence**			
II	10	HU16102	Communication skills	online exam	2	**No equivalence**			
	11	SC16108	Mathematics -II	TH	4	SC19110	Engg. Math	TH	4
	12	SC16106	Chemistry of Engg. Materials	TH, TW	5	SC19106	Applied Chemistry	TH, PR, TW	5
	13	IS16202	Principles of Measurements	TH, PR, TW	5	IS19201	Principles of Measurements	TH, PR, TW	5
	14	EC16204	Basic of Electronic Engg.	TH, PR	5	IS19206	Basic of Electronic Engg.	TH, PR, TW	7
	15	WS16201	Workshop Practices	TW	4	WS19201	Workshop Practices	TW	4
	16	ME16201	Engineering Drawing-I	PR, TW	6	**No Equivalence**			
	17	NC16201	Spoken Tutorial Work			**No equivalence**			
	18	NC16202	Digital India			**No equivalence**			

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III	19	IS16203	Process Measurement-I	TH, PR	7	**No Equivalence**			
	20	IS16204	Control System Components	TH, PR	5	IS19205	Control System Components	TH,OR,TW	5
	21	IS16205	Electronic Devices and Circuits	TH, PR	5	**No Equivalence**			
	22	IT16204	Digital Techniques	TH, PR	5	IT19204	Digital Techniques	TH, PR, TW	5
	23	EE16206	Electrical Machine	TH, PR	5	EE19211	Electrical Machine	TH, PR, TW	5
	24	CO16202	C-Programming	online exam	4	C and CPP (Spoken tutorial)		MOOC	4
	25	IS16301	Professional Practice	TW	2	**No Equivalence**			
	26	HU16104	Environmental Studies	OR, TW	2	HU19102	Environmental Studies	OR, TW	2
IV	27	IS16206	Process Measurement-II	TH, PR	7	IS19203	Industrial Measurements	TH, OR, TW	7
	28	IS16302	Instrumentation Circuit Design	TH, PR	7	IS19304	Instrumentation Circuit Design	TH, PR	7
	29	IS16207	Electronic Measuring Instruments	online exam	5	**No Equivalence**			
	30	IS16303	Microcontrollers	TH, PR	5	IS19307	Microcontrollers	PR, TW	7
	31	IS16304	Power Electronic	TH, PR	5	**No Equivalence**			
	32	IS16306	Mini Project	TW	2	**No Equivalence**			
	33	IS16305	Professional software	PR	2	**No Equivalence**			
	34	ME16315	Drafting Practices	TW	2	**No Equivalence**			
V	35	IS16307	Process Control Systems	TH, PR	6	IS19301	Process Control Systems	TH, PR	5
	36	IS16308	Biomedical Instrumentation	TH, OR,TW	6	IS19305	Biomedical Instrumentation	TH, OR	5
	37	IS16309	Unit Operations & Instrumentation	TH, OR	6	IS19306	Unit Operations & Instrumentation	TH, OR	5
	38	IS16401	Mechatronics	TH, OR	6	**No Equivalence**			
	39	IS16402	Analytical Instrumentation	TH, OR	6	IS19401	Analytical Instrumentation	TH, OR, TW	5
	40	EC16403	Embedded Systems	TH, OR	6	IS19406	Advance Embedded Systems	TH, OR, TW	5
	41	MG16501	Industrial Organization and Management	TH	3	**No Equivalence**			
	42	IS16310	Industrial Training (4 week)	OR, TW	4	**No Equivalence**			
	43	IS16311	Project & Seminar Stage -I	OR	4	IS19309	Project**	OR, TW	4

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VI	44	IS16312	Maintenance of Instruments & Systems	TH, OR, TW	6	IS19302	Maintenance of Instruments & Systems	TH, OR	5
	45	IS16313	Industrial Automation	TH, PR, TW	8	IS19303	Industrial Automation	TH, PR	7
	46	IS16314	Feedback control system	TH, PR, TW	6	**No Equivalence**			
	47	IS16403	Distributed Control System	TH, OR	6	IS19404	Distributed Control System	TH, OR, TW	5
	48	IS16404	Power Plant Instrumentation	TH, OR	6	IS19402	Power Plant Instrumentation	TH, OR, TW	5
	49	IS16405	Building Automation	TH, OR	6	IS19403	Building Automation	TH, OR, TW	5
	50	MG16502	Entrepreneurship Development	OR, TW	3	**No Equivalence**			
	51	IS16315	Industrial Training (2 week)	OR, TW	2	**No Equivalence**			
	52	IS16316	Project & Seminar Stage -II	OR, TW	4	IS19309	Project **	OR, TW	4

**** - For following P-19 course there are more than one courses equivalent in P-16 scheme**

Sr. No.	P-19 Scheme		P-16 Scheme		Remark
	Course Code	**Course Title**	**Course Code**	**Course Title**	
1	IS19309	Project	IS16308	Project & Seminar-I	Here student has to clear both P-16 courses, then he will be awarded 4 credits
			IS16310	Project & Seminar-II	

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Instrumentation Engg.

CDC Incharge

Head of Department
Instrumentation Engg.

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Policy for Course Detention P19

If the theory attendance of the student in any course in a semester is less than 75% and practical attendance is less than 100% (student has not completed all the prescribed practicals and not submitted the Term Work), he/she will be detained in that course at the end of the semester. Such student will not be allowed to appear for end semester examination of that course. Such students need to do course registration of that course again as per detention rules given below. Student has to satisfy the attendance and Term work criterion. After that he/she will be allowed for examination of that course. Rules of detention are as follows

- If a student is detained in any course of first year, he/she will not be eligible for second year admission, till he/she will not clear his/her detention.
- If a student is detained in any course of second year, he/she will not be eligible for third year admission, till he/she will not clear his/her detention.
- However, if a student is detained in any course of Odd semester, he/she can register for detained courses (maximum 2) in even semester, by paying additional fees as per rules.
- If a student is detained in any course of Even semester, he/she can register for detained courses (maximum 2) in vacation semester, for which he/she needs to pay additional fees as per rules of vacation semester.
- Student will not be eligible for registration of Inplant training unless, he/she completes minimum 100 credits.
- MOOC courses are exempted from above rules.
- Detention rule is not applicable for First Year Backlog courses of Direct Second Year admitted students.

Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- I

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
HU19101	Communication skill	2	2	--	4	4	60	20	20	25*	--	25	150
SC19101	Basic Physics	3	2	--	5	5	60	20	20	25*	--	25	150
SC19109	Basic Mathematics	4	--	--	4	4	60	20	20	--	--	--	100
IS19201	Principles of measurement	3	2	--	5	5	60	20	20	50	--	25	175
IS19202	Instrumentation Workshop Practice	--	4	--	4	4	--	--	--	--	--	50	50
WS19201	Workshop Practice	--	4	--	4	4	--	--	--	--	--	50	50
IS19309	Libre office suite writer and draw (Spoken Tutorial)	--	4#	--	4#	4	--	--	--	--	--	--	--
	Total	**12**	**18**	**--**	**30**	**30**	**240**	**80**	**80**	**100**	**--**	**175**	**675**
Student Centered Activity(SCA)					**05**								
Total Contact Hours					**35**								

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

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

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Programme: **Diploma in CE/ME/IT/CO/IS/EE/EC/LG/LT (Sandwich pattern)**										
Course Code: HU19101				Course Title: Communication Skills						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
02	**02**	**--**	**04**	**60**	**20**	**20**	**25***	--	**25**	**150**

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

Rationale:

Communication skills play a vital and decisive role in career development. In this age of globalization, competition is tough. Hence effective communication skills are important. The subject, Communication Skills introduces basic concepts of communication. It also describes the verbal, non-verbal modes and techniques of oral & written communication.

In this context, it will help the engineering diploma students to select and apply the appropriate methods of communication in various situations and business communication. Students are also required basics of communication and use of different skills.

This course will guide and direct to develop a good personality and improve communication skills. It will enable the students to utilize the skills necessary to be a competent communicator.

Course Outcomes: Student should be able to

CO1	Apply proper communication technique to cope up with the challenges of the modern world.
CO2	Interpret feedback at various situations by using appropriate body language and avoid the barriers in effective communication.
CO3	Able to participate in Group Discussion and Acquire the practical knowledge of an interview.
CO4	Able to develop PowerPoint Presentation and Business correspondence.
CO5	Write letters, circulars, memos, notices, reports and communicate effectively in written communication.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Communication** 1.1 Elements of Communication 1.2 Communication Cycle 1.3 Types of communication 1.4 Definition and Types of Barriers- a) Mechanical b) Physical c) Language d) Psychological 1.5 How to overcome Barriers **Course Outcome: CO1 Teaching Hours :6 hrs Marks: 14 (R- 2, U-4, A-8)**
2	**Non- verbal Communication** 2.1 Meaning and Importance of Non-verbal Communication 2.2 Body Language 2.3 Aspects of Body Language 2.4 Graphic language **Course Outcome: CO2 Teaching Hours :6 hrs Marks: 12 (R- 4, U-4, A-4)**
3	**Group Discussion and Interview Skills** 3.1 Need and Importance of Group Discussion 3.2 Use of Knowledge and Logical sequence. 3.3 Types of Interview 3.4 Preparing for an Interview **Course Outcome: CO3 Teaching Hours :6 hrs Marks: 10 (R-2, U-4, A-4)**
4	**Presentation Skills** 4.1 Presentation Skills - Tips for effective presentation 4.2 Guidelines for developing PowerPoint presentation **Course Outcome: CO4 Teaching Hours :4 hrs Marks: 08 (R- 2, U-2, A-4)**
5	**Business Correspondence** 5.1 Office Drafting – a) Notice b) Circular c) Memo d) Email-writing. 5.2 Job Application with resume. 5.3 Business Letters – a) Enquiry b) Order c) Complaint 5.4 Report Writing – a) Fall in Production b) Accident Report **Course Outcome: CO5 Teaching Hours: 8 hrs Marks: 16 (R- 4, U-4, A-8)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to Communication**	2	4	8	14
2	**Non- verbal Communication**	4	4	4	12
3	**Group Discussion and Interview Skills**	2	4	4	10
4	**Presentation Skills**	2	2	4	8
5	**Business Correspondence**	4	4	8	16
	Total	**14**	**18**	**28**	**60**

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

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1, CO4	Conversation between students on various situations.	02
2	3	CO2, CO4	Non- Verbal Communication.	02
3	3	CO3, CO4	Group Discussion	02
4	4	CO3, CO4	Mock Interview	02
5	5	CO4, CO5	Business Communication a) Advertisement, Tender, Diary writing. b) Job Application with Resume.	02
6	1	CO1	Communication Barriers	
7	5	CO5	Business Letters – a) Enquiry b)Order c)Complaint	
8	4	CO1, CO4	Speeches- a) Welcome Speech b) Farewell Speech c) Vote of Thanks	02
9	5	CO5	Report Writing – a) Fall in Production b) Accident Report	02
10	All	CO4	Showing Videos on different types of Communication.	02
11		CO1	*Articles	02
12		CO1	*Preposition and Conjunction	02
13		CO1	*Direct Indirect Speech	02
14		CO1	*Change the voice	
15		CO1	*Vocabulary Building	
			Total	**30**

Note: Experiments No. 1 to 10 are compulsory and should map all units and Cos. Remaining 5 experiments are to be perform on the importance of topic. .* This experiments will be performed in practical hours only.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Communication Skills	Joyeeta Bhattacharya - Reliable Series	9780000176981
2	Communication Skills	Sanjay Kumar, PushpaLata- Oxford University Press	978-0199488803
3	Successful presentation Skills	Andrew Brad bury- The Sunday Times	9780749456627

E-References:

1. Website: www.mindtools.com/page8.html-99k
2. Website:www.inc.com/guides/growth/23032.html-4
3. Website: www.khake.com/page66htm/-72k
4. Website: www.BM Consultant India Consultant India.Com
5. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-English
6. MYCBSEGUIDE
7. Website: www.letstak.co.in

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

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

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

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

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

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

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

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

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

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

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

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

COVs PO and CO Vs PSO Mapping (Information Technology)

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

CO Vs PO and CO Vs PSO Mapping (LG/LT Engineering)

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

Industry Consultation Committee:

Sr. No	**Name**	**Designation**	**Institute/Organisation**
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Ms Shilpa D. Khune	Corporate Consultant Trainer	Mahindra Pride Classroom
3	Mrs. S.S. Kulkarni	Lecturer in English	Government Polytechnic, Pune.
4	Mrs. K.S.Pawar	Lecturer in English	Government Polytechnic, Mumbai
5	Mrs. N.N.Dhake	Lecturer in English	Government Polytechnic, Mumbai

Curriculum Development,
Department of Science and Humanities

Head of Department
Department of Science and Humanities

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in IS/EE (Sandwich pattern)**										
Course Code: SC19101				Course Title: Basic Physics						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**--**	**05**	**60**	**20**	**20**	**25***	--	**25**	**150**

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

Rationale:

The subject is included under the category of science. The special feature of the subject is to develop the laboratory skill using principles of scientific phenomenon. This course will serve to satisfy the need of the technical students for their development in technical field. The course is designed by selecting the topics which will develop intellectual skills of the students and will guide students to solve broad based engineering problems. Ultimately the focus of the course is to develop psychomotor skills in the students.

Course Outcomes: Student should be able to

CO1	State the different physical quantities, identify the proper unit of it and to estimate error in the measurement of physical quantities.
CO2	Apply laws of motion in various engineering applications.
CO3	Create awareness about the properties and application of light, LASER, Ultrasonic waves, sound waves and nanotechnology in engineering field.
CO4	Identify the physical properties of the various materials such as elasticity, viscosity.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Units and Measurements** 1.1 Fundamental Physical quantities, examples. 1.2 Derived physical quantities, examples. 1.3 Definition and requirements of unit 1.4 System of units, C. G. S., M. K. S. and S. I. units. 1.5 Rules to write the unit and conventions of units and Significant figures, rules to write significant figures. 1.6 Error – Definition, types of errors and estimation of errors. 1.7 Numerical **Course Outcome: CO1 Teaching Hours: 6 hrs Marks: 08 (R- 2, U-2, A-4)**

2	**Motions** 2.1 Linear motion –Definition – distance, displacement, velocity, acceleration, retardation, equation of motions, acceleration due to gravity and equation motion under gravity, numerical 2.2 Periodic motions: a) Oscillatory motion, b) Vibratory motion, c) S.H.M. d) Circular motion. (only definition and examples), terms related to S.H.M.: Definition: Time period, frequency, amplitude, wavelength, and phase 2.3 Angular motion: a) Definition: angular motion, Uniform circular motion, Radius vector, linear velocity, Angular velocity, Angular acceleration, b) Relation between linear velocity and angular Velocity(derivation), Radial or centripetal and acceleration, Three equations of motion (no derivations), Centripetal and Centrifugal force, examples applications. **Course Outcome: CO2 Teaching Hours: 10 hrs, Marks: 10 (R- 2 , U- 4 , A- 4)**
3	**Modern Physics** 3.1 Photo Electricity Concept of quantum theory of light, Einstein's Photoelectric equation, Characteristics of photo electric effect, application of photo electric effect 3.2 LASER 3.2.1 LASER introduction 3.2.2 Properties of laser 3.2.3 Spontaneous and stimulated emission, 3.2.4 Population inversion, Optical pumping. 3.2.5 Applications of LASER **Course Outcome: CO3 Teaching Hours: 8 hrs, Marks: 10 (R- 2 , U- 4 , A- 4)**
4	**Optics and Ultrasonic Waves** 4.1 Optics: 4.1.1 Revision of reflection and refraction of light. 4.1.2 Laws of refraction, Snell's law. 4.1.3 Determination of refractive index. 4.1.4 Dispersion, dispersive power, Prism formula (derivation) 4.1.5 Numerical 4.2 Ultrasonic Waves 4.2.1 Ultrasonic waves and infrasonic waves. 4.2.2 Audible range of soundwave 4.2.3 Properties of ultrasonic wave. 4.2.4 Applications **Course Outcome: CO3 Teaching Hours :6 hrs Marks: 10 (R- 2 , U- 4 , A-4)**
5	**Nanotechnology** 5.1 Introduction to nanotechnology. 5.2 Definition of nanoscale, nano meter and nanoparticles, nanotechnology. 5.3 Definition and examples of nanostructured materials. 5.4 Applications of nanotechnology in different fields - a) electronics, b) automobile, c) medical, d) textile,

	e) cosmetics, f) environmental, g) space and defence **Course Outcome: CO3 Teaching Hours :4 hrs Marks: 8 (R- 2 , U-2 , A-4)**
6	**General Properties of Matter** 6.1 Elasticity: 6.1.1 Deformation, deforming force, internal restoring force, Elastic, plastic and rigid substances, their examples 6.1.2 Definition of elasticity, stress, strain and its types. 6.1.3 Hooke's Law and elastic limit. 6.1.4 Stress versus Strain diagram, yield point, breaking point 6.1.5 Definition Young's Modulus, bulk modulus and modulus of rigidity relation among them. 6.1.6 Factor of safety. 6.1.7 Applications of elasticity. 6.1.8 Numerical 6.2 Viscosity : 6.2.1 Concept and Definition of viscosity, velocity gradient. 6.2.2 Newton's law of viscosity, Co-efficient of viscosity, unit of viscosity 6.2.3 Stoke's law, terminal velocity, derivation of Stoke's formula. 6.2.4 Streamline flow, turbulent flow, critical velocity, examples. 6.2.5 Reynold's number and its significance. 6.2.6 Applications of viscosity 6.2.7 Numerical **Course Outcome: CO4 Teaching Hours : 11 hrs Marks: 14 (R- 4 , U- 4 , A-6)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Units and Measurements**	2	2	4	08
2	**Motion**	2	4	4	10
3	**Modern Physics**	2	4	4	10
4	**Optics and Ultrasonic**	2	4	4	10
5	**Nanotechnology**	2	2	4	08
6	**General Properties of Matter**	4	4	6	14
	Total	**14**	**20**	**26**	**60**

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

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1	To know your Physics laboratory and Use of Scientific Calculator	02
2	1	CO1	To measure the dimensions of given objects and to determine their volume using Vernier caliper	02
3	2	CO2	To determine Acceleration due to gravity by simple pendulum	02
4	3	CO3	To study photoelectric effect by using photo cell	02
5	4	CO3	To determine refractive index by pin method	02
6	6	CO4	To determine coefficient of viscosity of liquid by Stokes' method	02
7	3	CO1	To measure the dimensions of given objects and to determine their volume using micrometer screw gauge.	02
8	2	CO2	To determine stiffness constant by using helical spring	02
9	3	CO3	To study projectile motion	02
10	4	CO3	To plot the characteristics of photo cell.	02
11	4	CO3	Experiments on LASER	02
12	3	CO3	Demonstration on spectrometer	02
13	5	CO4	To study Engineering applications of Nanotechnology	02
14	6	CO4	To determine Young's modulus of elasticity of wire using Young's apparatus.	02
15	ALL	CO1	Showing Video on different applications related to units,	02
Total				**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining 4 experiments are to be perform on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Applied Physics	Manikpure & Deshpande S.Chand & company	978-8121919548
2	Applied Physics	B.G.Bhandarkar, Vrinda Publication	0071779795
3	Optics & Optical Fibres	Brijlal Subhramanyan	978-3662527641
4	Engineering Physics	Gaur and S.L. Gupta S.Chand& Company	0-07-058502
5	Physics	Resnick and Halliday Tata McGraw Hills	978-0-071755487-3
6	Physics part I& II	H.C. Varma	9788177091878
7	Properties of Matter	D.S. Mathur	978-8121908153

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1. www. Physics.org
2. www.ferrofphysics.com
3. www.physicsclassroom.com
4. http;//hperphysics.phastr.gsu.edu/hbase/hph.htm
5. www.youtube/physics
6. www.sciencejoywagon.com/physicszone
7. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-physics
8. MYCBSEGUIDE
9. https://ndl.iitkgp.ac.in/

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

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

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

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
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Curriculum Development,
Department of Science and Humanities

Head of Department
Department of Science and Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in CE/ME/IT/CO/EC/IS/EE(Sandwich Pattern)**										
Course Code: SC19109				Course Title: Basic Mathematics						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
04	**-**	**-**	**04**	**60**	**20**	**20**	**-**	-	**-**	**100**

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

Rationale:

This subject is kept under the branch of sciences. This subject intends to teach student basic facts ,concepts, principles, and procedure of mathematics as a tool to analyze engineering problems and as such lays down foundation for understanding the engineering and core technology subject.

Course Outcomes: Student should be able to

CO1	Identify the basic principles of mathematics about the field analysis of any engineering problem.
CO2	Apply rules , concept and properties to solve the basic problems.
CO3	Establish relation between two variables.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Trigonometry:** 1.1Trigonometric ratios of allied angles, compound angles, multiple. angles (2A, 3A), Sub multiple angles 1.2 Factorization and De-factorization Formulae 1.3 Inverse Circular function (definition and simple problems). **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**Vectors:** 2.1 Definition of vector , position vector 2.2 Algebra of vectors(Equality, addition ,subtraction and scalar multiplication) 2.3 Dot (Scalar) product & Vector (Cross) product with properties. **Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U-4 , A-4)**

3	**Logarithms:** 3.1 Definition of logarithm 3.2 Laws of logarithm 3.3 simple examples based on laws. **Course Outcome:CO2 Teaching Hours : 10hrs Marks:10(R-4 , U- 4 , A-2)**
4	**Probability :** 4.1Definition of random experiment , sample space, event, occurance of event and types of event (Impossible , mutually exclusive , exhaustive ,equally likely) 4.2 Definition of Probability 4.3 Addition & Multiplication Theorems of probability without proof , simple examples **Course Outcome: CO1 Teaching Hours :10hrs Marks:10 (R-4, U- 4 , A-2)**
5	**Determinants:-** 5.1 Definition of Determinant 5.2 Expansion of Determinant of order 2X3 5.3 Crammer's rule to solve simultaneous equations in 3 unknowns **Course Outcome: CO2 Teaching Hours :10 hrs Marks:10 (R- 2 , U-4 , A-4)**
6	**Matrices:** 6.1 Definition of a matrix of order m x n 6.2 Types of matrices 6.3 Algebra of matrices - equality, addition, subtraction ,multiplication & scalar multiplication. 6.4 Transpose of matrix. 6.5 Minor , co-factor of an element. 6.6 Adjoint & inverse of a matrix by adjoint method. 6.7 Solution of a simultaneous equations by matrix inversion method. **Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U- 4 , A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total
1	**Trigonometry**	04	04	02	10
2	**Vectors**	02	04	04	10
3	**Logarithms**	04	04	02	10
4	**Probability**	04	04	02	10
5	**Determinants**	02	04	04	10
6	**Matrices**	02	04	04	10
	Total	**18**	**24**	**18**	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mathematics for Polytechnic Students	S.P.Deshpande, Pune Vidyavardhini Graha Prakashan	-
2	Mathematics for Polytechnic Students (Volume I)	H.K.Dass, S.Chand Prakashan	9788121935241
3	Companions to Basic Maths	G.V.Kumbhojkar, Phadke Prakashan	10-B07951HJDQ 13-B07951HJDQ
4	Applied Mathematics	N.Raghvendra Bhatt late, Tata McGraw Hill Publication Shri R Mohan Singh	9789339219567, 9339219562

E-References:

1. www.math-magic.com
2. www.Scilab.org/-SCI Lab
3. www.mathworks.com/Products/Matlab/-MATLAB
4. www.wolfram.com/mathematica/-Mathematica
5. https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig
6. www.dplot.com/-Dplot
7. www.allmathcad.com/-Math CAD
8. www.easycalculation.com
9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (COMPUTER ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (INFORMATION TECHNOLOGY)

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

CO Vs PO and CO Vs PSO Mapping (ELECTRONICS ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
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3	Mr. A.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai
4	Mr.V.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Science and Humanities

Head of Department
Department of Science and Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19201				Course Title: Principles of Measurement						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**50**	–	**25**	**175**

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

Rationale:

Instrumentation is defined as the art and science of measurement and control of physical variables within a production or manufacturing area. The physical variables like temperature, pressure, flow rate, level, displacement, force, pH, humidity, and etc. are measured in industries to monitor and control the overall operation of plant. For conversion of these physical quantities into electrical forms, various types of transducers are used. Hence it is essential to study the conversion/ transduction principles. This course mainly deals with study of various transduction principles as well as characteristics of measuring instruments.

Course Outcomes: Student should be able to

CO1	Discuss concept of metrology and measurement.
CO2	Define the performance characteristics of measuring instruments.
CO3	Demonstrate the transduction principles of different transducers.
CO4	Explain measurement of given process variable using different transducers.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Metrology and Measurement** 1.1 Definitions of Metrology, Types of Metrology 1.2 Definition of Measurement , Instrumentation 1.3 Significance of Measurement .Methods of Measurements,Generalized Measurement System .Applications of Measurement Systems **Course Outcome: CO1 Teaching Hours : 4 hrs Marks: 4 (R-2 , U-2, A-0)**
2	**Instrument's Performance Characteristics** 2.1 Classification of Instruments : Active and Passive instruments ,Null-type and Deflection-type instruments , Analogue and Digital instruments, , Smart instruments & non smart instruments 2.2 Types of Performance Characteristics 2.3 Definitions-Static Characteristics of Instruments: Accuracy, Precision, calibration, Range and

	span ,Linearity, Sensitivity , Repeatability & Reproducibility, Resolution & Threshold, Drift, Hysteresis band, Dead zone.(Definition only) 2.4 Definitions-Dynamic Characteristics of Instruments: Speed of Response, Dynamic Error, Fidelity. 2.5 Errors in Measuring Instruments 2.5.1 Types of Errors 2.5.2 Sources of Errors 2.5.3 Reduction of Errors **Course Outcome: CO2 Teaching Hours :10 hrs Marks:12 (R-2 , U-6 , A-4)**
3	**Transduction Principles of Sensors & Transducers** 3.1 Different Physical Variables Measured in Industries, Definitions of Sensor & Transducer and their difference, Classification of Transducers. **Principle of Operation, List of Examples & Applications of –** 3.2 Resistive transducers (Potentiometer, RTD, Thermistor & LDR) & Piezo-resistive sensors 3.3 Capacitive transducers based on change in area of plates, change in distance between plates and change in dielectric between plates 3.4 Inductive transducers- Self-generating type- Electromagnetic type, Electrodynamics type, and Eddy current type Passive type- Variable Inductance type, Mutual Inductance type 3.5 Hall-effect sensors ,Piezoelectric transducers 3.6 Photoelectric sensors - Photo emissive, Photo conductive and Photovoltaic 3.7 Ultrasonic transducers, Radar sensors. **Course Outcome: CO3 Teaching Hours :10 hrs Marks:14 (R-4 , U-6 , A-4)**
4	**Principles of Pressure Measurement** 4.1 Pressure -Definition, Units of Pressure, Pascal's Law 4.2 Absolute, Gauge, Atmospheric, Vacuum, and Differential Pressures. **Principles of Operation and Applications of –** 4.3 Barometer 4.4 Manometers- Piezometer , U-tube manometer, Single limb manometer 4.5 Bourdon tube- C type, Bellows & Diaphragm **Course Outcome: CO4 Teaching Hours :6 hrs Marks:8 (R-0 , U-4 , A- 4)**
5	**Principles of Flow Measurement** 5.1 Types of fluid flows, Rate of flow or discharge(Q), Continuity equation 5.2 Bernoulli's equation for ideal and real fluids and applications **Principle of Operation and Applications of** – 5.3 Venturimeter, Orifice Meter, Rotameter **Course Outcome:CO4 Teaching Hours :08hrs Marks:12 (R- 2 , U-6 , A- 4)**
6	**Principle of Temperature Measurement** 6.1 Difference between heat and temperature, temperature Scale. Different units of temperature measurement and their conversion 6.2 Modes of heat transfer, Thermal conductivity **Principle of Operation of –** 6.3 Thermal expansion thermometers (liquid thermometer, Bimetallic Strip)

	6.4 Thermoelectric thermometers – (Seebeck, Peltier, and Thomson effects)- principle of Thermocouple **Course Outcome:CO4 Teaching Hours : 7 hrs Marks: 10 (R- 2 , U-4 , A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Metrology and Measurement	02	02	--	04
2	Instrument's Performance Characteristics	02	06	04	12
3	Transduction Principles of Sensors & Transducers	04	06	04	14
4	Principles of Pressure Measurement	--	04	04	8
5	Principles of Flow Measurement	02	06	04	12
6	Principles of Temperature Measurement	02	04	04	10
	Total	**12**	**28**	**20**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To identify direct and indirect measuring instruments in the given lab	2
2	2	CO2	To find an accuracy, precision, range and span of mechanical instruments (e.g. Level indicator).	2
3	3	CO3	To verify the resistive transduction principle of transducer.	2
4	4	CO4	To measure gauge pressure and differential pressure using U- tube manometer.	2
5	5	CO4	To measure liquid flow rate using rotameter.	2
6	6	CO4	Measurement of temperature by using temperature sensor.	2
7	2	CO2	To find an accuracy, precision, range and span of electrical instruments (e.g. DMM- voltage, current and resistance).	2
8	3	CO3	To verify the inductive transduction principle by converting displacement / velocity into voltage.	2
9	4	CO4	To measure atmospheric pressure using barometer.	2
10	5	CO4	To measure liquid flow rate using orifice meter.	2
11	5	CO4	To measure liquid flow rate using venturi meter.	2
12	3	CO3	To verify photo conductive principle by converting light intensity into resistance (LDR).	2
13	3	CO3	To verify the capacitive transduction principle by converting liquid level into change in capacitance.	2

14	4	CO4	Identify different pressure mechanical pressure transducer in lab.	2
15	3	CO3	To verify the piezoelectric transduction principle applicable for only dynamic measurement.	2
Total				**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining 4 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	A Course in Electrical and Electronic Measurements and Instrumentation	A.K. Sawhney Dhanpat Rai and co, New Delhi.2015	9788177001006
2	Measurement-And-Instrumentation-Principles-3rd-Edition1	Alan S. Morris Butterworth-Heinemann, Oxford. 2001	9780750650816
3	A TextBook of Fluid Mechanics and Hydraulic Machines (in S.I. Units)	Dr. R. K. Bansal Laxmi Publication, New Delhi. 2018	9788131808153
4	A Textbook on Heat Transfer	Dr. S.P. Sukhatme Universities Press (India) Fourth edition (2005)	9788173715440
5	Instrumentation System and devices	Rangan Mani Sharma Tata McGraw Hill	9780074633502
6	Industrial instrumentation and controls	S.K. Singh Tata McGraw Hill, New Delhi	9780070262225

E-References:

1. https://www.youtube.com/ "type name of instrument"
2. http://www.vlab.co.in/
3. https://www.electronics-tutorials.ws/io/io_3.html
4. https://nptel.ac.in/course.html
5. https://www.slideshare.net/nsihag/transducers-17950953
6. https://en.wikipedia.org/wiki/Transducer

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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3	Mr. U.B.Shinde	Lecturer in Instrumentation Engineering	Govt. Polytechnic Mumbai
4	Mrs. S.T. Shinde	Lecturer in Instrumentation Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engineering

Head of Department
Department of Instrumentation Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19202				Course Title: Instrumentation Workshop Practice						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4**	--	**4**	--	--	--	--	--	**50**	**50**

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

Rationale:

Instrumentation workshop practice will provide real industrial environment which helps students to develop technician skills related to instrumentation field. The course is designed to impart hands-on-skills in the field of electronics & instrumentation such as testing of electronic components, cables, connectors, soldering and de-soldering techniques, PCB making etc. This course is useful for students to build, test, maintain and troubleshoot simple electronic circuits on PCB.

Course Outcomes: Student should be able to

CO1	Select appropriate tools, components and instrument.
CO2	Test the given electronic components.
CO3	Perform the soldering and de-soldering with utmost safety.
CO4	Develop PCB, assemble components and test the circuit.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Tools** 1.1 Tools: Nose pliers, wire stripper, screwdrivers, allen keys, cutter, hand hacksaw, soldering iron, de-soldering pump, crimping tools (for RJ-45, RJ-11), and cable testers. (Free hand constructional sketches may be drawn on drawing sheet) 1.2 Multimeters: Need of Multimeter, Analog and digital Multimeter, Measurement of parameter using multimeter. **Course Outcome: CO1**
2	**Switches, Cables and Connectors** 2.1 Types of switches: SPST, SPDT, Toggle, thumbwheel, rotary, slide, micro switch, membrane switch. 2.2 Cable: Flat, Ribbon, Co-axial, twisted pair, UTP, Fiber optic. 2.3 Connector Types: PCB edge connector, Berg (strip) connector, FRC connector, D-type, BNC, TNC, MCB, RJ-45, RJ-11, USB (A, B, mini, micro). **Course Outcome: CO1**

3	**Component Testing** 3.1 Identification and testing of following components. Resistors, Capacitors, Inductors, Transformers, PN Junction Diode, Bipolar Junction Transistors (BJT), Filed Effect Transistors (FET), Unijunction Transistor (UJT), Metal Oxide Semiconductor FET (MOSFET), LED, 7- Segment Displays, SCR, DIAC, TRIAC. 3.2 Terminal identification and major specifications of component from its data sheet. **Course Outcome: CO2**
4	**Soldering and De-soldering** 4.1 Soldering Basics: Solder joint: Dry solder joint, cold solder joint, Good and Bad solder joint, Soldering material, Soldering tools: Soldering Iron, soldering station. 4.2 De-soldering Technique: Tools used for de-soldering, De-solder Wick, De-solder Pump 4.3 Precaution during soldering and de-soldering. **Course Outcome: CO3**
5	**PCB Making** 5.1Types of PCB's: Glass Epoxy, paper phenolic, Single Sided, double sided, Selection and application of PCB's. Drawing electronic circuit, designing PCB layout and artwork. Use of paint, Templates, Pen. 5.2 Demonstration of PCB making equipments: Deep coating machine, UV exposure unit, Etching machine, dryer (oven) and scanner with lens. Drilling machine, Shearing machine. Developing negative film and making PCB. **Course Outcome: CO4**
6	**Mini Project** 6.1 Selection and testing of components to be used in the mini project. 6.2 PCB layout and artwork design: Transfer the artwork on copper clad, Etching and drilling, mounting and soldering components. 6.3 Testing and fault finding of circuit, Wire harnessing and final assembly along with enclosure. **Course Outcome: CO4**

Suggested Specifications Table (Theory): --NA---

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To know Instrumentation Workshop Lab: A) Demonstration for identification and use of tools. (Nose pliers, wire stripper, screwdrivers, allen keys, allen screw, cutter, hand hacksaw, soldering iron, de-soldering pump, crimping tools (for RJ-45, RJ-11), and cable testers.(4 Hours) B) Prepare the sheet of free hand sketch of various tools used in Instrumentation Workshop and write their uses. (4 Hours)	8
2	1	CO1	Multimeters: (A) To identify analog and digital multimeters and to identify different range selection for AC/DC voltage/Current, Resistance, continuity, diode, transistor. (B) To measure resistance, voltage and current using analog and digital multimeter.	4
3	2	CO1	To identify and test various types of switches, cables and connectors (Lead identification, testing, uses).	8

			(A) SPST, SPDT, Toggle, thumbwheel, rotary, slide, micro switch, membrane switch. (2 Hours) (B) PCB edge connector, FRC connector, D-type, BNC, TNC, MCB, RJ-45, RS-232, USB connectors. (2 Hours) (C) Flat, Ribbon, Co-axial, twisted pair, UTP. (2 Hours) Prepare the chart for symbols with terminal identification, uses and testing procedures. (2 Hours)	
4	3	CO2	To identity and test passive components available in your lab: **Resistors**: Thick film and Thin film resistors, Network and Surface Mount Resistors, Variable Resistors, Special resistors e.g. thermistor, LDR. **Capacitors**: Dielectric, Variable, Electrolytic: aluminium/tantalum, Film: radial/axial lead, Ceramic. **Inductors**: Iron core, Ferrite core, Air core, bobbin based, torroidal, multilayer, film, variable, coupled. (by color codes and with multimeter/LCR meter)	4
5	4	CO3	Demonstration and practice of soldering and de-soldering technique.	4
6	5&6	CO4	Mini project: To prepare PCB (with layout, artwork designed by the student) for small electronic circuits. Note: Mini project group may consist of 3-4 students. Student has to demonstrate the project and submit the project report.	8
7	3	CO2	To identify and test Diode, LED, BJT, FET, UJT, MOSFET and 7- Segment display using multimeter.	4
8	3	CO2	To identity and test DIAC, SCR and TRIAC using multimeter.	2
9	4	CO3	To identity Solder joint, Dry and cold solder joint, good and bad solder joint, soldering material, soldering tools	2
10	4	CO3	To perform soldering by soldering material & soldering tools. Precaution to be taken during de-soldering	2
11	4	CO3	To perform De-soldering by De-solder Wick, De-solder Pump. Precaution to be taken during de-soldering	2
12	5	CO4	Draw circuit schematic, layout and artwork using one of the PCB making software mentioned below. (Express PCB, Free PCB, EAGLE PCB, workbench etc).	4
13	5	CO4	To identify different types of PCB. Teacher shall explain artwork design rules, types of PCB's: Glass Epoxy, Selection of PCB's, PCB layout and artwork design, Use of paint, Templates, Pen etc paper phenolic, Single Sided, double sided, Selection of PCB's, PCB layout and artwork design, Use of paint, Templates, Pen etc.	4
14	5	CO4	To search information on different PCB making equipments.	2
15	5	CO4	To identify different instruments/ equipments used in making PCB.	2
Total				**60**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining 4 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electronic Devices and Circuit: An Introduction	Mottershead Allen PHI Learning, New Delhi	9788120301245
2	Electronic Devices and Circuit Theory	Boylestead Robert, Louis Neshelsky Pearson Education, 10th edition	9788131727003
3	The Art of Electronics	Paul Horowitz Winfield Hill Cambridge University Press, New Delhi	9780521370950
4	Electronics Principles	Malvino, Albert Paul, David McGraw Hill Education	9780073222776
5	Principles of Electronics	Mehta V.K., Mehta Rohit S. Chand and Company	9788121924504
6	Basic Electronic Engineering	Baru V., Kaduskar R. , Gaikwad S.T. Dreamtech Press	9789350040126
7	Fundamentals of Electronic Devices and Circuits	David A. Bell Oxford University Press	9780195425239
8	A text book of Applied Electronics	Sedha R.S. S. Chand	9788121904209

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2. http://www.allelectronics.com
3. http://www.techniks.com
4. http://www.aplab.com
5. https://electronicsclub.info

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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Department of Instrumentation Engineering

I/C, Curriculum Development Cell

Principal

Programme : ME/CE/IS (Sandwich Pattern)										
Course Code: WS19201				Course Title: Workshop Practice						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
0	**4**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**50**	**50**

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

Rationale:

Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops. The knowledge of basic shops like Wood working, Fitting, Welding, Plumbing and Sheet Metal shop is essential for technicians to perform their duties in industries. Irrespective of engineering stream, the use of workshop practices in day to day industrial as well domestic life helps to solve various minor but critical problems. Working in workshop develops the attitude of working in a group and the basis for safety awareness is created. This foundation course intends to impart basic know-how of various hand tools and their use in different sections of manufacturing. The students are advised to undergo each skill experience with remembrance, understanding and application with special emphasis on attitude of enquiry to know why and how for the various instructions and practices imparted to them in each hop. Furthermore, the demonstration of CNC Machine will give feel of advancement in industry.

Course Outcomes: Student should be able to

CO1	Lay-outing of shop & Sketching of jobs, tools & equipment.
CO2	Select appropriate tools, machinery, equipment and consumables for given application.
CO3	Use & Operate hand tools, equipment and machinery in different shops.
CO4	Prepare the simple jobs as per specification & drawing.
CO5	Maintain workshop related tools, equipment and machineries.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to workshop: -** 1.1 Workshop layout, Importance of various sections/shop of workshop, Types of jobs done in each shop. 1.2 Causes of accidents, general safety rules and work procedure in workshop, Safety signs and symbols, First Aid. 1.3 Fire, Causes of Fire, Basic ways of extinguishing the fire. Classification of fire, Firefighting

	equipment, fire Extinguishers and their types. 1.5 Issue and return system of tools, equipment and consumables. **Course Outcome: CO1,CO2** **Teaching Hours : 06**
2	**Smithy and Forging:-** 2.1 Sketching, understanding the specifications, materials, various applications and methods used in Smithy and Forging shop along with use of tools like anvil, hammers, Swage block, tongs, chisels, flatters etc; 2.2 Demonstration of Smithy and Forging operations like bending, setting down, bulging, Upsetting etc; 2.3 Preparation of smithy & forging, job. 2.4 Safety precautions & Personal Protective Equipments. **Course Outcome: CO1,CO2,CO3,CO4,CO5** **Teaching Hours :10**
3	**Carpentry Section :-** 3.1 Types of wood and their applications. 3.2 Types of carpentry hardware's and their uses. 3.3 Sketching, understanding the specifications, materials, various applications and Methods used in Carpentry shop along with use of tools like saws, planner, chisels, Hammers, mallet, marking 3.4 Demonstration of carpentry operations such as marking, sawing, planning, chiseling, gauge, Vice, try square, rule, etc; Grooving, boring, joining, etc; 3.5 Preparation of wooden joints. 3.6 Safety precautions & Personal Protective Equipments. **Course Outcome: CO1,CO2,CO3,CO4,CO5** **Teaching Hours: 10**
4	**Welding Section: -** 4.1 Types, sketching, understanding the specifications, materials and applications of arc & Gas welding, Accessories and consumables. 4.2 Demonstration of metal joining operations like arc welding, soldering and brazing. Show effect of Current and speed. Also demonstrate various welding positions. 4.3 Demonstrate gas cutting operation. 4.4 Preparation of metal joints. 4.5 Safety precautions & Personal Protective Equipments. **Course Outcome: CO1,CO2,CO3,CO4,CO5** **Teaching Hours: 10**
5	**Fitting Section** 5.1 Sketching, understanding the specifications, materials, various applications and methods used in fitting, Marking, measuring, work holding, cutting & finishing tools. 5.2 Demonstration of various fitting operations such as chipping, filing, scraping, grinding, Sawing, marking, Drilling, tapping, etc; 5.3 Preparation of male, female joint. 5.4 Safety precautions & Personal Protective Equipments **Course Outcome: CO1,CO2,CO3,CO4,CO5** **Teaching Hours :12**
6	**Plumbing Section** 6.1 Types, specification, material , applications and demonstration of pipe fitting tools 6.2 Demonstration of pipe fitting operations such as marking, cutting, bending, threading, assembling, Dismantling etc. 6.3 Types and application of various spanners such as flat, fix, ring, box, adjustable etc. 6.4 Preparation of pipe fitting jobs. 6.5 Concept and conversions of SWG and other gauges in use. Use of wire gauge. 6.6 Safety precautions & Personal Protective Equipments **Course Outcome: CO1,CO2,CO3,CO4,CO5** **Teaching Hours : 06**

7	**Lathe and CNC Operations :-** 7.1 Working principle of lathe along with sketch and procedure for its general maintenance. 7.2 Demonstration of Lathe machine operation like plain turning, taper turning, threading, Chamfering, etc. 7.3 Simple job demonstration for a group on CNC Machine. **Course Outcome:CO5** **Teaching Hours : 06**

List of experiments:

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1	Causes of accidents, general safety rules and work procedure in workshop, Safety signs and symbols, First Aid. Perform mock drill session in group of minimum 10 students for Extinguishing fire.	06
2	2	CO1,CO2,CO3,CO4,CO5	Prepare job involving operations like bending, setting down, bulging, upsetting etc; e.g. Pegs (Square/round), Hook, Hammer tongue, Agro equipment etc. (Individually)	10
3	3	CO1,CO2,CO3,CO4,CO5	Prepare two wooden joints as per given drawings. (Individually)	10
4	4	CO1,CO2,CO3,CO4,CO5	Prepare lap joint/butt joint using either arc / gas welding as per given drawing.(Individually)	10
5	5	CO1,CO2,CO3,CO4,CO5	Prepare one Male- Female type fitting job as per given drawing. (Individually)	12
6	6	CO1,CO2,CO3,CO4,CO5	Prepare two pipe joints as per given drawings. (Individually)	06
7	7	CO5	Demonstration of Lathe machine & CNC machine operations.	06
		Total		**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Workshop Technology - 1	Hazra and Chaudhary Media promoters & Publisher private limited.	9788185099149
2	Workshop Technology - 1	W.A.J.Chapmam Taylor &francis.	9780713132694
3	Workshop Practice Manual for Engineering Diploma & ITI Students	Hegde.R .K Sapna Book House, 2012,	9798128005830
4	Workshop familiarization.	E. Wilkinson Pitman engineering craft series. 1972	978 0273 3167 56
5	Mechanical workshop practice.	K.C.John PHI. 2010	978 812 03416 61
6	Workshop practice manual	K. Venkata Reddy,B. S. Publications. 6th ed ,2015	978 8178 0030 78

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2. http://wwwabmtools.com/downioads/Woodworking%20Carpentry%20Tools.pdf d.
3. http://www.weldingtechnology.org e.http://www.newagepublishers.com
4. http://wwwyoutube.com/watch?v=TeBX6cKKHWY g
5. http://wwwyoutube.com/watch?v=QHF0sNHnttw&feature=related h
6. http://www.youtube.com/watch?v= K v l zo9CAxt4&feature=relmfu i.
7. http://sourcing.indiamart.com/engineerig/articles/materials-used-hand-tools/

CO Vs PO and CO Vs PSO Mapping(Mechanical)

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

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

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

CO Vs PO and CO Vs PSO Mapping(Instrumentation)

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

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2	Shri N. M. Ambadekar	Workshop Superintendent,	G. P. Thane
3	Shri D. B. Jadhav	Senior Manager	Auto. Division, Mahindra and Mahindra Ltd., Kandivali

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Workshop superintendent
Department of workshop

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:IS19 309				Course Title: Libre Office Suite (Writer and Draw)						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4#**	**--**	**4**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

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

Course Content Details:

Unit No	Topics / Sub-topics
1	**Libre office suite writer** 1. **Promo of LibreOffice Suite** Outline: - LibreOffice promo - Features of LibreOffice - Uses of LibreOffice - LibreOffice formats - LibreOffice tutorials in Spoken Tutorial - Applications of LibreOffice, Libre Office tutorials in various languages 2. **Introduction to LibreOffice Writer** Outline: Introduction to LibreOffice Writer Basic Features Toolbars How to open, close and save a document Save in MS Office, PDF and other formats Open MS Office Documents Change Bold icon Change Font Size , Change Font Name. 3. **Typing text and basic formatting** Outline: Typing text and basic formatting Aligning Text in writer Bullet points and Numbering Cut Copy and Paste option Bold/Underline/Italics Font name/Font size/Font color in Writer, Other important and popularly used formatting features. 4. **Inserting pictures and objects** Outline: Inserting pictures and other objects in a document Inserting pictures Inserting Tables Hyperlinks (within, across documents, from web) Creating tables AutoFormat Optimal Column Width option 5. **Viewing and printing a text document** Outline: Viewing and printing a text document Viewing Documents Printing Documents Print Layout, Web Layout, Zoom factor , View layout. Page Preview bar Printer functions Quick Printing Print in ,reverse page order 6. **Using search replace auto correct** Outline: Using search replace auto correct Find, Search, replace for select text Auto-correct feature Spell check Language Settings 7. **Typing in local languages** Outline: Typing in local languages Using SCIM to type in Indian languages Bilingual typing 8. **Using track changes**

	Outline: Using track changes as a peer review / collaborative constructivist tool, accepting and rejecting changes How to use record changes to peer review documents, accept/reject these 9. **Headers Footers and notes** Outline: Headers, Footers and notes, Page format – header footer, how these can change within the same document (first page without header footers), Useful footer information (page number, title), Insert Footnotes and endnotes Insert/Remove Header and Footer 10. **Creating newsletter** Outline: Creating newsletter Advanced use as a desktop tool to create a note with multiple columns use features like word count, Spell check, create newsletters in LibreOffice Writer and few operations that can be performed on them.
2	**Libre office suite Draw** 1. **Promo of LibreOffice Suite** Outline: - LibreOffice promo - Features of LibreOffice - Uses of LibreOffice - LibreOffice formats - LibreOffice tutorials in Spoken Tutorial - Applications of LibreOffice. 2. **Introduction** Outline: Introduction to LibreOffice Draw LibreOffice Draw Create and save an Impress Draw file LibreOffice Draw Workspace Graphics - Bitmap or raster image - Vector graphics. 3. **Create simple drawings** Outline: Create simple drawings Basic shapes (lines, arrows, rectangles and squares, circles) (How to improve upon a water cycle diagram by adding shapes and so on.) Geometric shapes 4. **Basics of working with objects** Outline: Basics of working with objects Cut, copy, paste objects Resize objects dynamically using handles Object Arrangement Adding a new page to a file Group and ungroup objects 5. **Fill objects with color** Outline: Fill objects with color, gradients, hatching and bitmaps Making outlines invisible Adding a shadow to the objects Creating new colors How to import a bitmap into Draw. 6. **Insert text in drawings** Outline: Insert text in drawings Insert text directly inside an object Changing the text color Working with text boxes and formatting text in objects Making the line wider. 7. **Common editing and print functions** Outline: Common editing and print functions Set the draw page for page size and margins Paper size, page count, page numbers, date, and time Undo and redo actions Rename a page Print. 8. **Polygons and Curves** Outline: Curves and Polygons Various types of Polygons Draw directions using arrows Flow charts Insert tables and graphs Page Margins and Orientation Font Type and Size modification 9. **Edit Curves and Polygons** Outline: Use the Edit Points toolbar Insert new points Move existing points Using control lines to change the shape of the objects Group the objects together 10. **Flow Charts Connectors Glue Points** Outline: Draw Flowcharts To Draw Beizer curve Insert text in flow charts Various text insertion options -Resizing shape to fit text width -Word wrap text in shape What is Flowchart.

	11. **Working with Objects** Outline: What are Grids? What are Guides? What are Snap Lines? Position objects with grids, guides and snap lines Resize objects exactly and duplicate objects Distribute objects. 12. **Import and Export Images** Outline: Import images into a Draw page *as a link * as an embedded image Edit Links Remove links Automatic embedding of images Delete the picture Export the whole Draw file or one or one page of the Draw file Export to a PDF, HTML, JPEG or a bitmap file , Edit Raster images using the Format Picture tool 13. **Basics of Layers Password Encryption PDF** Outline: Basics-of-Layers-Password-Encryption-PDF Layers -Layout -Controls - Dimensions 14. **Working with 3D objects** Outline: Enable the grids and the guide lines How to create 3D objects Extrusion(Creating 3D objects, using 2D objects) 3D Toolbar 3D Rotation Object Typing text in 3D objects using Text tool, Ready-made 3D shapes. 15. **Set Draw preferences** Outline: Learn how to set the following preferences: **Properties **Create versions **View in color/grayscale/black-and-white Setting Title, Subject, Keywords and Comments of a file.

Coordinator,
Curriculum Development,
Department of Instrumentation

Head of Department
Department of Instrumentation

I/C, Curriculum Development Cell

Principal

Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- II

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
SC19110	Engineering Mathematics	4	--	--	4	4	60	20	20	--	--	--	100
SC19106	Applied Chemistry	3	2	--	5	5	60	20	20	25*	--	25	150
IS19204	Electronic Measurement and Instruments	3	2	--	5	5	--	--	--	50*	--	25	75
IS19206	Basics of Electronics Engineering	3	4	--	7	7	60	20	20	50	--	25	175
EE19206	Fundamental of Electrical Engineering	3	2	--	5	5	60	20	20	50	--	25	175
IS19310	Inkscape (Spoken Tutorial)	--	4#	--	4#	4	--	--	--	--	--	--	--
	Total	**16**	**14**	**--**	**30**	**30**	**240**	**80**	**80**	**175**	**--**	**100**	**675**
Student Centered Activity(SCA)					**05**								
Total Contact Hours					**35**								

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

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

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

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

Coordinator, Curriculum Development, Department of Instrumentation Engg.

In-Charge Curriculum Development Cell

Head of Department Department of Instrumentation Engg.

Principal

Programme : **Diploma in CE/ME/CO/IF/EC/EE/IS (Sandwich pattern)**										
Course Code: SC19110				Course Title: ENGINEERING MATHEMATICS						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**--**	**--**	**4**	**60**	**20**	**20**	**--**	---	**--**	**100**

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

Rationale:

This subject is kept under the branch of sciences. This subject intends to teach student basic facts ,concepts, principles, and procedure of mathematics as a tool to analyze engineering problems and as such lays down foundation for understanding the engineering and core technology subject.

Course Outcomes: Student should be able to

CO1	Define the basic principles of function, limits, derivatives, complex number and relations between two variables.
CO2	Apply rules, concept and properties to solve the problems
CO3	Solve the given problems of integration using suitable method.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Function** 1.1 Definition of variable, constant, intervals such as open, closed, semi-open etc 1.2 Definition of function, value of function and types of functions and simple examples **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**Limits** 2.1 Definition of neighbourhood, concept and definition of limit 2.2 Limits of Algebraic function 2.3 Limits of Trigonometric Functions with simple examples **Course Outcome:CO1 Teaching Hours:10 hrs Marks: 10 (R- 2 , U-4 , A-4)**
3	**Derivatives & Application of derivative** 3.1 Definition of the derivative. 3.2 Derivatives of standard function.(No proof by first principle)

	3.3 Differentiation of sum, difference, product and quotient of two or more functions 3.4 Differentiation of composite function with simple example. 3.5 Second order derivative. 3.6 Geometrical Meaning of Derivative 3.7 Tangents & Normals to the curve, 3.8 Maxima & minima of the function 3.9 Radius of curvature **Course Outcome:CO2 Teaching Hours : 10 hrs Marks:10 (R-4 , U- 4 , A-2)**
4	**Integration & Application of integration** 4.1Definition of integration as antiderivative ,Integration of standard function 4.2 Rules of integration(Integration of sum, difference, scalar multiplication) without proof 4.3 Integration by substitution 4.4 Integration of composite function 4.5 Definition of definite integral 4.6 Properties of definite integral with simple problems 4.7 Area under the curve 4.8 Area bounded by two curves **Course Outcome: CO3 Teaching Hours :10 hrs Marks:10 (R-4, U- 4 , A-2)**
5	**Complex Number:-** 5.1 Definition of complex number Cartesian ,Polar ,Exponential form of complex number 5.2 Algebra of complex number :-Equality, addition, Subtraction, Multiplication & Division with simple examples **Course Outcome: CO2 Teaching Hours :10hrs Marks:10 (R- 2 , U-4 , A-4)**
6	**Numerical Analysis** 6.1 Solution of Algebraic equations using – i) Bisectional method ii) Regular – Falsi method iii) Newton- Raphson method 6.2 Solution of simultaneous equation (i) Gauss elimination method (ii) Jacobi's method (iii) Gauss-Seidal method **Course Outcome:CO2 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U- 4, A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Function**	04	04	02	10
2	**Limits**	02	04	04	10
3	**Derivatives & Application of Derivatives**	04	04	02	10
4	**Integration & Application of Integration**	04	04	02	10
5	**Complex Number**	02	04	04	10
6	**Numerical Analysis**	02	04	04	10
	Total	**18**	**24**	**18**	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mathematics for Polytechnic Students	S.P.Deshpande, Pune Vidyavardhini Graha Prakashan	-
2	Mathematics for Polytechnic Students (Volume I)	H.K.Dass, S.Chand Prakashan	9788121935241
3	Companions to Basic Maths	G.V.Kumbhojkar, Phadke Prakashan	10-B07951HJDQ 13-B07951HJDQ
4	Applied Mathematics	N.Raghvendra Bhatt late, Tata McGraw Hill Publication Shri R Mohan Singh	9789339219567, 9339219562

E-References:

1. www.math-magic.com
2. www.Scilab.org/-SCI Lab
3. www.mathworks.com/Products/Matlab/-MATLAB
4. www.wolfram.com/mathematica/-Mathematica
5. https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig
6. www.dplot.com/-Dplot
7. www.allmathcad.com/-Math CAD
8. www.easycalculation.com
9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (COMPUTER ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (INFORMATION TECHNOLOGY)

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

CO Vs PO and CO Vs PSO Mapping (ELECTRONICS ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Mrs. Deepawali S. kaware	Lecturer in Mathematics	Government polytechnic Vikaramgad
3	Mr. A.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai
4	Mr.V.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Sci. & Humanities

Head of Department
Department of Sci. & Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in EE/IS (Sandwich Pattern)**										
Course Code: SC19106				Course Title: Applied Chemistry						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2.30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25***	**-**	**25**	**150**

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

Rationale:

The subject is included under category of basic sciences. The role is to understand the fundamental concepts and facts about infrastructure of physical matters and their interrelationship. This will provide input for better understanding of other foundation and technology subjects

Course Outcomes: Student should be able to

CO1	Apply the principles of chemistry under different engineering situations.
CO2	Apply various applications of electrolysis and cells and batteries in engineering field.
CO3	Adopt methods of prevention of corrosion for environmental and safety concerns.
CO4	Select suitable Alloy, Lubricants, material for a particular use effectively.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Atomic Structure** 1.1 Introduction of atom, Molecules, Fundamental Particles, Proton, Neutron, Electron. their mass, charge, location. And symbol Bohr's theory, Postulates, Structure of modern atom. 1.2 Atomic number and atomic mass number. Atomic weight Numerical based on atomic number & atomic mass number. 1.3 Rules governing filling up of atomic orbitals.Quantum no.,Paulis Exclusion Principle, Aufbau's Principle ,Hund's rule. Electronic configuration of atoms up to atomic number 30 1.4 Valence and chemical bonding. Valence : Definition, & examples. Types of valance : Electrovalence & Co-valance . 1.5 Electrovalent bond: Definition, Formation Formation of NaCl 1.6 Co-valent bond : Definition & formation Formation of following molecules Single bond :,Chlorine. Double bond : Oxygen,, Triple Bond : Nitrogen.

	1.7 Distinction between electrovalent and covalent compound. **Course Outcome: CO1 Teaching Hours : 7 hrs Marks: 10 (R- 2, U-4, A-4)**
2	**Electrochemistry** 2.1 Definition of Electrochemistry, Electrolytes: Definition, Types. Differences between Atom and ion . Definition of ionization & electrolytic dissociation, Arrhenius theory, Degree of ionization with factors affecting it. 2.2 Terms related to Electrolysis Mechanism of electrolysis. Examples of: mechanism of Electrolysis of $CuSo_4$ by using Cu electrodes. 2.3 Faradays First law and its mathematical derivation. Faradays second law & its mathematical derivation, Numerical based on laws of Faraday. 2.4 Application of Electrolysis: Electroplating, Electrorefining. **Course Outcome: CO2 Teaching Hours : 7 hrs Marks: 10 (R- 4, U-4 , A-2)**
3	**Cells And Batteries** 3.1 Conductor: Definition, types (metallic, electrolytic), Difference between them. 3.2 Ohms law, Charging and discharging of cells, Closed circuit voltage, Open circuit voltage, Electrochemical couple,Seperator,Electromotive force (E.M.F) 3.3 Cells: Definition, types (Electrolytic and Electrochemical), difference between them. 3.4 Classification of Electrichemical cell (primary and Secondary) Definition and Difference between them. 3.5 Primary cells: Lachlance cell,Dry cell,Daniel cell 3.6 Secondary cell : Lead acid storage cell or battery, Nickel cadmium cell or battery 3.7 Lead acid storage battery: construction,working,charging and discharging, electrical charecteristics, methods of charging storage batteries, indication of fully charged battery, Maintenance of Lead acid batteries, application of Lead acid storage batteries. **Course Outcome:CO2 Teaching Hours : 7 hrs Marks: 10 (R- 4 , U-4 , A-2)**
4	**Corrosion** 4.1 Definition of corrosion.Types of corrosion . Atmospheric & Electrochemical Corrosion. 4.2 Mechanism of atmospheric corrosion, types of oxide film formed,(stable,unstable,volatile,with examples). 4.3 Electrochemical corrosion/immersed corrosion Definition. Example.Factors Affecting , Atmospheric & Electrochemical Corrosion. 4.4 Protection of metals from Corrosion:- By protective coatings a)organic coating (Paints and Varnishes),b)inorganic coating (Metallic Coating). 4.5 Different methods of Protective metallic coatings. A) Hot dipping (Galvanizing & Tinning) b) Sherardizing c) Metal Spraying **Course Outcome: CO3 Teaching Hours :6 hrs Marks: 10 (R-2, U- 4 , A-4)**
5	**Lubricants** 5.1 Definition of lubricant, example , functions of lubricant, classification of lubricants (solid, semi-solid and liquid) examples. conditions under which each lubricant is used. 5.2 Lubrication: definition and types. conditions under which each lubricant is used Types of lubrications, Fluid film, Boundary, Extreme pressure lubrication. Definition, diagram & description of each type. 5.3 Characteristic of good lubricant A) Physical Characteristics • Viscosity

	• Viscosity index • Oiliness • Volatility • Flash point & Fire Point • Cloud and Pour point B) Chemical Characteristics • Acidity /Neutralization no. • Emulsification • Saponification value **Course Outcome: CO4 Teaching Hours :6 hrs Marks: 10 (R- 4 , U-4 , A-2)**
6	**Materials And Alloys.** 6.1 **Metallic**: Metals & their characteristics, (hardness, ductility, malleability, toughness, brittleness, tensile strength, weldability,casting, forging, soldering) 6.2 Physical and chemical properties and uses of following metals (Fe, Cu,Al,Cr,Ni,Pb,Zn,Ag,Sn). 6.3 **Non-Metallic:** Definition of non-metallic engineering materials 6.4 **Plastic**: Definition , example Polymerization : definition different Types of Polymerization addition and condensation Addition polymerization : definition formation of polyethylene , Condensation-polymerization : definition and examples, formation Of nylon-66 Types of plastic: thermo softening ,thermo setting plastics, Differences between them. Compounding of plastic , Materials needed for it (pigments,fillers,Plasticizers accelerators etc), Properties and engineering applications 6.5 **Rubber**: Definition of rubber (elastomer). Natural rubber : Basic unit in natural rubber(isoprene), Occurrence & Processing of Latex . Drawbacks of natural Rubber Vulcanisation.: Definition. process, Chemical reactions Synthetic rubber: Importance, Example Buna-S Buna-N, Butyl rubber, Thiokol, Neoprene) Properties of rubber: Elasticity,Tack, Rebound abrasion resistance Uses of rubber 6.6 **Thermal insulating materials** Definition, ExamplesThermocole, Glasswool. Thermocole: Definition,. Preperation,Properties & uses Glass wool. Definition,.Preperation,Properties & uses **Alloys** 6.7 Definition of alloy: purposes of preparation of Alloy. 6.8 Preparation of binary alloy by fusion method. 6.9 Classification of alloy : Ferrous and non Ferrous Alloy. 6.10 **Ferrous alloy :** Steel, Definition and classification based on % of C (Mild carbon steel, medium carbon steel, high carbon steel, their properties &uses), 6.11 **Non-Ferrous Alloys** Aluminum Alloys: Duralumin Solders Alloys : Woods metal Bearing Alloys : Babbitt metal **Course Outcome:CO4 Teaching Hours :12 hrs Marks: 10 (R- 2 , U-6 A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Atomic Structure**	02	04	04	10
2	**Electrochemistry**	04	04	02	10
3	**Cells And Batteries**	04	04	02	10
4	**Corrosion**	02	04	04	10
5	**Lubricants**	04	04	02	10
6	**Materials And Alloys**	02	06	02	10
	Total	**18**	**26**	**16**	**60**

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

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1	Introduction of chemistry laboratory &safety measures.	2
2	2	CO2	Determination of electrochemical equivalent of copper by using cu -electrodes	2
3	4	CO3	To find out pH of different solutions using Lovibond comparator, pH paper, pH meter	2
4	5	CO4	Determination of coefficient of viscosity of given oil (Glycerin) by using Ostwald's Viscometer	2
5	1	CO1	A Qualitative analysis of any three salt solutions. Basic radicals : Cu^{++}, Fe^{++}, Fe^{+++}, Cr^{+++}, Mn^{++}, Ni^{++}, Zn^{++}, Ca^{++}, Ba^{++}, Mg^{++} $NH4^{+}$ **Acidic Radicals**: **Cl^{-} ,Br^{-},I^{-},CO_3^{--}, SO_4^{--},NO_3^{-}**	6
6	2	CO2	Determination of conductivity of different electrolytes by using conductivity meter.	2
7	4	CO3	To Study Corrosion of Aluminum rod and iron rod in acidic and basic medium and plot a graph of rate of corrosion	2
8	5	CO4	To find out acid value of given lubricant	2
9	3	CO2	Construction of Daniel Cell and measure its E M F.	2
10	4	CO3	Determination of percentage of moisture in given soil sample.	2
11	6	CO4	Estimation of percentage purity of iron from the given alloy sample	2
12	6	CO4	To find out the % of cu from the given alloy sample	2
13	6	CO4	Preparation of phenol formaldehyde / Bakelite plastic	2
			Total	**30**

Note: Experiments No. 1 to 10 are compulsory and should map all units and Cos. Remaining experiments are to be perform on the importance of topic/availability of time.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering Chemistry	M.M. Uppal, Khanna Publisher, Delhi	978-81-7409-262-5
2	Poytechnic Chemistry	V.P. Mehta, Jain Brothers, Delhi	978-81-8360-093-X
3	Applied Chemistry	P.C. Jain, Monica Jain, Dhanpat Rai and Sons , Delhi	13: 9788187433170
4	Chemistry in Engineering and technology Volume 1 and 2	J.C. Kurlacose, J. Jairam Tata Mcgraw hill.	9780074517352

E-References:

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2. www.ferrofchemistry.com
3. www.chemistryclassroom.com
4. http;//hperchemistry.phastr.gsu.edu/hbase/hph.htm
5. www.youtube/chemistry
6. www.sciencejoywagon.com/
7. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-chemistry

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

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

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Mrs. Vaishali Gokhale	Lecturer in Chemistry	Govt. Polytechnic Pune
3	Mrs J. V. Iyengar	Lecturer in Chemistry	Government polytechnic Mumbai
4	Mrs. S. M. Patil	Sel. Gr. Lecturer in Chemistry	Govt. Polytechnic Mumbai

Coordinator, Head of Department
Curriculum Development, Department of Sci. & Humanities
Department of Sci. & Humanities

I/C, Curriculum Development Cell Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19204				Course Title: Electronic Measurement and Instruments						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**-**	**-**	**-**	**50***	**-**	**25**	**75**

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

Unit No	Topics / Sub-topics
1	**Fundamentals of Measurements and Bridges:** 1.1 Classification of instruments-Absolute Instruments, Secondary Instruments 1.2 Standards and their Classification - International, Primary, Secondary, Working. 1.3 Calibration of Instruments-definition, need etc. 1.4 Grounding-Importance of ground, types of Grounding (earth ground, chassis ground, signal ground),Equipment grounding for safety. 1.5 Bridges: 1.5.1 DC Bridges- Wheatstone bridge, Kelvin Bridge 1.5.2 AC Bridges- Maxwell's bridge, Schering's bridge **Course Outcome: CO1**
2	**Analog DC and AC Meters**: 2.1 Classification of Analog Instruments. 2.2 PMMC-Working Principle, Construction, Sources of torque. 2.2.1 Analog DC Ammeters and Voltmeters, concept of loading effect and sensitivity.

	2.2.2 Analog AC Ammeter and Voltmeter-Average Responding(Rectifier type) 2.3 Ohmmeter- series and shunt. 2.4 Analog Multimeter- Circuit diagram and operation. **Course Outcome: CO2**
3	**Digital Instruments**: 3.1 Resolution, Sensitivity and Accuracy of digital display. 3.2 Digital frequency meter-Block Diagram and operation only. 3.3 Digital Voltmeter-Ramp type DVM, Integrating type DVM, Successive approximation type DVM, Dual slope type DVM. (Block diagram, Operation and waveforms) 3.4 Digital Multi meter -Block Diagram and operation. 3.5 LCR, Q- meter-Block diagram and operation only. 3.6 Digital phase meter-Block diagram and operation only. **Course Outcome: CO3**
4	**Oscilloscope:** 4.1 Display system – CRT, construction and operation. Deflection of electron beam in CRT, Electrostatic and Electromagnetic deflection. 4.2 Vertical deflection system- Input coupling selector, input attenuator, pre-amplifier, main vertical amplifier, delay line. 4.3 Horizontal deflection system –Trigger circuit, time base generator, Main horizontal amplifier. 4.4 CRO Probes- General block diagram of CRO probe, passive voltage probe and their compensation, active voltage probes, current probes. 4.5 CRO – Block diagram of single beam single trace, single beam -dual trace oscilloscope. 4.6 CRO–specifications (single beam-dual trace). 4.7 Block diagram of Digital storage oscilloscope (DSO). 4.8 Measurement of amplitude, time period, frequency and phase using CRO, tracing of diode and transistor characteristics using CRO. **Course Outcome: CO4**
5	**Signal Generator and Wave Analyzer:** 5.1 Concept of signal generator. 5.2 Need, block diagram, operation, applications and specifications of signal generators: AF and RF type, function generator and pulse generator, Pattern generator. 5.3 Need, block diagram, operation, applications and specifications of spectrum and logic analyzer **Course Outcome:CO4**

Suggested Specifications Table (Theory): --NA---

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Use Wheatstone bridge to determine unknown resistance.	02
2	2	CO2	Identify the parts of PMMC analog multimeter and perform	02

			measurement of different electrical parameters.	
3	3	CO3	Identify the front panel control of DMM and measure different electrical parameters using DMM.	02
4	4	CO4	Identify the front panel control of CRO and measure amplitude and frequency of different signals using CRO.	02
5	5	CO4	Identify the front panel control of function generator and measure frequency and amplitude of different waveforms available at the output of function generator	02
6	1	CO1	Calibrate the given multimeter with standard instrument.	02
7	2	CO2	Calculate the sensitivity of the given analog voltmeter.	02
8	3	CO3	Observe values of given resistance, inductance, capacitance using LCR meter and compare those with component codes.	02
9	4	CO4	Measure unknown frequency and phase difference with respect to given signal using lissajous patterns.	02
10	5	CO4	Identify the front panel control of DSO and measure various parameters of given signal.	02
11	1	CO1	Use Schering bridge to determine unknown capacitance.	02
12	2	CO2	Calculate the loading effect of the given analog voltmeter.	02
13	4	CO4	Testing of components using CRO. (Resistors, Capacitors, Transformers, PN junction diode, Zener Diode and LED). Draw the observed nature of patterns/waveforms.	02
14	4	CO4	Measure amplitude and frequency of given signal using cursor method using DSO.	02
15	5	CO4	Determine the frequency of given signal using spectrum analyzer.	02
Total				**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining 05 experiments are to be performing on the importance of topic.

References/ Books:

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

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2. https://www.allaboutcircuits.com/textbook/alternating-current/chpt-12/ac-voltmeters-ammeters/
3. https://www.elprocus.com/cro-cathode-ray-oscilloscope-working-and-application/
4. https://www.slideshare.net/dineshsharma9277/analog-and-digital-multimeters
5. https://www.electronics-notes.com/articles/test-methods/
6. https://en.wikipedia.org/wiki/"type name of topic"

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mrs. Priyanka Patil	Assistant Engineer	ONGC, Mumbai
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3	Mr. U.B.Shinde	Lecturer in instrumentation Engg.	Govt. Polytechnic, Mumbai
4	Mrs. S.T. Shinde	Lecturer in instrumentation Engg.	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19206				Course Title: Basics of Electronics Engineering						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**4**	**-**	**7**	**60**	**20**	**20**	**50**	--	**25**	**175**

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

Rationale:

Instrumentation engineers have to study and apply the basic principles, analyze and troubleshoot simple electronic circuits in measurement and control applications. To acquire these levels of understanding, the basic knowledge of electronic devices and circuits is essential. This Course deals with construction, working principle, applications of electronic components.

Course Outcomes: Student should be able to

CO1	Describe the Fundamentals of Diode
CO2	Select different types of Diodes for given applications.
CO3	Analyze different Biasing circuits (BJT and FET).
CO4	Explain regulation and its circuits.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Semiconductor Diodes:** 1.1 Classification of component on the basis of energy band theory and effect of Temperature. 1.2 Different types of Semiconductor and their materials. P-type and N-type Semiconductors. 1.3 Symbol, Construction, working principle, Forward and Reverse Biasing, V-I Characteristics and applications of: PN junction diode, Zener diode, LED , Photo diode. **Course Outcome: CO1 Teaching Hours : 07 hrs Marks: 10 (R-4 , U-6, A-0)**
2	**Diode applications:** 2.1 Types of rectifier: Circuit, waveform and working of Half Wave, Full Wave Rectifier (Bridge and Center tapped). 2.2 Parameters of rectifier: Average DC value of current and voltage, ripple factor, ripple frequency, PIV of diode, TUF, efficiency of rectifier. 2.3 Diode as clipper and clamper: 2.3.1 Circuit diagram, waveform and working of positive, negative and biased clippers. 2.3.2 Circuit diagram, waveform and working of positive, negative and biased clampers. 2.4 Applications of LED: power indicator, seven segment display.

	2.5 Applications of photodiode: alarm circuit, counter circuit **Course Outcome: CO2 Teaching Hours :08hrsMarks:12 (R-2 , U-4 , A-6)**
3	**Transistor Fundamentals:** 3.1 Classification of transistors (BJT, FET, UJT). 3.2 Construction and working of PNP and NPN transistors. 3.3 Transistor configuration: CB, CE, CC. 3.4 Working and characteristics of transistors in CB,CE and CC modes. 3.5 BJT Biasing: DC load line, Operating point, stabilization, Concept of thermal runaway. 3.6 Types of biasing: circuit and analysis of Fixed bias, base bias with Emitter feedback, Voltage divider bias.(circuit, working, derivation for IC, VCE) 3.7 Transistor as a Switch and Single stage CE amplifier. 3.8 Construction and working of UJT- (circuit diagram and working) **Course Outcome: CO3 Teaching Hours :11hrs Marks:14(R-2, U-6 , A-6)**
4	**Field Effect Transistor:** 4.1 Symbol, Construction, working and characteristics of JFET (N-channel and P-channel) and MOSFET (Depletion and enhancement Type). 4.2 FET Biasing: Fixed, Self-bias, Voltage divider bias. 4.3 Applications of FET. 4.4 Comparison of FET with BJT. **Course Outcome: CO3 Teaching Hours :11 hrs Marks:14 (R-2 , U-4 , A-6)**
5	**Passive Filters and Regulated Power supply:** 5.1 Types of Filters: Waveform and working of Shunt Capacitor, series Inductor and Π filter. 5.2 Block diagram of DC regulated power supply. 5.3 Definition of load regulation and line regulation. 5.4 Zener diode as voltage regulator. 5.5 Transistorized series and shunt regulator- circuit diagram and working. **Course Outcome:CO4 Teaching Hours :08hrs Marks:12 (R-2, U-4 , A- 6)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Semiconductor Diodes**	04	06	--	10
2	**Diode applications**	02	04	06	12
3	**Transistor Fundamentals**	02	06	06	14
4	**Field Effect Transistor**	02	04	06	12
5	**Passive Filters and Regulated Power supply**	02	04	06	12
	Total	**12**	**24**	**24**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To plot the V-I characteristic of semiconductor P-N diode. Find out static, dynamic resistance and knee voltage of P-N diode.	04
2	2	CO2	To construct and test half wave rectifier and draw input/output waveform.	02
3	3	CO3	To plot V-I characteristics of BJT and find out input resistance and o/p resistance of BJT in CE Mode.	04
4	4	CO3	To plot the V-I characteristic of FET.	02
5	5	CO4	To construct and test circuit for Zener regulator. Find out load and line regulation.	02
6	1	CO1	To plot the V-I characteristic of Zener diode.	02
7	2	CO 2	To construct and test full wave center tapped rectifier and draw input/output waveform.	02
8	3	CO 3	To plot the V-I characteristic of UJT.	02
9	4	CO 3	To plot the V-I characteristic of MOSFET.	02
10	5	CO 4	To construct and test Capacitive filter using Bridge wave rectifier.	02
11	2	CO2	To construct and test the circuit for Power ON indicator.	02
12	3	CO3	To construct and test transistor as a switch circuit.	02
13	3	CO3	To construct and test the circuit for voltage divider biasing.	02
14	5	CO 4	To construct and test π filter using Bridge wave rectifier.	04
15	2	CO 2	To construct and test clipper circuit (Positive, negative and biased) Draw input and output waveform.	06
16	2	CO 2	To construct and test clamper circuit (Positive, negative and biased) Draw input and output waveform.	06
17	3	CO 3	To construct and test single stage CE amplifier.	02
18	5	CO 4	To construct and test Inductive filter using Bridge wave rectifier.	04
19	2	CO 2	To construct and test object detector circuit using photodiode.	04
20	3	CO 3	To construct and test the circuit for base biasing.	04
Total				**60**

Note: Experiments No. 1 to 5are compulsory and should map all units and Cos. Remaining 10 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electronic Devices and Circuit Theory	Boylestad Robert, Louis Nashelsky Pearson Education, 2015 11th edition	9789332542600
2	A Text book of Applied Electronics	Sedha R. S. S. Chand Publications 2008 3rdedition	9788121927833
3	Electronics Principles	Malvino Albert, David bates McGraw Hill Education2017 7thedition	9780070634244
4	Principles of Electronics	Mehta V.K. S. Chand and Company 2014 7thedition	9788121917230
5	Basic Electronic Engineering	Baru V., Kaduskar R. Gaikwad S.T. Dreamtech Press 2011 7thedition	9789350040126

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2. http://vlabs.iitkgp.ernet.in/be/#
3. https://www.electronicshub.org/
4. https://www.allaboutcircuits.com
5. https://www.slideshare.net/babaiarup3/basic-electronics-20135927
6. https://en.wikipedia.org/wiki/"type name of topic"

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. S. K. Kamble	Proprietor	Saitronics Pvt. Ltd. Kamothe
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3	Mr. F.S.Bagwan	Lecturer in instrumentation Engg.	Govt. Polytechnic, Mumbai
4	Mrs. S.T.Shinde	Lecturer in instrumentation Engg.	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: EE19206				Course Title: Fundamentals of Electrical Engineering						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**50**		**-**	**150**

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

Rationale:

All the equipment related to instrumentation utilizes electrical energy for their operations. Diploma holders from this branch come across various types of electrical circuits and devices. The purpose of this subject is to give fundamental knowledge of electrical engineering so that they will be able to handle electrical equipments, circuits and analyze simple DC/AC circuits.

Course Outcomes: Student should be able to

CO1	Define basic terminologies related to electrical circuit
CO2	Solve simple DC circuits.
CO3	Analyze DC network theorems
CO4	State concepts of ac fundamentals and solve simple ac series circuits.
CO5	Compare star and delta connected polyphase system.
CO6	Identify various types of wiring and safety precautions.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basic Concepts:** 1.1 Electric Current: Definition, Direction of current, unit, Electric potential, potential difference, Concept of EMF and Potential difference. 1.2 Resistance: Definition, unit, Factors on which resistance depends, Effect of temperature on resistance. *(simple numerical)* 1.3 Conductance, Ohms Law. 1.4 Electric power and energy concept and unit. *(simple numerical)* 1.5 Measurement of voltage, current, power and energy. 1.6 Effects of Electric Current: Heating Effect, Magnetic Effect and Chemical Effect. *(Only Introduction)* **Course Outcome: CO1 Teaching Hours :07 hrs Marks: 10 (R-4, U-2, A-4)**

2	**DC Circuits**: 2.1 Introduction to concept. 2.2 DC series circuit: Concept, Equation for equivalent resistance connected in series, main characteristics, advantages, disadvantage, and application of series circuit. 2.3 DC Parallel circuit**:** Concept, Equation for equivalent resistance connected in parallel, main Characteristics, advantages, application of Parallel circuit, Current divider rule. 2.4 Series parallel circuit, Application of series parallel circuit.*(simple numerical)* 2.5 Definition of: Circuit, Parameter, Liner circuit, Nonlinear circuit, Bilateral circuit, Unilateral circuit, Electric network, Passive-Network, Active network, Node, Branch, Loop, Mesh. 2.6 Kirchhoff's current law, Kirchhoff's voltage law, signs convention. *(simple numerical limited up to two variables on above)* **Course Outcome: CO2 Teaching Hours : 07 hrs Marks: 10 (R- 2 , U- 4 , A- 4)**
3	**DC Network theorem:** 3.1 Network Analysis: Direct method, Network reduction method. 3.2 Statement, Explanation, and simple Numerical on following theorem. i. Mesh/Loop analysis ii. Nodal analysis iii. Superposition theorem. iv. Thevenin's theorem. v. Norton's theorem. vi. Maximum Power Transfer Theorem. **Course Outcome: CO3 Teaching Hours :07 hrs Marks : 12 (R- 2 , U- 6, A- 4)**
4	**AC Fundamentals:** 4.1 Difference between AC and DC quantity. Advantages of AC Over DC. 4.2 Generation of A.C. Voltage and current. Mathematical Expression of alternating quantity & its derivation. 4.3 Definition of Waveform, Instantaneous value, Cycle, Time period, Frequency, Amplitude, Peak value, Average value and RMS value, Form factor and Peak factor for sinusoidal (*simple numerical*) 4.4 Phase, Phase difference, Phasor representation of sinusoidal quantities 4.5 Circuit diagram, phasor diagram and wave form of a.c. circuits through pure Resistance, Pure Inductance and pure Capacitance. Concept of inductive reactance 4.6 and capacitive reactance. 4.7 Circuit diagram, phasor diagram and wave form of a.c. circuits 4.8 RL, RC and RLC circuit. Impedance and Impedance Triangle. *(simple numerical)* 4.9 Active power, Reactive power and apparent power. 4.10 Power factor and its significance **Course Outcome: CO4 Teaching Hours:10 hrs Marks:10 (R- 0, U-4 A-6)**

5	**Polyphase Circuits:** 5.1 Difference between single phase and polyphase system, Generation of three-phase a.c. supply, Advantages of three-phase supply over single-phase supply. 5.2 Concept of phase sequence and balanced/unbalanced load. 5.3 Star connected system, Relation between phase and line values of current and voltage in balanced Star system. (no derivation) 5.4 Delta connected system, Relation between phase and line values of current and voltage in balanced Delta system. (no derivation) 5.5 Active, Reactive and Apparent power in three phase Star/Delta system. 5.6 Advantages of star and delta connected system (Simple Numerical based on above.) **Course Outcome: CO5 Teaching Hours:06 hrs Marks:10 (R- 2, U-4 A-4)**
6	**Electrical wiring:** 6.1 Types of wiring for Domestic Installation: Conduit, Casing and Capping and Concealed (brief information and application) 6.2 Concept of lighting circuit and power circuit. 6.3 Electric wiring - wiring accessories, switches, sockets, ICDP, ICTP, Ratings of Wires, switches, sockets used for lighting and power circuit. 6.4 Fuses, importance and types for domestic applications. MCB, their ratings for domestic applications. 6.5 One lamp controlled by one switch. Staircase wiring. 6.6 Earthing, necessity and types. 6.7 Safety precautions in electrical indoor & outdoor installations. **Course Outcome: CO6 Teaching Hours :08 hrs Marks: 8 (R- 2 , U-4 , A- 2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	**Basic Concepts**	07	4	2	4	10
2	**DC Circuits**	07	2	4	4	10
3	**DC Network theorem**	07	2	6	4	12
4	**AC Fundamentals**	10	--	4	6	10
5	**Polyphase circuit**	06	2	4	4	10
6	**Electrical wiring**	08	2	4	2	8
	Total	**45**	**12**	**24**	**24**	**60**

List of experiments: Total 08 experiments (or turns) out of 11experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To measure current, voltage, power and energy in single-phase circuit	04
2	2	CO2	Measure voltages and currents in series and parallel resistive circuit.	04
3	3	CO3	Verify Superposition theorem applicable to D.C. circuit.	04
4	4	CO4	Observe AC and DC waveform on CRO and find magnitude of DC voltage, peak average, R.M.S. values and frequency of AC voltage,	04
5	5	CO5	Verify relationship between line and phase values of voltage and current in star and delta connected balanced load	04
6	6	CO6	Prepare extension board with three pin sockets.	04
7	2	CO2	Verify Kirchhoff's current & voltage laws.	04
8	3	CO3	Verify Thevenin's theorem and Norton's theorem applicable to D.C. circuit	04
9	4	CO4	Determine impedance, phase angle of R-L series circuit, plot phasor diagram and also calculate active, reactive and apparent power consumed in R-L series circuit.	04
10	6	CO6	Identify different types of wires and accessories switch, fuse, socket outlet used in wiring and write their rating	04
11	6	CO6	Safety precautions to be observed for indoor and outdoor installations and know first aid practice also refer artificial respiration chart	04
Total				**30**

Note: Experiments No. 1 to 6 are compulsory and should map all units and Cos. Remaining 02 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Technology (Volume I)	B. L. Theraja and A. K. Thereja, S. Chand and Co. Ltd. Edition 2005	8121924405
2	Basic Electrical Engineering	V. K. Mehta and Rohit Mehta, S. Chand and Co. Ltd. Edition 2012	9788121908719
3	Electrical Technology	Edward Hughes, ELBS Publications. Edition 2012	9780582226968
4	Electrical Estimation and Costing	Surjit Singh, Dhanpat Rai & Co. Edition 2014	1234567150995

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1. www.nptel.com
2. www.electrical4u.com
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4. https://ndl.iitkgp.ac.in/
5. https://phet.colorado.edu/

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	2	2	-	2	3	-
CO2	3	3	-	2	2	-	2	3	-
CO3	3	3	-	2	2	-	2	3	-
CO4	3	3	-	2	2	-	2	3	-
CO5	3	3	-	2	2	-	2	3	-
CO6	3	-	-	2	2	-	2	3	-

Industry Consultation Committee:

Sr. No	**Name**	**Designation**	**Institute/Organisation**
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2	Mrs.S.P. Phadnaik	Lecturer in Electrical Engineering	G.P. Pune
3	Miss A.V. Patil	Lecturer in Electrical Engineering	Govt. Polytechnic Mumbai
4	Dr. P. N. Padghan	Lecturer in Electrical Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Electrical Engineering

Head of Department
Department of Electrical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:IS19 310				Course Title: Inkscape						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4#**	**--**	**4**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

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

Course Content Details:

Topics / Sub-topics
1. Overview of Inkscape Outline: - Introduction to Inkscape - Interesting features - Usage of Inkscape - Installation of Inkscape in Linux and Windows OS - Draw a rectangle - Saving an Inkscape file
2. Create and edit shapes Outline: Create and edit shapes Inkscape interface Create basic shapes like rectangle, square circle, ellipse polygons, stars Fill color Learn about the different types of handles -resize rotate skew Modify shapes using handles.
3. Fill color and stroke Outline: Fill color in objects Give objects an outline Various types of Gradients Giving Patterns and Stroke paint and style
4. Create and edit multiple objects Outline: *Copy and paste objects *Duplicate and clone objects *Group and Order various objects *Multiple selection and invert selection *Clipping and Masking
5. Layers and Boolean operations Outline: *Layers and layer pallette *Add a new layer *Rename a layer *Position a layer above or below other layers *Lock a layer *Hide a layer *Various modes *Add various filters .
6. Align and distribute objects Outline: *Align and distribute various objects *Align objects with reference to something *Arrange objects in rows and columns *Set spacing between objects *Create a tile pattern
7. Create and Format Text Outline: - Inserting text - Formatting text - Aligning text - Spacing and bullet - Making a simple flyer
8. Text tool features Outline: -Manual kerning -Horizontal kerning -Vertical shift -Character rotation -Spell check - Superscript -Subscript
9. Basics of Bezier Tool Outline: -Drawing using Bezier tool -Modes of bezier tool -Shapes of the paths -Node tool -Add, edit, delete nodes -Join and break paths
10. Text Manipulation

Outline: -Text on path in Inkscape -Text on shape in inkscape -Image inside text -Text in perspective -Cutout text in inkscape.

11. **Create an A4 Poster**
    Outline: - To make an A4 poster for Spoken Tutorial - Explaining to set page size for A4, default units (pixel/cm/inch), Orientation and Guides - Explaining to design with shapes and path.
12. **Create a 3-fold brochure**
    Outline: - Explaining how to set page size, default unit in Inkscape - Orientation and about Guides for 3-fold - Separating the page into 3 fold with rulers - Design the brochure -Importance.
13. **Design a CD label**
    Outline: - Creating a CD design label - Document settings - Designing the layout - Alignment of text and images - Saving the document and exporting in various formats
14. **Design a visiting card**
    Outline: - To set the page size for visiting card and setting other document properties in Inkscape - Arrangement of the various objects in the visiting card - Explaining how to arrange file
15. **Create patterns in Inkscape**
    Outline: - Create Patterns in Inkscape - Patterns using Cloning - Pattern along Path in Inkscape - Patterns using Spray tool - Path Effect Editor in Inkscape
16. **Special effects on text**
    Outline: - Special effects on text in Inkscape - Reflected text in Inkscape - Labeled text - Change the text case in Inkscape
17. **Trace bitmaps in Inkscape**
    Outline: - Inkscape - Difference between raster and vector image - Various raster and vector formats - Convert raster image to vector
18. **Warli art for Textile design**
    Outline: - Creating a simple Warli art in Inkscape - Repeat patterns using cloning - Application of the Warli art in Textile design
19. **Mango pattern for Textile design**
    Outline: - Mango pattern in Inkscape for Textile design - Repeat patterns using cloning - Draw using Pattern along Path

Coordinator,
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Head of Department
Department of Instrumentation

I/C, Curriculum Development Cell

Principal

Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- III

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19203	Industrial Measurements	3	4	--	7	7	60	20	20	--	25*	25	150
IS19208	Applied electronics	3	2	--	5	5	60	20	20	25	--	25	150
IS19205	Control System Components	3	2	--	5	5	60	20	20	--	25*	25	150
EE19211	Electrical Machines	3	2	--	5	5	60	20	20	25	--	25	150
IS19207	Digital Techniques	--	4	--	4	4	--	--	--	50*	--	50	100
IS19311	C and CPP (Spoken Tutorial)	--	4 #	--	4 #	4	--	--	--	--	--	--	--
	Total	**12**	**18**	**--**	**30**	**30**	**240**	**80**	**80**	**100**	**50**	**150**	**700**
Student Centered Activity(SCA)					**05**								
Total Contact Hours					**35**								

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

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

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

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

In-Charge
Curriculum Development Cell

Head of Department
Department of Instrumentation Engg.

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:IS19203				Course Title: Industrial Measurements						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**04**	**--**	**07**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

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

Rationale:

In industry, Instrumentation engineering diploma graduates are expected to handle basic instruments for the measurements of various process parameters. The diploma graduates should be able to select proper instruments for the measurement of the parameters and maintain these instruments for different applications. This course mainly deals with study of various transducers as well as applications of measuring instruments.

Course Outcomes: Student should be able to

CO1	Demonstrate the operation of given displacement transducers.
CO2	Use the given pressure transducers to measure pressure.
CO3	Describe the working of given level transducers.
CO4	Explain the flow transducer application for measurement of flow.
CO5	Suggest a temperature transducer for an application.

Course Content Details:

Unit No	Topics / Sub-topics
1	**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: LVDT, RVDT. 1.4 Capacitive Transducers- Capacitance principle, Concept & variable capacitance due to change in dielectric media, area of the plate, distance between the plates. 1.5 Displacement transducer selection criteria. (Diagram, construction, working, range, advantages, Disadvantages, and applications.) **Course Outcome: CO1 Teaching Hours : 08hrs Marks: 12 (R- 2, U-4, A-6)**

2	**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 Electronic pressure sensors: strain gauge-type, capacitive-type, inductive-type, and piezo-electric-type pressure sensors. 2.6 Differential pressure transmitter applications. 2.7 Calibration of pressure gauge using dead weight tester (Diagram, construction, operation, range, selection criteria, advantages, and applications and above pressure transducers.) **Course Outcome: CO2 Teaching Hours : 08hrs Marks: 12 (R- 2, U-4, A-6)**
3	**Level Measurement** 3.1 Sight-type Instruments: Glass gauges, displacers, tape float 3.2 Pressure-type Instruments: Differential pressure, bubblers, and Diaphragm. 3.3 Electrical- Instruments: Capacitance probes, resistance tapes, and conductivity probes. 3.4 Sonic- type Instruments: Ultrasonic –type level measurement 3.5 Radiation-type Instruments: Nuclear type ,Radar (microwave) type. 3.6 Level transducer selection criteria. (Diagram, construction, operation, range advantages, disadvantages & applications of above transducers.) **Course Outcome: CO3 Teaching Hours : 06hrs Marks: 10 (R- 2, U-4, A-4)**
4	**Flow Measurement** 4.1 Flow principles:Bernoulli's equation, Reynolds's number and flow types. 4.2 Flow-meters classification 4.3 Variable head flowmeters: Orifice plates, venturi-meter, flow nozzle, pitot tubes. 4.4 Variable area flowmeter: Rotameter. 4.5 Velocity-type flowmeters: Turbine-type, magnetic –type,vortex shedding type, ultrasonic type flow meters. 4.6 Positive-Displacement Flowmeters: Rotary-vane and Nutating-disk type flowmeters. 4.7 Corilios Mass flowmeters. 4.8 Flow meter selection criteria. (Diagram, construction, operation, range, advantages, disadvantages & applications of above transducers.) **Course Outcome: CO4 Teaching Hours : 12hrs Marks: 12 (R- 2, U-6, A-4)**
5	**Temperature Measurement** 5.1 Temperature: Definition, Temperature scales, International Practical Temperature Scale (IPTS). 5.2 Non electrical-type Temperature Measurement: Filled system thermometers, Bimetallic strip thermometers 5.3 Electrical -type Temperature Measurement: Resistance Temperature Detectors (RTDs), RTD measurementcircuits: 2 wire, 3wire and 4-wire compensation circuits. Thermistors, Thermocouples-Principle, thermocouple effects and laws, cold junction compensation techniques, Thermocouple tables, characteristics 5.4 Pyrometers: Radiation and optical Pyrometers.

	5.5 Integrated-Circuit Temperature Sensors. 5.6 Temperature transducer selection criteria. (Working Principle, construction, materials, range, Advantages, disadvantages, applications.) **Course Outcome: CO5 Teaching Hours : 11hrs Marks: 14 (R- 4, U-6, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Displacement Measurement**	2	4	6	12
2	**Pressure Measurement**	2	4	6	12
3	**Level Measurement**	2	4	4	10
4	**Flow Measurement**	2	6	4	12
5	**Temperature Measurement**	4	6	4	14
	Total	**12**	**24**	**24**	**60**

List of experiments: 15-20experiments (or turns) out of 33 experiments(or turns)

Sr. No.	Unit No	CO's	Title of the Experiments	Hours
1	1	CO1	Use the potentiometer to measure the linear displacement	2
2	2	CO2	To Measure Pressure using the given Bourdon Tubes– C type, Helical type or Spiral type	2
3	3	CO3	To measure water level using the given level transducers.	2
4	4	CO4	To measure Flow rate using given flow meter.	2
5	5	CO5	To plot the characteristics of PT-100 (Temp. Vs. Resistance)	2
6	1	CO1	Use the potentiometer to measure the angular displacement	2
7	1	CO1	Use the LVDT to measure linear displacement.	2
8	1	CO1	Use the RVDT to measure angular displacement.	2
9	1	CO1	To measure displacement using capacitive transducer	2
10	1	CO1	Micro project on displacement measuring instrument	4
11	1	CO1	Use the strain gauge to measure weights.	2
12	2	CO2	To Measure Pressure using the given well/ U-tube or inclined tube manometers	2
13	2	CO2	To observe Pressure measurement using the DP transmitter	2

14	2	CO2	To Measure vacuum using the given vacuum gauge.	2
15	2	CO2	To measure the pressure using given electronic pressure sensor/instrument.	2
16	2	CO2	To Calibrate the given pressure gauge by using dead weight tester	4
17	2	CO2	Micro project on pressure measuring instrument	4
18	3	CO3	To measure water level using the Bubbler method.	2
19	3	CO3	To measure water level using the given sight type instrument.	2
20	3	CO3	To measure level using conductivity probes instrument	2
21	3	CO3	To observe level measurement using sonic type instrument	2
22	3	CO3	To observe level measurement using radiation type instrument	2
23	3	CO3	To measure Level using the given DP transmitter.	2
24	3	CO3	Micro project on level measuring instrument	4
25	4	CO4	To measure Flow rate using orifice meter/venturimeter .	2
26	4	CO4	To measure Flow rate using Rotameter.	2
27	4	CO4	To measure Flow rate using DP transmitter.	2
28	5	CO5	To plot the characteristics of the given thermocouples (Temp. Vs. Voltage) J - type , K .	2
29	5	CO5	To plot the characteristics of the given thermocouples (Temp. Vs. Voltage) T - type, S and R - type .	2
30	5	CO5	To Plot the characteristics of a thermistor (Temp. Vs. Resistance)	2
31	5	CO5	To Calibrate the given temperature transducers.	2
32	5	CO5	Micro project on temperature measuring instrument.	4
33	All	All	Industrial visit	4
				60

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
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	9789385880629
3	Transducers and Instrumentation	D.V.S. Murthy, Prentice Hall India, 2 edition,2008	978-8120335691
4	Instrumentation Devices and Systems	C.S.Rangan , V.S.V. Mani , G.R. Sarma, Tata McGraw Hill, 2nd edition,2001	9780074633502
5	Industrial Instrumentation and control	S.K.Singh, Tata McGraw Hill,2 edition,2003	9780074519141
6	A Course in Electrical and Electronics Measurement and Instrumentation	A. K. Sawhney, DhanpatRai& Co,19th edition,2011	978-8177001006
7	Principles of Industrial Instrumentaion	D. Patranabis Tata McGraw Hill,2 edition,2001	9780074623343
8	Instrument Engineers Handbook Vol .Proecss Measurement	Bela G. Liptak Chilton Book Co U.S.A ,5th edition.2016	9781498727648

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CO Vs PO and CO Vs PSOMapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr Sagar Panchal	Senior Engineer	VVF Ltd Taloja.
2	Mr. C.S. Tamkhane	Lecturer in Instrumentation	Govt. Polytechnic Pen
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4	Mr. K. U. Dawane	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
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I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19208				Course Title: Applied Electronics						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25**	**--**	**25**	**150**

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

Rationale:

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

Course Outcomes: Student should be able to

CO1	Interpret different types of amplifiers
CO2	Demonstrate sine, square and pulse oscillators
CO3	Distinguish between various power electronics devices
CO4	Interpret different power conversion devices
CO5	Maintain power devices based basic control circuits

Course Content Details:

Unit No	Topics / Sub-topics
1	**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 & operation 1.2.4 Current series feedback amplifier circuit & operation 1.3 Power amplifiers 1.3.1 Classification

	1.3.2 Nonlinear distortion and efficiency of conversion 1.3.3 Push-pull amplifier 1.3.4 Complementry symmetry push-pull amplifier **Course Outcome: CO1 Teaching Hours : 12 Marks: 12 (R-04, U-04, A-04)**
2	**Oscillators** 2.1 Barkhausen criterion 2.2 RC phase shift oscillator 2.3 Weinbridge oscillator 2.4 Hartley oscillator 2.5 Colpit's oscillator 2.6 Crystal oscillator 2.7 Astable multivibrator 2.8 Monostable multivibrator 2.9 Bistable multivibrator 2.10 UJT relaxation oscillator (circuit, operation, equation for output frequency, no derivation) **Course Outcome: CO2 Teaching Hours : 08 Marks: 12 (R-02, U-06, A-04)**
3	**Power Devices** 3.1 SCR (Thyristor) 3.1.1 Symbol, construction, principle of operation, V-I characteristic 3.1.2 Turn On methods: R, RC triggering 3.1.3 Turn-off methods: load, line, external pulse, forced class C commutation 3.2 DIAC, TRIAC, IGBT, MOSFET 3.2.1 Symbol, construction, operation and V-I characteristic of DIAC, TRIAC, IGBT, MOSFET **Course Outcome: CO3 Teaching Hours : 08 Marks: 12 (R-02, U-06, A-04)**
4	**Power conversion** 4.1 Controlled Rectifiers 4.1.1 Single phase full controlled rectifier 4.1.2 Three phase full controlled rectifier 4.2 Chopper 4.2.1 Principle of operation 4.2.2 Control strategy: static and variable frequency system 4.2.3 Four quadrant chopper 4.3 Inverter 4.3.1 Single phase bridge inverter 4.3.2 Three phase 120˚ bridge inverter 4.3.3 Sinusoidal PWM inverter

	(circuit diagram, operation and application) **Course Outcome: CO4 Teaching Hours : 09 Marks: 12 (R-02, U-04, A-08)**
5	**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 1Ø full control converter 5.6 Speed control of 3Ø induction motor by v-f method (Circuit diagram, construction, operation and application only) **Course Outcome: CO5 Teaching Hours : 08 Marks: 12 (R-02, U-04, A-06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Amplifiers**	04	04	04	12
2	**Oscillators**	02	06	04	12
3	**Power Devices**	02	06	04	12
4	**Power Conversion**	02	04	06	12
5	**Thyristor Applications**	02	04	06	12
	Total	**12**	**24**	**24**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To plot frequency response of RC-coupled amplifier.	2
2	2	CO2	To calculate the frequency of RC phase shift/ Wein bridge oscillators.	2
3	3	CO3	To plot the V-I characteristic of SCR. Measure Breakdown voltage, latching & holding current.	2
4	4	CO4	To observe/plot the output waveforms of single/three phase full controlled rectifier.	2
5	5	CO5	To test & observe the output for solid state relay.	2
6	1	CO1	To plot frequency response of transformer -coupled amplifier.	2

7	2	CO2	To calculate the frequency of Hartley/Colpit's oscillators.	2
8	3	CO3	To plot the V-I characteristic of DIAC. Measure Breakdown voltage, latching & holding current.	2
9	4	CO4	To observe/plot the output waveforms of four quadrant chopper.	2
10	5	CO5	To Test D.C motor speed control using chopper.	2
11	3	CO1	To perform Push pull amplifier and calculate its efficiency.	2
12	4	CO2	To perform Astable/ Bistable multivibrator and observe output waveforms.	2
13	5	CO3	To plot the V-I characteristic of TRIAC. Measure Breakdown voltage, latching & holding current.	2
14	3	CO4	To observe/plot the output waveforms of single-phase bridge inverter.	2
15	4	CO5	To construct TRIAC based temperature control circuit and test.	2
Total				**30**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electronic devices and Circuit Theory	R. Boylestad & L. Nasnlsky, Pearson Education India, 11th edition, 2015	978-9332542600
2	Electronic devices & Circuits : An Introduction	Allen Mottershed, PRENTICE HALL, 1st edition, 1979	978-8120301245
3	Electronic devices and Circuit Theory	J. Milman & C. C. Halkias, McGraw Hill Education, 1st edition, 1967	978-0070423800
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

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4. https://www.tutorialspoint.com/
5. http://www.electronicshub.org/
6. http://electrofriends.com//
7. https://www.electrical4u.com/concept-of-power-electronics/
8. https://www.polytechnichub.com/

CO Vs PO and CO Vs PSO Mapping:

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

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I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:IS19205				Course Title: Control System Components						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**--**	**05**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

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

Rationale:

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

Course Outcomes: Student should be able to

CO1	Operate the given hydraulic system component.
CO2	Demonstrate the operation given pneumatic component.
CO3	Use the control valve for an application.
CO4	Test the given electric control system component.
CO5	Demonstrate the working of given auxiliary process control component.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Hydraulic System Components:** 1.1. Introduction 1.2. Block diagram of Hydraulic system. 1.3. Applications of Hydraulic system. 1.4. Symbols of hydraulic components 1.5. Hydraulic pumps: Centrifugal pump, Reciprocating pump,Gear Pump,Vane Pump(construction and working) 1.6. Pressure regulation 1.7. Directional control valves: Check Valve, Spool valve,2/2, 3/2, 4/2, 4/3, 5/2 1.8. Pressure control valves: Direct type of relief valve, Unloading Valve, Sequence valve. 1.9. Actuators: single-acting cylinder & double-acting cylinders, rotary actuator. 1.10. Development of simple hydraulic circuits.

	Course Outcome: CO1eaching Hours :12hrsMarks: 14 (R- 2, U-6, A-6)
2	**Pneumatic System Components:** 2.1. Introduction 2.2. Components of a pneumatic system**.** 2.3. Air compressors:- types, Reciprocating type compressor(construction and working) 2.4. Pressure Regulator cum filter 2.5. Flapper-nozzle system. 2.6. Volume boosters 2.7. Pneumatic relay 2.8. Converters: Pneumatic to Electrical (P to I) and Electrical to Pneumatic Converters (I to P). 2.9. Development of simple pneumatic circuits. **Course Outcome:CO2Teaching Hours :08 Marks:10(R-2 , U-4 , A-4)**
3	**Control Valves** 3.1 Definition, terminology and classification. 3.2 Control valve types: Globe valve, Ball, Butterfly, Solenoid valves(construction, working, valve part materials, ISA symbols, advantages, disadvantages and applications) 3.3 Control valve flow characteristics 3.4 Control valve parameters: Control valve capacity (Cv), valve rangeability, turn-down, valve size and valve gain. 3.5 Control valve problems: Cavitation and flashing. 3.6 Control Valve Actuators: - Spring diaphragm type and piston type pneumatic, electrical actuator. 3.7 Valve positioners: Necessity, types-motion balance and force balance 3.8 Selection criteria of control valves. **Course Outcome: CO3 Teaching Hours :12hrsMarks: 14 (R- 2, U-6, A-6)**
4	**Electrical Control System Components:** 4.1 Switches:Toggle switches, push buttons, DIP switch, rotary switch, thumbwheel switch, limit switches.(No theory question to be asked in exam on switches.) 4.2 Electromechanical devices: Control Relays - Electro-mechanical relay, Reed relay, Solid state relay, Overload relay, Motor starters. 4.3 Circuit breakers: -Need of Circuit Breaker, Operating Principle, and types (Construction, symbolic representation, working, and applications.) 4.4 Special motors: servomotors, stepper motors. (construction,working principle and applications) 4.5 Comparison between pneumatic, hydraulic and electric systems. **Course Outcome:CO4 Teaching Hours :07 Marks:12 (R-2 , U-4 , A-6)**

5	**Auxiliary Components:** 5.1 Alarm annunciator. 5.2 Feeders and dampers. 5.3 Transmitters: 2 wire, 4 wire, DP Transmitter (force balance type). 5.4 Temperature Switch, Pressure Switch. 5.5 Relief Valves, safety valves and rupture disk. (Construction, diagram, symbolic representation, working, applications.) **Course Outcome:CO5 Teaching Hours :06Marks:10 (R-4 , U-4 , A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Hydraulic System Components	2	6	6	14
2	Pneumatic System Components	2	4	4	10
3	Control Valves	2	6	6	14
4	Electrical Control System Components	2	4	6	12
5	Auxiliary Components	4	4	2	10
	Total	**12**	**24**	**24**	**60**

List of experiments: Total 10-12 experiments(or turns) out of 17 experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Implementation and testing of Hydraulic circuits for single-acting cylinders.	2
2	2	CO2	Implementation and testing of Pneumatic circuits for single-acting cylinders.	2
3	3	CO3	To draw and identify the parts of cut-view section of single-seated globe valve.	2
4	4	CO4	To test and observe the operation of electro-mechanical relay.	2
5	5	CO5	To find switching time of a temperature switch.	2
6	1	CO1	Implementation and testing of Hydraulic circuits for double acting cylinders.	2
7	2	CO2	Implementation and testing of Pneumatic circuits for double acting cylinders.	2
8	2	CO2	To find the sensitivity of pressure to current converter.	2
9	2	CO2	To find the sensitivity of current to pressure converter.	2
10	3	CO3	To observe the construction of different valves.	2

			(Globe, ball, gate and butterfly valves).	
11	3	CO3	To demonstrate the operation of any two type of control valve actuators.	2
12	3	CO3	To test the performance of electro-pneumatic valve positioner.	2
13	4	CO4	To test and observe the operation of Solid state relay.	2
14	4	CO4	To test the given switch.	2
15	5	CO5	To find the switching time of pressure switch.	2
16	5	CO5	To observe the operation of DP Transmitter.	2
17	5	CO5	To observe the operation of Alarm Annunciator.	2
Total				**30**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Hydraulics and Pneumatics: A Technician's and Engineer's Guide	Andrew Parr, Butterworth-Heinemann; 3rd edition,2011	978-0080966748
2	Process control and Instrument technology	C.D.Johnson, Prentice Hall India Learning Private Limited; 8th edition,2006	978-8120330290
3	Process Control	Peter Harriott,Tata McGraw Hill,1edition ,2012	9780070993426
4	Industrial Electronics	Thomas E. Kissell,Prentice Hall Publications,3rd edition, 2012	9780131218642
5	Pneumatics, Festo Didactic	Festo	--
6	Hydraulics, Festo Didactic	Festo	--

E-References:

1. https://nptel.ac.in/courses/112/105/112105047/
2. https://nptel.ac.in/courses/112/103/112103249/
3. https://www.youtube.com/watch?v=MbKrIieogNc
4. https://www.youtube.com/watch?v=FVR7AC8ExIM
5. https://www.youtube.com/watch?v=c-468UPUV2o
6. https://www.youtube.com/watch?v=w5_89hBeRAA
7. https://nptel.ac.in/courses/103/105/103105130/

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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1	Mr. Sagar Panchal	Senior Engineer	VVF Ltd Taloja
2	Mrs. V.K .Pawar	Lecturer in Instrumentation Engg.	Govt. Polytechnic Karad
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Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:**EE19211**				Course Title: **Electrical Machines**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	2	-	5	60	20	20	25		25	150

Abbreviations: L- Theory Lecture,P-Practical,TU-Tutorial,TH- Theory Paper TS1&TS2- Term Tests,PR-Practical,OR-Oral,TW: Term Work (progressive assessment),* Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination.
Note: For Minimum passing marks under various heads, refer, examination rule AR 25. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

This is the subject aim to teach concepts, principle and procedure for operation of electrical machine. Students will be able to analyze the characteristics of DC motor,3-phase and single-phase Induction motor. They also learn applications of 1-phase induction motors and special machine

These machines are used in various fields, industries and many more utilization systems. Learning & the skills obtained will be helpful in satisfying duties such as supervisor, controller and R& D technician.

Course Outcomes: Student should be able to

CO1	Describe working principle of different electric machines.
CO2	Identify different parts of electric machines
CO3	Select appropriate method of speed control and electric braking for the given motor used for the specified motor
CO4	Select appropriate motor suitable for the particular application.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Transformer:** 1.1 Construction and working principle of Transformer. 1.2 Transformer losses. 1.3 Transformer Testing: O.C & S.C test, direct loading test on transformer. 1.4 Efficiency, regulation and rating of transformer. 1.5 Auto Transformer advantages, disadvantages and applications. 1.6 Instrument transformer types and use. 1.7 Three phase transformer – Types of connections and applications **Course Outcome: CO1,CO2 Teaching Hours:08Hrs. Marks: 10(R- 2, U-4 , A- 4)**

2	**DC Motor:** 2.1 Principle, Constructional parts of DC motor and material used for them. 2.2 Types of DC motor and schematic diagram : series ,shunt and compound. 2.3 Back emf and torque equation of DC motor(No derivation) 2.4 Electrical, speed armature current and mechanical characteristics of DC motors series, shunt and compound motors 2.5 Necessity of starter for DC motor, basic concept. 2.6 Reversal of the direction of rotation 2.7 Speed control of DC Shunt and series motors. ● Armature voltage control method ● field control method 2.8Applications of series, shunt and compound motors. **Course Outcome:CO1,CO2,CO3 Teaching Hours:09Hrs. Marks: 12(R-2,U-4,A-6)**
3	**Induction Motor:** 3.1 Principle of operation, advantages & disadvantages. 3.2 3ph Squirrel cage induction motor – construction, application 3.3 Slip Ring Induction motor – construction, application 3.4 Synchronous speed, % slip [simple problems] 3.5 Starting of 3 phase induction motor: DOL, Star-Delta, Reduced voltage starter 3.6 Reversal of direction of rotation. 3.7 Starting Torque & Torque – Slip characteristics. 3.8 Speed control: Voltage control, Rotor resistance control &frequency control. **Course Outcome:CO1,CO2,CO3 Teaching Hours:11Hrs. Marks: 14(R-2,U-6,A-6)**
4	**Single phase Induction motor and special motors:** Schematic representation, principle of operation and applications of : 4.1 Split phase induction motors. 4.2 Capacitor start induction motor 4.3 Universal motor 4.4 Stepper motor 4.5 Brushless dc motor 4.6 AC Servo motor 4.7 DC Servo motor **Course Outcome: CO1, CO2 Teaching Hours:11Hrs. Marks:14 (R- 2, U-6 A-6)**
5	**Industrial applications of electric motors:** 5.1 Definition of electric drive and advantages 5.2 Classification of electric drive 5.3 Factors governing selection of motor 5.4 Motors for different industrial drives 5.5 Electric Braking: i) Plugging applied to D.C. motor & Induction motor ii) Rheostat braking applied to D.C. motor & Induction motor **Course Outcome:CO3, CO4 Teaching Hours :06Hrs. Marks: 10(R- 4 , U-4 , A- 2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	**Transformer**	08	2	4	4	10
2	**DC Motor**	09	2	4	6	12
3	**Induction Motor**	11	2	6	6	14
4	**Single phase Induction motor and special motors**	11	2	6	6	14
5	**Industrial applications of electric motors**	06	4	4	2	10
	Total	**45**	**12**	**24**	**24**	**60**

List of experiments: Total 08experiments (or turns) out of 10experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	**CO1CO2**	Perform OC and SC test on transformer and find copper and iron losses	04
2	2	**CO1CO2 CO3**	Connect the starter of dc shunt motor and start the motor, reverse the direction of rotation.	04
3	3	**CO1 CO2CO3**	Connect the three phase induction motor using DOL, Star Delta and reduced voltage method	04
4	4	**CO1CO2**	Prepare the specification chart of various types of special machines	04
5	5	**CO3 CO4**	Prepare chart for electric braking of motors	04
6	6	**CO1CO2**	Perform direct load test on transformer and find efficiency and regulation of transformer	04
7	2	**CO1CO2 CO3**	Control the speed of DC motor using armature voltage control method	02
8	3	**CO1CO2 CO3**	Measure the slip of induction motor by tachometer method and reverse the direction of rotation of three phase induction motor	04
9	4	**CO1 CO2CO3**	Control the speed of DC motor using field control method	02
10	6	**CO1CO2 CO3**	Control the speed of induction motor by variable frequency method	04
Total				**30**

Note: Experiments No. 1 to 5 are compulsory and should map all units and Cos.Remaining 03 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Technology (Volume II)	B. L. Theraja and A. K. TherajaS. Chand and Co. Ltd.Twenty Third edition	ISBN-10: 8121924375 ISBN-13: 978-8121924375
2	Electric Machines	Ashfaq Husain, Dhanpat Rai & Co. Third edition 2016	ISBN-13**:** 978-8177001662
3	Electrical Machines	S.K. Bhattacharya, McGraw Hill Education; Fourth edition (1 July 2017)	ISBN-10: 9332902852 ISBN-13: 978-9332902855
4	Utilisation of Electric Power & Electric Traction	G. C. Garg; S. K. Khanna Publisher, New Delhi, edition	ISBN-10: 8174091645 ISBN-13: 9788174091642

E-References:

- www.nptel.com
- www.electrical4u.com
- www.khanacademy.org
- https://ndl.iitkgp.ac.in/

CO VsPO and CO Vs PSOMapping

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

Industry Consultation Committee:

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

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:IS19207				Course Title: Digital Techniques						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30Hrs)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4**	**--**	**4**	**--**	**--**	**--**	**50***	**--**	**50**	**100**

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

Rationale:

This course forms the foundation of computers. This course is introduced with the view that 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 logical circuits like multiplexer, demultiplexer, counters, registers etc. This course covers the number systems, logic gates, combinational & sequential logic circuits, analog to digital and digital to analog converters which are important parts of digital systems.

Course Outcomes: Student should be able to

CO1	Familiarize with 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 circuitsusing logic gates
CO4	Design sequential circuits using flip flop.

Course Content Details:

Unit No	Topics / Sub-topics
1	**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. Binary subtraction using 1's and 2's complement 1.5. Types of codes : BCD code, Excess 3 code, Gray code 1.6. Binary to Gray and Gray to Binary code conversion. 1.7. BCD addition and BCD subtraction using 9's complement **Course Outcome: CO1**

2	**Logic Gates and Boolean algebra:** 2.1 Symbol, truth table, logical expression of Basic Gates (AND, OR, NOT), Derived gates (EX-OR, EX-NOR),Universal gates (NAND, NOR) . 2.2 NAND and NOR gate as a universal gates. 2.3 Characteristics of logic gates: Propagation delay, power dissipation, fan in, fan out, Noise Margin. 2.4 Boolean algebra: Boolean laws, 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**
3	**Combinational Circuits:** 3.1 Design of Half adder, full adder, Half subtractor and full subtractor using K-map and realization using gates. 3.2 Design 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), demultiplexer tree, 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**
4	**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 and Ring counter circuit and waveforms. Design example of MOD-N counter, 4.5 Synchronous counter- Implementation of 3-bit synchronous counter using k-map with waveforms. 4.6 Shift Registers: Definition, classification, circuit diagram, working and timing diagrams of SISO, SIPO, PISO, PIPO,bidirectional shift register. **Course Outcome:CO4**

Suggested Specifications Table (Theory):

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

List of Experiments: Total 18-20 experiments(or turns) out of 27experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To convert the given numbers of number system into another number system.	2
2	2	CO2	To verify Truth Table of basic gate AND, OR, NOT, NAND, NOR, Ex-OR & Ex-NOR gates using ICS.	2
3	3	CO3	To construct Half Adder and Half subtractor & verify the Truth Table	2
4	4	CO4	To verify truth table of SR FF using ICs.	2
5	2	CO2	Implement simple Boolean equation using logic gates and verify output.	2
6	3	CO3	To construct Full Adder and verify the Truth Table	2
7	4	CO4	To verify truth table of D and T FF using ICs.	2
8	2	CO2	To implement basic logic gates using universal logic gate (NAND).	2
9	3	CO3	To construct Full subtractor & verify the Truth table	2
10	4	CO4	To verify truth table of JK FF using ICs.	2
11	2	CO2	To implement basic logic gates using universal logic gate (NOR).	2
12	2	CO2	Implement and verify truth table of De Morgan's theorem.	2
13	3	CO3	To construct Full subtractor & verify the Truth table	2
14	3	CO3	Design binary to gray convertor using K-map reduction techniques, realize it with using gates and verify the truth table.	2
15	3	CO3	Design gray to binary convertor using K-map reduction techniques, realize it with using gates and verify the truth table.	2
16	3	CO3	To verify truth table of 8:1 multiplexer using IC 74151.	2
17	3	CO3	To verify truth table of 3 line to 8 line decoder using IC.	2
18	4	CO4	Design 1-Bit comparator using k-map reduction technique. Realize it with using gates and verify the truth table.	2
19	4	CO4	To verify the truth table of Comparator (IC7485).	2
20	4	CO4	To construct 3 bit ripple counter using Flip Flop and verify its operation	2
21	4	CO4	To construct and test MOD-6 asynchronous counter using IC 7490.	2
22	2	CO2	Implement and verify truth table of Duality theorem.	2
23	3	CO3	To verify truth table of 4:1 multiplexer using logic gates	2
24	3	CO3	To verify truth table of 1:4 demultiplexer using logic gates	2
25	3	CO3	To design adder and subtractor circuit by using 4 bit parallel binary adder IC (IC7483)	4
26	3	CO3	To implement a circuit to convert BCD to seven segment display using decoder / driver IC. (IC 7447)	4
27	4	CO4	To develop a mini project based on applications of sequential circuits.	4
		Total		**60**

Note: Experiments No. 1 to 5and 27 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	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 edition (2016)	978-8120352681
4	Digital Electronics	G.K. kharate Oxford; Reprint edition (2010)	978-0198061830

E-References:

1. https://www.tutorialspoint.com/digital_electronics/index.asp
2. https://www.nesoacademy.org/electronics
3. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
4. www.youtube.com "enter the name of topic"
5. https://drive.google.com/file/d/1tGb-DYogAwGBurLaxzMMWebru_2o8TA6/view
6. https://www.indiabix.com/electronics-circuits/ "select the circuit for simulation "

CO VsPO and CO Vs PSOMapping

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

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4	Mrs. S T Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

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Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:IS19 311				Course Title: C and CPP						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4#**	**--**	**4**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

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

Course Content Details:

Topics / Sub-topics
1. First C Program Outline: 1) First C Program -Header Files --example: #include <stdio.h> -main() - Curly braces -printf() -semicolon ; -Compiling a C program --example: gcc filen..
2. First Cpp Program Outline: First C++ Program -Header files --example: #include <iostream> -main() - Curly braces -cout<< -semicolon ; -Compiling a C++ program --example: g++ filen..
3. Tokens Outline: 3) Tokens in C and C++ -Data types, constants, identifiers -Keywords --example: if, break, else -Constants -Data types --example: int, float, char, double -F..
4. Functions Outline: Functions -What is a function -Syntax for declaration of a function - Function with arguments --example: return-type function-name(parameter); - Function without array.
5. Scope of Variables Outline: Scope of Variables -Introduction -Syntax of declaring a variable --example: data-type var-name; -Syntax for initializing a variable --example: data-type var-name .
6. If and Else If Statement Outline: Check the conditions in a program -What are Statements. -Syntax for if and -If-else Statement -Errors
7. Nested If and Switch Statement Outline: Nested if and switch statement -Nested if statement. -Switch statement. - Syntax for nested-if statement -Syntax for switch statement -break statement -Comparision
8. Increment and Decrement Operators Outline: Increment and Decrement Operators -Increment Operator --example: ++ - Postfix increment --example: a++ -Prefix increment --example: ++a -Decrement Operator ..
9. Arithmetic Operators Outline: Arithmetic Operators -Arithmetic Operators -Addition Operator --example: a + b -Subtraction Operator --example: a - b -Multiplication Operator --example: a *..
10. Relational Operators

Outline: Relational Operators -Double Equal to --example: a == b -Not Equal to -- example: a != b -Greater Than --example: a > b -Less Than --example: a < b -Gr.. 2/2

11. **Logical Operators**
    Outline: Logical Operators -And && -Or || -Not !
12. **Loops**
    Outline: Loops -Loops -Syntax for while and do-while loop -Comparison of while and do-while loop -Syntax for -for loop -Errors
13. **Arrays**
    Outline: Arrays -What are arrays -1-D Arrays -Syntax for Declaration of arrays -- example: data type array_name [size]; -Syntax for Initialization of arrays
14. **Working with 2D Arrays**
    Outline: Working with 2-D Arrays -What are 2-D Arrays. -Range of arrays -Syntax for Declaration of 2-D arrays --example: data type array_name[row][column]; -Syntax for integer.
15. **Strings**
    Outline: Strings -What is a string -Syntax for declaring a string -Syntax for initializing a string -To read a string from keyboard
16. **String Library Functions**
    Outline: String Library Functions What are string library functions. Types of string library functions -Strcpy -Strlen -Strcmp -Strcat
17. **Working with Structures**
    Outline: Working with Structures -Introduction -Syntax of structures -Declaration and initialization -Declaration of structure variable -Accessing structure variables
18. **Understanding Pointers**
    Outline: Understanding Pointers -Introduction -Syntax of Pointer --example: int *iptr; -Declaration --example: int a; (integer a) int *aptr; (pointer to an integer..
19. **Function Call**
    Outline: Function call -types of function calls -function pass by value -function pass by reference
20. **File Handling in C**
    Outline: Files in C -File handling functions -Opening a File closing a file --example: fopen, fclose -Reading data from a File.

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Principal

Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- IV

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

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

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

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

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

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

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

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

Suggested Specifications Table (Theory):

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

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

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

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

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

References/ Books:

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

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

E-References:

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

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

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

Suggested Specifications Table (Theory):

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

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

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

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

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

References/ Books:

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

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

E-References:

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

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

Suggested Specifications Table (Theory):

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

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

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

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

References/ Books:

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

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

E-References:

1. https://nptel.ac.in/courses/112/105/112105248/
2. https://nptel.ac.in/courses/112/107/112107216/
3. https://nptel.ac.in/courses/103/103/103103035/

CO Vs PO and CO Vs PSO Mapping:

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

Suggested Specifications Table (Theory):

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

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

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

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

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

References/ Books:

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

E-References:

1. https://nptel.ac.in/courses/108105102/ [week 5 onwards video lectures]
2. http://www.circuitstoday.com/8051-microcontroller
3. http://www.mikroelektronika.co.yu/english/product/books/8051book/01.htm
4. https://www.intorobotics.com/8051-microcontroller-programming-tutorials-simulators-compilers-and-programmers/
5. http://www.8052.com/tut8051.phtml
6. http://electrofriends.com/articles/electronics/microcontroller-electronics-articles/8051-8951/80518951-microcontroller-instruction-set/
7. www.edsim51.com
8. www.faqs.org/microcontroller

CO Vs PO and CO Vs PSO Mapping:

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
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Coordinator,
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Head of Department,
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I/C, Curriculum Development Cell

Principal

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

Suggested Specifications Table (Theory):

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

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

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

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

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

References/ Books:

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

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

E-References:

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

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

Suggested Specifications Table (Theory):

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

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

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

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

References/ Books:

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

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

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

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

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

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

Rationale:

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

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

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

Suggested Specifications Table (Theory):

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

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

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

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

References/ Books:

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

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

E-References:

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

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

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

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

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

Rationale:

Technicians working in industries or elsewhere essentially require the knowledge of environmental Studies so as to enable them to work and produce most efficient, economical and eco-friendly finished products. Solve various engineering problems applying ecosystem to produce eco – friendly products. Use relevant air and noise control method to solve domestic and industrial problems. Use relevant water and soil control method to solve domestic and industrial problems. To recognize relevant energy sources required for domestic and industrial problems. Solve local solid and e-waste problems.

Course Outcomes: Student should be able to

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

Course Content Details:

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

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

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

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

List of tutorials:

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

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Environmental Studies	S.C. Sharma & M.P. Poonia Khanna Publishing House, New Delhi	ISBN: 978-93-86173-09-6
2	Understanding Chemistry	C.N.Rao Universities Press(India) Pvt. Ltd. 2011	ISBN:13-9788173712500
3	Waste water treatment for pollution control and reuse	Arceivala, Soli Asolekar, Shyam Mc-Graw Hill Education India Pvt. Ltd. New york, 2007	ISBN:978-07-062099
4	Elements of Environmental Pollution control	O.P.Gupta Khanna Publishing House, New Delhi	ISBN:13-9789382609667

E-References:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Civil Engg.

Head of Department
Department of Civil Engg.

I/C, Curriculum Development Cell

Principal

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

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

Course Content Details:

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

Outline: Beamer Creating a presentation using Beamer

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- V

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19302	Maintenance of Instruments & Systems	3	2	--	5	5	60	20	20	--	25*	--	125
IS19303	Industrial Automation	3	4	--	7	7	60	20	20	50*	--	--	150
IS19305	Biomedical Instrumentation	3	2	--	5	5	60	20	20	--	25*		125
IS19404 IS19405 IS19406	**Elective-II Group** Distributed Control Systems Agriculture Instrumentation Advance Embedded Systems	3	2	--	5	5	60	20	20	--	25*	25	150
IS19501	Industrial Management & Entrepreneurship	3	--	2	5	5	--	--	--	--	25*	25	50
IS19309	Project	--	4	--	4	4	--	--	--	--	50*	50	100
IS19408	Scilab (Spoken tutorial)	--	4 #	--	4 #	4	--	--	--	--	--	--	--
	Total	**15**	**18**	**02**	**35**	**35**	**240**	**80**	**80**	**50**	**150**	**100**	**700**
Total Contact Hours					**35**								

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

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

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

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

In-Charge
Curriculum Development Cell

Head of Departments
Department of Instrumentation Engg.

Principal

Programme :**Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:**IS19302**				Course Title: **Maintenance of Instruments and Systems**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**		**25***		**125**

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

Rationale:

Engineering maintenance is an important sector of economy to improve efficiency & progress of industries. Instrumentation diploma engineers have major role in maintenance of instruments and systems in process and manufacturing industries. Acquiring knowledge of maintenance and calibration of instruments is essential for instrumentation students. This course tends student to gain the various aspects of maintenance and calibration of different instruments and systems used in process and manufacturing industries.

Course Outcomes: Student should be able to

CO1	Select the maintenance /troubleshooting techniques for given field instruments/systems
CO2	Maintain the given field instruments / systems
CO3	Use of calibration method for maintenance and troubleshooting of field instruments/systems
CO4	Explain calibration of various process parameter equipment/system used in industry
CO5	Prepare the maintenance /troubleshooting and calibration reports

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Maintenance and Troubleshooting** 1.1 Maintenance- Definition, Need for Instruments/Control Systems Maintenance. 1.2 Types of Maintenance: Corrective Maintenance, Preventive, Maintenance and Predictive Maintenance. 1.3 Troubleshooting- Definition, Maintenance versus Troubleshooting 1.4 Basic Troubleshooting Techniques- Logical Analysis, Divide and Conquer, Remove and Conquer, and Built in Diagnostics. 1.5 Maintenance Department Functions 1.6 Job Planning and Scheduling.

	1.7 Typical Maintenance Work Order System (Maintenance Plan-daily/weekly/fortnightly/monthly/quarterly/annually). **Course Outcome:CO1 Teaching Hours :6hrs Marks: 08(R- 2, U-4, A-2)**
2	**Field Instruments Maintenance & Troubleshooting** 2.1 Elements of Preventive Maintenance 2.2 Role of Instrument Maintenance Technicians/Supervisors/ Engineers. 2.3 Safety Practices to be followed while Maintenance and Troubleshooting 2.4 Preventive Maintenance Tips/checklist and Troubleshooting Guidelines for following field instruments 2.4.1 DP Transmitters 2.4.2 Flow Transmitters- Turbine type Flow Meters 2.4.3 RTD /Thermocouple based Temperature Transmitters 2.4.4 Control Valves/Actuator Subsystems. 2.4.5 Current to Pressure (I/P) Converter and pressure(P/I) to current converter 2.4.6 Electro-pneumatic Valve Positioner **Course Outcome:CO2 Teaching Hours :08hrs Marks: 10(R- 2, U-4, A-4)**
3	**Industrial Calibration introduction** 3.1 Calibration –Definition and Need for Instruments Calibration. 3.2 Types of Calibration Standards and Traceability concept 3.3 ISO9000: Requirements of Calibration. 3.4 Individual Instrument Calibration versus Loop Calibration. 3.5 Bench Calibration versus Field Calibration 3.6 Calibration Status Labels and NABL Calibration Reports **Course Outcome: CO3 Teaching Hours :05hrs Marks: 8 (R- 2, U-4, A-2)**
4	**Calibration of Temperature and Pressure Measuring Instruments** 4.1 Temperature Standards and Standard Temperature Sources 4.2 Basic Methods of Temperature Calibration 4.3 Calibration of RTDs and Thermocouples using Fixed-point Method 4.4 Calibration of RTDs and Thermocouples using Comparison Method 4.5 Calibration of Temperature Transmitters using Temperature Simulators. 4.6 Calibration of Temperature Indicators using Temperature Simulators 4.7 Calibration of Pressure Gauges using Pneumatic/Hydraulic Dead Weight Tester (DWT) 4.8 Calibration of Pressure Transmitters using Pressure Calibrators 4.9 Calibration of Electronic Differential Pressure (DP) Transmitter 4.10 Calibration of smart Differential Pressure (DP) Transmitter **Course Outcome: CO4 Teaching Hours :10hrs Marks: 12 (R- 2, U-4, A-6)**
5	**Calibration of Flow and Liquid Level Measuring Instruments** 5.1 Gravimetric and Volumetric Calibration of Liquid Flowmeters 5.2 Volumetric and Gravimetric- PVTt Calibration of Gas Flowmeters 5.3 Calibration of Liquid/Gas Flowmeters using Master Flowmeters 5.4 Calibration of Turbine type Flow Transmitter 5.5 Rotameter Calibration 5.6 Calibration of DP type Level Transmitter in Open/Closed Tanks 5.7 Calibration of Capacitance type Level Transmitter

	5.8 Calibration Air Purge Level Indicator. **Course Outcome: CO4 Teaching Hours:10hrs Marks: 12 (R- 2, U-4, A-6)**
6	**Maintenance and Troubleshooting of PLC AND DCS System** 6.1 Troubleshooting tips of Automation and Process Control loops 6.2 Troubleshoot 4-20 mA Current Loop of 2-Wire/3-Wire Transmitters 6.3 PLC Preventive Maintenance Checklist and troubleshooting 6.4 Distributed Control System (DCS) Maintenance and troubleshooting 6.5 Calibration & Maintenance Report of PLC & DCS **Course Outcome: CO5 Teaching Hours :6hrs Marks: 10 (R- 2, U-4, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to Maintenance and Troubleshooting**	2	4	2	8
2	**Field Instruments Maintenance & Troubleshooting**	2	4	4	10
3	**Industrial Calibration introduction**	2	4	2	8
4	**Calibration of Temperature and Pressure Measuring Instruments**	2	4	6	12
5	**Calibration of Flow and Liquid Level Measuring Instruments**	2	4	6	12
6	**Maintenance and Troubleshooting of PLC AND DCS System**	2	4	4	10
	Total	**12**	**24**	**24**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Study of Instrument Maintenance Tools- Identification, Function, Operation and Safety Precautions	2
2	2	CO2	Maintain Field/bench service of an Air Pressure Regulator.	2
3	3	CO3	Calibration of PT-100 or Thermocouple (J / K type).	2
4	4	CO4	Field/bench service given transmitter-Pressure/DP/Temperature	2
5	5	CO4	Calibration of Capacitance type Level transmitter	2
6	6	CO5	Troubleshoot the PLC based control system	2
7	2	CO2	Field/bench service given Current to Pressure (I/P) converter.	2
8	6	CO5	Troubleshoot 4-20 mA Current Loop of 2-Wire/3-Wire Transmitters	2

9	1	CO1	Prepare Preventive Maintenance Plan (Work Order System)-(Daily/weekly/fortnightly/monthly/quarterly/annually)	2
10	2	CO2	Field/bench service given Control valve	2
11	4	CO4	Calibration of Differential Pressure (DP) transmitter for liquid level/flow measurement	2
12	3,4	CO3, 4	Calibration of PT-100 or Thermocouple (J / K type).	2
13	4	CO4	Calibrate a Pressure Gauge with a pneumatic/hydraulic Dead Weight Tester.	2
14	2	CO2	Maintenance &Calibration of Current to Pressure (I/P) converter.	2
15	2	CO2	Maintenance &Calibration of Pressure to current (P/I) converter.	2
16	6	CO5	Describe preventative maintenance of PLC	2
17	ALL	ALL	Industrial Visit (IDEMI or any process industry)	
Total				**30**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Maintenance of Instruments& Systems: Practical Guides For Measurement And Control	Lawrence D. Goettsche, ISA, 2005	9781556175121
2	Calibration: A Technician's Guide	Mike Cable, ISA, 2005	9781556179129
3	Industrial Process Automation Systems Design and Implementation	B. R. Mehta, Y. J. Reddy Elsevier Publisher, 2014	9780128010983
4	Process Instrumentation –Teacher Edition	Brown A. O., Powler, Malcom, Mid-America Vocational Curriculum Consrotium, Stillwater, Okla, 1989	9781292026015
5	Engineering Maintenance – A Modern Approach	B. S. Dhillon, CRC Press, 2002	9781587161421
6	Maintenance and Troubleshooting Instruction Manuals from Industries		

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3. https://calibrationawareness.com
4. https://automationforum.co
5. https://automationforum.in

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. T. D. Shinde	Project Engineer	Emerson Process Management Pvt. Ltd.
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4	Smt. K. U. Waghmare	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19303**				Course Title: **Industrial Automation**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**04**	**-**	**07**	**60**	**20**	**20**	**50***	-	**-**	**150**

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

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid-term and second skill test at the end of the term

Rationale:

Now a days PLC & SCADA system are used in most of the industries for automation. PLC & SCADA systems are used for monitoring and controlling various plant operations. The knowledge of PLC & SCADA system is essential to the instrumentation diploma holder. This course is introduced with the view that the students of instrumentation must be familiar with PLC & SCADA systems and their application in industries.

Course Outcomes: Student should be able to

CO1	Identify the role of different component of the given PLC
CO2	Use the given PLC instruction for developing an application
CO3	Understand the operation of SCADA system
CO4	Explain the topology & protocol in the given application
CO5	Develop industrial application using PLC & SCADA

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to automation and PLC** 1.1 Automation overview, Requirement of automation systems, Architecture of Industrial Automation system 1.2 Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, 1.3 Communication. Advantages of automation 1.4 Introduction of PLC , Block diagram and functions of elements of PLC, Memory organization in PLC, Types of PLC: fixed and modular PLC, Programming devices types, Operation of PLC, Types of Programming Language (Introductory approach) , & Advantages & Disadvantages 1.5 Types of modules: Input modules and output modules : DC module, AC module, Analog Module. (Basic concepts, block diagram, Wiring diagram ,concept of sourcing & sinking) 1.6 PLC Status indicators: Fault, Run, Power, Fault

	1.7 Specifications of PLC **Course Outcome: CO1 Teaching Hours : 06 hrs Marks: 8(R- 4, U-4, A-0)**
2	**PLC Instructions** 2.1 Basic concept of ladder 2.2 Rules of ladder, I/O Addressing 2.3 Classification of PLC instructions (Explanation and examples) 2.3.1 Bit type instructions: XIC,XIO,OTE,OTL,OSR 2.3.2 Logical instructions : OR,AND,NOT,XOR 2.3.3 Comparison instructions: EQU,NEQ,LES,LEQ,GRT,GEQ,LIM 2.3.4 Timer :TON,TOF,RTO, RES 2.3.5 Counter: CTU,CTD, High speed Counter 2.3.6 Math : ADD,SUB,MUL,DIV, 2.3.7 Advanced Math : SCP 2.4 Data files Simple programs to demonstrate the use of above instructions **Course Outcome: CO2 Teaching Hours:15 hrs Marks: 20 (R- 2, U-4, A-14)**
3	**Introduction to SCADA** 3.1 Definition 3.2 Block diagram of SCADA, Operation 3.3 Elements of SCADA: RTU, MTU, Communication interface, HMI 3.4 Benefits of SCADA 3.5 Types of SCADA: Single master single remote, single master multiple control, multiple master multiple control 3.6 Concept of tag, types of tags, Tag addressing 3.7 Concept of mimic diagram 3.8 Concept of Alarm: generation ,types, trend- types **Course Outcome: CO3 Teaching Hours : 06 hrs Marks: 08 (R-4, U- 4, A- 0)**
4	**Communication protocols** 4.1 Network topologies- types : bus, ring, star, protocol 4.2 RS485 - features, working, applications 4.3 HART protocol- concept, features, definition, operation, applications 4.4 Field bus –concept, features, definition, operation, applications 4.5 Ethernet- concept, features, operation, applications **Course Outcome: CO4 Teaching Hours : 09 hrs Marks: 12 (R- 2, U- 4, A- 6)**
5	**Applications programs** 5.1 Batch process Control 5.2 Diesel generator set control 5.3 Drum/Bottle Filling System 5.4 Traffic light control 5.5 Elevator control 5.6 Water distribution system (I/O Addressing, ladder diagram, tag database, mimic diagram for above applications Mimic diagram ,program, device addressing, animation, alarm generation) **Course Outcome: CO5 Teaching Hours : 09 hrs Marks: 12 (R-0, U- 0, A- 12)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to PLC**	4	4	0	8
2	**PLC Instructions**	2	4	14	20
3	**Introduction to SCADA**	4	4	0	8
4	**Communication protocols**	2	4	6	12
5	**Applications programs**	0	0	12	12
	Total	**12**	**16**	**32**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify the type of PLC in the lab , PLC component and their role.	04
2	2	CO2	Development of basic logic functions using ladder logic.	04
3	3	CO3	Configuration of RSVIEW 32 In Touch software	04
4	4	CO4	Identify the type of communication network in the lab	04
5	5	CO5	Develop the ladder program and test it : batch process	04
6	6	CO2	Develop ladder diagram to test OTL & OTU instructions	04
7	1	CO2	Develop traffic light control using TON , TOF & RTO instruction	04
8	2	CO2	Develop program for counting the given event using CTU & CTD instruction	04
9	3	CO2	Develop Program to Verify the given comparison instruction	04
10	4	CO2	Develop Program to Verify the given Mathematical Instruction	04
11	5	CO3	Creation of analog, digital tags and addressing of these tags in SCADA for given application	04
12	6	CO3	Creation and configuration of alarms in SCADA for given application	04
13	5	CO3	Observation of trends of variables in SCADA for given application	04
14	6	CO3	Develop ladder logic and graphics for SCADA applications	04
15	5	CO5	Develop application using PLC & SCADA	04
		Total		**60**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Programmable logic controller	V.R. Jadhav Khanna Publishers , New Delhi,2017	9788174092281
2	Programmable logic controller	Petruzella F.D. Tata- McGraw Hill India, New Delhi, Forth edition 2010	9780071067386
3	Programmable logic controller and industrial automation: An introduction	Mitra, Madhuchandra, Sengupta , Samerjit Penram International Publication, New Delhi	9788187972174
4	Practical SCADA for Industry	Bailey, David; Wright, Edwin Newnes International Edition	9780750658058

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2. http://www.hse.gov.uk/
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4. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Praveen Nalavade	Associate Chief Engineer – Instrumentation & Control Design	Technip FMC
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3	Mr. K. U. Dawane	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. U. B Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19305**				Course Title: **Biomedical Instrumentation**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**25***	**--**	**125**

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

Rationale:

The use of biomedical instruments is increasing day by day in health care. Now day's advanced, complex and precision biomedical instruments are being used in most of the hospitals. Diploma Instrumentation engineer are therefore also supposed to know about the biomedical instrumentation fundamentals, it is important as the students may get employment in hospitals where they will have to understand construction working application of different biomedical instruments. This course tends to develop basic skills in operation, test and maintenance of various biomedical instruments.

Course Outcomes: Student should be able to

CO1	Identify the function of physiology of human body
CO2	Illustrate electrodes for different bio signals generated by human body organs with a suitable recorder
CO3	Select biomedical instrument for biomedical parameters measurement
CO4	Demonstrate life support biomedical instruments/imaging instrument for specified application
CO5	Maintain biomedical instruments with electrical safety

Course Content Details:

Unit No	Topics / Sub-topics
1	**Physiological system of human body** 1.1 Man-instrument system:-component block diagram ,working 1.2 Problems encountered in measuring living system. 1.3 Types of physiological system of human body. 1.4 Cardiovascular system:- Internal structure of Heart, Cardiovascular circulation ,heart sounds 1.5 Respiratory system: - physiology, mechanism of breathing, lung volume and capacities. 1.6 Nervous system: - structure and functioning of neuron, structure of brain, neuronal communication.

	Course Outcome: CO1 Teaching Hours :07hrs Marks:10 (R-2, U-4 , A- 4)
2	**Bioelectric signal and Electrodes** 2.1 Resting and action potential-concept, schematic diagrams and waveform 2.2 Introduction to typical bioelectric signals e.g. ECG, EEG, EMG, ERG, EOG, and EGG. 2.3 Electrode theory- Electrode electrolyte interface with schematic diagram 2.4 Electrodes: - Construction and diagram of various electrode used for measuring ECG, EMG, EEG. 2.4.1 Microelectrodes 2.4.2 Surface-electrodes:-Suction cup electrode, Disposable electrode, Floating type electrode, Metal disk type electrode 2.4.3 Needle electrodes **Course Outcome: CO2 Teaching Hours :06hrs Marks:10 (R-2, U-4, A- 4)**
3	**Biomedical Recorders** 3.1 Electrocardiograph:- Block diagram ,description. 3.2 ECG waveform with labels describes relating cardiac activity of the heart. 3.3 Einthoven's triangle. 3.4 Bipolar and unipolar leads used for ECG measurements. 3.5 Electro encephalograph:-working principle. 3.6 Electromyograph:-block diagram, description. **Course Outcome: CO2 Teaching Hours :10hrs Marks:12 (R-2, U-6 , A- 4)**
4	**Biomedical Parameters Measuring Instruments** 4.1 Indirect blood pressure measurement- Sphygmo-manometer 4.2 Respiration rate measurement- Spirometer 4.3 Measurement of heart sound- Phono-Cardiograph. 4.4 Measurement of Oxygen Saturation in Blood Stream and Pulse Rate -Pulse Oximeter (Diagram, construction and working only of above instruments). **Course Outcome:CO3 Teaching Hours :08hrs Marks:10 (R-2, U-2 , A- 6)**
5	**Life support equipment and imaging system** 5.1 Defibrillator:-concept of fibrillation ,Types of defibrillator , DC defibrillator (diagram ,working, output waveform) 5.2 Pacemaker:-Concept of pacemaker, Types of pacemaker-internal and external, working of various pacing modes. 5.3 Ventilators-Basic concept and working 5.4 X-ray: - principle of X rays, block diagram of X ray machine and working 5.5 CAT- principle of CT scan, block diagram, working and applications 5.6 MRI:-basic principle and application 5.7 Ultrasonography:-basic principle and application **Course Outcome: CO4 Teaching Hours :12hrs Marks:14 (R-2, U-6 , A- 6)**
6	**Electrical safety** 6.1 Micro shock & macro shock. 6.2 Effects of leakage current on human body 6.3 Types of leakage current 6.4 Precaution to minimize electric shock hazards & leakage current. **Course Outcome: CO5 Teaching Hours :02hrs Marks:04 (R-2 , U-2 , A- 0)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Physiological system of human body**	02	04	04	10
2	**Bioelectric signal and Electrodes**	02	04	04	10
3	**Biomedical Recorders**	02	06	04	12
4	**Biomedical Parameters Measuring Instruments**	02	02	06	10
5	**Life support equipment and imaging system**	02	06	06	14
6	**Electrical safety**	02	02	--	04
Total		**12**	**24**	**24**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Use video program to understand the working of cardiovascular system.	2
2	2	CO2	Identify ECG, EEG, EMG electrodes.	2
3	3	CO2	Simulate 12 lead ECG signals using virtual lab.	2
4	4	CO3	Measure blood pressure using sphygmomanometer.	2
5	5	CO4	Observe the functioning of DC defibrillator system on virtual lab simulator.	2
6	6	CO5	Prepare a chart of General effects of electric current on human body.	2
7	1	CO1	Use video program to understand the working of nervous system.	2
8	3	CO2	Use virtual lab to plot the EMG.	2
9	4	CO3	Measure respiration rate using spirometer.	2
10	1	CO1	Use video program to understand the working of respiratory system	2
11	5	CO4	Use video program to understand the working of X-RAY machine.	2
12	5	CO4	Use video program to understand the working of MRI.	2
13	5	CO4	Use video program to understand the working of CT scan.	2
14	5	CO4	Simulate pacemaker using virtual lab.	2
15	5	CO4	Use video program to understand the working of Ultrasonography.	2
			Total	**30**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Handbook of biomedical instrumentation	R. S. Khandpur McGraw Hill Education Third edition (2014)	978-9339205430
2	Introduction to biomedical equipment technology	Carr Joseph J. Brown J.M Pearson Education 4th edition (2002)	978-8177588835
3	Biomedical instrumentation measurements.	Leslie P Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson Education India; 2 edition (2015)	978-9332556911
4	Medical instrumentation application & design	John G. Webster John Wiley & Sons 4th edition (2009)	978-0471676003

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2. https://www.electronicsandcommunications.com/2019/06/biomedical-engineering.html
3. https://medlineplus.gov/encyclopedia.html
4. https://www.slideshare.net/kerolus/ecg-49879220

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

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4	Mrs. S.T. Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19404**				Course Title: **Distributed Control Systems**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**-**	**05**	**60**	**20**	**20**	**-**	**25***	**25**	**150**

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

Rationale:

In today's competitive production environment, process industries demand a totally integrated control and optimization solution that can increase productivity, reliability, and quality while minimizing cost. Distributed Control System (DCS) is designed to meet these customers' needs. The distributed architecture of DCS reduces impact from loss of system components and ensures production continuity. The component and network redundancy guarantees the operability of critical system and control functions.DCS also ensures operation safety and effectiveness. The DCS advanced solutions deliver operating efficiency improvement, productivity gain. Unit reliability and availability enhancement, and overall cost reduction

Course Outcomes: Student should be able to

CO1	Identify the different components of given DCS
CO2	Describe the role of given module in DCS.
CO3	Classify displays used in DCS
CO4	Understand alarm management system in DCS .
CO5	Develop simple PID control loop with Alarm, control, trends using given DCS system.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to distributed control system(DCS)** 1.1 Introduction to DCS. 1.2 Direct Digital control, centralized computer system, Distributed control. 1.3 DCS Evolution history. 1.4 Generalized DCS architecture and its feature. 1.5 Main difference between PLC and DCS. 1.6 DCS Suppliers and their system name. **Course Outcome: CO1 Teaching Hours :08 hrs Marks: 12(R- 6, U-4, A-2)**

2	**DCS MODULES:** 2.1 Input and output module: Local , Remote, rack mounted. 2.2 Controller Module: 2.3 Power supply module 2.4 Communication Module 2.5 Workstation: Operator and Engineer 2.6 Data Highway and local IO bus 2.7 Redundancy in the DCS (Functions, types and specification as per above modules) **Course Outcome: CO2 Teaching Hours :09 hrs Marks: 12 (R- 2 , U- 4 , A- 6)**
3	**DCS DISPLAYS**: 3.1 Standard Display: Overview display, unit or area Overview display, Group display, Graphics display, trend display, Loop display. 3.2 User -defined display: Plant mimic display, area mimic display, Group mimic diagram and batch control system diagram. **Course Outcome:CO3 Teaching Hours : 09 hrs Marks: 12 (R-2 , U- 4 , A- 6)**
4	**DCS Alarm Management and Database** 4.1 Alarm reporting, types of Alarm generated and acceptance of alarms 4.2 The different types of logs and report that can be configured on DCS system, 4.3 Data history use in logs, reports and trend display. 4.4 The need for different security levels to various operating parameters configuration (Operator, Engineer, supervisor) Organization of system database in one folder on database server **Course Outcome: CO3 Teaching Hours :09 hrs Marks: 12 (R- 2 , U-10- , A-0)**
5	**DCS Programming:** 5.1 Introduction 5.2 DCS Programming Language requirement. 5.3 DCS Programming language(Ladder logic, Functional block diagram Structured text, Sequential flow chart) 5.4 FBD/SFC/Ladder language example 5.5 Example of data acquisition 5.6 Example of Control Logic 5.7 Example of Alarm system **Course Outcome: CO5 Teaching Hours :10 hrs Marks: 12 (R- 0 ,U- 0 , A-12)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to distributed control system(DCS)**	6	4	2	10
2	**DCS MODULES**	2	4	6	12
3	**DCS DISPLAYS**	2	4	6	12
4	**DCS Alarm Management and Database**	2	10	0	12

5	**DCS Programming**	0	0	12	14
	Total	**12**	**22**	**26**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Preparing URS (User requirement specification)and FRS(Functional requirement specification) for any small Automation process in the lab.	02
2	2	CO2	Understand the Input output module and controller module with detailed specification.	02
3	3	CO3	Study of communication modules with detailed communication protocol.	02
4	4	CO4	Study of Workstation: Operator and Engineer	02
5	5	CO5	Prepare cause and effect document for any small process and develop control logic diagram for the same.	02
6	6	CO2	Prepare small process Graphical representation and display on HMI screen.	02
7	1	CO2	Develop and implement temperature measurement in DCS trainer setup using DCS programming language SFC	02
8	2	CO2	Develop and implement level measurement in DCS trainer setup using DCS programming language SFC.	02
9	3	CO2	Develop and implement Flow measurement in DCS trainer setup using DCS programming language SFC.	02
10	4	CO2	Develop and implement temperature measurement in DCS trainer setup using DCS programming language FBD	02
11	5	CO3	Develop and implement level measurement in DCS trainer setup using DCS programming language FBD.	02
12	6	CO3	Develop and implement Flow measurement in DCS trainer setup using DCS programming language FBD.	02
13	5	CO3	Develop and implement pressure measurement in DCS trainer setup using DCS programming language FBD/SFC.	02
14	6	CO3	Developing and configuring Graphical user interface for any two control loop.	02
15	5	CO5	Develop and implement PID level Control loop in DCS trainer setup using DCS programming language FBD/SFC	02
		Total		

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Instrument Engineers Handbook,Volume3: Process Software and Digital Networks	Bela G. Liptak, Eren CRC Press, Fourth Edition 2016	9781439863435

2	Industrial Process Automation Systems: Design and Implementation	B.R. Mehta, Y. Jaganmohan Reddy Butterworth-Heinemann, 2014	9780128010983
3	Control Systems (DCS): For Engineers and Technicians	IDC Technologies	
4	Industrial Instrumentation & Control Third Edition	Singh S. K. Tata McGraw-Hill Education,2009	9780070262225

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2. https://automationforum.in
3. http://www.hse.gov.uk
4. http://literature.rockwellautomation.com/

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr H. K. Kadam	Rtd. HR Manager	RCF Ltd.
2	Mr. Sanjay Rajput	Lecturer in Instrumentation Engg.	Govt. Polytechnic Jintur
3	Mr. S.T. Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. U. B Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19405**				Course Title: **Agriculture Instrumentation**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**-**	**05**	**60**	**20**	**20**	**-**	**25***	**25**	**150**

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

Rationale:

Agricultural industries are mostly dependent on nature behaviour. To avoid crop failure, increasing crop quantity and quality, protecting crop, etc is a big challenge for farmers as well as for agro industries. It will be very appropriate to provide knowledge of sensors used in agriculture field, know green house automation schemes and automation associated with agriculture and food processing plants/ systems to instrumentation and control engineers.

Course Outcomes: Student should be able to

CO1	Characterize problems and possible technological solution of agro industries.
CO2	Explain soil properties and sensors used to measure
CO3	Demonstrate continuous and batch process
CO4	Familiarize with current literature in irrigation system associated agricultural instrumentation
CO5	Develop automation scheme for green house

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction** 1.1 Necessity of instrumentation & control for agriculture and food processing 1.2 Remote sensing 1.3 Biosensors in agriculture 1.4 Standard for food quality **Course Outcome: CO1 Teaching Hours : 7 hrs Marks: 10(R- 4, U-4, A-2)**
2	**Soil science and sensors** 2.1 Engineering properties of soil pH, conductivity, resistivity, temperature, soil moisture and salinity, ion concentration measurement. 2.2 Method of soil analysis, permeability & seepage analysis, shear strength, Mohr's circle of stress, active & passive earth pressures.

	2.3 Instrumentation for environmental conditioning of seed germination and growth **Course Outcome: CO2 Teaching Hours : 10 hrs Marks: 14 (R- 2 , U-4, A- 8)**
3	**Food Processing** 3.1 Flow diagram of sugar plant & instrumentation set up for it, 3.2 Flow diagram of fermenter & control (batch process), 3.3 Flow diagram of dairy industry & instrumentation set up for it, 3.4 Juice extraction control process & instrumentation set up for it 3.5 Oil extraction plant and instrumentation set up for it. **Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 14 (R- 2 , U- 4 , A-8)**
4	**Instrumentation in Irrigation** 4.1 Water distribution & management control, 4.2 Auto drip & sprinkler irrigation systems, 4.3 Irrigation canal management systems, upstream & downstream control concept, 4.4 SCADA for DAM parameters & control **Course Outcome: CO4 Teaching Hours : 8 hrs Marks:10 (R- 2 , U-6 , A-2)**
5	**Topic Title: Green-houses & instrumentation** 5.1 Concept & construction of green houses, merits & demerits 5.2 Ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge, carbon dioxide enrichment measurement & control. 5.3 Leaf area length evaportranspiration, temperature, wetness & respiration measurement 5.4 Data logging, electromagnetic radiations photosynthesis, infrared & UV bio sensor methods in agriculture 5.5 Agro-metrological instrumentation weather stations **Course Outcome: CO5 Teaching Hours : 10 hrs Marks:12 (R- 2 , U-6 , A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction**	4	4	2	10
2	**Soil science and sensors**	2	4	8	14
3	**Food Processing**	2	4	8	14
4	**Instrumentation in Irrigation**	2	6	2	10
5	**Green houses & instrumentation**	2	6	4	12
	Total	**12**	**24**	**24**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To study different bio sensors used in agro automation	02
2	2	CO2	To test soil resistivity moisture and salinity	02
3	3	CO3	To study flow diagram of dairy industry and instrumentation set up	02
4	4	CO4	To study application of SCADA for DAM and irrigation system.	02
5	5	CO5	To study heating cooling and ventilation control in Green house	02
6	6	CO2	To test soil pH, conductivity	02
7	1	CO3	To study juice extraction control set up	02
8	2	CO3	To study flow diagram of sugar industry and instrumentation set up	02
9	3	CO4	To study Auto drip irrigation systems	02
10	4	CO5	To study sprinkler irrigation systems	02
11	5	CO6	To study heating , temperature & humidity control in Green house	02
12	6	CO1	To study flow diagram of Juice extraction control process	02
13	5	CO2	To study UV biosensors in Green house	02
14	6	CO3	Case study on agriculture instrumentation	02
15	5	CO5	Case study on greenhouse instrumentation	02
			Total	**30**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Instrumentation handbook-process control	Bela G. Liptak., Published by Chilton, Philadelphia (1969)	9780801955198
2	Process control and instrumentation technology	C.D. Johnson Published by Wiley	9780471057895
3	Principle of Farm Machinery	Kepner, Robert Allen Publisher: Avi Pub. Co Publication Date: 1972	9780870551246
4	Agricultural Engineering	Jack Rudman Published by National Learning Corporation (2004)	9780837339467

5	Environmental Engineering	Jeffrey Jeffrey Peirce Published by Butterworth-Heinemann (2003)	9780750672948
6	Automatic Control for food processing system,	Moreira, Rosana G. Published by Springer (2001)	9780834217812

E-References:

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3. https://www.eolss.net/Sample-Chapters/C18/E6-43-35-04.pdf
4. https://www.climatecontrol.com/blog/greenhouse-control-systems/
5. https://autogrow.com/your-growing-environment/automated-greenhouse

CO VsPO and CO Vs PSOMapping

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

Industry Consultation Committee:

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

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: **IS19406**				Course Title: **Advance Embedded Systems**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

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

Rationale:

Embedded systems play a vital role in characterizing, developing as well as creating new processes in automation. They address several requirements of automation and thus enable highly project specific solutions. A new age of automation began with networking as a common place, the total networking of intelligent digital systems. In the future, machines should be able to control each other through new information and communication techniques. Production processes such as production, planning and service should be automatically optimized. The entire process should occur in real time as much as possible in order to achieve a self-organizing production system. This course intends to develop skills to maintain and build the automated and real time systems.

Course Outcomes: Student should be able to

CO1	Comprehend the meaning of embedded system
CO2	Interpret the various communication interfaces
CO3	Develop basic application circuits using Arduino board
CO4	Use memories and peripherals in basic embedded applications
CO5	Interpret the features of Real Time Operating System

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basics of Embedded Systems** 1.1 Definition of Embedded System 1.2 Block Diagram of Embedded System 1.3 Embedded System Architectures: Von-Neumann/Harvard, RISC/CISC, DSP 1.4 Characteristics of Embedded Systems: size, performance, flexibility, maintainability, latency, throughput, correctness, processor power, power consumption, safety, NRE cost, cost 1.5 Classification of Embedded Systems: 1.5.1 Based on Performance of microcontroller: Small scale, Medium scale, Sophisticated 1.5.2 Based on performance and functional requirements: Real time, Standalone, Networked, Mobile

	1.6 Applications of Embedded Systems **Course Outcome: CO1 Teaching Hours : 06hrs Marks: 10 (R-04, U-04, A-02)**
2	**Communication Interfaces** 2.1 Modes of communication: Serial/Parallel, Synchronous/Asynchronous 2.2 Onboard Communication Interfaces: I²C, CAN, SPI, PSI 2.3 External Communication Interfaces: RS232, USB 2.4 Wireless Communication Interfaces: IrDA, Bluetooth, Zigbee (Features and basic principle, difference) **Course Outcome: CO2 Teaching Hours : 09 hrs Marks: 12 (R-02, U-06, A-04)**
3	**AVR Microcontroller** 3.1 Features of ATMega 328P Microcontroller and Arduino 3.2 Arduino: open source community 3.3 Arduino boards based on Atmrga328 Microcontroller 3.4 Functional Block Diagram of Arduino Uno 3.5 Functions of each pin of Arduino Uno 3.6 Arduino Programming 3.6.1 Data types, Variables, Operators 3.6.2 IO functions 3.6.3 PWM function 3.6.4 Random Functions 3.6.5 Interrupts 3.6.6 Serial Communication:RS232, I²C, SPI 3.7 Basic IO Interfacing 3.7.1 Sensors: Humidity, Temperature, Ultrasonic, PIR 3.7.2 Motors: DC, Servo, Stepper **Course Outcome: CO3 Teaching Hours : 13 hrs Marks: 14 (R-02, U-04, A-08)**
4	**System Memory and Peripherals** 4.1 Memory System Architecture 4.1.1 Cache Memory, Virtual Memory 4.1.2 Memory Management Unit 4.1.3 Address translation 4.2 Memory Technologies 4.2.1 SRAM, DRAM 4.2.2 ROM, EPROM, E²PROM, NVROM 4.3 Peripheral Devices 4.3.1 Watchdog Timer 4.3.2 DMA Controller **Course Outcome: CO4 Teaching Hours : 07 hrs Marks: 10 (R-02, U-04, A-04)**
5	**Real Time Operating System** 5.1 Types of Operating Systems: General purpose, RTOS, Soft/Hard RTOS 5.2 Architecture of an RTOS 5.3 Characteristics of an RTOS: Consistency, Scalability, Reliability, Performance, Predictability

	5.4 Tasks, process and threads 5.5 Multiprocessing and Multitasking: Co-operative, Preemptive, Non-Preemptive multitasking 5.6 Scheduling Algorithms: Preemptive, Non-Preemptive, Round Robin 5.7 Interrupt handling, Semaphore, Deadlock **Course Outcome: CO5 Teaching Hours : 10 hrs Marks: 14 (R-02, U-06, A-06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Basics of Embedded Systems**	04	04	02	10
2	**Communication Interfaces**	02	06	04	12
3	**AVR Microcontroller**	02	04	08	14
4	**System Memory and Peripherals**	02	04	04	10
5	**Real Time Operating System**	02	06	06	14
	Total	**12**	**24**	**24**	**60**

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify the family of given microcontrollers on the basis of IC number and architecture.	2
2	2	CO2	To study sensor information acquisition in Arduino IDE using USB serial interface.	2
3	3	CO3	To interface Humidity/ soil moisture sensor module with Arduino.	2
4	4	CO4	To read and write data in internal E^2PROM memory in Arduino board.	2
5	5	CO5	To study Rtuin OS or Duin OS or any other free RTOS for Arduino and test simple looping program.	2
6	1	CO1	Identify the different blocks and pins on given Arduino development board.	2
7	2	CO2	Interface GSM module with Arduino board using RS 232 interface to send and receive message.	2
8	3	CO3	To implement Voltmeter using Arduino Board.	2
9	4	CO4	To interface external SRAM memory using Arduino board.	2
10	3	CO3	Interface RTC module with Arduino board using I^2C to read time/ date and store data in SRAM.	2
11	4	CO4	To control Motor Speed using Arduino Board.	2
12	3	CO3	Interface Bluetooth module with Arduino board and transfer data to and fro.	2

13	4	CO4	To implement Ultrasonic Range Finder/level controller using Arduino Board.	2
14	4	CO4	To implement LPG Leakage Detector Board.	2
15	4	CO4	To implement Arduino Camera Interface.	2
			Total	**30**

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

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Embedded System Architecture, Programming and Design	Rajkamal, McGraw Hill Education; 3rd edition, 2017	978-9332901490
2	An Embedded Software Primer	David E. Simon, Addison-Wesley Professional, 1st edition, 1999	978-0201615692
3	Introduction to Embedded Systems	Shibu K V, McGraw Hill Education India Private Limited; 2nd edition, 2017	978-9339219680
4	Embedded Systems	B Kanta Rao, Prentice Hall (I), 1st edition, 2011	978-8120340817
5	Embedded System Design	Steve Heath, Newnes, 2nd edition, 2002	978-0750655460
6	Arduino for Beginners: Essential Skills Every Maker Needs	John Baichtal, Que Publishing, 1st edition, 2013	978-0789748836
7	Introduction to Arduino: A piece of cake!	Alan G. Smith, CreateSpace Independent Publishing Platform, 1st edition, 2011	978-1463698348
8	Getting Started with Sensors	Kimmo Karvinen and Tero Karvinen, Maker Media, 1st edition, 2014	978-1449367084

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9. https://www.tutorialspoint.com/operating_system/index.htm

CO Vs PO and CO Vs PSO Mapping:

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

Industry Consultation Committee:

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4	Mr. F. S. Bagwan	Lecturer in Instrumentation Engg.	Government Polytechnic, Mumbai

Coordinator,
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Head of Department,
Department of Instrumentation Engineering

I/C, Curriculum Development Cell

Principal

Programme :**Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:**IS19501**				Course Title: **Industrial Management & Entrepreneurship**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hrs)	TS2 (1 Hrs)	PR	OR	TW	Total
3	**-**	**2**	**5**	**-**	**-**	**-**	**-**	**25***	**25**	**50**

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

Rationale:

Diploma pass out students are normally placed at the supervisory or Junior Engineer level when they go to industries. they are act as link between higher management & workers to handle material and machinery to get the targeted output. This subject gives knowledge of managing different resources of the organizations effectively and as an Entrepreneur create a new idea of project & implement it to opens up many employment opportunities. This course deals with different aspects of management, which helps technician to manage the changed environment in the industry.

Course Outcomes: Student should be able to

CO1	Understand the different business types and management functions
CO2	Describe the functions of different departments
CO3	Explain industrial safety rules and act.
CO4	Manage purchase inventory and project
CO5	Develop the awareness about entrepreneurship and collect information of support systems to entrepreneur.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Overview of Business Management Process** 1.1 Definition of Business, 1.2 Types of Business- Service, Manufacturing & Trades 1.3 Globalization: introduction, Advantages & Disadvantages 1.4 Management- Various Definitions 1.5. Levels of Management 1.6. Basic Functions of Management- Planning, Organizing, Staffing, Directing & Controlling 1.7. Fourteen Principles of Management **Course Outcome:CO1 Teaching Hours :08 hrs**

2	**Topic Title: Organizational and Financial Management** 2.1. Organization- Definition and Types 2.2 Forms of Ownership, Proprietorship, Partnership, Joint Stock Company, Co-Operative Society, Government Sector. 2.3 Human Resource Management- Personnel management Definition & Functions. 2.4 Financial Management: Objectives, Capital types and Source of capital 2.5 Budgets: Types of budget, profit & loss account & Balance Sheet **Course Outcome:CO2 Teaching Hours :08 hrs**
3	**Topic Title: Industrial Safety and Management** 3.1. Causes of Accident 3.2. Safety Precautions 3.3. Introduction To: 3.4. Factory Act 1948 3.5. Workmen Compensation Act **Course Outcome:CO3 Teaching Hours :6 hrs**
4	**Topic Title: Materials and Project Management** 4.1. Inventory Management: Definition of Inventory and inventory Control, Objectives of Inventory Control 4.2. ABC Analysis, Graphical Representation 4.3. Economic Order Quantity (E.O.Q.): Graphical Representation and Calculation of E, O.Q. 4.4 Purchasing: Function of Purchasing 4.5 Project Management: Definition and Meaning of Project 4.6 Introduction to C.P.M & P.E.R.T, Preparation Of Network 4.7 Concept of Break-Even Analysis 4.8. Project Risk and Quality Management: Qualitative and Quantitative Analysis of Risks and Quality. **Course Outcome:CO4 Teaching Hours :10 hrs**
5	**Topic Title: Entrepreneurship & Business opportunity** 5.1. Definition of entrepreneur, entrepreneurship 5.2. Characteristics of entrepreneurship 5.3. Functions of entrepreneurship 5.4. Barriers of entrepreneurship 5.5 Identifying trends, opportunities and ideas of Business 5.6 Marketing Concept **Course Outcome:CO5 Teaching Hours:08 hrs**
6	**Topic Title: Scope and Support Systems** 6.1. Trading, Consultancy, Franchises, Service Sectors, Emerging Areas 6.2 Small Enterprises 6.2.1. Definition, Characteristics & Types 6.2.2. Problems Faced by SSI 6.2.3. Industrial Sickness- Causes & Corrective Measures 6.3. Functions & Supportive Institutes (MSME, SIDBI, DICS, SSIB, NSIC, MITCON, TCO's, MIDC) 6.4. Government Agencies **Course Outcome: CO5 Teaching Hours :5 hrs**

Term Work:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Study different Types of Business and List your interest and hobbies and list your business idea related to each interest.	2
2	2	CO2	Study of Different forms of organization and write procedure for training and recruitment	2
3	3	CO3	Make detail survey on Industrial Safety Act, describe any one act with one example	2
4	4	CO4	To represent the purchase Inventory using graphical representation and calculation using EOQ	2
5	5	CO5	Study of biography of successful entrepreneur indicating milestone achievement, summarize important trails.	2
6	6	CO5	Assess yourself as Entrepreneur to achieve success.	2
7	1	CO1	Select one product or service for business and describe how different than others.	2
8	2	CO2	Use internet or library to find out different sources of capital and budgets	2
9	6	CO5	Develop a project on a business opportunity incorporating as per standard format provided under guidelines of concern faculty. Components of project Report: One-page entire project Summary, introduction, project concept, promotors, process & technology, location and infrastructure, plant & machinery required, manpower, Raw Material, Market Survey, cost of project & sources of finance, project profitability, conclusion	4
10	5	CO5	Identify the market for your business, develop questionnaires to conduct primary data research, determine your course of action and determine competitor are, analyze each competitor in terms of price, facility, location, strength & weakness determine strategy to deal with each competitor.	4
11	4	CO4	Find our Break-even Analysis of your business, describe how many units you sell to break even & you think of way to lower the breakeven point.	4
12	5	CO5	Make a live conversation with an entrepreneur raise the issue of your interest pertaining to various aspects of entrepreneurship and make a report on it.	2
13	all	all	A Case study on entrepreneur/Businessman	4
14	all	all	Make Report on Industry visit for study of business / entrepreneurship	4
			Total	**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Industrial Engineering and Management	Dr. O. P. Khanna , Dhanpat Rai & Sons., New Delhi, 1980	9788189928353, 9788189928353
2	Industrial Management	Rustom S. Davar, Vikas publication, 1999	9780706999051
3	Industrial Management	Jhamb & Bokil , Everest Publication ,Pune., 2013	978-8176602044

4	Organization& Management	R. D. Aggarwal , Tata Mc'graw hill	9780074515068
5	Entrepreneurship Development	Preferred By Colombo plan staff college of technical education, Tata Mc Graw Hill Publishing co. ltd. New Delhi, 1998	---
6	A Manual on How to prepare Project Report	J.B. Patel, D.G. Allampolly, EDI study material, Ahmedabad, Gujarat	----
7	A Manual on Business opportunity Identification &Selection	J.B. Patel, S.S. Modi, EDI study material, Ahmedabad, Gujarat	---
8	A Hand book of New Entrepreneurs	J.B. Patel, S.S. Modi, EDI study material, Ahmedabad, Gujarat	----
9	National Directory of Entrepreneur Motivator & Resource person	S.B. Sareen, H. Anil Kumar, EDI study material, Ahmedabad, Gujarat	----
10	New Initiative in Entrepreneurship Education & Training	J.B. Patel, S.S. Modi, EDI study material, Ahmedabad, Gujarat	---

E-References:

1. https://ndl.iitkgp.ac.in/
2. www. scribd.com
3. www.slideshare.net.com
4. htttps://nptel.ac.in

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. P.P. Choudhary	Rtd Lecturer in Mechanical Engg. (Six-sigma Master Black belt.)	Govt. Polytechnic Mumbai
2	Mr. B.B. Kulkarni	Rtd Lecturer in Mechanical Engg.	Govt. Polytechnic Mumbai
3	Mr U. B. Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Ms. K.U. Waghmare	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

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Principal

Programme: Diploma in Instrumentation Engineering (Sandwich Pattern)										
Course Code: **IS19309**				Course Title: **Project**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	TU	PR	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1 Hr)	PR	OR	TW	Total
--	**--**	**4**	**4**	**--**	**--**	**--**	**--**	**50***	**50**	**100**

Rationale:

Diploma holder need to be capable of doing self-Study throughout their life as the technology is developing with fast rate. Student will be able to find out various sources of technical information and develop self-study techniques to prepare a project and write a project report. This subject is intended to teach students to understand facts, concepts and Techniques of measurement, control, its repairs, fault finding and testing, estimation of cost and procurement of material, fabrication and manufacturing of various items used in instrumentation field. This will help the students to acquire skills and attitudes so as to discharge the function of supervisor in industry and can start his own small-scale enterprise.

Course Outcomes: Students will be able to:

CO1	Implement the skills acquired in the previous semesters to solve complex engineering problems
CO2	Survey towards developing a solution/product which helps in life time learning
CO3	Test the designed project model and evaluate its performance
CO4	Communicate effectively in oral or written format to present the working of their project/product

G E N E R A L G U I D E L I N ES:

1. The Project groups of fifth semester will continue the project work in sixth semester and complete project in all respect (fabrication, assembly, development of control logic, implementation, testing, and validation.

2. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by respective guide in every week.

3. The guides should regularly monitor the progress of the project work.

4. The project work along with project report should be submitted as part of term work in third year sixth semester on or before the term end date.

5. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

"Format of Project Report"

Major Contents:

i. Introduction
ii. Literature survey
iii. Detailed Theory: 1) Planning and design
2) Development and Implementation work
3) Methodology
4) Applications
5) Advantages and Disadvantages.
iv. Future scope
v. Conclusion
vi References.

(No. of copies of seminar report to be prepared = S+2, where S is no. of students in group.)

6. The evaluation of project work at final oral examination should be done jointly by the internal and external examiners. The guide should be internal examiner for oral examination. The external examiner should be from the related area of the concerned project. He/She should have minimum of five years of experience at institute level or industry.

CO Vs PO and CO Vs PSO Mapping

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Sagar Tinkhede	Functional Manager	GS E&C Mumbai Pvt Ltd
2	Mr. Tushar Shinde	Project Engineer	Emerson Automation solution Pvt. Ltd.
3	Mr. S.G. Thube	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. U. B Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

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Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:IS19408				Course Title: Scilab						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4#**	**--**	**4**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

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

Course Content Details:

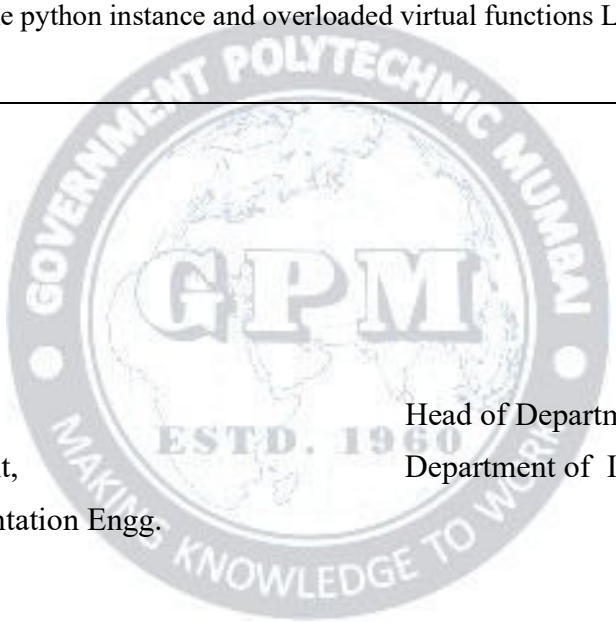
Topics / Sub-topics
1. Introduction to Scilab and its benefits Outline: What is FOSS? Why FOSS ? About Scilab and its benefits Scilab is reliable Use of Scilab in CNES Use of Scilab for space mission analysis and flight dynamics Industrial application
2. Self learning of Scilab through Spoken Tutorials Outline: About Spoken Tutorial Created for self learning Dubbed in all 22 languages Scilab spoken tutorials 25 spoken tutorials on Scilab Side by side learning Spoken tutorial used as ..
3. The amazing resource of Scilab Textbook Companion Outline: Opensource software problem, no good documentation for FLOSS Solution: Textbook companion project Scilab code for standard textbooks Demo of Textbook companion Download Scilab
4. Scilab Lab migration, Toolboxes and Forums Outline: Lab migration Demo of Lab migration on FOSSEE Scilab website Download PDF for lab solution Scilab Toolboxes FOSSEE Optimisation toolbox available on atoms website IEEE paper ..
5. Installing Outline: Installing Show where to download from and how to decide which version to choose (OS and 32/64bit) (www.scilab.org/download) Windows installation (Internet Connection i..
6. Getting Started Outline: Getting Started *Expressions: Show mathematical expressions with numbers *Variables *Diary command *Define symbolic constants. *Basic functions *suppressing output(;) *he..
7. Vector Operations Outline: Vector Operations *Define vector *Calculate length of a vector. *Perform mathematical operations on Vectors such as addition, subtraction and multiplication. *Define a matrix...
8. Matrix Operations Outline: Matrix Operations *Access the elements of Matrix *Determine the determinant, inverse and eigen values of a matrix. *Define special matrices. *Perform elementary row operation.
9. Conditional Branching

Outline: Conditional Branching * 'if' and 'then' with the example * use of the 'else' keyword * use of the 'elseif' keyword * example for select

10. **Iteration**
    Outline: Iteration Explain syntax of 'for' statement- tell that the variable iterates over a list/vector/matrix (or an expression that evaluates to any of these). Give example: ..
11. **Scripts and Functions**
    Outline: Scripts and Functions *Introduction to the file formats in Scilab. *SCRIPT files. *sce versus .sci *Inline functions.
12. **Plotting 2D graphs**
    Outline: Plotting 2D graphs About linspace: linspace is a linearly spaced vector. Plot a simple graph: x=linspace(12,34,10), y=linspace(-.1,2,10), plot(x,y) plot2d Using clf() clear..
13. **Xcos Introduction**
    Outline: Xcos Introduction What is XCOS. What is palette. To collect the blocks from the palette and connect them to construct the block diagram. Set the parameters of different blocks..
14. **File handling**
    Outline: File Handling- Scilab File handling Writing to a file using write() Reading from a file using read() Opening an existing file using mopen() Closing an already opened file usi..
15. **User Defined Input and Output**
    Outline: User Defined Input and Output in Scilab Input Function. mprintf() save() and load() Used to quit scilab midway through calculation and continue at later stage.
16. **Integration**
    Outline: *Develop Scilab code for different Composite *Numerical Integration algorithms *Divide the integral into equal intervals *Apply the algorithm to each interval *Calculate the com..
17. **Solving Non linear Equations**
    Outline: Numerical methods- Solving Non- linear Equations Learn how to solve nonlinear equations using numerical methods Learn Bisection method Learn Secant method Learn h..
18. **Linear equations Gaussian Methods**
    Outline: * Explain Gauss Elimination method algorithm * Explain code for Gauss Elimination method and solve an example using this code * Explain Gauss Jordan method algorithm ..
19. **Linear equations Iterative Methods**
    Outline: 1. Solve system of linear equations using iterative methods 2. Use Jacobi and Gauss Seidel iterative methods 3. Learn how to iterate until we converge at the solution 4. Learn h..
20. **Interpolation**
    Outline: Numerical Interpolation Develop Scilab code for different Numerical Interpolation algorithms Calculate new value of function from given data points
21. **ODE Euler methods**
    Outline: Solving ODEs using Euler Methods 1. Solve ODEs using Euler and Modified Euler methods 2. Develop Scilab code to solve ODEs
22. ODE Applications
    Outline: Solving ODEs using Scilab ode Function Use Scilab ode function Solve typical examples of ODEs Plot the solution
23. Optimization Using Karmarkar Function
    Outline: * About Optimization * Use of Scilab function Karmarkar in Optimization
24. Digital Signal Processing
    Outline: Plotting continuous and discrete sine waves. Plotting step function. Plotting ramp function.
25. Control systems

Outline: 1. Define a continuous time system: second and higher order 2. Response plot for step input 3. Response plot for sine input 4. Bode plot 5. Study numer and denom Scilab function.

26. Discrete systems
    Outline: * Define discrete time system variable z * Define first order discrete time system * Explain ones, flts, dscr, ss2tf functions
27. Calling User Defined Functions in XCOS
    Outline: * Write a squaring function * Use of scifunc block in XCOS * Use of MUX block * Call functions having multiple inputs and outputs
28. Simulating a PID controller using XCOS
    Outline: Simulating a PID controller using Xcos: 1. Modifying firstorder.xcos file to implement a PID controller 2. Closing the loop 3. Setting PID gains and observing its response
29. Developing Scilab Toolbox for calling external C libraries
    Outline: Compiling an external C library Generating shared library Copying the shared library to Scilab Toolbox Interfacing the shared library with Scilab Understanding the important co..
30. Developing Scilab Toolbox for calling Python and its functions
    Outline: About Scithon toolbox About header folder Interfacing between Scilab and Python Files used for starting the python instance and overloaded virtual functions Links to understand.



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Principal

Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- VI

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

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

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19308	Inplant training		40		40	20					100*	100	200
	Total	**--**	**40**	**--**	**40**	**20**					**100**	**100**	**200**
Total Contact Hours					**40**								

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

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

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Head of Departments
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Programme :**Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19308				**Course Title: Inplant Training**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
	40^		**20**					**100***	**100**	**200**

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

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term.

(^) Twenty weeks Industrial Training

Rationale:

We are in the era of skill development. Indian industrial sector is passing through highly competitive phase due to globalization. Cut throat competition is predominant and quality is one of the decisive factors for sustainability. Quality has become a decisive factor in attracting students and faculty to an institution. The institutions which offer quality education will survive present scenario. Quality education cannot be complete without Inplant training.

Inplant Training provides an exposure to industry work culture, under the guidance of experienced persons within the organization. This exposure will include all or most of the following aspects of business: management; personnel policy, financial, marketing and purchasing functions, legal and social aspects, operations and technical activities. This mechanism of Inplant training also provides an opportunity for the industries to contribute during the formative period of student's development.

Course Outcomes: Student should be able to

CO1	To gain first-hand experience of working as an engineering professional, including the technical application of engineering methods.
CO2	To work with other engineering professionals and to experience the discipline of working in a professional organization.
CO3	Develop technical, interpersonal and communication skills, both oral and written.
CO4	Develop insight into communication aspects of engineers with other Professional groups.
CO5	Observe the functioning and organization of business and companies and prepare the reports
CO6	Exposure to management programmes and systems, effective administration methods and compile the information

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	3	3	3	3	3	3	2	1
CO2	2	3	3	3	3	3	3	2	2
CO3	2		2	3	3	3	3	2	2
CO4	2		2	3	3	3	3	3	2
CO5	2		2	3	3	3	3	3	3
CO6	3		3	3	3	3	3	1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. H.K. Kadam	Rtd. HR Manager	RCF Pvt. Ltd.
2	Mr. F.S. Bagwan	Lecturer in Instrumentation Engg	Govt. Polytechnic Mumbai
3	Mr U. B. Shinde	Lecturer in Instrumentation Engg	Govt. Polytechnic Mumbai
4	Mr K.U. Dawane	Lecturer in Instrumentation Engg	Govt. Polytechnic Mumbai

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