



# **Government Polytechnic, Mumbai**

*Department of Electrical  
Engineering*

## **P-19 Curriculum**

**(Sandwich Pattern + Out Come Based)**

# **Department of Electrical Engineering**

## **INSTITUTE VISION**

Transform knowledge into work

## **INSTITUTE MISSION**

We are committed to:

- quality education for lifelong 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 values, safety and environment friendly practices and teaching learning innovations.

## **DEPARTMENT VISION**

**Develop competent electrical professionals and practicing engineers.**

## **DEPARTMENT MISSION**

We are committed for quality education through

- continuous up-gradation of the faculties and laboratories.
- development and up gradation of standard, safe laboratory practices.
- creating entrepreneurial awareness.
- developing the consciousness of energy management and renewable energy.
- serving the society

## **Department of Electrical Engineering**

### **PROGRAM OUTCOMES (POs) - 07**

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 analyze 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 analyze individual needs and engage in updating in the context of technological changes.

## **Department of Electrical Engineering**

### **PROGRAM EDUCATIONAL OBJECTIVES (PEO)**

**PEO1.** The students will practice their Technical skills to meet the need of industry and society.

**PEO2.** The students will practice their profession with ethics, integrity, safety and social Responsibility with attention to health, environment, team work and effective communication.

**PEO3.** They will be able to upgrade their knowledge by life-long learning in the context of technological changes to enhance technical and entrepreneurial abilities.

### **PROGRAM SPECIFIC OUTCOMES (PSO)**

**PSO1:** The ability to operate, supervise, test and maintain the various machineries, electrical installations and power system equipments.

**PSO2:** The ability to carry out energy audit, prepare electrical estimates and costing and to read, interpret and implement electrical drawing.

**PSO3:** The ability to practice profession with attention to energy conservation, ethical principles, safety, environmental aspects and socially beneficial activities.

# **Government Polytechnic Mumbai**



## **Curriculum Philosophy** **(P19 Outcome based Curriculum)** **(Sandwich Pattern)**

## 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 cope with 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 MOOC in 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 considering evolving 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 the knowledge 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 Programwise Board of Studies. I acknowledge all the stake holders, alumines 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 knowing what 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? Identify 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



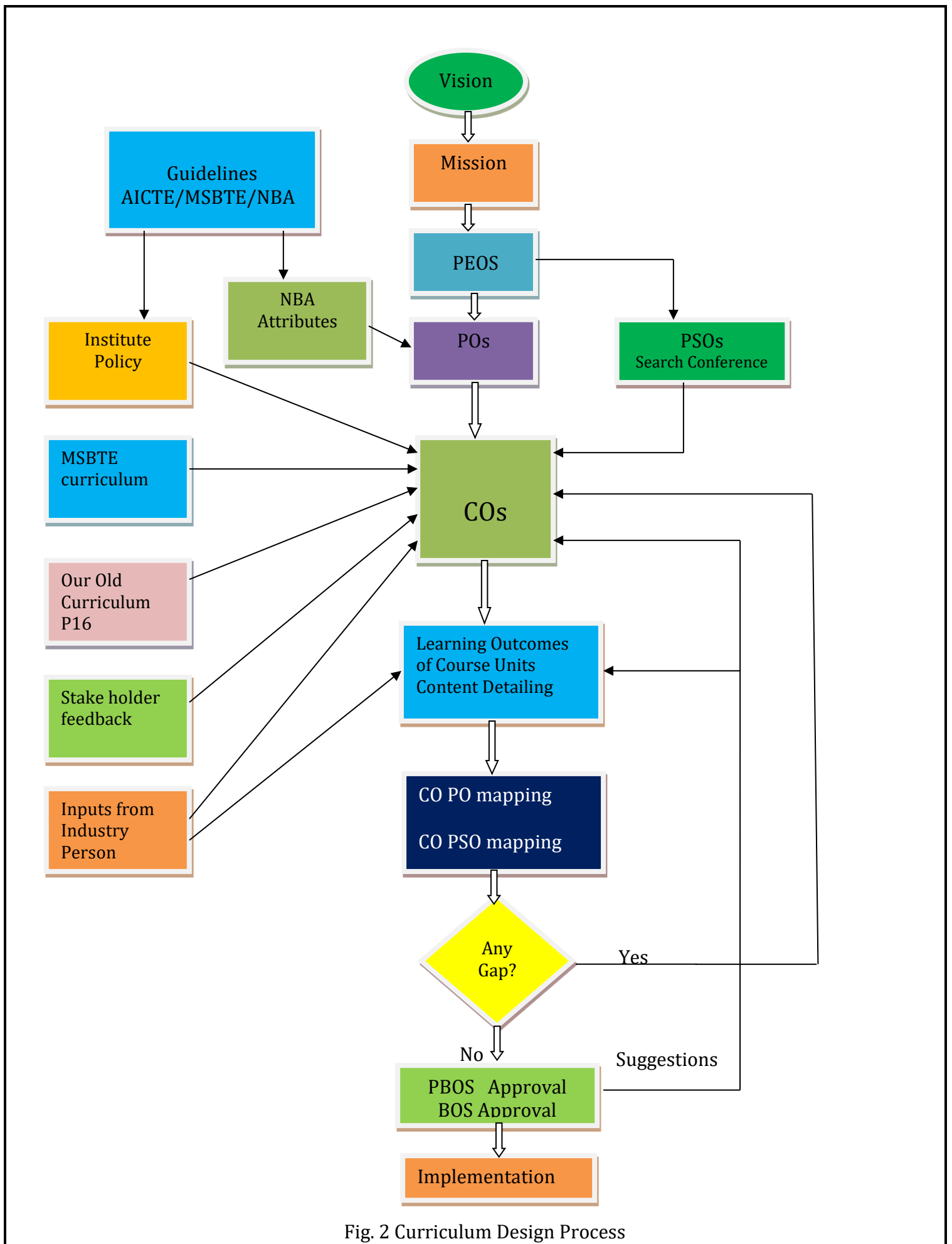


Fig. 2 Curriculum Design Process

Figure 1 shows outcome based education philosophy. Vision and mission statements will be 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 lifelong 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 analyze 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 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 statements are 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 curriculum should be offered to students, we have offered Outcome based curriculum in 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 framework 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.

2019 curriculum 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 incorporated six 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**

<b>Year</b>	<b>Semester</b>	<b>Credits</b>	<b>Teaching hours</b>	<b>Marks</b>
<b>First</b>	<b>First</b>	30	35	600 to 700
	<b>Second</b>	30	35	600 to 700
<b>Second</b>	<b>Third</b>	30	35	600 to 700
	<b>Fourth</b>	35	35	700 to 800
<b>Third</b>	<b>Fifth</b>	35	35	700 to 800
	<b>Sixth</b>	20	40	200
<b>Total</b>		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 5<sup>th</sup> semester and Inplant training will be considered along with weightage of third and fourth semester courses as shown in following table.

All courses of fifth semester	700 to 800 Marks
Inplant Training	200 Marks
Consolidated marks of third and fourth semester*	200 marks
Total marks	1100 to 1200 Marks

\*Consolidated Marks of third and fourth semester – the total marks of third and fourth semesters are converted to 100 marks each. These marks are then added (3<sup>rd</sup>Sem + 4<sup>th</sup>sem) as 100+100 = 200 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 burden 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 incompleteness of MOOC. Whenever student completes certification, in that term, in the result of term end examination credits will be allotted.

If a MOOC is performed through NPTEL, course is free but for getting certification, student has to pay extra fees. In such a case, to avoid financial burden on students, MCQ based examination of such courses will be conducted by respective departments and certification can be provided by respective department. For certification, passing criteria of 40% should be used.



## 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
ME	Mechanical Engineering

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.

## Department of Electrical Engineering

### 180 Credit Scheme P-19 Level Wise Marks Distribution

P-19 curriculum scheme is divided into 5 levels.

- Science & Humanities (10 to 15%)
- Core Technology Courses (25 to 30%)
- Applied Technology Courses (45 to 50%)
- Diversified Courses (5 to 10%)
- Management Courses (3 to 5%)

Sr. No.	Course Level	Course Code	Credits	% of Course Level	Marks	% of Marks
1	Science & Humanities	HU 19101, SC 19101, SC 19105, SC 19110, SC 19106, HU 19102	24	13.33	700	17.72
2	Core Technology Courses	EE 19201, EE 19202, ME 19208, EE 19204, EC 19207, EE 19203, EE 19205, EE 19207, EE 19208, EE 19209	48	26.67	1000	25.32
3	Applied Technology Courses	EE 19301, EE 19302, EE 19303, EE 19304, EE 19305, EE 19306, EE 19307, EE 19308, EE 19309, EE 19310, EE 19311	78	43.33	1575	39.87
4	Diversified Courses	EE 19401, EE 19402, EE 19403, EE 19404, EE 19405, EE 19406, EE 19407, EE 19408	28	15.55	625	15.82
5	Management Courses	EE 19501	02	1.11	50	1.27
		<b>Total Credits</b>	<b>180</b>	<b>100</b>	<b>3950</b>	<b>100</b>

**Department of Electrical Engineering**

**Semester wise Credit and Marks Distribution**

<b>Sr. No.</b>	<b>Semester</b>	<b>Theory</b>	<b>PR / OR / TW</b>	<b>Total</b>	<b>Total Credits</b>	<b>Total Teaching Hrs</b>
<b>1</b>	First	400	300	700	30	35
<b>2</b>	Second	400	275	675	30	35
<b>3</b>	Third	400	275	675	30	35
<b>4</b>	Fourth	500	350	850	35	35
<b>5</b>	Fifth	400	450	850	35	35
<b>6</b>	Sixth	00	200	200	20	40
<b>7</b>	<b>Total</b>	<b>2100</b>	<b>1850</b>	<b>3950</b>	<b>180</b>	<b>215</b>

**Total Marks - 3950;**

**Theory Marks - 2100 (53.16%);**

**PR / OR / TW Marks - 1850 (46.84%)**

<b>P-19 Curriculum Chart at a Glance (Dept. of Electrical Engg.) G.P. Mumbai</b>						
<b>Sr. No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Cre dits</b>	<b>TH</b>	<b>PR/OR/TW</b>	<b>Total Teaching Hours</b>
<b>First Semester</b>						
1	HU 19 101	Communication Skills	4	2	2 PR	4
2	SC 19 101	Basic Physics	5	3	2 PR	5
3	SC 19 105	Basic Mathematics	4	4	--	4
4	EE 19 201	Basic Electrical Engineering	6	4	2 PR	6
5	EE 19 202	Electrical Materials and Wiring	4	2	2 PR	4
6	ME 19 208	Engineering Graphics	3	1	2 PR	3
7	EE 19 204	Libre-Office Calc <sup>#</sup> (Spoken Tutorial)	4 <sup>#</sup>	--	4TU	4 <sup>#</sup>
8	Students Centered Activity (SCA)					5
<b>Total</b>			<b>30</b>			<b>35</b>
<b>Second Semester</b>						
1	SC 19 110	Engineering Mathematics	4	4	--	4
2	SC 19 106	Applied Chemistry	5	3	2 PR	5
3	EC 19 207	Elements of Electronics Engineering	6	4	2 PR	6
4	EE 19 203	Computer Aided Electrical Drawing	4	-	4 PR	4
5	EE 19 301	Electrical & Industrial Measurement	8	4	4 PR	8
6	EE 19 205	C-Programming <sup>#</sup> (Spoken Tutorial)	3 <sup>#</sup>	--	3TU	3 <sup>#</sup>
7	Students Centered Activity (SCA)					5
<b>Total</b>			<b>30</b>			<b>35</b>
<b>Third Semester</b>						
1	HU 19 102	Environmental Studies	2	--	2 TU	2
2	EE 19 207	Electrical Power Generation	4	4	--	4
3	EE 19 208	Electrical Circuit & Network	8	4	2 PR& 2TU	8
4	EE 19 209	DC Machine & Transformer	6	4	2 PR	6
5	EE 19 302	Elect. Transmission & Distribution	6	4	2 PR	6
6	EE 19 303	Linux (Spoken Tutorial)	4 <sup>#</sup>	--	4TU	4 <sup>#</sup>
7	Students Centered Activity (SCA)					5
<b>Total</b>			<b>30</b>			<b>35</b>
<b>Fourth Semester</b>						
1	EE 19 304	Electrical Estimation & Costing	6	4	2 TU	6
2	EE 19 305	Utilization of Electrical Energy	6	4	2 TU	6
4	EE 19 306	AC Machines	8	4	2 PR& 2TU	8
5	EE 19 401	Fundamentals of Power Electronics	6	4	2 PR	6
6	EE 19 402	Special Machines (Optional)	6	4	2 TU	6
	EE 19 403	Illumination Engineering (Optional)	6	4	2 TU	6
7	EE 19 404	Arduino <sup>#</sup> (Spoken Tutorial)	3 <sup>#</sup>	--	3 TU	3 <sup>#</sup>
<b>Total</b>			<b>35</b>			<b>35</b>
<b>Fifth Semester</b>						
1	EE 19 307	Switchgear & Protection	6	4	2 PR	6
2	EE 19 308	Testing & Maintenance of Elect. Equip.	6	4	2 PR	6
3	EE 19 309	Project & Presentation	4	--	4 PR	4
4	EE 19 310	Elect. Energy Conservation & Audit	4	3	1 TU	4
5	EE 19 405	Industrial Automation	6	4	2 PR	6
6	EE 19 406	Electric Mobility (Optional)	4	3	1 TU	4
	EE 19 407	Emerging Trends in Electrical Engg. (Opt)	4	3	1 TU	4
7	EE 19 501	Entrepreneurship & Start-Ups	2	--	2 PR	2
8	EE 19 408	LaTeX <sup>#</sup> (Spoken Tutorial)	3 <sup>#</sup>	--	3 TU	3 <sup>#</sup>
<b>Total</b>			<b>35</b>			<b>35</b>
<b>Sixth Semester</b>						
1	EE 19 311	In-plant Training	<b>20</b>	--	40 PR	40
<b>Grand Total (Credits)</b>			<b>180</b>		<b>Teaching Hrs</b>	<b>215</b>

**GOVERNMENT POLYTECHNIC MUMBAI**  
 (Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
**With effect from AY 2019-20**

Programme: Diploma in Electrical Engineering (Sandwich Pattern)

Term / Semester - I

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		TH	TS1	TS2	PR	OR	TW	Total
HU 19 101	Communication Skills	2	2	0	4	4	60	20	20	25*	0	25	150
SC 19 101	Basic Physics	3	2	0	5	5	60	20	20	25*	0	25	150
SC 19 109	Basic Mathematics	4	0	0	4	4	60	20	20	0	0	0	100
EE 19 201	Basic Electrical Engineering	4	2	0	6	6	60	20	20	50*	0	0	150
EE 19 202	Electrical Materials and Wiring	2	2	0	4	4	0	0	0	50*	0	50	100
ME 19 208	Engineering Graphics	1	2	0	3	3	0	0	0	25*	0	25	50
EE 19 204	Libre-Office Calc <sup>#</sup> (Spoken Tutorial)	--	--	4	4 <sup>#</sup>	4 <sup>#</sup>	--	--	--	--	--	--	--
<b>Total</b>		<b>16</b>	<b>10</b>	<b>04</b>	<b>30</b>	<b>30</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>200</b>	<b>00</b>	<b>100</b>	<b>700</b>
Students Centred Activity (SCA)					<b>5</b>								
					<b>35</b>								

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 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.

Department Coordinator,  
 Curriculum Development,  
 Dept. of Electrical Engineering

Head of Department  
 Dept. of Electrical Engineering

In-Charge  
 Curriculum Development Cell

Principal

# GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomously Institute, Government of Maharashtra)

**Teaching and Examination Scheme (P19)**

**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - II**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
SC 19 110	Engineering Mathematics	4	0	0	4	4	60	20	20	0	0	0	100
SC 19 106	Applied Chemistry	3	2	0	5	5	60	20	20	25*	0	25	150
EC 19 207	Elements of Electronics Engineering	4	2	0	6	6	60	20	20	25*	0	25	150
EE 19 203	Computer Aided Electrical Drawing	0	4	0	4	4	0	0	0	50*	0	50	100
EE 19 301	Electrical and Industrial Measurement	4	4	0	8	8	60	20	20	50*	0	25	175
EE 19 205	C-Programming# (Spoken Tutorial)	--	--	3	3	3	--	--	--	--	--	--	--
	<b>Total</b>	<b>15</b>	<b>12</b>	<b>03</b>	<b>30</b>	<b>30</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>150</b>	<b>00</b>	<b>125</b>	<b>675</b>
Student Centered Activity (SCA)					<b>05</b>								
Total Contact Hours					<b>35</b>								

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 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.

Department Coordinator,  
Curriculum Development,  
Dept. of Electrical Engineering

Head of Department  
Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

Principal

**GOVERNMENT POLYTECHNIC MUMBAI**  
 (Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - III**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
HU 19 102	Environmental Studies	--	--	2	02	02	--	--	--	--	25	25	50
EE 19 207	Electrical Power Generation	4	--	--	04	04	60	20	20	--	--	--	100
EE 19 208	Electrical Circuit & Network	4	2	2	08	08	60	20	20	50*	--	25	175
EE 19 209	DC Machine & Transformer	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 302	Electrical Transmission & Distribution	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 303	Linux <sup>#</sup> (Spoken Tutorial)	--	--	4	04 <sup>#</sup>	04 <sup>#</sup>	--	--	--	--	--	--	--
<b>Total</b>		<b>16</b>	<b>06</b>	<b>08</b>	<b>30</b>	<b>30</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>150</b>	<b>25</b>	<b>100</b>	<b>675</b>
Student Centered Activity (SCA)					<b>05</b>								
Total Contact Hours					<b>35</b>								

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 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.

Department Coordinator,  
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**GOVERNMENT POLYTECHNIC MUMBAI**  
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**Teaching and Examination Scheme (P19)**  
**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
EE 19 304	Electrical Estimation & Costing	4	--	2	06	06	60	20	20	--	50*	25	175
EE 19 305	Utilization of Electrical Energy	4	--	2	06	06	60	20	20	--	50*	--	150
EE 19 306	AC Machines	4	2	2	08	08	60	20	20	50*	--	50	200
EE 19 401	Fundamentals of Power Electronics	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 402	Special Machines (Optional)	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 403	Illumination Engineering (Optional)	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 404	Arduino <sup>#</sup> (Spoken Tutorial)	--	--	3	03 <sup>#</sup>	03 <sup>#</sup>	--	--	--	--	--	--	--
<b>Total</b>		<b>20</b>	<b>06</b>	<b>09</b>	<b>35</b>	<b>35</b>	<b>300</b>	<b>100</b>	<b>100</b>	<b>150</b>	<b>100</b>	<b>100</b>	<b>850</b>
Total Contact Hours					<b>35</b>								

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 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.

Department Coordinator,  
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**GOVERNMENT POLYTECHNIC MUMBAI**  
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**Teaching and Examination Scheme (P19)**  
With effect from AY 2019-20

Programme: Diploma in Electrical Engineering (Sandwich Pattern)

Term / Semester - V

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
EE 19 307	Switchgear & Protection	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 308	Testing & Maintenance of Electrical Equipment's	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 309	Project & Presentation	--	4	--	04	04	--	--	--	--	50*	50	100
EE 19 310	Electrical Energy Conservation & Audit	3	--	1	04	04	--	--	--	--	50*	50	100
EE 19 405	Industrial Automation	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 406	Electric Mobility (Optional)	3	--	1	04	04	60	20	20	--	25*	25	150
EE 19 407	Emerging Trends in Electrical Engineering (Optional)	3	--	1	04	04	60	20	20	--	25*	25	150
EE19 501	Entrepreneurship & Start-Ups	--	2	--	02	02	--	--	--	--	25*	25	50
EE 19 408	LaTeX# (Spoken Tutorial)	--	--	3	03#	03#	--	--	--	--	--	--	--
<b>Total</b>		<b>18</b>	<b>12</b>	<b>05</b>	<b>35</b>	<b>35</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>850</b>
Total Contact Hours					<b>35</b>								

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 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.

Department Coordinator,  
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# GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomously Institute, Government of Maharashtra)

**Teaching and Examination Scheme (P19)**

**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester – VI**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
EE 19 311	In-Plant Training	--	40	--	40	20	--	--	--	--	100*	100*	200
	<b>Total</b>	--	<b>40</b>	--	<b>40</b>	<b>20</b>	--	--	--	--	<b>100</b>	<b>100</b>	<b>200</b>

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 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.

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Dept. of Electrical Engineering

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Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

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## Department of Electrical Engineering

### First Year Electrical Engineering- List of Exemption Courses

(Entry Qualification higher than SSC)

The details of the exemption of courses for the students those who are admitted to First year Electrical Engineering Diploma with higher entry education are expressed in the following table. (If till some cases are special then accordingly the decision will be taken)

Sr. No	Entry Qualification	Course Exemption (Title & Code)	Sem ester	Credit Exemption	Total Credits Exempted
1	HSC Science (PCM - Electrical Maintenance)	1. Communication Skills (HU19101) 2. Basic Physics (SC19101) 3. Basic Mathematics (SC19105) 4. Electrical Materials and Wiring (EE19202) 5. Engineering Mathematics (SC19110) 6. Applied Chemistry (SC19106) 7. Environmental Studies (HU19102)	I  I I I  II  II III	4  5 4 4  4  5 2	28
2	HSC Vocational (Electrical Technology 1,2,3)	1. Communication Skills (HU19101) 2. Basic Electrical Engineering (EE19201) 3. Electrical Materials and Wiring (EE19202) 4. Environmental Studies (HU19102)	I  I I  III	4  6 4  2	18
3	HSC Science (PCMB)	1. Communication Skills (HU19101) 2. Basic Physics (SC19101) 3. Basic Mathematics (SC19105) 4. Engineering Mathematics (SC19110) 5. Environmental Studies (HU19102)	I  I I II  III	4  5 4 4  2	19
4	ITI (Electrician)	1. Electrical Materials and Wiring (EE19202)	I	4	04

Dept. CDC Coordinator

Inst. CDC Coordinator

H.O.D

Principal

## Department of Electrical Engineering

### Direct Second Year Electrical Engineering- List of Backlog Courses

(Directly Admitted to Second Year Electrical Engineering)

The details of the Backlog course for the students those who are admitted directly to Second year (III<sup>rd</sup> Sem) Electrical Engineering Diploma they have to appear for the Backlog Courses which are expressed in the following table. (If till some cases are special then accordingly the decision will be taken)

Sr. No	Odd / Even Semester	Backlog Courses (Title & Code)	Sem ester	Credit	Total Credits
1	Odd Sem (During Sem-III)	1. Basic Mathematics (SC19105) 2. Basic Electrical Engineering (EE19201)	I I	4 6	10
2	Even Sem (During Sem-IV)	1. Elements of Electronics Engineering (EC19207) 2. Computer Aided Electrical Drawing (EE19203)	II II	6 4	10

The students who are admitted directly to second year, they have to complete their two backlog courses of Sem-I during Odd Sem (Sem-III) & two backlog courses of Sem-II during Even Sem (Sem-IV).

Dept. CDC Coordinator

Inst. CDC Coordinator

H.O.D

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## Department of Electrical Engineering

The following courses for our represents the equivalence courses for P-16 to P-19 scheme

### Equivalence Courses for Electrical Engg. Programmes

<b>Semester I (First)</b>						
Sr. No.	P-16 Scheme			P-19 Scheme		
	Course Code	Course Title	Credits	Course Code	Course Title	Credits
	HU16 101	Basics of Communication	3	HU 19 101	Communication Skills	4
	SC16 104	Engineering Physics	5	SC 19 101	Basic Physics	5
	SC16 107	Mathematics-I	4	SC 19 109	Basic Mathematics	4
	AM16 201	Engineering Mechanics	5			
	CO16 202	C-Programming	4	EE 19 205	C-Programming <sup>#</sup> (Spoken Tutorial)	3
	HU16 103	Generic Skills	2	<b>No Equivalence</b>		
	WS16 201	Workshop Practice	4	<b>No Equivalence</b>		
	CO16 203	Computer Workshop	2	EE 19 204	Libre-Office Calc <sup>#</sup> (Spoken Tutorial)	4
<b>Semester II (Second)</b>						
	HU16 102 <sup>#</sup>	Communication Skills <sup>#</sup>	2	HU 19 101	Communication Skills	4
	SC16 108	Mathematics-II <sup>*</sup>	4	SC 19 110	Engineering Mathematics	4
	SC16 106	Chemistry of Engineering Material	5	SC 19 106	Applied Chemistry	5
	EE16 202	Basic Electrical Engg.	8	EE 19 201	Basic Electrical Engineering	6
	EC16 202	Elements of Electronics Engineering <sup>**</sup>	6	EC 19 207	Elements of Electronics Engineering	6
	ME16 201	Engineering Drawing-I	6	ME 19 208	Engineering Graphics	3
<b>Semester III (Third)</b>						
	EE16 208	Electrical Material and Wiring	4	EE 19 202	Electrical Materials and Wiring	4
	EE16 209	Electrical Measurement	7	EE 19 301	Electrical & Industrial Measurement	8
	EE16 210 <sup>#</sup>	Electrical Power Generation <sup>#</sup>	4	EE 19 207	Electrical Power Generation	4
	ME16 211	Elements of Mechanical Engg.	4	<b>No Equivalence</b>		
	HU16 104	Environmental Studies	2	HU 19 102	Environmental Studies	2
	EE16 211	Electrical Circuit & Network	7	EE 19 208	Electrical Circuit & Network	8
	EE16 212	DC Machine & Transformer	7	EE 19 209	DC Machine & Transformer	6

<b>Semester IV (Fourth)</b>						
	EE16 501	Professional Practices	2	EE19 501	Entrepreneurship & Start-Ups	2
	EE16 301	Maintenance of Domestic Appliances	4	EE 19 202	Electrical Materials and Wiring	4
	EE16 302	Industrial Measurement	7	EE 19 301	Electrical & Industrial Measurement	8
	EE16 303 <sup>#</sup>	Electrical Transmission & Distribution <sup>#</sup>	5	EE 19 302	Elect. Transmission & Distribution	6
	EE16 304	Utilization of Electrical Energy	5	EE 19 305	Utilization of Electrical Energy	6
	EE16 307	AC Machines	6	EE 19 306	AC Machines	8
	EE16 402	Renewable Energy Sources	6	EE 19 207	Electrical Power Generation	4
<b>Semester V (Fifth)</b>						
	EE16 213	Computer Aided Electrical Drawing	3	EE 19 203	Computer Aided Electrical Drawing	4
	EE16 305	Electrical Energy Conservation & Audit	6	EE 19 310	Electrical Energy Conservation & Audit	4
	EE16 306	Switchgear & Protection	5	EE 19 307	Switchgear & Protection	6
	EE16 308	Project and Seminar –I	4	EE 19 309	Project & Presentation	4
	EE16 401	Power Electronics & Drives	6	EE 19 401	Fundamentals of Power Electronics	6
	EE16 403	Principles of Control System	5	<b>No Equivalence</b>		
	EE16 404	Illumination Engineering (Optional)	3	EE19 403	Illumination Engineering (Optional)	6
	EE16 405	Power System Analysis (Optional)	3	<b>No Equivalence</b>		
	EE16 312	Industrial Training -I	4	EE19 311	Im-Plant Training	20
<b>Semester VI (Sixth)</b>						
	EE16 309	Electrical Estimation and Costing	5	EE 19 304	Electrical Estimation & Costing	6
	EE 16 310	Project and Seminar-II	4	EE 19 309	Project & Presentation	4
	EE 16 311	Testing & Maintenance of Electrical Equipments	7	EE 19 308	Testing & Maintenance of Elect. Equip.	6
	EE16 408	Microcontroller and Applications (Optional)	5	<b>No Equivalence</b>		
	EE16 406	Special Machines (Optional)	5	EE19 402	Special Machines (Optional)	6
	EE16 407	Industrial Automation	5	EE 19 405	Industrial Automation	6
	EE16 313	Industrial Training -II	2	EE19 311	Im-Plant Training	20
	MG16 502	Entrepreneurship Development	3	EE19 501	Entrepreneurship & Start-Ups	2
	MG16 501 <sup>#</sup>	Industrial Organization & Management <sup>#</sup>	3	EE19 501	Entrepreneurship & Start-Ups	2

New Courses offered in P-19 Scheme						
				EE 19 303	Linux <sup>#</sup> (Spoken Tutorial)	4
				EE 19 404	Arduino <sup>#</sup> (Spoken Tutorial)	3
				EE 19 408	LaTeX <sup>#</sup> (Spoken Tutorial)	3
				EE 19 406	Electric Mobility (Optional)	4
				EE 19 407	Emerging Trends in Elect. Engg (Optional)	4
Non Creditable Courses in P-16 scheme						
	NC16 101	Yoga				
	NC16 102	Social Work				
	NC16 201	Spoken Tutorial Work				
	NC16 202	Digital India				

**Red color-** Courses which are repeated

**Green color-** Courses which are new in P-19 scheme

**Purple color-** Non creditable Courses in P-16 scheme

For following P-19 courses there are more than one courses equivalent in P-16 courses.

Sr. No.	P-19 Scheme		P-16 Scheme		Remark
	Course Code	Course Title	Course Code	Course Title	
1	HU 19 101	Communication Skills (Sem-I)	HU 16 101	Basics of Communication (Sem-I)	If student clear any one or two of P-16 courses then he will be awarded 4 credits
			HU 16 102	Communication Skills (Sem-II)	
2	EE 19 202	Electrical Materials & Wiring (Sem-I)	EE 16 208	Electrical Material & Wiring (Sem-III)	If student clear any one or two of P-16 courses then he will be awarded 4 credits
			EE 16 301	Maintenance of Domestic Appliances (Sem-IV)	
3	EE 19 207	Electrical Power Generation (Sem-III)	EE16 210	Electrical Power Generation	If student clear any one or two of P-16 courses then he will be awarded 4 credits
			EE 16 402	Renewable Energy Sources (Sem-III)	
4	EE 19 309	Project & Presentation (Sem-V)	EE 16 308	Project & Seminar-I (Sem-V)	Here student has to clear both P-16 courses, then he will be awarded 4 credits
			EE 16 310	Project & Seminar-II (Sem-VI)	

5	EE 19 311	Im-Plant Training (Sem-VI)	EE 16 312	Industrial Training-I (Sem-V)	Here student has to clear both P-16 courses, then he will be awarded 20 credits
			EE 16 313	Industrial Training-II (Sem-VI)	
6	EE 19 501	Entrepreneurship & Start-Ups (Sem-V)	EE 16 501	Professional Practices (Sem-IV)	If student clear any one or two or three of P-16 courses then he will be awarded 2 credits
			MG16 502	Entrepreneurship Development (Sem-VI)	
			MG16 501	Industrial Organization & Management (Sem-VI)	

**Head of Department Electrical Engg.**

**G.P. Mumbai**

**Principal**

**G.P. Mumbai**



## Change of Branch

If the student is eligible to change the course from any available branches to Electrical Engg., then he has to know the primary knowledge of following courses and has to clear the registered courses mentioned in the table.

Sr. No.	First Year Branch	Primary Courses (Code & Title)	Credits / TH-PR-TU / Marks	Courses to be Registered during Odd / Even semester (Code & Title)	Credits / TH-PR-TU / Marks
1	Civil Engg.	1. EE19202 Electrical Materials & Wiring 2. EC19207 Elements of Electronics Engg.	1. 4 / TH-2, PR-2 / 100 (PR-50* & TW-50) 2. 6 / TH-4, PR-2 / 150 (TH-100, PR-25* & TW-25)	1. EE19201 Basic Electrical Engg. 2. EE19301 Electrical & Industrial Measurement	1. 6 / TH-4, PR-2 / 150 (TH-100, PR-50*) 2. 8 / TH-4, PR-4 / 150 (TH-100, PR-50*, TW-25)
2	Computer Engg.	1. EE19202 Electrical Materials & Wiring	1. 4 / TH-2, PR-2 / 100 (PR-50* & TW-50)	1. EE19201 Basic Electrical Engg. 2. EE19301 Electrical & Industrial Measurement	1. 6 / TH-4, PR-2 / 150 (TH-100, PR-50*) 2. 8 / TH-4, PR-4 / 150 (TH-100, PR-50*, TW-25)
3	Electronics Engg.	1. EE19202 Electrical Materials & Wiring	1. 4 / TH-2, PR-2 / 100 (PR-50* & TW-50)	1. EE19201 Basic Electrical Engg. 2. EE19301 Electrical & Industrial Measurement	1. 6 / TH-4, PR-2 / 150 (TH-100, PR-50*) 2. 8 / TH-4, PR-4 / 150 (TH-100, PR-50*, TW-25)
4	Information Technology	1. EE19202 Electrical Materials & Wiring	1. 4 / TH-2, PR-2 / 100 (PR-50* & TW-50)	1. EE19201 Basic Electrical Engg.	1. 6 / TH-4, PR-2 / 150 (TH-100, PR-50*)

				2. EE19301 Electrical & Industrial Measurement	2. 8 / TH-4, PR-4 / 150 (TH- 100, PR- 50*, TW- 25)
5	Instrumentation Engg.	1. EE19202 Electrical Materials & Wiring	1. 4 / TH-2, PR-2 / 100 (PR- 50* & TW-50)	1. EE19201 Basic Electrical Engg.	1. 6 / TH-4, PR-2 / 150 (TH- 100, PR- 50*)
6	Mechanical Engg.	1. EE19202 Electrical Materials & Wiring	1. 4 / TH-2, PR-2 / 100 (PR- 50* & TW-50)	1. EE19201 Basic Electrical Engg. 2. EE19301 Electrical & Industrial Measurement	1. 6 / TH-4, PR-2 / 150 (TH- 100, PR- 50*) 2. 8 / TH-4, PR-4 / 150 (TH- 100, PR- 50*, TW- 25)
7	Leather Goods / Leather Technology	1. EE19202 Electrical Materials & Wiring 2. EC19207 Elements of Electronics Engg.	1. 4 / TH-2, PR-2 / 100 (PR- 50* & TW-50) 2. 6 / TH-4, PR-2 / 150 (TH- 100, PR- 25* & TW-25)	1. EE19201 Basic Electrical Engg. 2. EE19301 Electrical & Industrial Measurement	1. 6 / TH-4, PR-2 / 150 (TH- 100, PR- 50*) 2. 8 / TH-4, PR-4 / 150 (TH- 100, PR- 50*, TW- 25)
8	Rubber Technology	1. EE19202 Electrical Materials & Wiring 2. EC19207 Elements of Electronics Engg.	1. 4 / TH-2, PR-2 / 100 (PR- 50* & TW-50) 2. 6 / TH-4, PR-2 / 150 (TH- 100, PR- 25* & TW-25)	1. EE19201 Basic Electrical Engg. 2. EE19301 Electrical & Industrial Measurement	1. 6 / TH-4, PR-2 / 150 (TH- 100, PR- 50*) 2. 8 / TH-4, PR-4 / 150 (TH- 100, PR- 50*, TW- 25)

Head of Electrical Engg.  
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# **Department of Electrical Engineering**

## **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 Electrical Engineering*

**P-19 Curriculum  
(Sandwich Pattern)**

**Semester-I  
(Course Contents)**

**GOVERNMENT POLYTECHNIC MUMBAI**  
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**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - I**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		TH	TS1	TS2	PR	OR	TW	Total
HU 19 101	Communication Skills	2	2	0	4	4	60	20	20	25*	0	25	150
SC 19 101	Basic Physics	3	2	0	5	5	60	20	20	25*	0	25	150
SC 19 109	Basic Mathematics	4	0	0	4	4	60	20	20	0	0	0	100
EE 19 201	Basic Electrical Engineering	4	2	0	6	6	60	20	20	50*	0	0	150
EE 19 202	Electrical Materials and Wiring	2	2	0	4	4	0	0	0	50*	0	50	100
ME 19 208	Engineering Graphics	1	2	0	3	3	0	0	0	25*	0	25	50
EE 19 204	Libre-Office Calc# (Spoken Tutorial)	--	--	4	4#	4#	--	--	--	--	--	--	--
	<b>Total</b>	<b>16</b>	<b>10</b>	<b>04</b>	<b>30</b>	<b>30</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>200</b>	<b>00</b>	<b>100</b>	<b>700</b>
	Students Centred Activity (SCA)				<b>5</b>								
					<b>35</b>								

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 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.

Department Coordinator,  
Curriculum Development,  
Dept. of Electrical Engineering

Head of Department  
Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

Principal

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

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 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

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

**Course Content Details:**

Unit No	Topics / Sub-topics
---------	---------------------

<b>1</b>	<p><b>Introduction to Communication</b>            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</p> <p><b>Course Outcome: CO1      Teaching Hours :6 hrs      Marks: 14 (R- 2, U-4, A-8)</b></p>
<b>2</b>	<p><b>Non- verbal Communication</b>            2.1 Meaning and Importance of Non-verbal Communication            2.2 Body Language            2.3 Aspects of Body Language            2.4 Graphic language</p> <p><b>Course Outcome: CO2      Teaching Hours :6 hrs      Marks: 12 (R- 4, U-4, A-4)</b></p>
<b>3</b>	<p><b>Group Discussion And Interview Skills</b>            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</p> <p><b>Course Outcome: CO3      Teaching Hours :6 hrs      Marks: 10 (R-2, U-4, A-4)</b></p>
<b>4</b>	<p><b>Presentation Skills</b>            4.1 Presentation Skills - Tips for effective presentation            4.2 Guidelines for developing PowerPoint presentation</p> <p><b>Course Outcome: CO4      Teaching Hours :4 hrs      Marks: 08 (R- 2, U-2, A-4)</b></p>
<b>5</b>	<p><b>Business Correspondence</b>            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</p> <p><b>Course Outcome: CO5      Teaching Hours: 8 hrs      Marks: 16 (R- 4, U-4, A-8)</b></p>

**List of experiments: Any 10 experiments out of 15**

Sr. No.	Unit No	COs	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.	02



			b) Job Application With Resume.		
6	1	CO1	Communication Barriers	02	
7	5	CO5	Business Letters – a) Enquiry b)Order c)Complaint	02	
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	02	
15		CO1	*Vocabulary Building	02	
				<b>Total</b>	<b>30</b>

**Note:** Experiments No.1 to 10 are compulsory. Remaining experiments are to be performed on availability of time.\* These experiments will be performed during practical hours only.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Communication Skills	Joyeeta Bhattacharya - Reliable Series	9780000176981, 0000176982
2	Communication Skills	Sanjay Kumar, PushpaLata- Oxford University Press	13: 978-0199488803
3	Successful presentation Skills	Andrew Brad bury- The Sunday Times	13: 9780749456627

#### E-References:

- 1) Website: [www.mindtools.com/page8.html](http://www.mindtools.com/page8.html)-99k
- 2) Website: [www.inc.com/guides/growth/23032.html](http://www.inc.com/guides/growth/23032.html)-4
- 3) Website: [www.khake.com/page66htm/](http://www.khake.com/page66htm/)-72k

Communication Skills (HU19101)

P-19 Scheme



- 4) Website: [www.BMConsultantIndia.com](http://www.BMConsultantIndia.com)
- 5) <https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-English>
- 6) MYCBSEGUIDE
- 7) Website: [www.letstak.co.in](http://www.letstak.co.in)
- 8) <https://learnenglishteens.britishcouncil.org/>

**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 Trainer/Consultant	
3	Mrs.S.S. Kulkarni	Lecturer in English	Government Polytechnic Pune
4	Mrs. K.S.Pawar	Lecturer in English	Government polytechnic Mumbai
5	Ms.N.N.Dhake	Lecturer in English	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 : <b>Diploma in EE/IS (Sandwich Pattern)</b>										
Course Code: <b>SC19101</b>				Course Title: <b>Basic Physics</b>						
Compulsory / Optional: <b>Compulsory</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs.30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>3</b>	<b>2</b>	<b>--</b>	<b>5</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>25*</b>	<b>--</b>	<b>25</b>	<b>150</b>

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 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	<p><b>Units and Measurements</b></p> <p>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</p> <p><b>Course Outcome: CO1    Teaching Hours: 6 hrs.    Marks: 08 (R- 2, U-2, A-4)</b></p>
2	<p><b>Motions</b></p> <p>2.1 <b>Linear motion</b> –Definition – distance, displacement, velocity, acceleration, retardation, equation of motions, acceleration due to gravity and equation motion under gravity, numerical  2.2 <b>Periodic motions:</b> 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 <b>Angular motion:</b> 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 acceleration , Three equations of motion (no derivations) , Centripetal and Centrifugal force, examples and applications.</p> <p><b>Course Outcome: CO2 Teaching Hours : 10 hrs., Marks: 10 (R- 2 , U- 4 , A- 4 )</b></p>
3	<p><b>Modern Physics</b></p> <p><b>3.1 Photo Electricity</b>  Concept of quantum theory of light, Einstein’s Photoelectric equation, Characteristics of photo electric effect, application of photo electric effect  <b>3.2 LASER</b>  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</p> <p><b>Course Outcome: CO3    Teaching Hours : 8 hrs., Marks: 10 (R- 2 , U- 4 , A- 4 )</b></p>
4	<p><b>4 Optics and Ultrasonic Waves</b></p> <p><b>4.1 Optics :</b>  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  <b>4.2 Ultrasonic Waves</b>  4.2.1 Ultrasonic waves and infrasonic waves.  4.2.2 Audible range of sound wave  4.2.3 Properties of ultrasonic wave.  4.2.4 Applications</p> <p><b>Course Outcome: CO3    Teaching Hours: 6 hrs. Marks: 10 (R- 2 , U- 4 , A-4 )</b></p>

<b>5</b>	<p><b>Nanotechnology</b>            5.1 Introduction to nanotechnology.            5.2 Definition of nanoscale, nanometer 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 defense</p> <p><b>Course Outcome: CO3 Teaching Hours :4 hrs. Marks: 8 (R- 2 , U-2 , A-4 )</b></p>
<b>6</b>	<p><b>General Properties of Matter</b>  <b>6.1 Elasticity:</b>            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  <b>6.2 Viscosity :</b>            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</p> <p><b>Course Outcome: CO4 Teaching Hours : 11 hrs Marks: 14 (R- 4 , U- 4 , A-6 )</b></p>

## Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	<b>Units and Measurements</b>	2	2	4	8
2	<b>Motion</b>	2	4	4	10
3	<b>Modern Physics</b>	2	4	4	10
4	<b>Optics and Ultrasonic</b>	2	4	4	10
5	<b>Nanotechnology</b>	2	2	4	8
6	<b>General Properties of Matter</b>	4	4	6	14
<b>Total</b>		<b>14</b>	<b>20</b>	<b>26</b>	<b>60</b>

**List of experiments:**

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

**Note: Experiments No.1 to 10 are compulsory and should map all units and Cos. Remaining 5 experiments are to be performing 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	10:8121919541 13:9788121919548
2	Applied Physics	B.G.Bhandarkar, Vrinda Publication	0071779795
3	Optics & Optical Fibres	Brijlal Subhramanyan	978-3-662-52764-1

4	Engineering Physics	Gaur and S.L.Gupta S.Chand & Company	0-07-058502
5	Physics	Resnick and Halliday Tata McGraw Hills	978-0-07-1755487-3
6	Physics part I & II	H.C.Varma	9788177091878
7	Properties of Matter	D.S.Mathur	13: 978-8121908153

**E-References:**

1. [www.physics.org](http://www.physics.org)
2. [www.physicsclassroom.com](http://www.physicsclassroom.com)
4. [www.youtube.com/physics](http://www.youtube.com/physics)
7. <https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-physics>
8. MYCBSEGUIDE
4. [www.ferrophysics.com](http://www.ferrophysics.com)
5. <http://hperphysics.phastr.gsu.edu/hbase/hph.htm>
6. [www.sciencejoywagon.com/physicszone](http://www.sciencejoywagon.com/physicszone)
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)**

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
1	Mr Rajesh Masane	Sr. Engineer	L&T Mumbai
2	Mrs B. J. Choudhary	Lecturer in Physics	Govt. Polytechnic Thane
3	Mrs S.A. Thorat	Lecturer in Physics	Govt. Polytechnic Mumbai
4	Dr. D.S. Nikam	Lecturer in Physics	Govt. Polytechnic Mumbai



Coordinator,  
Curriculum Development,  
Department of Sci. & Humanities

Head of Departments  
Department of Sci. & Humanities

I/C, Curriculum Development Cell

Principal

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

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 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

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

**Course Content Details:**

Unit No	Topics / Sub-topics
1	<p><b>1. Trigonometry:</b></p> <p>1.1 Trigonometric ratios of allied angles, compound angles, multiple angles (2A, 3A), Sub multiple angles</p> <p>1.2 Factorization and De-factorization Formulae</p> <p>1.3 Inverse Circular function (definition and simple problems).</p> <p><b>Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)</b></p>
2	<p><b>2. Vectors:</b></p> <p>2.1 Definition of vector , position vector</p> <p>2.2 Algebra of vectors (Equality, addition ,subtraction and scalar multiplication)</p> <p>2.3 Dot (Scalar) product &amp; Vector (Cross) product with properties.</p> <p><b>Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U-4 , A-4 )</b></p>
3	<p><b>3. Logarithms:</b></p> <p>3.1 Definition of logarithm</p> <p>3.2 Laws of logarithm</p> <p>3.3 simple examples based on laws.</p> <p><b>Course Outcome: CO2 Teaching Hours : 10hrs Marks:10 (R-4 , U- 4 , A-2 )</b></p>
4	<p><b>4. Probability :</b></p> <p>4.1 Definition of random experiment , sample space, event, occurrence of event and types of event ( Impossible , mutually exclusive , exhaustive ,equally likely )</p> <p>4.2 Definition of Probability</p> <p>4.3 Addition &amp; Multiplication Theorems of probability without proof , simple examples</p> <p><b>Course Outcome: CO1 Teaching Hours :10hrs Marks:10 (R-4, U- 4 , A-2 )</b></p>
5	<p><b>5. Determinants:-</b></p> <p>5.1 Definition of Determinant</p> <p>5.2 Expansion of Determinant of order 2X3</p> <p>5.3 Cramer's rule to solve simultaneous equations in 3 unknowns</p> <p><b>Course Outcome: CO2 Teaching Hours :10 hrs Marks:10 (R- 2 , U-4 , A-4 )</b></p>
6	<p><b>6. Matrices:</b></p> <p>6.1 Definition of a matrix of order m x n</p> <p>6.2 Types of matrices</p> <p>6.3 Algebra of matrices - equality, addition, subtraction ,multiplication &amp; scalar multiplication.</p> <p>6.4 Transpose of matrix.</p> <p>6.5 Minor , co-factor of an element.</p> <p>6.6 Adjoint &amp; inverse of a matrix by adjoint method.</p> <p>6.7 Solution of a simultaneous equations by matrix inversion method.</p> <p><b>Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U- 4 , A- 4 )</b></p>

**Suggested Specifications Table (Theory):**

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

**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](http://www.math-magic.com)
2. [www.Scilab.org/-SCI](http://www.Scilab.org/-SCI) Lab
3. [www.mathworks.com/Products/Matlab/-MATLAB](http://www.mathworks.com/Products/Matlab/-MATLAB)
4. [www.wolfram.com/mathematica/-Mathematica](http://www.wolfram.com/mathematica/-Mathematica)
5. <https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig>
6. [www.dplot.com/-Dplot](http://www.dplot.com/-Dplot)
7. [www.allmathcad.com/-Math CAD](http://www.allmathcad.com/-Math CAD)
8. [www.easycalculation.com](http://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
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

Head of Department

Coordinator,  
Curriculum Development,  
Department of Science And Humanities

Department of Science And Humanities

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: <b>EE 19 201</b>				Course Title: <b>Basic Electrical Engineering</b>						
Compulsory / Optional: <b>Compulsory</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>04</b>	<b>2</b>	<b>--</b>	<b>6</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>			<b>150</b>

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 midterm and second skill test at the end of the term

### Rationale:

This is the subject where the principles of electrical energy are studied. Knowledge of basics of electrical is essential to apply on all type of electrical machines, instruments, devices and equipment's. The basic aim of this course is that, the student must learn the electrical safety, basic concepts, rules and laws of electric and magnetic circuits and practical's. The knowledge of this course will be useful for other higher-level subject.

**Course Outcomes:** Student should be able to

EE19 201.1	Measure electrical accident with electrical safety
EE19 201.2	Understand basic concepts of electrical engineering
EE19 201.3	Solve simple electrical DC circuit with basic terminology
EE19 201.4	Interpreting electrostatic study focusing on capacitor
EE19 201.5	Explain magnetic circuit & electromagnetic induction
EE19 201.6	Learn prior ac fundamentals

### Course Content Details:

Unit No	Topics / Sub-topics
1	<p><b>1: Electrical Safety</b></p> <p>1.1 Meaning and causes of Electrical accident            1.2 Factors on which severity of shock depends            1.3 Procedure for rescuing the person who have received an electric shock            1.4 Methods of providing Artificial respiration.            1.5 Electrical fire</p> <ul style="list-style-type: none"> <li>• Causes of fire due to electrical reason</li> <li>• Precautions to be taken to avoid fire due to electrical reason.</li> <li>• Types of fire extinguishers</li> </ul> <p><b>Course Outcome:</b> EE19 201.1 <b>Teaching Hours :7 hrs</b> <b>Marks: 8 (R- 2, U-6, A-0)</b></p>

2	<p><b>2: Basic Concept</b></p> <p>2.1 Concept of Electric Current.</p> <p>2.2 Concept of Electric Potential, Potential Difference (P D) and Electro-Motive-Force (EMF).</p> <p>2.3 Concept of Resistance, - Laws of Resistance, Concept of Resistivity and Conductivity, Effect of Temperature on Resistance, Temp. co-efficient of Resistance (simple numerical)</p> <p>2.4 Classification of Electric Current: - Direct Current (DC), Alternating Current (AC), advantages of alternating current over direct current, application of direct and alternating current</p> <p>2.5 Ohm's Law, Concept of Voltage drop and Terminal Voltage.</p> <p>2.6 Resistance in Series, Voltage Division Formula.</p> <p>2.7 Resistance in Parallel, Current Division Formula. (Simple Numerical on 2.6 &amp; 2.7)</p> <p>2.8 Calculations of Equivalent Resistance of simple Series, Parallel and Series Parallel Circuits. (Simple Numerical)</p> <p>2.9 Duality Between Series and Parallel Circuits.</p> <p>2.10 Effects of Electric Current Heating Effect, Magnetic Effect, Chemical Effect with applications</p> <p>2.11 Concept of Electrical Work, Power and Energy with S.I. unit. (simple numerical)</p> <p>2.12 Types of Resistors and their Applications.</p> <ul style="list-style-type: none"> <li>- Carbon Composition</li> <li>- Deposited Carbon</li> <li>- High Voltage Ink Film</li> <li>- Metal Film</li> <li>- Metal Glaze</li> <li>- Wire Wound</li> </ul> <p><b>Course Outcome: EE19 201.2 Teaching Hours :14 Marks: 12 (R- 2 , U- 4 , A- 6 )</b></p>
3	<p><b>3:D.C. Circuits</b></p> <p>3.1 Definitions of terms Related to Electric Circuits, Circuit Parameters, Linear Circuit, Non-linear Circuit, Bi-lateral Circuit, Uni-lateral Circuit, Electric Network, Passive Network, Active Network, Node, Branch, Loop, Mesh.</p> <p>3.2 Energy Sources:</p> <ul style="list-style-type: none"> <li>3.3.1 Independent Voltage Sources</li> <li>3.3.2 Independent Current Sources</li> <li>3.3.3 Sources conversion</li> </ul> <p>3.3 Concept of Open and Short circuit</p> <p>3.4 Kirchhoff's Laws</p> <ul style="list-style-type: none"> <li>- Kirchhoff's Current Law</li> <li>- Kirchhoff's Voltage Law</li> </ul> <p><b>(Simple Numerical with maximum two equations)</b></p> <p>3.5 Delta-Star and Star-Delta Transformation. <b>(simple numerical)</b></p> <p><b>Course Outcome: EE19 201.3 Teaching Hours : 10 Marks : 10 (R- 0 , U- 4 , A- 6 )</b></p>



4	<p><b>4: Capacitors</b></p> <p>4.1 Electrostatics: Static Electricity, Absolute &amp; Relative Permittivity of a Medium, Coulombs Laws of electrostatics, Electric Field, Electrostatic induction, Electric Flux, Electric flux Density, electric potential &amp; energy, potential Difference, Breakdown voltage &amp; dielectric strength.</p> <p>4.2 Concept and Definition of Capacitor</p> <p>4.3 Parallel Plate Capacitor:  - Uniform Di-electric Medium  - Medium Partly Air.  - Composite Medium. <b>(Simple Numerical)</b></p> <p>4.4 Capacitors in Series, Capacitors in Parallel</p> <p>4.5 Calculations of Equivalent Capacitance of simple Series, Parallel and Series Parallel Combinations of Capacitors. <b>(Simple Numerical)</b></p> <p>4.6 Energy Stored in Capacitor.  <b>(No Derivation and Simple Numerical)</b></p> <p>4.7 Charging and Discharging of Capacitor <b>(No Derivation and Simple Numerical)</b></p> <p>4.8 Types of Capacitors and their Applications. Electrolytic, Non-Electrolytic (Paper, Mica, Plastic)</p> <p><b>Course Outcome: EE19 201.4 Teaching Hours : 10 Marks: 10 (R- 2 , U- 2 , A- 6)</b></p>
5	<p><b>5: Magnetic Circuits &amp; Electromagnetic Induction</b></p> <p>5.1 Magnetism: Absolute and Relative Permeabilities of a Medium, Laws of Magnetic Force, Magnetic field strength, Flux &amp; Flux Density.</p> <p>5.2 Magnetic Circuit - Ohm's law of Magnetic Circuit.</p> <p>5.3 Definitions Concerning Magnetic Circuit. Magneto-Motive-Force (MMF), Ampere Turns (AT), Reluctance, Permeance, Reluctivity. <b>(simple numerical)</b></p> <p>5.4 Comparison Between Electric and Magnetic circuit.</p> <p>5.5 Concept of Leakage Flux, Useful Flux &amp; Fringing.</p> <p>5.6 Magnetization Curve (B - H Curve), Magnetic Hysteresis, Hysteresis Loop. Hysteresis Loops for Hard &amp; Soft Magnetic Materials. Area of Hysteresis Loop, Hysteresis Loss. <b>(No Derivation and No Numerical)</b></p> <p>5.7 Types of Magnets and their applications</p> <p>5.8 Magnetic effect of electric current, Dot &amp; cross conventions, Right hand thumb rule, Interaction between magnetic fields, force on current carrying conductors, Fleming's left hand rule</p> <p>5.9 Faraday's Laws of Electromagnetic Induction.</p> <p>5.10 Direction of induced EMF and current, Lenz's Law, Fleming's right hand rule, Induced EMF, Dynamically induced EMF, statically induced EMF, self-Inductance (L), Mutual Inductance, co-efficient of coupling.</p> <p>5.11 Inductances in Series and parallel. <b>(No Derivation and No Numerical)</b></p> <p>5.12 Types of Inductors and their Applications.  - Air Cored Inductors  - Iron Cored Inductors  - Ferrite Cored Inductors.</p> <p>5.13 Energy Stored in Magnetic Field  <b>(No Derivation and Simple Numerical)</b></p>

	<b>Course Outcome: EE19 201.5 Teaching Hours : 14 Marks: 14 (R- 4 , U- 4 , A- 6 )</b>
<b>6</b>	<p><b>6: Introduction of AC Fundamental</b></p> <p>6.1 Generation of A.C. Voltage (simple loop generator), Fundamental Equation of A.C. Voltage and current.</p> <p>6.2 Important terms: instantaneous value, waveform, cycle, Periodic Time, frequency, amplitude, R.M.S value, Average value, Form factor, Peak factor, Phase, Phase difference (simple numerical)</p> <p><b>Course Outcome: EE19 201.6 Teaching Hours : 5 Marks: 6 (R- 2 , U- 4 , A-0 )</b></p>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Electrical Safety	2	6	0	8
2	Basic Concept	2	4	6	12
3	DC Circuit	0	4	6	10
4	Capacitors	2	2	6	10
5	Magnetic Circuit & Electromagnetic Induction	4	4	6	14
6	AC Fundamental	2	4	0	6
<b>Total</b>		12	24	24	60

**List of experiments: Any 10 experiments out of 15**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 201.1	Trace your electrical engineering laboratory: Terms related to Electrical Engineering with Nomenclature, Symbols (wherever necessary) and their respective Units a. Draw electrical symbol for machines and equipment b. Draw layout of electrical laboratory. c. Prepare Charts of electrical safety and demonstrate the operation of fire extinguisher	6
2	2	EE19 201.2	To verify the effect of temperature on resistance of copper conductor	2
3	3	EE19 201.3	Verify Kirchhoff's current law	2

4	4	EE19 201.4	To plot the charging and discharging curves of a capacitor and determine the time constant.	2
5	5	EE19 201.5	To plot the B-H curve for magnetic material and determine the relative Permeability	2
6	6	EE19 201.6	To observe AC & DC waveform & measure its voltage on CRO	2
7	1	EE19 201.1	First Aid Treatment: Precautions if person gets an electric shock. Methods of artificial respiration.	2
8	2	EE19 201.2	To determine the equivalent resistance (Req.) of Series connected resistances	2
9	3	EE19 201.3	Verify Kirchhoff's voltage law.	2
10	4	EE19 201.4	Demonstrate different types of capacitors.	2
11	5	EE19 201.5	To verify Faraday's First Law of electromagnetic Induction (For Dynamically & Statically Induced EMF)	2
12	2	EE19 201.2	To determine the equivalent resistance (Req.) of Parallel connected resistances	2
13	2	EE19 201.2	To verify Rheostat as a current regulator & potential divider.	2
14	3	EE19 201.3	To measure of e.m.f. of d.c. source and to calculate its internal resistance by connecting it to an external load.	2
15	5	EE19 201.5	Demonstrate different types of Inductor.	2
<b>Total</b>				<b>34</b>

**Note: Experiments No. 1 to 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	Electrical Technology (Volume I)	B. L. Theraja and A. K. Thereja , S. Chand and Co. Ltd.	81-219-2440-5
2	Basic Electrical Engineering	V. K. Mehta and Rohit Mehta, S. Chand and Co. Ltd.	9788121908719
3	Electrical Technology	Edward Hughes, ELBS Publications	9780582226968
4	Testing and maintenance of electrical machines	B.P.Patil ,nirali Prakashan 2 nd ed 2012	978-93-81595-58-9

#### E-References:

1. [www.nptel.com](http://www.nptel.com)

2. [www.electrical4u.com](http://www.electrical4u.com)
3. [www.khanacademy.org](http://www.khanacademy.org)
4. <https://ndl.iitkgp.ac.in/>

### CO VsPO and CO Vs PSOMapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 201.1	3	3	--	2	2	--	3	2	2	2
EE19 201.2	3	3	--	2	2	--	3	2	2	--
EE19 201.3	3	3	--	2	2	--	3	2	2	--
EE19 201.4	3	3	--	2	2	--	3	2	2	--
EE19 201.5	3	3	--	2	2	--	3	2	2	--
EE19 201.6	3	3	--	2	2	--	3	2	2	--

### Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Kuldeep Singh Rajput	Deputy Executive Engineer	400KV RSOM, Kharghar Navi Mumbai
2	Mrs.S.P. Phadnaik	Lecturer in Electrical Engineering	G.P. Pune
3	Miss A.V. Patil	Lecturer in Electrical Engineering	G.P.Mumbai
4	Dr. P. N. Padghan	Lecturer in Electrical Engineering	G.P.Mumbai

Coordinator,  
Curriculum Development,  
Department of Electrical Engg.

Head of Departments  
Department of Electrical Engg.

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: <b>EE 19 202</b>				Course Title: <b>Electrical Materials and Wiring</b>						
Compulsory / Optional: <b>Compulsory</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH	TS1	TS2	PR	OR	TW	Total
<b>2</b>	<b>2</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>50*</b>	<b>0</b>	<b>50</b>	<b>100</b>

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 midterm and second skill test at the end of the term.

### Rationale:

Basic knowledge of materials used in electrical engineering is essential for an electrical engineer. Also the knowledge of wiring accessories, wiring methods is vital for an electrical engineer. This subject is intended to develop skills of wiring and testing in the electrical wiring installations. This subject also gives insight of Electrical Engineering Materials.

**Course Outcomes:** Student should be able to

EE19202.1	Apply safety precautions
EE19202.2	List different types of electrical materials, fuses, tools , accessories & wires
EE19202.3	Make up different types of wiring

### Course Content Details:

Unit No	Topics / Sub-topics
1	<p><b>1: Classification of electrical materials.</b></p> <p>1.1 Observe safety precautions in electrical indoor and outdoor installations.            1.2 Importance of Materials in Electrical Engineering</p> <p><b>Course Outcome: EE19202.1, EE19202.2</b> <b>Teaching Hours :2 hrs</b></p>
2	<p><b>2: Conducting Materials (Physical, Mechanical and Electrical properties)</b></p> <p>2.1 Current Carrying Conducting Materials ( Copper, Aluminum, Bronze and Iron)            2.2 Non Current Carrying Conducting Materials ( Cast iron, Cast Steel, etc)</p> <p><b>Course Outcome: EE19202.2</b> <b>Teaching Hours: 4 hrs</b></p>
3	<p><b>3: Insulating Materials(Thermal , Mechanical and Electrical properties):</b></p>

	<p>3.1 Classification on basis of state of materials as solid ,liquid gaseous insulating materials ( Introduction and applications )</p> <p>3.2 Classification on the basis of temperature withstanding ability such as Y (O), A, E, B, F,H and C type with list of insulating materials in each type.</p> <p>3.3 Effect of Nano Technology on properties of materials</p> <p><b>Course Outcome: EE19202.2</b> <b>Teaching Hours: 4hrs</b></p>
4	<p><b>4: Magnetic Material ( Introduction and Applications )</b></p> <p>4.1 Classification of magnetic material as Paramagnetic, Diamagnetic and Ferromagnetic material</p> <p>4.2 C.R.G.O. Silicon Steel</p> <p>4.3 H.R.G.O. Silicon Steel</p> <p>4.4 Amorphous Metal</p> <p><b>Course Outcome: EE19202.2</b> <b>Teaching Hours: 4hrs</b></p>
5	<p><b>5: Wiring</b></p> <p>5.1 Classification of electrical installations</p> <p>5.2 General requirements of electrical installation</p> <p>5.3 Reading &amp; interpretation of electrical engineering drawings &amp; symbols related to installations</p> <p>5.4 Types of Wires – PVC, CTS, TRS , Lead Sheathed, flexible, multicore, single strand, multi-strand</p> <p><b>Course Outcome: EE19202.2</b> <b>Teaching Hours: 6 hrs</b></p>
6	<p><b>6: Methods of Wiring and Different types of Wiring systems</b></p> <p>6.1 Methods of Electrical Wiring systems w.r.t taking connection</p> <p>6.2 Joint Box or Tee or Jointing system</p> <p>6.3 Loop-in or Looping system</p> <p>    <b>6.3.1</b> Advantages of loop-in method of wiring</p> <p>    <b>6.3.2</b> Disadvantages of loop-in method of wiring</p> <p>6.4 Different types of Electrical wiring systems</p> <p>6.5 Cleat Wiring</p> <p>    <b>6.5.1</b> Advantages of Cleat wiring</p> <p>    <b>6.5.2</b> Disadvantages of Cleat wiring</p> <p>6.6 Casing and Capping wiring</p> <p>    <b>6.6.1</b> Advantages of Casing and Capping wiring</p> <p>    <b>6.6.2</b> Disadvantages of Casing and Capping wiring</p> <p>6.7 Lead sheathed wiring</p> <p>6.8 Conduit wiring</p> <p>    <b>6.8.1</b> Surface conduit wiring</p> <p>    <b>6.8.2</b> Concealed conduit wiring</p> <p>6.9 Types of Conduit</p> <p>    <b>6.9.1</b> Metallic conduit</p> <p>    <b>6.9.2</b> Nonmetallic conduit</p> <p>6.10 Advantages of Conduit wiring system</p> <p>6.11 Disadvantages of Conduit wiring system</p>

6.12	Comparison between different Wiring systems
<b>Course Outcome: EE19202.3</b>	<b>Teaching Hours: 12 hrs</b>

**List of experiments: Any 10 experiments out of 17**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	5	EE19202.1	Observe safety precautions in electrical indoor and outdoor installations.	2
2	5	EE19202.2	Draw different symbols used in electrical engineering.	4
3	2	EE19202.2	Identify the current carrying conducting material in at least five electrical accessories / devices.	2
4	5	EE19202.2	Draw diagrams of different wiring accessories.	4
5	6	EE19202.3	Build wiring circuit for one lamp controlled by one switch	2
6	5	EE19202.2	Identify the different types of tools used in electrical engineering.	2
7	5	EE19202.2	Identify the different types of fuses with their applications.	2
8	5	EE19202.2	Identify samples of different types of wires.	2
9	6	EE19202.3	Build a sample staircase wiring	2
10	6	EE19202.3	Build a sample godown wiring	2
11	6	EE19202.3	Build a sample cleat wiring	2
12	6	EE19202.3	Build a sample Casing Capping wiring	2
13	6	EE19202.3	Build a sample Conduit wiring	2
14	6	EE19202.3	Trace and draw electrical installation of a classroom	2
15	6	EE19202.3	Trace and draw electrical installation of a laboratory / workshop	2
16	4	EE19202.2	Identify the magnetic material in a given electrical motor, Electric choke/ballast.	2
17	3	EE19202.2	Identify the name and class of insulation of insulating material in any five electrical accessories / equipment/ instrument/ device	2
<b>Total</b>				<b>30</b>

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

**References/ Books:****a) Books:**

Sr. No.	Title	Author	Publisher	ISBN
1	An Introduction to Electrical Engineering Materials	C.S.Indulkar	S.Chand, New Delhi	10: 8121906660 /13: 9788121906661
2	Electrical Wiring Estimating and Costing	S.L.Uppal	Dhanpat Rai and Sons	9788174092403
3	Electrical Estimating and Costing	Surjit Singh	Dhanpat Rai and Sons	6700000000308

**b) Websites:**

1. <http://www.electricaltechnology.org/2015/09/types-of-wiring-systems-electrical-wiring-methods.html>

**E-References:**

1. [www.nptel.com](http://www.nptel.com)
2. [www.electrical4u.com](http://www.electrical4u.com)
3. [www.khanacademy.org](http://www.khanacademy.org)
4. <https://ndl.iitkgp.ac.in/>

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19202.1	1	-	-	-	2	-	1	-	1	1
EE19202.2	1	1	-	1	2	1	2	-	2	2
EE19202.3	1	1	1	2	2	2	3	2	3	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation	Sign
1	Mr. Kuldeep Singh Rajput	Deputy Executive Engineer	400KV RSOM, Kharghar Navi Mumbai	
2	Mrs. Meenakshi Shirsat	Lecturer in Electrical Engineering	MSBTE, Mumbai	
3	Mrs. J. D. Waghmare	Lecturer in Electrical Engineering	G.P.Mumbai	
4	Mrs. V.U. Bhosle	Lecturer in Electrical Engineering	G.P.Mumbai	



Coordinator,  
Curriculum Development,  
Department of Electrical Engg.

Head of Departments  
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I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code:ME19 208				Course Title: Engineering Graphics						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH	TS1	TS2	PR	OR	TW	Total
<b>01</b>	<b>02</b>	-	<b>03</b>	-	-	-	<b>25*</b>	-	<b>25</b>	<b>50</b>

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 midterm and second skill test at the end of the term.

**Note:** Practical Examination shall be conducted out of 50 Marks and the obtained marks be converted out of 25 marks as per examination scheme.

**Rationale:** Engineering drawing is the common graphical language of engineers, technicians and workers to express engineering ideas and concepts. Correct interpretation of engineering drawings is one of the basic duties of First Line Supervisors. This Engineering Graphics course induces the concepts of accuracy and exactness of information required to work as electrical technician. It also develops judgments about small distances and angles.

This course is useful in developing imagination, drafting and sketching skills of the students.

**Course Outcomes:** Student should be able to

ME19 208.1	Draw geometric figures and engineering curves using appropriate drawing instruments
ME19 208.2	Draw orthographic views of given object by applying principles of orthographic projections
ME19 208.3	Draw isometric view from given orthographic views, by applying principles of isometric projections
ME19 208.4	Draw the free hand sketches of given engineering objects/elements

**Course Content Details:**

Unit No	Topics / Sub-topics
1	<b>Principles of Drawing</b> 1.1 Drawing instruments and their uses, Standard sizes of drawing sheets (ISO-A series), letters and numbers (single stroke vertical), Conventions of lines and their applications, Drawing Scales (reduced, enlarge and full size), Methods of Dimensioning: Chain, parallel and coordinate dimensioning (Refer SP-46 Code latest Edition)

	1.2 Simple Geometrical Constructions, Redrawing figures using above geometrical constructions <b>Course Outcome-ME19 208.1</b>	<b>Teaching Hours–02</b>	<b>Marks – 06</b>
2	<b>Engineering Curves and Loci of Points</b> 2.1 Method to draw Ellipse by Arcs of Circle Method and Concentric Circle Method. 2.2 Method to draw Parabola and Hyperbola by Directrix and Focus Method. 2.3 Loci of Points for Single Slider Crank Mechanisms <b>Course Outcome-ME19 208.1</b>	<b>Teaching Hours–03</b>	<b>Marks – 08</b>
3	<b>Orthographic projections</b> 3.1 Introduction to orthographic projections, Symbol of First Angle Projection, Conversion of pictorial view into orthographic views –Top, Front and End View of objects containing plain surfaces, slant surfaces, slots, ribs, cylindrical surfaces. (First Angle Projection Method Only) 3.2 Sectional Orthographic Views and conversion of pictorial view into sectional orthographic views (Objects involving plain surfaces, slant surfaces, slots, ribs, cylindrical surfaces, threads etc.) <b>Course Outcome-ME19 208.2</b>	<b>Teaching Hours– 04</b>	<b>Marks – 14</b>
4	<b>Isometric projections:</b> 4.1 Isometric scale, Comparison of Natural Scale with Isometric Scale 4.2 Conversion of Orthographic Views into Isometric View/Projection (Objects involving plain surfaces, slant surfaces, slots, ribs, cylindrical surfaces,holes etc) <b>Course Outcome-ME19 208.3</b>	<b>Teaching Hours– 04</b>	<b>Marks – 14</b>
5	<b>Freehand sketches</b> 5.1 Drawing of proportional freehand sketches of – Different types of thread forms, nuts, bolts, screws, washers and foundation bolts (Rag and Lewis type) 5.2 Electrical Components such as- Fuses: Rewireable, HRC Cartridge, MCB single pole, double pole, , MCCB, Insulator-Pin, Shackled, Disc (String), Isolator: Vertical, Horizontal, Pantograph, Transformer: Cut section, Core & Shell (Teacher shall also explain use/ function of all the above elements) <b>Course Outcome-ME19 208.4</b>	<b>Teaching Hours–02</b>	<b>Marks – 08</b>

**List of Drawing Sheets: Total 05 Sheets (All compulsory)**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	ME19 208.1	<b>Basics of Engineering Graphics</b> Drawing sheet containing types of lines, Lettering, Redrawing given figure, dimensioning and geometrical constructions	06
2	2	ME19 208.1	<b>Engineering curves and loci of points</b> (minimum 4 problems)	06

3	3	ME19 208.2	<b>Orthographic projections</b> Using first angle method of projections (minimum 2 problems) and one problem on sectional orthographic views	06
4	4	ME19 208.3	<b>Isometric Projection</b> One problem using isometric scale and one with natural scale	06
5	5	ME19 208.4	<b>Freehand sketches:</b> i) Drawing of proportional freehand sketches of – Different types of thread forms, nuts, bolts, screws, washers and foundation bolts (Rag and Lewis type) ii) Electrical Components such as- Fuses: Rewindable, HRC Cartridge, MCB single pole, double pole, , MCCB, Insulator-Pin, Schackle, Disc (String), Isolator: Vertical, Horizontal, Pantograph, Transformer: Cut section, Core & Shell	06
<b>Total</b>				<b>30</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering drawing	N.D.Bhatt, Charotar Publishing House, 53 <sup>rd</sup> Edition, 2016	978-93-80358-178
2	Engineering Graphics	P.J. Shah, S. Chand, revised edition, 2014	978-81-21929-679
3	Engineering Drawing	Amar Pathak, Wiley Publication, 1 <sup>st</sup> Ed. 2010	978-93-50040-164
4	Engineering drawing	D.Jolhe, Tata McGraw Hill Education, 2017	978-00-70648-371
5	Textbook on engineering drawing	K.L.Narayan,, P.Kannaiah, Scitech publications, 24 <sup>th</sup> reprint, 2010,	978-81-83714-228
6	Engineering drawing practice for school and colleges	IS Code SP-46	-
7	Electrical Engineering Drawing	S.K.Bhattacharya, New Age International Publishers 2 <sup>nd</sup> Edition, 1998, 2005 Reprint,	978-81-22408-553

**E-References:**

1. <https://ndl.iitkgp.ac.in/>
2. <https://ocw.mit.edu/courses/drawing>
3. <https://nptel.in/courses/drawing>
4. <https://home.iitk.edp.ac.in>

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
ME19 208.1	1	1	2	-	2	2	1	1	1	-
ME19 208.2	1	1	1	-	1	1	1	1	2	-

ME19 208.3	1	1	1	-	1	1	1	1	2	-
ME19 208.4	2	2	2	2	1	2	2	2	2	2

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. I.N.Khuspe	Sel. Grade Lecturer in Electrical Engineering	Govt. Polytechnic, Mumbai
2	Mr. U.A.Agnihotri	Sel. Grade Lecturer in Mechanical Engineering	Govt. Polytechnic, Mumbai
3	Mr. Ruhil Alwi	Sr. Executive	Coffee Day Beverages, Mumbai
4	Mr. A.S. Sangwkar	Sel. Grade Lecturer in Mechanical Engineering	Govt. Polytechnic, Thane
5	Mr. E.C. Dhembre	Lecturer in Mechanical Engineering	Govt. Polytechnic, Mumbai

Coordinator,

Curriculum Development,

Department of Electrical & Mechanical  
Engineering

Head of Department

Department of Electrical & Mechanical  
Engineering

I/C, Curriculum Development Cell

Principal

## EE 19 204 Libre Office

### 1. **Introduction to Libre Office Calc** (Foss: *LibreOffice Calc on BOSS Linux – English*)

**Outline:** Introduction to LibreOffice Calc What is Calc, Who should use Calc, What can be done using Calc. About spreadsheets, sheets and cells. Basic features – parts of main Ca..

### 2. **Working with Cells**

**Outline:** Working with Cells How to enter numbers, text, numbers as text, date and time in Calc. How to Navigate between cells and in between sheets. How to select items in row..

### 3. **Working with Sheets**

**Outline:** Working with Sheets Inserting and Deleting rows and columns Calc. Inserting and Deleting Sheets in Calc. Renaming Sheets

### 4. **Formatting Data**

**Outline:** Formatting Data Borders, Color, Formatting Text, Increasing Cell Size Formatting multiple lines of text, numbers, fonts, cell borders, cell background Automatic Wrappi..

### 5. **Basic Data Manipulation**

**Outline:** Basic Data Manipulation Paste and paste special (values, transpose), pasting a spreadsheet into writer as a table Introduction to Formulas – Sum, Average, basic formula..

### 6. **Working with Data**

**Outline:** Working with data Speed up using Fill tools and Selection lists. Sharing content between sheets Remove data, Replace data, Change part of a data.

### 7. **Using Charts & Graphs**

**Outline:** Using Charts and graphs in Calc Creating, Editing and Formatting Charts Types of charts Resizing and moving of charts

### 8. **Formulas & Functions**

**Outline:** Formulas and Functions Creating formulas, operator types and referencing Basic arithmetic and statistic functions - relative and fixed (\$) referencing in a function ..

### 9. **Linking Calc Data**

**Outline:** Linking Calc Data Referencing other sheets and documents Working with Hyperlinks



**Government Polytechnic,  
Mumbai**

*Department of Electrical Engineering*

**P-19 Curriculum  
(Sandwich Pattern)**

**Semester-II  
(Course Contents)**

**GOVERNMENT POLYTECHNIC MUMBAI**  
(Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - II**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
SC 19 110	Engineering Mathematics	4	0	0	4	4	60	20	20	0	0	0	100
SC 19 106	Applied Chemistry	3	2	0	5	5	60	20	20	25*	0	25	150
EC 19 207	Elements of Electronics Engineering	4	2	0	6	6	60	20	20	25*	0	25	150
EE 19 203	Computer Aided Electrical Drawing	0	4	0	4	4	0	0	0	50*	0	50	100
EE 19 301	Electrical and Industrial Measurement	4	4	0	8	8	60	20	20	50*	0	25	175
EE 19 205	C-Programming# (Spoken Tutorial)	--	--	3	3	3	--	--	--	--	--	--	--
<b>Total</b>		<b>15</b>	<b>12</b>	<b>03</b>	<b>30</b>	<b>30</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>150</b>	<b>00</b>	<b>125</b>	<b>675</b>
Student Centered Activity (SCA)					<b>05</b>								
Total Contact Hours					<b>35</b>								

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 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.

Department Coordinator,  
Curriculum Development,  
Dept. of Electrical Engineering

Head of Department  
Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

Principal



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

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 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	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	<b>1. Function</b> 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 <b>Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)</b>
2	<b>2. Limits</b> 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 <b>Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 2, U-4, A-4)</b>
3	<b>3. Derivatives &amp; Application of derivative</b> 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 <b>Course Outcome: CO2 Teaching Hours : 10 hrs Marks: 10 (R-4, U-4, A-2)</b>
4	<b>4. Integration &amp; Application of integration</b> 4.1 Definition 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 <b>Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R-4, U-4, A-2)</b>
5	<b>5. Complex Number:-</b> 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 <b>Course Outcome: CO2 Teaching Hours : 10 hrs Marks: 10 (R- 2, U-4, A-4)</b>
6	<b>6. Numerical Analysis</b> 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 <b>Course Outcome: CO2 Teaching Hours : 10 hrs Marks: 10 (R- 2, U-4, A-4)</b>

**Suggested Specifications Table (Theory):**

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

**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](http://www.math-magic.com)
2. [www.Scilab.org/-SCI](http://www.Scilab.org/-SCI) Lab
3. [www.mathworks.com/Products/Matlab/-MATLAB](http://www.mathworks.com/Products/Matlab/-MATLAB)
4. [www.wolfram.com/mathematica/-Mathematica](http://www.wolfram.com/mathematica/-Mathematica)
5. <https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig>
6. [www.dplot.com/-Dplot](http://www.dplot.com/-Dplot)
7. [www.allmathcad.com/-Math CAD](http://www.allmathcad.com/-Math CAD)
8. [www.easycalculation.com](http://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 (ELCTRONICS 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,  
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Department of Sci. & Humanities

Head of Departments  
Department of Science & Humanities

I/C, Curriculum Development Cell

Principal

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

Abbreviations: L- Theory; P-Practical; TU-Tutorial; TH- Theory Paper; TS1 and TS2- Term Tests; PR- Practical Exam; OR-Oral Exam; TW: Term Work (progressive assessment), \* Indicates assessment by External Examiner else Internal assessment.

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

### 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	<p style="text-align: center;"><b>Atomic Structure</b></p> <p>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.</p> <p>1.2 Atomic number and atomic mass number. Atomic weight Numerical based on atomic number &amp; atomic mass number</p> <p>1.3 Rules governing filling up of atomic orbitals. Quantum no., Pauli's Exclusion Principle, Aufbau's Principle, Hund's rule.</p> <p>Electronic configuration of atoms up to atomic number 30</p> <p>1.4 Valence and chemical bonding. Valence : Definition, &amp; examples. Types of valance : Electrovalence &amp; Co-valence</p> <p>1.5 Electrovalent bond: Definition, Formation Formation of NaCl</p> <p>1.6 Co-valent bond : Definition &amp; formation Formation of following molecules Single bond :, Chlorine. Double bond : Oxygen,, Triple Bond : Nitrogen,,</p> <p>1.7 Distinction between electrovalent and covalent compound.</p> <p><b>Course Outcome: CO1 Teaching Hours : 7 hrs Marks: 10 (R- 2, U-4, A-4)</b></p>
2	<p style="text-align: center;"><b>Electrochemistry</b></p> <p>2.1 Definition of Electrochemistry, Electrolytes: Definition, Types. Differences between Atom and ion . Definition of ionization &amp; electrolytic dissociation, Arrhenius theory, Degree of ionization with factors affecting it.</p> <p>2.2 Terms related to Electrolysis Mechanism of electrolysis. Examples of: mechanism of Electrolysis of <math>\text{CuSO}_4</math> by using Cu electrodes.</p> <p>2.3 Faradays First law and its mathematical derivation. Faradays second law &amp; its mathematical derivation, Numerical based on laws of Faraday.</p> <p>2.4 Application of Electrolysis: Electroplating, Electrorefining.</p> <p><b>Course Outcome: CO2 Teaching Hours : 7 hrs Marks: 10 (R- 4 , U-4 , A-2 )</b></p>
3	<p style="text-align: center;"><b>Cells And Batteries</b></p> <p>3.1 Conductor: Definition, types (metallic, electrolytic), Difference between them.</p> <p>3.2 Ohms law, Charging and discharging of cells, Closed circuit voltage, Open circuit voltage, Electrochemical couple, Separator, Electromotive force (E.M.F)</p> <p>3.3 Cells: Definition, types (Electrolytic and Electrochemical), difference between them.</p> <p>3.4 Classification of Electricchemical cell ( primary and Secondary) Definition and Difference between them.</p> <p>3.5: Primary cells: Lachlance cell, Dry cell, Daniel cell</p> <p>3.6 secondary cell : Lead acid storage cell or battery, Nickel cadmium cell or battery</p> <p>3.7 Lead acid storage battery: construction, working, charging and discharging, electrical characteristics, methods of charging storage batteries, indication of fully charged battery, Maintenance of Lead acid batteries, application of Lead acid storage batteries.</p> <p><b>Course Outcome: CO2 Teaching Hours : 7 hrs Marks: 10 (R- 4 , U-4 , A-2 )</b></p>

4	<p><b>Corrosion</b></p> <p>4.1 Definition of corrosion.Types of corrosion . Atmospheric &amp; 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 &amp; 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 &amp; Tinning)  b) Sherardizing c) Metal Spraying</p> <p><b>Course Outcome: CO3 Teaching Hours :6 hrs Marks: 10 (R-2, U-4 , A-4 )</b></p>
5	<p><b>Lubricants</b></p> <p>.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 &amp; description of each type.  5.3 Characteristic of good lubricant  A) Physical Characteristics</p> <ul style="list-style-type: none"> <li>• Viscosity</li> <li>• Viscosity index</li> <li>• Oiliness</li> <li>• Volatility</li> <li>• Flash point &amp; Fire Point</li> <li>• Cloud and Pour point</li> </ul> <p>B) Chemical Characteristics</p> <ul style="list-style-type: none"> <li>• Acidity /Neutralization no.</li> <li>• Emulsification</li> <li>• Saponification value</li> </ul> <p><b>Course Outcome: CO4 Teaching Hours :6 hrs Marks: 10 (R-4 , U-4 , A-2 )</b></p>
6	<p><b>Materials And Alloys.</b></p> <p><b>Metallic</b></p> <p>6.1 Metals &amp; 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).</p> <p><b>Non-Metallic</b></p> <p>6.3 Definition of non-metallic engineering materials  <b>6.4 Plastic:</b>  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</p>



	<p>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</p> <p><b>6.5 Rubber:</b> definition of rubber (elastomer). Natural rubber : Basic unit in natural rubber(isoprene), Occurrence &amp; Processing of Latex . Drabacks 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</p> <p><b>6.6 Thermal insulating materials</b> Definition, ExamplesThermocole, Glasswool. Thermocole: Definition,. Preperation,Properties &amp; uses Glass wool. Definition,.Preperation,Properties &amp; uses</p> <p><b>6.7 Alloys</b> Definition of alloy: purposes of preparation of Alloy. Preparation of binary alloy by fusion method. Classification of alloy : Ferrous and non Ferrous Alloy.</p> <p><b>6.8 Ferrous alloy</b> : Steel, Definition and classification based on % of C (Mild carbon steel, medium carbon steel, high carbon steel, their properties &amp;uses),</p> <p><b>6.9 Non-Ferrous Alloys</b> Aluminum Alloys: Duralumin Solders Alloys : Woods metal Bearing Alloys : Babbitt metal</p> <p><b>Course Outcome: CO4 Teaching Hours :12 hrs Marks: 10 (R- 2 , U-6 A-2 )</b></p>
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**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
<b>Total</b>		<b>18</b>	<b>26</b>	<b>16</b>	<b>60</b>



**List of experiments:**

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 : $\text{Cu}^{++}$ , $\text{Fe}^{++}$ , $\text{Fe}^{+++}$ , $\text{Cr}^{+++}$ , $\text{Mn}^{++}$ , $\text{Ni}^{++}$ , $\text{Zn}^{++}$ , $\text{Ca}^{++}$ , $\text{Ba}^{++}$ , $\text{Mg}^{++}$ , $\text{NH}_4^+$ <b>Acidic Radicals: <math>\text{Cl}^-</math>, <math>\text{Br}^-</math>, <math>\text{I}^-</math>, <math>\text{CO}_3^{--}</math>, <math>\text{SO}_4^{--}</math>, <math>\text{NO}_3^-</math></b>	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
			<b>Total</b>	<b>30</b>

**Note: Experiments No. 1 to 10 are compulsory and should map all units and COs. Remaining experiments are to be performed on the basis of 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

**1. E-References:**

- www.chemistry.org
- [www.chemistryclassroom.com](http://www.chemistryclassroom.com)
- [www.youtube/chemistry](http://www.youtube/chemistry)
- <https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-chemistry>
- www.ferrofchemistry.com
- <http://hperchemistry.phastr.gsu.edu/hbase/hph.htm>
- www.sciencejoywagon.com/

**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:**

<b>Sr. No</b>	<b>Name</b>	<b>Designation</b>	<b>Institute/Organisation</b>
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.
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4	Mrs J. V. Iyengar	Lecturer in Chemistry	Government polytechnic Mumbai.
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Department of Sci. & Humanities

Head of Departments  
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I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: EE 19 207				Course Title: Elements of Electronics Engineering						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>04</b>	<b>02</b>	--	<b>08</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	--	--	<b>150</b>

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 mid-term and second skill test at the end of the term

#### Rationale:

It is necessary for the students of electronics and related branches to study and apply the basic principles, analyze and troubleshoot simple subsystems. To acquire this level of understanding, the basic knowledge of electronic devices and circuits is essential. This Course is one of the core subjects which are deals with construction, working principle, application of active components.

**Course Outcomes:** Student should be able to

EC19 207.1	Describe the Fundamentals of Diode
EC19 207.2	Identify different types of Diodes and their applications
EC19 207.3	Illustrate the Transistor fundamentals and its Biasing techniques (BJT AND FET)
EC19 207.4	Interpret the working of regulated power supply
EC19 207.5	Interpret the Number system, Combinational circuits and Sequential circuits

#### Course Content Details:

Unit No	Topics / Sub-Topics
<b>1</b>	<p><b>Topic Title: Semiconductor Diode</b></p> <p>1.1 Classification of component on the basis of energy band theory and effect of Temperature.</p> <p>1.2 Different types of Semiconductor and their materials. P-type and N-type</p>

	<p>Semiconductors. Symbol, Construction, working principle, Forward and Reverse Biasing, V-I Characteristics and applications of following diodes: PN junction, Zener, LED, Photo diode.</p> <p><b>Course Outcome: EC19 207.1, EC19 207.2</b>      <b>Teaching Hours : 08 hrs</b> <b>Marks:10 (R- 2, U-4, A-4)</b></p>
2	<p><b>Topic Title: Diode Application</b></p> <p>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. Types of Filters: Waveform and working of Shunt Capacitor, series Inductor, and <math>\pi</math> filter.</p> <p><b>Course Outcome: EC19 207.2</b>    <b>Teaching Hours : 08 hrs</b>    <b>Marks: 10 (R- 2, U-4, A-4)</b></p>
3	<p><b>Topic Title: Transistor Fundamentals</b></p> <p>3.1 Construction and working of PNP and NPN transistors. 3.2 Transistor configuration: CB, CE, CC. 3.3 Working and characteristics of transistors in CE mode. 3.4 BJT Biasing: DC load line, Operating point, stabilization, Concept of thermal runaway. Types of biasing: circuit and analysis of Fixed bias, base bias with Emitter feedback, Voltage divider bias. 3.5 Transistor as Switch and Single stage CE amplifier. ( circuit diagram and working)</p> <p><b>Course Outcome: EC19 207.3</b>    <b>Teaching Hours :12 hrs</b>    <b>Marks:12 (R- 4, U-8, A-0)</b></p>
4	<p><b>Topic Title: Field Effect Transistor</b></p> <p>4.1 Symbol, Construction, working and characteristics of JFET (N-channel and P-channel) and MOSFET (Depletion and enhancement Type) 4.2 FET Biasing: Source self bias , Drain to source bias. 4.3 Applications of FET Comparison of FET with BJT.</p> <p><b>Course Outcome: EC19 207.3</b>    <b>Teaching Hours : 08</b>      <b>Marks:08 (R-4, U-4, A-0)</b></p>
5	<p><b>Topic Title: Regulated Power Supply</b></p>

	<p>5.1 Block diagram of DC regulated power supply.            5.2 Definition of load regulation and line regulation.            5.3 Zener diode as voltage regulator.</p> <p><b>Course Outcome: EC19 207.4    Teaching Hours : 04    Marks:04 (R-0, U-2, A-2)</b></p>
<b>6</b>	<p><b>Topic Title:Digital Electronics</b></p> <p>6.1 Number Systems:            a) Binary numbers, Octal numbers, Decimal number Hexadecimal numbers:            Conversion of one number System to another system(including Fractional number)</p> <p>6.2 Logic Gates and Families:            a) AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR gate: Truth table, equation, symbol, IC numbers, Block diagram of logic IC's (Students must be made aware of pin diagram of logic gates.)(pin diagram should not be asked for exam)            b) NOR &amp; NAND as Universal gate.</p> <p>6.3 Flip-flop:            a) S-R Flip-flop using NOR and NAND.            b) Types of triggering: Edge, level            c) Clocked S-R flip flop, D flip flop, JK flip flop, T flip flop.            (Diagram, Symbol, Truth table, operation and application)</p> <p>6.4 Counters:            a)Classification of counters: Synchronous &amp; Asynchronous/ripple (Circuit diagram, working and waveform)</p> <p>8.5 MUX/DEMUX:            a) Realization and working of 2 : 1, 4 : 1 , 8 : 1 multiplexer using logic gates            b) Realization and working of 1 : 2, 1 : 4 , 1 : 8 De-multiplexer using logic gates.</p> <p>8.6 <b>DAC: Types</b>, weighted resistor circuit and R-2R Ladder circuit, DAC IC 0808 specifications.</p> <p>8.7. ADC : Block diagram, types and working of dual slope ADC, SAR ADC, ADC0808/0809 Specification.</p> <p><b>Course Outcome: EC19 207.5    Teaching Hours : 20    Marks:16 (R-4, U-8, A-4)</b></p>

### Suggested Specifications Table (Theory):

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Semiconductor Diode	08	02	04	04	10
2	Diode Application	08	02	04	04	10
3	Transistor Fundamentals	12	04	08	00	12



4	Field Effect Transistor	08	04	04	00	08
5	Regulated Power Supply	04	00	02	02	04
6	Digital Electronics	20	04	08	04	16
<b>Total</b>		<b>60</b>	<b>16</b>	<b>30</b>	<b>14</b>	<b>60</b>

**Legends:** R-Remember; U-Understand; A-Apply and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**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	EC19 207.1	To plot the V-I characteristic of semiconductor P-N diode. Find out static, dynamic resistance and knee voltage of P-N diode.	02
2	1	EC19 207.2	To plot the V-I characteristic of Zener diode	02
3	1	EC19 207.2	To plot the V-I characteristic of LED diode	02
4	1	EC19 207.2	To plot the V-I characteristic of Photo diode	02
5	2	EC19 207.2	To construct and test half wave rectifier with C Filter	02
6	2	EC19 207.2	To construct and test full wave rectifier with LC filter	02
7	3	EC19 207.2	To construct and test Bridge wave rectifier with $\pi$ filter	02
8	3	EC19 207.3	To plot i/p and o/p characteristics of BJT and find out input resistance and o/p resistance of BJT in CE Mode	02
9	3	EC19 207.3	To construct and test transistor as a switch and calculate rise time and fall time.	02
10	4	EC19 207.3	To plot the characteristic of FET	02
11	5	EC19 207.4	To construct and test Zener regulator. Find out load and line regulation	02
12	6	EC19 207.5	Verify truth table of all gates	02
13	6	EC19 207.5	Verify truth table of D and T flip-flop	02
14	6	EC19 207.5	Design and Implement 3-bit asynchronous counter	02
15	6	EC19 207.5	Verify truth table of 8:1 Multiplexer using IC 74151	02
16	6	EC19 207.5	Verify truth table of 1:8 DeMultiplexer using IC	02
<b>Total</b>				

**References/ Books:**

Sr. No.	Book Title	Author	Publication
1	Electronic Devices and Circuit: An Introduction	Mottershead Allen	PHI Learning, New Delhi
2	Electronic Devices and Circuit Theory	Boylestead Robert, Louis Neshelsky	Pearson Education, 10 <sup>th</sup> edition
3	Electronics Principles	Malvino, Albert Paul, David	McGraw Hill Education
4	Principles of Electronics	Mehta V.K., Mehta Rohit	S. Chand and Company
5	A text book of Applied Electronics	Sedha R.S.	S. Chand
6	Modern Digital Electronics	R.P.Jain	Tata McGraw Hill

**CO Vs PO and CO Vs PSO Mapping**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EC19 207.1	3	-	-	-	-	-	-	-	-	-
EC19 207.2	2	2	2	-	-	-	2	1	-	-
EC19 207.3	2	2	-	1	-	-	1	-	-	-
EC19 207.4	1	-	1	1	-	-	2	2	-	2
EC19 207.5	3	-	2	-	-	-	2	1	-	1

**Industry Consultation Committee:**

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Principal

<b>Programme : Diploma in Electrical Engineering (Sandwich Pattern)</b>										
<b>Course Code: EE19 203</b>				<b>Course Title: Computer Aided Electrical Drawing</b>						
<b>Compulsory / Optional: C</b>										
<b>Teaching Scheme and Credits</b>				<b>Examination Scheme</b>						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	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 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:

The computer software's become the essential part of today's world to keep pace with rowing technology and demand for the timely product design. Computer aided drawing software allow engineer to increase productivity, improves the quality, accuracy of the drawing, saves time and easier for documentation. Objective of this course is to provide practice in freehand sketching of electrical drawing, use of computer based software to draw working electrical drawing. This course also provides practice to read and interpret working electrical engineering drawings.

### Course Outcomes: Student should be able to

EE19 203.1	<b>Make Use of Computer Aided Electrical Drawing Software</b>
EE19 203.2	<b>Reproduce (Redraw) free hand proportionate sketches related to electrical engineering drawings</b>
EE19 203.3	<b>Reproduce (Redraw) electrical engineering drawings using drafting software</b>
EE19 203.4	<b>Read and interpret electrical drawings</b>
EE19 203.5	<b>Print/Plot the drawing</b>

### Course Content Details:

Following contents are to be explained in the practical hours

Unit No	Topics / Sub-topics
1	<b>Introduction to CAD Software :</b> Explore the basic features, commands and general structure of the Electrical CAD software (open source/AutoCAD) environment. 1.1 Start and exit the session 1.2 GUI of electrical CAD software 1.3 On-line help 1.4 File types with extensions

	1.5 Initial settings- limit, units etc. 1.6 Drawing command- line, circle, arc, square, spline, Array, Repeat Region, part marking 1.7 Editing commands 1.8 View command 1.9 Dimensioning commands 1.10 Lettering , Text , title 1.11 Layer & layer properties 1.12 Print /Plot the drawing 1.13 Import export of File to other file formats
2	<b>Electrical and Electronics Symbols :</b> 2.1 Concept of electrical symbols and its importance 2.2 Different electrical and electronics symbols as per IS: 2032 1976 or latest code 2.3 Preparation and subsequent use of standard template for drawing in CAD
3	<b>Electrical Drawings :</b> 3.1 Concept of Electrical drawings 3.2 Types of Electrical drawings- Circuit diagram, wiring diagram, control circuit diagram , single line diagram, block diagram, layout diagram, schematic diagram and logic diagram

**List of experiments: All experiments are compulsory**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 203.1 EE19 203.5	<b>Practice open source Electrical CAD/AutoCAD software-</b> Open sample examples, read and understand Create new file Practice basic drawing commands to draw Line, circle arc, ellipse, triangle square and other geometric figures Perform basic operations such copy , erase, delete, undo , redo, mirror, zoom, offset Prepare minimum 2 simple drawings using above commands. Save drawing -with default extension and as pdf format Print the drawing on A3/A4paper.	6
2	1	EE19 203.1 EE19 203.5	<b>Preparation of standard template for drawing in CAD.</b> Standard template should include the name of students, enrolment no. of student, etc. Draw minimum 4 simple geometric figures/patterns using draw and Edit commands in a prepared template. Save and print drawing on A3/A4 paper	2
3	1	EE19 203.1 EE19 203.3 EE19 203.5	<b>Draw minimum 2 proportionate drawings on sketchbook</b> with creative imagination which includes combinations of geometric pattern for example Rangoli/Street light Pole/Decorative Garden lamp post Redraw the above drawing using CAD software Save and print drawing on A3/A4 paper	4

4	2	EE19 203.1 EE19 203.2 EE19 203.3 EE19 203.5	<b>Electrical and electronics symbols/legends</b> Draw Electrical and electronics symbols/legends as per IS: 1032 or Latest code by free hand on sketch book Draw same symbols by using drafting software Save and print file	4
5	3	EE19 203.1 EE19 203.3 EE19 203.4 EE19 203.5	<b>Layout of ceiling fans and luminaries</b> Collect electrical installation layout plan of ceiling fans and luminaries fitted in a residential/commercial office / classroom (any one) Read, understand and redraw the same using drawing software Save and print the file on A3/A4paper.	4
6	3	EE19 203.1 EE19 203.3 EE19 203.4 EE19 203.5	<b>Single line diagram of electrical installation of a residential, commercial office or educational classroom</b> Collect drawings of single line drawings of any one installation Read and interpret the drawing. Draw the same using drawing software Save and print the file on A3/A4paper.	4
7	3	EE19 203.1 EE19 203.3 EE19 203.5	<b>Visit to electrical laboratory and workshop</b> Draw Panel layout diagram like Distribution panel in the laboratory/ electrical meter room/ workshop (any one) on sketch book Draw the same electrical panel layout diagram at above place using drawing software, Prepare and draw single line diagram of above panel layouts Save and print the file on A3/A4paper.	4
8	3	EE19 203.1 EE19 203.3 EE19 203.5	<b>Visit to 11 KV substation of the institute or near by small scale industry</b> having outdoor/indoor switch yard □ Observe, and sketch, outdoor/indoor switch yard, layout of equipment with specifications on sketch book Draw the same using drawing software Prepare and draw single line diagram of above panel layouts Save and print the file on A3/A4paper	6
9	3	EE19 203.1 EE19 203.2 EE19 203.3 EE19 203.5	<b>Trace wiring of any one of the following</b> Star Delta semi - automatic Starter, DOL Starter Draw using free hand on sketch book Draw the wiring diagram of any one equipment using layer concept using drawing software Save and print the file on A3/A4paper.	4
10	3	EE19 203.1 EE19 203.3 EE19 203.4 EE19 203.5	<b>Single line diagram for different substation layouts.</b> Collect single line diagram of any 132 KV or 400 KV substations. Read and interpret drawing. Draw the same using drawing software Save and print the file on A3/A4paper	6
11	3	EE19 203.1 EE19 203.3 EE19 203.5	<b>Draw block diagram of any one type of power plan layout</b> by free hand on sketch book. Draw the same using drawing software Save and print the file on A3/A4paper.	4
12	3	EE19 203.1 EE19 203.2	<b>Draw diagram of sequential operation of control circuits</b> used for functional operation of electric motors/electric	6

		EE19 203.3 EE19 203.5	devices by free hand on sketch book. (At least two circuits) Example- Operation of five electric motors working in tandem <input type="checkbox"/> Draw the same using drawing software Save and print the file on A3/A4paper.	
13	3	EE19 203.1 EE19 203.3 EE19 203.4 EE19 203.5	<b>Collect, read and interpret electrical control circuit for the operations of</b> – (any three) Fridge, washing machine, air conditioner, machines used in metal turning workshop, APFC panel etc. Redraw the electrical control diagram of any two using drawing software Save and print file	6
14	3	EE19 203.1 EE19 203.3 EE19 203.5	<b>Collect existing ladder diagram used for operation of any industrial process</b> Draw ladder diagram of above using drafting software Save and print the file on A3/A4paper	2
<b>Total</b>				<b>60</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Libre CAD user manual	<a href="https://wiki.librecad.org/index.php/LibreCAD_users_Manual">https://wiki.librecad.org/index.php/LibreCAD_users_Manual</a>	-----
2	Electrical Engineering Drawing	S. K. Bhattacharya, New Age International Publisher, Second Edition, Reprint 2005	81-224-0855-9
3	Control of Electrical Machines	S. K. Bhattacharya, Brijinder Singh, New Age International Publisher, First Edition, 1996	8122409970
4	Graphical Symbols used in Electro technology	IS: 2032 1976, Bureau of Indian Standards	-----
5	Electrical Engineering Drawing Part 1	SurjitSingh, Katariya S.K.Publisher, revised edition, 2001	10: 9350143054 13: 978-9350143056
6	Electrical Engineering Drawing Part 2	SurjitSingh, Katariya S.K.Publisher	10: 9350143216 13: 978-9350143216
7	Electrical Engineering Drawing	C. R. Dargan, Computech Publications Limited, 2 <sup>nd</sup> edition 2010	8173180032, 9788173180033
8	Practical Troubleshooting of Electrical Equipment and Control Circuits	Mark Brown, Jawahar Rawtani, Dinesh Patil, Elsevier Publisher, 2004	0080480284, 9780080480282
9	Handbook of Electrical Motor Control Systems	Eswar, Tata McGraw-Hill Education, 1990	0074601113, 9780074601112

**E-References:**

1. [https://wiki.librecad.org/index.php/LibreCAD\\_users\\_Manual](https://wiki.librecad.org/index.php/LibreCAD_users_Manual)
2. <https://www.autodesk.in/campaigns/autocad-tutorials>
3. <https://www.youtube.com/watch?v=6gYLGt9DEqs> An Introduction to AutoCAD Electrical
4. <https://www.youtube.com/watch?v=Ua2IK-PCfUU> for single line diagram
5. <https://www.youtube.com/watch?v=Z05xuqhGNZ8> AutoCAD Electrical Tutorial | Panel Drawings

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 203.1	3	--	1	3	2	3	2	2	3	--
EE19 203.2	3	--	1	2	2	2	2	2	3	--
EE19 203.3	3	--	1	2	1	2	2	2	3	--
EE19 203.4	3	--	1	2	1	2	2	2	3	--
EE19 203.5	3	--	1	2	1	2	2	2	3	--

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Dr. Dilip Lulekar	HOD , Electrical Engineering	Govt. Polytechnic Nagpur
2	Mrs Swati Kadam	Manger, Electrical Engineering	Siemens
3	Dr. Vijay Rathod	Lecturer , Mechanical Engineering	Govt. Polytechnic Mumbai
4	Ishwar N. Khuspe (Curriculum Content Designer)	Lecturer In Electrical Engineering	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: EE 19 301				Course Title: Electrical and Industrial Measurement						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	4	-----	8	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 mid term and second skill test at the end of the term

**Rationale:** The course Electrical & Industrial Measurement is an important subject in the field of Electrical Engineering. This subject deals with the technique of measuring. Voltage, current and wattage by the indicating type of instruments. The technique of measurement of Electrical power in single phase and three phase circuits will be studied here. Measurement of energy and calibration and adjustment of energy meters will be studied under this subject. Prior to above the working principle construction of all type of measuring instruments like indicating, integrating and recording type will also be studied here. Users of potentiometers and other resistance measuring instruments are included under this subject. The course also covers Concept, Classification, Construction and working of some of major transducers.

**Course Outcomes:** Student should be able to

EE19 301.1	Define terminology used in electrical measuring instruments.
EE19 301.2	Demonstrate various constructional parts of electrical measuring instruments with working principles.
EE19 301.3	Measure electrical quantities with various instruments.
EE19 301.4	Select Instrument Transformers for measurement
EE19 301.5	Explain calibration procedure of electrical measuring instruments.
EE19 301.6	Select suitable transducer for particular application.

**Course Content Details:**

Unit No	Topics / Sub-topics
1	<p><b>Basic Concepts:</b></p> <p>1.1 Purpose of measurement &amp; significance of measurement.</p> <p>1.2 Various effects of electricity employed in electrical measuring instruments.</p> <p>1.3 Characteristics of Instruments: <u>Static</u>- Accuracy, Precision, sensitivity, resolution, Static error, Repeatability, Drift, Dead zone. <u>Dynamic</u>- speed of response, Lag, Fidelity, Dynamic error.</p> <p>1.4 Types of static error- Gross, Systematic, Random.</p> <p>1.5 Classification of instruments based on –</p> <p>a) Electrical effects.</p> <p>b) Nature of operation.</p>



	<p>c) Limits of permissible errors. 1.6 Different types of torque in Analog Instruments.</p> <p><b>Course Outcome: EE19 301.1      Teaching Hours : 6 hrs      Marks: 6 (R- 4, U-2, A-0)</b></p>
2	<p><b>Measurement of Current, Voltage and Resistance:</b> 2.1 Construction and principle of PMMC, MI &amp; Electro-dynamometer type Instrument. Merits and demerits. 2.2 Methods of production of torque. 2.3 Extension of Range of Ammeter and Voltmeter. (Simple Numerical) 2.4 Different methods of Extension of Range of Ammeter and Voltmeter. 2.5 Errors and their compensation. 2.6 Calibration of Ammeter and Voltmeter. 2.7 Use and Advantages of Clamp on meter, Digital ammeters and voltmeters 2.8 Classification of Resistance- Low, Medium and High. 2.9 Methods of Measurements of Low, Medium and High Resistance (Potentiometer, Wheatstone's bridge and Megger) 2.10 Measurement of Earth resistance- Earth tester (Analog &amp; Digital) 2.11 Advantages of Digital Multimeter, 2.12 Applications of CRO, Lissajous patterns on CRO, Power factor meter, clamp on meter and Frequency meter</p> <p><b>Course Outcome: EE19 301.2,3      Teaching Hours :14      Marks:16 (R-6,U-6,A-4)</b></p>
3	<p><b>Instrument Transformers:</b> 3.1 Construction, theory and errors in CT and PT. 3.2 Effect of secondary of CT open circuited. 3.3 Use of CT and PT for extension of ranges.</p> <p><b>Course Outcome: EE19 301.4      Teaching Hours: 6      Marks:4 (R- , U- , A- 4)</b></p>
4	<p><b>Measurement of Power:</b> 4.1 Concept of power in A.C. Circuit. 4.2 Principle and Construction of dynamometer type wattmeter 4.3 Errors and their compensation. 4.4 Poly phase wattmeter. 4.5 Measurements of power in 3 phase circuit for balanced and unbalanced load 4.6 Effect of power factor variation on wattmeter readings in two wattmeter method. 4.7 Measurement of reactive power in three phase balanced load by one wattmeter method and two wattmeter method. 4.8 Advantages of Digital Wattmeter</p> <p><b>Course Outcome: EE19 301.2,3      Teaching Hours: 8      Marks: 10 (R-4,U-4,A-2)</b></p>
5	<p><b>Measurement of Electrical Energy:</b> 5.1 Concept of electrical energy. 5.2 Constructional feature &amp; principle of working of single phase and three-phase induction type energy meter. 5.3 Constructional feature &amp; principle of working of single phase and three-phase bidirectional (Import-Export type) energy meter. 5.4 Different types of errors and their compensation. 5.5 Calibration of energy meter. 5.6 Advantages of Electronic energy meter. 5.7 Tri vector meter- Construction, working and Applications.</p> <p><b>Course Outcome: EE19 301.2,3,5      Teaching Hours :8      Marks:4 (R- , U- 4 , A- )</b></p>

<b>6</b>	<b>Transducers:</b> 6.1 Facts and concept of Instrumentation 6.2 Concept of Transducers 6.3 Classification of Transducers -Primary and Secondary Transducers -Electrical and Mechanical Transducers -Analog and Digital Transducers -Active and Passive Transducers 6.4 Construction and working principles of Transducers -Resistive, Inductive and capacitive transducers -Strain gauge (No derivation only formula) -Types of strain gauges:- unbounded, bounded, Semiconductor - Bourden tube, Bellows, Diaphragm. -LVDT -Piezoelectric transducer, photoconductive cell, photovoltaic cells, -load cell. -RTD, Thermistor, Thermocouple. -Pyrometers (Radiation, optical, Photoelectric) ultrasonic temperature Transducers. - Electromagnetic and turbine flow meter, ultrasonic flow meter.
	<b>Course Outcome: EE19 301.6      Teaching Hours :18      Marks: 20 (R-8,U-6,A-6)</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basic Concepts	4	2	0	06
2	Measurement of Current, Voltage and Resistance	6	6	4	16
3	Instrument Transformers	0	0	4	04
4	Measurement of Power	4	4	2	10
5	Measurement of Electrical Energy	0	4	0	04
6	Transducers	8	6	6	20
<b>Total</b>		<b>22</b>	<b>22</b>	<b>16</b>	<b>60</b>

**List of experiments:**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 301.1	To demonstrate any one type of static error in given instrument	02
2	2	EE19 301.2	To study the constructional details of PMMC and MI instruments.	04

3	2	<b>EE19 301.3</b>	To measure high value of DC current by low range ammeter with shunt.	04
4	3	<b>EE19 301.4</b>	i) To measure high value of AC current by low range ammeter with CT. ii) To measure high value of AC voltage by low range voltmeter with PT.	04
5	5	<b>EE19 301.5</b>	To calibrate and use single phase energy meter.	02
6	6	<b>EE19 301.6</b>	To measure temperature using thermocouple.	04
7	4	<b>EE19 301.3</b>	To measure active and reactive power in three phase balanced load by one wattmeter method.	04
8	4	<b>EE19 301.3</b>	To measure active power in three phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter reading.	04
9	2	<b>EE19 301.3</b>	To measure high value of DC voltage by low range voltmeter with multiplier.	04
10	2	<b>EE19 301.3</b>	To measure medium resistance by Wheatstone's bridge.	04
11	2	<b>EE19 301.3</b>	To measure insulation resistance by Megger.	04
12	2	<b>EE19 301.3</b>	To measure Earth resistance by earth tester. (Substation / Earth pit.)	04
13	5	<b>EE19 301.5</b>	To calibrate and use three phase energy meter.	04
14	6	<b>EE19 301.6</b>	To plot characteristics of Thermistor	04
15	6	<b>EE19 301.6</b>	To plot characteristics of RTD.	04
16	6	<b>EE19 301.6</b>	To measure liner displacement by LVDT	04
<b>Total</b>				<b>60</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical & Electronic Measurement & Instruments	A.K. Sawhney Dhanpat Rai & Sons, India . 11 <sup>th</sup> Edition Revised, 1995	ISBN-10: 8177001000 ISBN-13: 978- 8177001006
2	Electrical Measurements and Measuring Instruments	Golding, E.W. and Widdis, F.C. Reem Publications Pvt. Ltd.; Third edition (2011)	ISBN-10: 8190630725 ISBN-13: 978- 8190630726
3	Fundamentals of Electrical Measurements	George G.Harrap & Co Ltd; 2nd Revised edition edition (19 July 1973)	ISBN-10: 0245519904 ISBN-13: 978- 0245519901
4	Basic Electrical Measurement	M.B. Stout , Prentice hall of India, India. 2 <sup>nd</sup> Edition, 1965,	ASIN: B000PFNZKW

**E-References:**

1. <https://ndl.iitkgp.ac.in/>

2. <https://www.electrical4u.com/electrical-engineering-articles/measurement/>
3. <https://nptel.ac.in> (A Course on Electrical and Electronic Instruments, Prof.Avishek Chatterjee, IIT Kharagpur)
4. <https://swayam.gov.in> (Electrical Measurement and Electronic Instruments, Prof.Avishek Chatterjee, IIT Kharagpur)

### CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 301.1	3	2	1	2	2	2	2	2	1	1
EE19 301.2	3	3	3	3	3	2	2	3	3	3
EE19 301.3	3	3	3	3	3	3	2	3	3	3
EE19 301.4	3	3	3	3	2	2	2	3	2	2
EE19 301.5	3	3	3	3	2	2	2	3	2	2
EE19 301.6	3	3	3	3	2	2	2	3	2	2

### Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr.Vijay F Badgujar	Dy Manager, Maintenance	Graphite India Ltd, Satpur, Nasik
2	Mrs. Asmita M Marathe	Additional Executive Engineer	MSEDCL, Thane
3	Mrs.S.S.Umare	LEE	Government Polytechnic Nashik
4	Name of Faculty (Curriculum Content Designer)	Dr.Mahesh S. Narkhede	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of Electrical Engineering

Head of Department  
Department of Electrical Engineering

I/C, Curriculum Development Cell

Principal

EE 19 205 C-Programming

1. **First C Program** (Foss: *C and Cpp - English*)

**Outline:** 1) First C Program -Header Files --example: #include <stdio.h> -main() - Curly braces -printf() -semicolon ; -Compiling a C program --example: gcc file..

2. **First Cpp Program**

**Outline:** First C++ Program -Header files --example: #include <iostream> -main() - Curly braces -cout<< -semicolon ; -Compiling a C++ program --example: g++ file..

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 ar..

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 - Compariso..

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..

## 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 --example: da..

## 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 init..

## 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



**Government Polytechnic,  
Mumbai**

*Department of Electrical Engineering*

**P-19 Curriculum  
(Sandwich Pattern)**

**Semester-III  
(Course Contents)**

**GOVERNMENT POLYTECHNIC MUMBAI**  
(Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - III**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
HU 19 102	Environmental Studies	--	--	2	02	02	--	--	--	--	25	25	50
EE 19 207	Electrical Power Generation	4	--	--	04	04	60	20	20	--	--	--	100
EE 19 208	Electrical Circuit & Network	4	2	2	08	08	60	20	20	50*	--	25	175
EE 19 209	DC Machine & Transformer	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 302	Electrical Transmission & Distribution	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 303	Linux <sup>#</sup> (Spoken Tutorial)	--	--	4	04 <sup>#</sup>	04 <sup>#</sup>	--	--	--	--	--	--	--
	<b>Total</b>	<b>16</b>	<b>06</b>	<b>08</b>	<b>30</b>	<b>30</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>150</b>	<b>25</b>	<b>100</b>	<b>675</b>
Student Centered Activity (SCA)					<b>05</b>								
Total Contact Hours					<b>35</b>								

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 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.

Department Coordinator,  
Curriculum Development,  
Dept. of Electrical Engineering

Head of Department  
Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

Principal



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

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	<b>Ecosystem</b> 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 <b>Course Outcome: CO1 Teaching Hours : 6 hrs Marks: 03 (R- NA, U-NA, A- NA)</b>
	<b>Air and Noise Pollution</b> 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

	<p>separator, Electrostatic Precipitator)</p> <p>2.3 Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler</p> <p>2.4 Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution</p> <p><b>Course Outcome: CO2 Teaching Hours : 6 hrs Marks: 05 (R- NA, U-NA, A- NA)</b></p>
3	<p><b>Water and Soil Pollution</b></p> <p>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</p> <p>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)</p> <p>3.3 Causes, Effects and Preventive measures of Soil Pollution : Causes – Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-waste</p> <p>3.4 Mangroves : Importance, benefits.</p> <p><b>Course Outcome:CO3 Teaching Hours : 6 hrs Marks: 05 (R- NA, U-NA, A- NA)</b></p>
4	<p><b>Renewable sources of Energy</b></p> <p>4.1 Solar Energy: Basics of Solar energy. Flat plate collector (Liquid &amp; Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.</p> <p>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</p> <p>4.3 Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy</p> <p>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</p> <p><b>Course Outcome:CO4 Teaching Hours : 6 hrs Marks:05 (R- NA, U-NA, A- NA)</b></p>
5	<p><b>Solid Waste Management OR E- Waste Management, ISO 14000 &amp; Environmental Management For Civil Engineering :</b></p> <p>5.1 Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste.</p> <p>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</p> <p>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.</p> <p>5.4 Concept of Carbon Credit, Carbon Footprint.</p> <p>5.5 Environmental management in fabrication industry.</p> <p>5.6 ISO14000: Implementation in industries, Benefits, ISO 45001:2018</p> <p>5.7 Role of MPCB in factory permit.</p> <p>5.8 Green pro IGBC certification, its benefits</p> <p style="text-align: center;"><b>OR</b></p> <p><b>For Computer Engineering &amp; Information Technology :</b></p> <p>5.1 E-Waste Electronic products which have become unwanted, non-working, obsolete</p> <p>5.2 E-Waste Management Services</p> <p>5.3 Separation of E-Waste from other waste</p>

	<p>5.4 Categorization of E-Waste into old working equipments, old computers, non-working components</p> <p>5.5 Authorized Recycling Facilities</p> <p>5.6 Refurbishing</p> <p style="text-align: center;"><b>OR</b></p> <p><b>For Electrical Engineering :</b></p> <p>5.1 Various e-waste sources, their constituents, and health impacts</p> <p>5.2 e-Waste Problem in India</p> <p>5.3 Initiatives on building awareness in e-waste management.</p> <p>5.4 Current Status of e-Waste Management &amp; Environmental (Protection) Act 1986</p> <p>5.5 Development of waste recycling technologies.</p> <p>5.6 Opportunities of e-Waste Management in India</p> <p>5.7 e-Waste Management techniques</p> <p style="text-align: center;"><b>OR</b></p> <p><b>For Electronics Engineering &amp; Instrumentation Engineering :</b></p> <p>5.1 Solid waste generation- Sources and characteristics of : E- waste, biomedical waste.</p> <p>5.2 Toxicity due to hazardous substances in E waste and their impact</p> <p>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</p> <p>5.4 Domestic E waste disposal and E waste management</p> <p>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.</p> <p>5.6 Concept of Carbon Credit, Carbon Footprint.</p> <p style="text-align: center;"><b>OR</b></p> <p><b>For Leather Technology/ Leather Goods &amp; Footware Technology :</b></p> <p>5.1 Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste.</p> <p>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</p> <p>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.</p> <p>5.4 Concept of Carbon Credit, Carbon Footprint.</p> <p>5.5 Environmental management in fabrication industry.</p> <p>5.6 ISO14000: Implementation in industries, Benefits.</p> <p>5.7 Solid waste management in leather and footwear industries</p> <p><b>Course Outcome:CO5 Teaching Hours : 6 hrs      Marks:07(R- NA, U-NA, A- NA)</b></p>
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**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 <b>or</b> an authorized e-waste recycling plant and prepare a report based on visit.	6
<b>Total</b>				<b>30</b>

**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](http://www.eco-prayer.org)
- 2) [www.teriin.org](http://www.teriin.org)
- 3) [www.cpcp.nic.in](http://www.cpcp.nic.in)
- 4) [www.cpcp.gov.in](http://www.cpcp.gov.in)
- 5) [www.indiaenvironmentportal.org.in](http://www.indiaenvironmentportal.org.in)
- 6) [www.whatis.techtarget.com](http://www.whatis.techtarget.com)
- 7) [www.sustainabledevelopment.un.org](http://www.sustainabledevelopment.un.org)
- 8) [www.conserve-energy-future.com](http://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 & Footwear 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
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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

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Curriculum Development,  
Department of Civil Engg.

Head of Department  
Department of Civil Engg.

I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: <b>EE19207</b>				Course Title: <b>Electrical Power Generation</b>						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 mts)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>4</b>	-	-	<b>4</b>	<b>60</b>	<b>20</b>	<b>20</b>	-	-	-	<b>100</b>

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 midterm and second skill test at the end of the term

### Rationale:

Electrical Engineering Diploma holders employed in the field of power generation mostly works in large thermal, hydro power stations, non-conventional power plants and substation. Some may hold independent charge of small generating station and substation. All of them need to know the various primary sources of energy available, the process of energy conversion, equipment necessary for these processes, safety measures and their function.

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

**Course Outcomes:** Student should be able to

<b>EE19207.1</b>	<b>Understand the types of power generation</b>
<b>EE19207.2</b>	<b>Interpret the layout of power plant</b>
<b>EE19207.3</b>	<b>Apply the knowledge of functioning of generating equipment for supervision and maintenance</b>
<b>EE19207.4</b>	<b>Apply safe practices in power plants</b>

### Course Content Details:

Unit No	Topics / Sub-topics
1	<p><b>Thermal Power Plants:</b> Coal, Gas/ Diesel</p> <p>1.1 Energy conversion process of thermal power plant(A block diagram concept)</p> <p>1.2 Layout and working of a typical thermal power plant (Coal, Gas/ Diesel)</p> <p>1.3 Properties of conventional fuels used in the energy conversion</p> <p>1.4 Equipment used in thermal power plants with its function: Coal, Gas/ diesel</p> <p>1.5 Functions of the following types of thermal power plants and their major auxiliaries:</p> <p>    1.5.1 Coal fired boilers: fire tube and water tube</p> <p>    1.5.2 Gas/diesel based combustion engines</p> <p>1.6 Temperature and pressure of steam in modern power plant. Introduction to Super Critical Technology Thermal power plants</p> <p>1.7 Safe Practices, observed in thermal power plants: coal, gas and diesel based</p> <p>1.8 Thermal power plants with capacity in Maharashtra</p>



	<p><b>Assignment: Demonstration of Watch video of working of thermal power plant and answer questions</b></p> <p><b>Course Outcome: EE19207.1, EE19207.2, EE19207.3, EE19207.4</b></p> <p><b>Teaching Hours : 12 Marks: 12 (R- 4, U-4, A-4)</b></p>
2	<p><b>Nuclear Power Plant</b></p> <p>2.1 Energy conversion process</p> <p>2.2 Atomic fusion and fission action, Commonly used Nuclear fuels</p> <p>2.3 Layout and working of a typical nuclear power plant</p> <p>2.3 Equipment used in nuclear power plants and their function only</p> <p>2.4 Disposal of nuclear waste and nuclear shielding</p> <p>2.5 Safe Practices observed in typical nuclear power plant</p> <p>2.6 Nuclear power plants with capacity at national and state level</p> <p><b>Assignment: Demonstration of video of working of nuclear power plant and answer questions</b></p> <p><b>Course Outcome: EE19207.1, EE19207.2, EE19207.3, EE19207.4</b></p> <p><b>Teaching Hours :06 Marks: 06 (R- 2, U- 2, A- 2 )</b></p>
3	<p><b>Hydro Power Plants</b></p> <p>3.1 Energy conversion process of hydro power plant</p> <p>3.2 Layout and working of a typical hydro power plant</p> <p>3.3 Equipment used in hydro power plants and their function only</p> <p>3.4 Classification of hydro power plant and type of water turbine: High, medium and low head</p> <p>3.5 Safe Practices observed in hydro power plants</p> <p>3.6 Pumped Storage Hydro Power Plants</p> <p>3.7 Hydro power plants with capacity in Maharashtra</p> <p><b>Assignment: Demonstration of video of working of hydro power plant and answer questions</b></p> <p><b>Course Outcome: EE19207.1, EE19207.2, EE19207.3, EE19207.4</b></p> <p><b>Teaching Hours :12 Marks:12 (R- 4, U- 4, A- 4 )</b></p>
4	<p><b>Solar Power Plants</b></p> <p>4.1 Solar Map of India: Global solar power radiation.</p> <p>4.2 Energy conversion process of solar power plant</p> <p>4.3 Solar Power Technology:</p> <p>4.3.1 Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors</p> <p>4.3.2 Solar Photovoltaic (PV) power plant: layout, construction, and working, Grid Connected and battery storage solar power plants</p> <p>4.3.3 Equipment used in solar power plants and their function only</p> <p>4.5 Safe Practices observed in solar power plants</p> <p>4.6 Major Solar power plants with capacity at national and state level</p> <p><b>Assignment: Demonstration of video of solar power plants and answer questions</b></p> <p><b>Course Outcome: EE19207.1, EE19207.2, EE19207.3, EE19207.4</b></p> <p><b>Teaching Hours : 12 Marks:12 (R- 4, U-4, A- 4 )</b></p>

<b>5</b>	<p><b>Wind Power Plants</b></p> <p>5.1 Wind Map of India: Wind power density and its unit of measurements, electrical power output</p> <p>5.2 Layout of Horizontal axis large wind power plant : Geared wind and Direct-drive wind plant</p> <p>5.3 Salient Features of electric generators used in large wind power plants:</p> <p>5.4 Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG)</p> <p>5.5 Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)</p> <p>5.6 Safe Practices observed in wind power plants</p> <p>5.7 Wind power plants with capacity in Maharashtra</p> <p><b>Assignment: Demonstration video of wind power plant and answer questions</b></p> <p><b>Course Outcome: EE19207.1, EE19207.2, EE19207.3, EE19207.4</b></p> <p><b>Teaching Hours : 10 Marks:10 (R-2, U-4, A-4 )</b></p>
<b>6</b>	<p><b>Biomass-Power Plants</b></p> <p>6.1 Energy conversion process of biomass based power plant</p> <p>6.2 Layout of a Bio-chemical based (e.g. biogas) power plant</p> <p>6.3 Layout of a Thermo-chemical based (e.g. Municipal waste) power plant</p> <p>6.4 Layout of an Agro-chemical based (e.g. bio-diesel) power plant</p> <p>6.5 Features of the solid, liquid and gas biomasses as fuel for biomass power plant.</p> <p>6.6 Safe Practices observed in bio-mass based power plants</p> <p>6.7 Biomass Power plant with capacity in Maharashtra</p> <p><b>Assignment: Demonstration of video biomass power plant and answer questions</b></p> <p><b>Course Outcome: EE19207.1, EE19207.2, EE19207.3, EE19207.4</b></p> <p><b>Teaching Hours : 8 Marks: 8 (R-2, U-4, A-2 )</b></p>

### Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Thermal Power Plants: Coal, Gas/ Diesel	4	4	4	12
2	Nuclear Power Plant	2	2	2	06
3	Hydro Power Plants	4	4	4	12
4	Solar Power Plants	4	4	4	12
5	Wind Power Plants	2	4	4	10
6	Biomass Power plants	2	4	2	08
<b>Total</b>		<b>18</b>	<b>22</b>	<b>20</b>	<b>60</b>

### References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
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1	Power Plant Engineering	Nag. P. K. McGraw Hill, New Delhi, 4 <sup>th</sup> Edition, 2017	978-9339204044
2	Electrical Power Generation	Tanmoy Deb, Khanna Publishing House, Delhi (Ed. 2018)	9789386173379
3	Generation of Electrical Energy	Gupta, B.R. S. Chand & Co. New Delhi, 2014	9788121901024
4	Wind Power Technologies	Rachel, Sthuthi; Earnest, Joshua, PHI Learning, New Delhi, 4 <sup>th</sup> Edition, 2019	938802849X
5	Solar Photovoltaic: Fundamentals, Technologies and Applications	Solanki, Chetan Singh PHI Learning, New Delhi Third edition, 2015	9788120351110
6	Wind Turbines	Hau, Erich, Springer-Verlag, Berlin Heidelberg, Germany	978-3-642- 27150-2
7	A Course in Electrical Power	Gupta, J.B. S. K Kataria and Sons, New Delhi. 2014,	9350143747
8	A Course in Electrical Power	Soni, Gupta, Bhatnagar, Dhanpatrai and Sons System, S.Chand & Co. New Delhi, 2005	9788121924962
9	Textbook of Renewable Energy	S.C. Bhatia, R. K. Gupta Woodhead Publishing India, 2018	9788193644607
10	Biomass to Renewable Energy Processes	Jay Cheng, CRC Press, 2 <sup>nd</sup> edition, 2017	9781498778794

**E-References:**

- <https://ndl.iitkgp.ac.in/>
- <https://blossoms.mit.edu>
- <https://electrical-engineering-portal.com>
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- <https://mnre.gov.in/>
- <https://www.mahaurja.com/meda/>

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19207.01	3	3	1	2	3	2	3	3	3	3
EE19207.02	3	2	2	3	3	2	3	3	3	3
EE19207.03	3	3	2	2	3	2	3	3	3	3
EE19207.04	3	2	2	2	3	2	3	3	3	3

**Industry Consultation Committee:**

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1	Sudesh N. Bhadange	SE, Hydro	Mahagenco, Prakashgad Bandra Mumbai
2	Narayan C. Amzare	SE, Nagpur Rural Circle	MSEDCL Nagpur
3	Barnalli Motling	HOD , Electrical Engineering	KJSP Vidyavihar , Mumbai
4	Nisha Wader	HOD, Electrical Engineering	VPM Polytechnic Thane
5	Sandeep Vishwarupe (Curriculum Content Designer)	HOD, Electrical Engg.	Govt. Polytechnic Mumbai
6	Ishwar Khuspe (Curriculum Content Designer)	Lecturer Electrical Engg.	Govt. Polytechnic Mumbai

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Department of Electrical Engineering

Head of Department  
Department of Electrical Engineering

I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>											
Course Code: EE 19 208				Course Title: Electrical Circuit & Network							
Compulsory / Optional: Compulsory											
Teaching Scheme and Credits				Examination Scheme							
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total	
<b>4</b>	<b>2</b>	<b>2</b>	<b>8</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50</b>	--	<b>25</b>	<b>175</b>	

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 mid term and second skill test at the end of the term

**Rationale:** Knowledge of Electrical Circuits is essential in maintaining the electrical equipment. Understanding the layout of electrical circuits, their functioning and behaviour lays a foundation stone for an electrical engineer. This course will help the students to use the principles of circuit analysis in designing, maintaining the electrical circuits of equipment & wiring installations and discharge their duties as a supervisor where ever needed

**Course Outcomes:** Student should be able to

EE19 208.1	Describe the different parameters of single-phase series AC circuits, their inter relationships and behaviour.
EE19 208.2	Describe the different parameters of single-phase parallel AC circuits, their inter relationships and behaviour.
EE19 208.3	Describe the different parameters of polyphase AC circuits, their inter relationships and behaviour.
EE19 208.4	Apply different circuit analysis techniques and theorems to solve basic circuit problems.

**Course Content Details:**

Unit No	Topics / Sub-topics
<b>1</b>	<p><b>Single Phase AC Series Circuits</b></p> <p>1.1 Instantaneous equations for voltage and current of ac quantity</p> <p>1.2 Vector representation of alternating quantity:</p> <ul style="list-style-type: none"> <li>➤ Rectangular form</li> <li>➤ Polar form</li> </ul> <p>(Numerical on form conversion)</p> <p>1.3 A.C through pure resistance alone:- Expression of voltage, current and power, waveforms of v, i &amp; p, phasor diagram.</p> <p>1.4 A.C through pure inductance alone:- Expression of voltage, current and power, waveforms of v , i &amp; p, phasor diagram.</p> <p>1.5 A.C through pure capacitance alone:- Expression of voltage, current and power, waveforms of , v, i &amp; p, phasor diagram.</p>

	<p>1.6 Waveforms, phasor diagram and expression of voltage, current and power, impedance triangle, nature of power factor in R-L, R-C, R-L-C series circuits (Numerical)</p> <p>1.7 Power triangle:-active power, reactive power and apparent power.</p> <p>1.8 Resonance in R-L-C series circuit (Numerical)</p> <p>1.9 Graphical Representation of Resonance, resonance curve, Quality (Q) Factor of series resonant circuit.</p> <p><b>Course Outcome: EE19 208.1 Teaching Hours :16 Marks: 18 (R-04 , U-04 , A-10 )</b></p>
2	<p><b>Single phase Parallel circuits</b></p> <p>2.1 Concept of susceptance, admittance and conductance</p> <p>2.2 Solving AC parallel circuit by vector or phasor method, Admittance method and vector algebra. (Numerical on above)</p> <p>2.3 Series equivalent of parallel circuit.</p> <p>2.4 Parallel equivalent of series circuit</p> <p>2.5 Parallel Resonance, Q-factor (Numerical).</p> <p>2.6 Graphical representation of parallel resonance.</p> <p>2.7 Comparison of series and parallel resonance</p> <p><b>Course Outcome: EE19 208.2 Teaching Hours :12 Marks: 12 (R- 04 , U- 04 , A-04 )</b></p>
3	<p><b>Polyphase circuits</b></p> <p>3.1 Principle of generation of 3 –<math>\phi</math> alternating emf.</p> <p>3.2 Advantages of Polyphase circuit over single phase circuit.</p> <p>3.3 Phase Sequence.</p> <p>3.4 Types of three phase connections-Star connection and delta connection.</p> <p>3.5 Concept of balanced and unbalanced load</p> <p>3.6 Relation between phase and line quantities of star connection.</p> <p>3.7 Relation between phase and line quantities of delta connection. (Numerical on balanced load only)</p> <p><b>Course Outcome: EE19 208.3 Teaching Hours :10 Marks: 10 (R- 04 , U- 02, A-04 )</b></p>
4	<p><b>Network Analysis-Techniques (DC Circuits) and Theorems</b></p> <p>4.1 Mesh analysis</p> <p>4.2 Nodal analysis using voltage and current sources</p> <p>4.3 Superposition Theorem.</p> <p>4.4 Thevenin's Theorem.</p> <p>4.5 Norton's Theorem.</p> <p>4.6 Maximum power transfer Theorem.</p> <p>4.7 Reciprocity theorem.</p> <p>4.8 Introduction to AC Network (How to solve only) (4.1 to 4.7 numerical on DC Circuits only)</p> <p><b>Course Outcome: EE19 208.4 Teaching Hours :22 Marks: 20 (R- 02 , U-04 , A- 014)</b></p>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Single Phase AC Series Circuit	04	04	10	18
2	Single phase Parallel circuit	04	04	04	12
3	Polyphase circuit	04	02	04	10
4	Network Theorems	02	04	14	20
<b>Total</b>		<b>14</b>	<b>14</b>	<b>32</b>	<b>60</b>

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 208.1	To carry out analysis of given RLC series circuit	02
2	2	EE19 208.2	To find out the current flowing through each component in RC parallel circuit	02
3	3	EE19 208.3	To carry out Three Phase Power Measurement	02
4	4	EE19 208.4	Verification of Reciprocity Theorem	04
5	4	EE19 208.4	Verification of Superposition Theorem	04
6	4	EE19 208.4	Verification of Thevenin's Theorem	02
7	4	EE19 208.4	Verification of Maximum Power Transfer Theorem	04
8	4	EE19 208.4	Verification of Norton's Theorem	04
9	2	EE19 208.2	To find out the current flowing through each component in LC parallel circuit	02
10	2	EE19 208.2	To find out the current flowing through each component in parallel RLC circuit	02
<b>Total</b>				<b>30</b>

**Note: Experiments No. 1 to 4 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.**

**Tutorial/Assignment:**

Sr. No.	Unit No	COs	Title of tutorial/assignment	Hours
1	1	EE19 208.1	Numerical on form conversion	02
2	1	EE19 208.1	Solve RL, RC and RLC series circuit	04

3	1	EE19 208.1	Solve problems on resonance in RLC series circuit	02
4	2	EE19 208.2	Solve AC parallel circuit by vector or phasor method, admittance method and vector algebra	04
5	2	EE19 208.2	Solve problems on Parallel Resonance and Q-factor	04
6	3	EE19 208.3	Solve problems on balanced three phase star and delta connection	04
7	4	EE19 208.4	Solve the problems on superposition theorem	04
8	4	EE19 208.4	Solve the problems on Thevenin's and Norton's Theorem	04
9	4	EE19 208.4	Solve the problems on Maximum Power transfer theorem and Reciprocity theorem	02
<b>Total</b>				<b>30</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	A Textbook of Electrical Technology - Volume I	B L Theraja , S Chand; Twenty Third edition (1 January 1959)	ISBN-10: 8121924405 ISBN-13: 978-8121924405
2	Electric Circuits	David A. Bell, Oxford University Press; Seventh edition (9 April 2009)	ISBN-10: 9780195694284 ISBN-13: 978-0195694284
3	Schaum's Outline of Electric Circuits, 6th edition (Schaum's Outlines)	Mahmood Nahvi, Joseph Edminister, McGraw Hill Education; 6 edition (16 December 2013)	ISBN-10: 0071830456 ISBN-13: 978-0071830454

**E-References:**

1. <https://ndl.iitkgp.ac.in/>
2. <https://nptel.ac.in/>
3. <http://vlabs.iitkgp.ac.in/asnm/>
4. <http://amrita.vlab.co.in/?sub=1&brch=75>

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 208.1	3	3	--	3	2	2	3	2	2	2
EE19 208.2	3	3	--	3	2	2	3	3	3	3
EE19 208.3	3	3	--	3	2	2	3	3	3	3
EE19 208.4	3	3	--	3	2	2	3	2	1	1



**Industry Consultation Committee:**

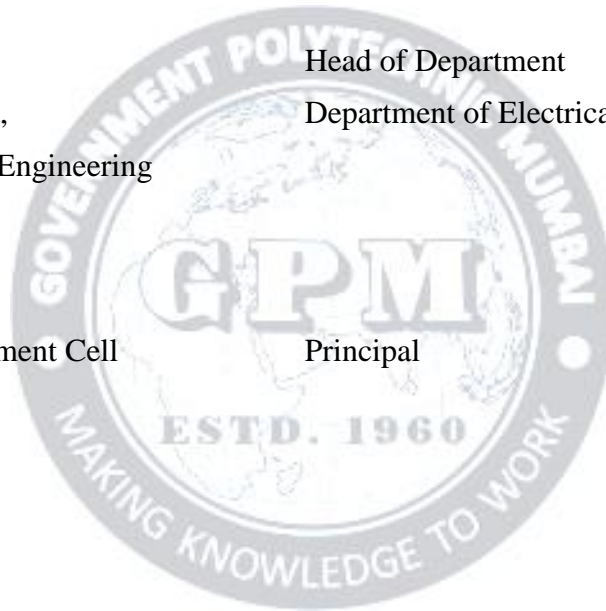
<b>Sr. No</b>	<b>Name</b>	<b>Designation</b>	<b>Institute/Organisation</b>
1	Mrs.Asmita S Marathe	Additional Executive Engineer	MSEDL, Thane
2	Mr.Vijay F Badguajr	Dy.Manager (Maintenance)	Graphite Vicarb India Ltd, Nasik
3	Mrs. R U Patil	LEE	VPM Polytechnic, Thane
4	Mrs. Rajitha TB	LEE	Bharti Vidyapeeth, Navi Mumbai
5	Miss .A.V. Patil	LEE	Govt. Polytechnic Mumbai
6	Dr.Mahesh S.Narkhede	LEE	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of Electrical Engineering

Head of Department  
Department of Electrical Engineering

I/C, Curriculum Development Cell

Principal



Programme: <b>Diploma in Electrical Engineering.</b>										
Course Code: EE 19 209				Course Title: DC Machines & Transformer						
Compulsory / Optional: <b>C</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>04</b>	<b>02</b>	<b>--</b>	<b>06</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	<b>--</b>	<b>25</b>	<b>175</b>

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

### Rationale:

This is the subject intends to teach facts , concepts, principle and procedure for operation and testing of electrical machine, such as d. c. generators, d. c. motors and single & three phase transformers. Students will be able to analyze the characteristics of d.c. Machines, transformer and qualitative parameters of these machines.

These machines are used in transmission, distribution & utilization systems. Knowledge gained by the students will be helpful in the study of technological subjects such as utilization of electrical energy, switchgear & protection, testing, maintenance of electrical machines.

The knowledge & the skills obtained will be helpful in discharging duties such as supervisor, controller & R & D technician.

**Course Outcomes:** Student should be able to

EE19 209.1	Explain different types of DC generators.
EE19 209.2	Maintain different types of DC motors.
EE19 209.3	Interprets single phase transformer.
EE19 209.4	Comprehend three phase transformers.
EE19 209.5	Demonstrate different types of special purpose transformers.

### Course Content Details:

Unit No	Topics / Sub-topics
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1	<p><b>Topic Title: Introduction to D.C. Machines.</b></p> <p>1.1 Principles of Electromechanical Energy Conversion.  1.2 Necessity of DC Machines.  1.3 Constructional parts of D.C. machines- Material used and their functions.  1.4 Armature windings: Types and comparison. ( No numerical)</p> <p><b>Course Outcome: EE19 209.1,EE19 209.2                      Teaching Hours : 04 hrs</b>  <b>Marks: 04 (R-02, U-02, A-)</b></p>
2	<p><b>Topic Title: D.C. Generators</b></p> <p>2.1 Working principle of D,C. Generator, Fleming’s right hand rule.  2.2 Types of D.C. Generators.  2.3 E.M.F equation &amp; voltage equation of all types of D.C. Generators.  2.4 Losses in D.C. Generator.  2.5 Power stages of D.C. Generator.  2.6 Characteristics of D.C. Generators.  2.7 Armature reaction.  2.8 Commutation, methods to improve commutation.  2.9 Applications of all generators. (simple numerical on above)</p> <p><b>Course Outcome: EE19 209.1   Teaching Hours : 10 hrs   Marks:10(R- 02, U-04, A-04)</b></p>
3	<p><b>Topic Title: D.C. Motors</b></p> <p>3.1 DC motor: Working principle, Fleming’s left hand rule, Types of DC motors.  3.2 Back e.m.f. and its significance, Voltage equation of DC motor.  3.3 Torque and Speed; Armature torque, Shaft torque,  3.4 DC motor starters: Necessity and working of three point starters.  3.5 Speed control of DC shunt and series motor: Flux and Armature control.  3.6 losses, efficiency and applications.(simple numerical on above)  3.7 Brushless DC Motor: Construction, working advantages and disadvantages and applications.</p> <p><b>Course Outcome: EE19 209.2   Teaching Hours :10   Marks: 10 (R-02, U-04, A-04 )</b></p>
4	<p><b>Topic Title: Single Phase Transformers</b></p> <p>4.1 Transformer: Principle of operation  4.2 Types of transformers: Shell type and core type.  4.3 Construction: Parts and functions, materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores,  4.4 EMF equation of transformer: Derivation, Voltage transformation ratio.  4.5 Concept of ideal transformer.  4.6 Transformer on No-load and on-load phasor diagram.  4.7 Magnetic leakage.  4.8 Equivalent circuit of transformer: Equivalent resistance and reactance.  4.9 Voltage regulation and Efficiency: Direct loading, OC/SC method.  4.10 kVA rating of transformer.  4.11 All day efficiency.</p>

	4.12 Polarity of transformer ( Simple numerical on above)  <b>Course Outcome: EE19 209.3      Teaching Hours : 16 Marks: 18 (R-06, U-06, A-06 )</b>
5	<b>Topic Title: Three Phase Transformers</b> 5.1 Bank of three single phase transformers, Single unit of three phase transformer. 5.2 Three phase transformers connections as per IS:2026 (part IV)-1977. 5.3 Vector groups 5.4 Three phase to two phase conversion (Scott Connection), 5.5 Selection of transformer as per IS: 10028 (Part I)-1985. 5.6 Criteria for selection of distribution transformer, and power transformer. 5.7 Amorphous Core type Distribution Transformer. 5.8 Need of parallel operation of three phase transformer. 5.9 Conditions for parallel operation.  <b>Course Outcome: EE19 209.4      Teaching Hours : 12 Marks: 10 (R-04, U-06, A- )</b>
6	<b>Topic Title: Special Purpose Transformers</b> 6.1 Single phase and three phase auto transformers: Construction, working and applications. 6.2 Isolation transformer: Constructional Features and applications. 6.3 Single phase welding transformer: constructional features and applications.  <b>Course Outcome: EE19 209.5      Teaching Hours : 08 Marks: 08 (R-, U- 04, A-04 )</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Introduction to D.C. Machines.	04	02	02	--	04
2	D.C. Generators	10	02	04	04	10
3	D.C. Motors	10	02	04	04	10
4	Single Phase Transformers	16	06	06	06	18
5	Three Phase Transformers	12	04	06	--	10
6	Special Purpose Transformers	08	00	04	04	08
<b>Total</b>		<b>60</b>	<b>16</b>	<b>26</b>	<b>18</b>	<b>60</b>

**Legends:** R-Remember; U-Understand; A-Applly and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**List of experiments:**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	-	ALL CO	Write a report on the machine laboratory in terms of practicing of reading name plates of various machines and their supply system.	02
2	1	EE19 209.1,2	To study the constructional parts of D.C. Machine.	04
3	2	EE19 209.1	To plot O.C.C. of D.C. Generator.	02
4	2	EE19 209.1	To plot load characteristic of D.C. Shunt Generator.	02
5	3	EE19 209.2	Speed control of D.C. Shunt motor using Flux control and Armature voltage control methods	04
6	3	EE19 209.2	Load test on D.C. Shunt motor and calculate torque and efficiency.	04
7	4	EE19 209.3	Determine the efficiency and voltage regulation of single phase transformer by direct loading.	04
8	4	EE19 209.3	To perform O.C.& S.C. test on single phase transformer to find efficiency and voltage regulation of transformer.	04
9	5	EE19 209.4	To study the constructional details of distribution and power transformer. ( based on a visit to transformer manufacturing or repairing industry)	
10	4	EE19 209.3	Parallel operation of single phase transformer.	04
<b>Total</b>				<b>30</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Machines, Vol-I, II	G.C. Garg & P.S. Bimbhra, Khanna Book Publishing House, New Delhi.	ISBN: 978-9386173-447, 978-93-86173-607
2	Electrical Technology Vol-II	Theraja B.L., . S. Chand and Co. Ltd., New Delhi.	ISBN: 9788121924375
3	Electrical Machines.	Bhattacharya S. K., McGraw Hill Education, New Delhi.	ISBN: 9789332902855
4	Electrical Machines.	Kothari D. P. and Nagrath, I. J., McGraw Hill Education. New Delhi.	ISBN: 9780070699670
5	Principles of Electrical Machines.	Mehta V. K. and Mehta Rohit, . S. Chand and Co. Ltd., New Delhi.	ISBN: 9788121930888
6	Electrical Machines Theory and Practice.	Bandyopadhyay M. N., PHI Learning Pvt. Ltd., New Delhi.	ISBN: 9788120329973 Vi
7	Basic Electrical Engineering.	Mittle V.N. and Mittle Arvind., McGraw Hill Education, New Delhi.	ISBN: 9780070593572

**E-References:**

1. [www.nptel.com](http://www.nptel.com)
2. [www.electrical4u.com](http://www.electrical4u.com)
3. [www.electrical-energeng-portal.com](http://www.electrical-energeng-portal.com)
4. [www.learnerstv.com](http://www.learnerstv.com)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 209.1	2	2	1	3	1	1	-	3	2	2
EE19 209.2	3	2	3	3	1	1	3	3	2	2
EE19 209.3	3	2	3	3	1	1	3	3	2	2
EE19 209.4	3	2	3	3	1	1	3	3	2	2
EE19 209.5	3	2	3	3	1	1	3	3	2	2

**Industry Consultation Committee:**

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1	Mr. L KS Rathore I.E.S.	DIRECTOR	REGIONAL ISNPECTORIAL ORGANISATION(WEST) CENTRAL ELECTRICITY AUTHORITY, WR(HQ) MINISTRY OF POWER GOVT OF INDIA
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Coordinator,

Head of Department

Curriculum Development,

Department of \_\_\_\_\_

Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: <b>EE 19 302</b>				Course Title: <b>Electrical Transmission &amp; Distribution</b>						
Compulsory / Optional: <b>C</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>4</b>	<b>2</b>	<b>-</b>	<b>6</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	<b>-</b>	<b>25</b>	<b>150</b>

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:

This is the subject where the principles of electrical transmission and distribution systems are studied. The electricity is generated in bulk at remote places and transmitted to long distances and then distributed in cities, villages and to industry. Knowledge of components of electrical transmission and distribution system and their functions is necessary for understanding power system performance. Study of load dispatch and HVDC transmission is also important for working in power sector.

**Course Outcomes:** Student should be able to

EE 19 302.1	Explain various transmission and distribution systems.
EE 19 302.2	Calculate the performance of transmission & distribution systems.
EE 19 302.3	Compare between HVDC and HVAC systems.
EE 19 302.4	Describe the Substation and the Power factor improvement.

### Course Content Details:

Unit No	Topics / Sub-topics
<b>1</b>	<p><b>Transmission line components and parameters:</b></p> <p>1.1 Introduction to line component.</p> <p>1.2 Types of conductor- Al, Cu, ACSR, AAC, AAAC, ACSR, HTLS conductor and solid stranded bundle conductors.</p> <p>1.3 Line supports – requirement, type. Construction of supporting structures, Towers, monopoles</p> <p>1.4 Spacing between conductors.</p> <p>1.5 Concept of length of span.</p> <p>1.6 Sag in overhead line.</p> <p>1.7 Calculations of sag: effect of wind and ice loading (Simple Numerical)</p> <p>1.8 Types of insulator – Pin, Suspension, Strain, Stay, Shackle.</p> <p>1.9 Safety factor, puncture and ultimate strength.</p>

	<p>1.10 Potential distribution over a string of suspension insulator.</p> <p>1.11 Simple numerical on string efficiency.</p> <p>1.12 Constants of transmission lines</p> <p>1.13 Skin effect</p> <p>1.14 Transposition of conductor and necessity.</p> <p>1.15 Proximity effect</p> <p><b>Course Outcome: EE 19 302.1 Teaching Hours : 14 Marks: 12 (R- 4, U- 4, A-4 )</b></p>
2	<p><b>Performance of transmission line:</b></p> <p>2.1 Classification of transmission line, Important terms, regulation &amp; efficiency of T/L</p> <p>2.2 Short transmission line, eq. circuit representation &amp; phasor diagram &amp; analysis. (Simple Numerical)</p> <p>2.3 Medium transmission line, End condenser method, Nominal T and <math>\pi</math> circuit representation &amp; analysis, phasor diagram.</p> <p>2.4 Ferranti effect.</p> <p>2.5 Introduction of Long transmission line.</p> <p>2.6 Corona</p> <ul style="list-style-type: none"> <li>• Factors affecting corona.</li> <li>• Important terms</li> <li>• Advantages and disadvantages of corona.</li> <li>• Methods of reducing corona effect</li> </ul> <p><b>Course Outcome: EE 19 302.1, EE 19 302.2</b> <b>Teaching Hours : 10 Marks: 12 (R- 4, U- 4, A- 4 )</b></p>
3	<p><b>EHVAC, HVDC and Load Dispatch Center:</b></p> <p>3.1 EHVAC transmission system, advantages, disadvantages.</p> <p>3.2 HVDC transmission system, applications, configuration &amp; parts of HVDC system, types of HVDC system, standard rated voltage, present status and growth prospects of HVDC transmission system</p> <p>3.3 Compare between EHVAC &amp; HVDC</p> <p>3.4 National, Regional and State Load Dispatch Centers.</p> <p>3.5 Introduction to grid and different voltage levels for HVAC and HVDC.</p> <p>3.6 Introduction to Line In Line Out system (LILO).</p> <p><b>Course Outcome: EE 19 302.1, EE 19 302.3</b> <b>Teaching Hours : 10 Marks: 10 (R- 4, U- 4, A- 2 )</b></p>
4	<p><b>Distribution system:</b></p> <p>4.1 Components of Distribution system - distributor, feeder and service mains.</p> <p>4.2 Classification of distribution system.</p> <p>4.3 A.C. distribution.</p> <p>4.4 Connection scheme of distribution system -radial and ring mains system.</p> <p>4.5 Factors to be considered for design considerations.</p> <p>4.6 Voltage drop calculation for feeder fed at one end for single phase and three phase four wire A.C. balanced system.</p>



	<b>Course Outcome: EE 19 302.1, EE 19 302.2</b> <b>Teaching Hours : 12</b> <b>Marks:12 (R- 4, U- 4, A- 4)</b>
<b>5</b>	<b>Underground Cables:</b> 5.1 Introduction and requirement. 5.2 Classification of Cable. 5.3 Cable conductor. 5.4 Cable construction. 5.5 Cable insulation, metallic sheathing and mechanical protection. 5.6 Comparison with overhead lines. 5.7 Methods of cable laying.  <b>Course Outcome: EE 19 302.1 Teaching Hours : 06</b> <b>Marks: 06 (R- 4, U- 2, A- 0)</b>
<b>6</b>	<b>Substation &amp; Power factor improvement:</b> 6.1 Introduction, classification of substations according to service & location. 6.2 Typical single line connection diagrams of substation layouts, 11 KV/0.415KV pole mounted distribution substation, 33KV/11KV substation, 132 KV or 220 KV substations. 6.3 Substation equipments and auxiliary systems, their functions, types (AIS, GIS, Hybrid) and substation earthing. 6.5 Causes and disadvantages of low power factor 6.6 P.F. improvement using static capacitor. 6.7 Advantage of P.F. improvement.  <b>Course Outcome: EE 19 302.4 Teaching Hours : 08</b> <b>Marks: 08 (R- 4, U- 4, A- 0)</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Transmission line components and parameters	4	4	4	12
2	Performance of transmission line	4	4	4	12
3	EHVAC , HVDC and Load Dispatch Center	4	4	2	10
4	Distribution system	4	4	4	12
5	Underground Cables	4	2	0	06
6	Substation & Power factor improvement	4	4	0	08
<b>Total</b>		<b>24</b>	<b>22</b>	<b>14</b>	<b>60</b>

**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	EE19 302.1	Identify different types of transmission and distribution line supports. Prepare report.	2
2	2	EE19 302.2	Assignment on string efficiency and sag.	2
3	3	EE19 302.3	Compare between HVDC and HVAC systems.	2
4	4	EE19 302.4	Identify different components of 11KV/0.415KV pole mounted distribution substation. Prepare report and draw sheet.	4
5	1	EE19 302.1	Identify different types of transmission line conductors. Prepare report.	2
6	1	EE19 302.1	Identify different types of overhead line insulators. Prepare report.	2
7	2	EE19 302.2	Assignment on transmission efficiency.	2
8	3	EE19 302.1	Identify different components of HVDC terminal substation. Prepare report.	2
9	3	EE19 302.1	Visit to Load Dispatch Centre and Prepare report.	4
10	4	EE19 302.1	Prepare report on various method of 3- Ph, 3- wire AC and 3- Ph, 4- wire AC Distribution system.	2
11	4	EE19 302.2	Assignment on voltage drops in the distributor.	2
12	4	EE19 302.1	Prepare report on various voltage control methods used in the power system.	2
13	5	EE19 302.1	Identify different types of underground cables. Prepare report.	2
14	6	EE19 302.4	Prepare report on various methods of improvement of power factor in A.C. System.	2
15	6	EE19 302.4	Identify different components of 132 or 220 or 400 KV outdoor substation. Prepare report and draw sheet.	4
<b>Total</b>				<b>36</b>

**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	Elements of Power System	V. K. Mehta and Rohit Mehta, S. Chand and Co. Ltd.	ISBN-10: 9788121924962 ISBN-13: 978-8121924962
2	Transmission & Distribution	J. B. Gupta , S. K. Khanna	ISBN-13: 978-9350143629 ISBN-10: 8185749574
3	Electrical Power System	Dr. S. L. Uppal ,Prof. S. Rao , Khanna Publisher, New Delhi.	ISBN-10: 8174092382 ISBN-13: 978-8174092380
4	A course in Electrical Power	Soni, Gupta, Bhatnagar , Dhanpat Rai & Sons	ISBN-10: 8177000209 ISBN-13: 978-8177000207
5	A course in Power plant Engineering	Dr. V. M. Domkundwar, Dhanpat Rai & Sons	ISBN-10: 8177001957 ISBN-13: 978-8177001952

6	Electrical Power system Design	M.V.Deshpande , Tata Mcgraw-Hill	ISBN-10: 9780074515754 ISBN-13: 978-0074515754
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**E-References:**

1. <https://ndl.iitkgp.ac.in/>
2. <https://www.electrical4u.com/electrical-engineering-articles/transmission,distribution,substation,cables/>
3. <https://nptel.ac.in> (Prof.D.P.Kothari)
4. <https://swayam.gov.in>
5. [www.khanacademy.org](http://www.khanacademy.org)
6. [www.youtube.com](http://www.youtube.com)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE 19 302.1	3	2	-	2	2	3	3	3	2	3
EE 19 302,2	3	2	3	-	-	-	-	1	-	1
EE 19 302.3	1	1	-	-	2	-	3	3	2	3
EE 19 302.4	3	1	-	1	2	3	3	3	2	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Nasir Quadri	Chief Engineer, Vashi Zone, MSETCL	Maharashtra State Electrical Transmission Co. Ltd, Mumbai
2	Mr. Kuldeep Singh Rajput	Executive Engineer, MSETCL	Maharashtra State Electrical Transmission Co. Ltd, Mumbai
3	Mr. Ranjit Khandar	Lecturer in Electrical Engineering	Govt. Polytechnic Yavatmal
4	Dr.Gajanan Gotmare	Lecturer in Electrical Engineering	Govt. Polytechnic Gondia
5	Mrs.J. D. Waghmare	Lecturer in Electrical Engineering	Govt. Polytechnic Mumbai
6	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 Electrical Engineering (Sandwich Pattern)

## Semester-III

### EE 19 303 Linux (17)

#### 1. Ubuntu Desktop 16.04

**Outline:** Ubuntu Linux Desktop 16.04 Ubuntu Linux Desktop on gnome environment The launcher Some of the icons visible on Launcher Calculator, gedit Text Editor, Terminal, Firefox .

#### 2. Desktop Customization 16.04

**Outline:** Desktop Customization 16.04 The Launcher Remove applications from the Launcher Add applications to the Launcher System Settings Appearance settings Workspace switcher Use.

#### 3. Installing Software 16.04

**Outline:** Installing software in Ubuntu Linux 16.04 OS Install software via Terminal Installing Synaptic Package Manager Install software via Synaptic Package Manager Configure proxy .

#### 4. Basic Commands

**Outline:** Basic Commands Commands with example Command interpreter Shell Using man Apropos What is Using --help option.

#### 5. General Purpose Utilities in Linux

**Outline:** General Purpose Utilities in Linux echo uname who passwd date cal Brief overview on Files and directories pwd ls cat.

#### 6. File System

**Outline:** File System File Directory File Inode Types of Files Home directory and Current directory Change Directory(cd) mkdir,rmdir

#### 7. Working with regular Files

**Outline:** Working with Regular Files cat rm cp mv cmp wc.

#### 8. File Attributes

**Outline:** File Attributes chown, chmod, chmod -R, displaying files with ls -l chmod u+, chmod a-w, chmod g+w, chmod -r, chgrp inode, hard link, symbolic link.

#### 9. Redirection Pipes

**Outline:** Redirection Pipes Input,output and error stream Redirection : > and >> Pipes : |.

#### 10. Working with Linux Process

**Outline:** Working with Linux Process Process Shell process Process spawning - parent and child process Process attributes - pid, ppid Init Process User proces.

### **11. The Linux Environment**

**Outline:** The Linux Environment Environment variable vs Local variables set command env command SHELL, HOME, PATH, LOGNAME, PS1, PS2 history ! and ~ ali.

### **12. Basics of System Administration**

**Outline:** Basics of System Administration Root login-su User management - UID, GID, useradd, usermod, userdel Discs – Du, df.

### **13. Simple Filters**

**Outline:** Simple filters Head tail sort cut paste.

### **14. The grep command**

**Outline:** The grep command To see the content of a file To list the entries of a particular stream To ignore cases Lines that do not match the pattern To list .

### **15. More on grep command**

**Outline:** More on grep command Search using grep To match more than one pattern To check a word that has different spelling Character class The use of \* T.

### **16. The sed command**

**Outline:** The sed command sed To print using sed Line Addressing Context Addressing.

### **17. More on sed command**

**Outline:** Some more on sed command substitute insert delete



**Government Polytechnic,  
Mumbai**

*Department of Electrical Engineering*

**P-19 Curriculum  
(Sandwich Pattern)**

**Semester-IV  
(Course Contents)**

**GOVERNMENT POLYTECHNIC MUMBAI**  
(Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
With effect from AY 2019-20

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
EE 19 304	Electrical Estimation & Costing	4	--	2	06	06	60	20	20	--	50*	25	175
EE 19 305	Utilization of Electrical Energy	4	--	2	06	06	60	20	20	--	50*	--	150
EE 19 306	AC Machines	4	2	2	08	08	60	20	20	50*	--	50	200
EE 19 401	Fundamentals of Power Electronics	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 402	Special Machines (Optional)	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 403	Illumination Engineering (Optional)	4	2	--	06	06	60	20	20	50*	--	25	175
EE 19 404	Arduino <sup>#</sup> (Spoken Tutorial)	--	--	3	03 <sup>#</sup>	03 <sup>#</sup>	--	--	--	--	--	--	--
<b>Total</b>		<b>20</b>	<b>06</b>	<b>09</b>	<b>35</b>	<b>35</b>	<b>300</b>	<b>100</b>	<b>100</b>	<b>150</b>	<b>100</b>	<b>100</b>	<b>850</b>
<b>Total Contact Hours</b>					<b>35</b>								

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 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.

Department Coordinator,  
Curriculum Development,  
Dept. of Electrical Engineering

Head of Department  
Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering.</b>										
Course Code: EE 19 304				Course Title: Electrical Estimation & Costing						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>04</b>	--	<b>02</b>	<b>06</b>	<b>60</b>	<b>20</b>	<b>20</b>	--	<b>50<sup>#</sup></b>	<b>25</b>	<b>175</b>

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 mid-term and second skill test at the end of the term

### Rationale:

Electrical Diploma holders should be able to collect the required information for estimating and costing of product of any given project. The student will be compatible to plan, draw layout and make survey to know current market rate of each component and material required. Knowledge of this subject will be helpful to work as a Contractor, an entrepreneur and execute different electrical installations. The knowledge of this course is also useful to do testing of any new installation. The IE rules related to an electrical installation are helpful while making an electrical installation and testing of an electrical installation.

**Course Outcomes:** Student should be able to

EE19 304.1	Follow National Electrical Code 2011 in electrical installations.
EE19 304.2	Estimate the electrical installation works
EE19 304.3	Estimate the work of non-industrial electrical installations.
EE19 304.4	Estimate the work of industrial electrical installations.
EE19 304.5	Prepare abstract, tender, quotation of public lighting and other installations.
EE19 304.6	Prepare abstract, tender, quotation of low tension (LT) substations.



**Course Content Details:**

Unit No	Topics / Sub-topics
1	<p><b>Topic Title: Electric Installation and Safety.</b></p> <p>1.1 Scope and features of National electric code 2011</p> <p>1.2 Types of electrical installation</p> <p>1.3 Fundamental principles for electrical installation</p> <p>1.4 Permit to work, safety instructions and safety practices</p> <p>1.5 Purpose of estimating and costing.</p> <p><b>Course Outcome: EE19 304.1 Teaching Hours : 06 hrs Marks:04 (R- 02, U-02, A-)</b></p>
2	<p><b>Topic Title: Estimation and Costing</b></p> <p>2.1 Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate</p> <p>2.2 Factors to be considered while preparation of detailed estimate and economical execution of work</p> <p>2.3 Contracts- Concepts of contracts, types of contracts, contractor, role of contractor</p> <p>2.4 Tenders and Quotations- Type of tender, tender notice, preparation of tender document, and method of opening of tender</p> <p>2.5 Quotation, quotation format, comparison between tender and quotation</p> <p>2.6 Comparative statement, format comparative statement. Order format, placing of purchasing order.</p> <p>2.7 Principles of execution of works, planning, organizing and completion of work, Billing of work</p> <p><b>Course Outcome: EE19 304.2 Teaching Hours :14 hrs Marks:12 (R-04, U-04, A-04)</b></p>

3	<p><b>Topic Title: Non-Industrial Installations</b></p> <p>3.1 Types of Non-industrial installations-- Office buildings, shopping and commercial centre, residential installation, Electric service and supply</p> <p>3.2 Design consideration of electrical installation in commercial buildings.</p> <p>3.3 Design procedure of installation- steps involved in detail, Estimating and costing of unit</p> <p>3.4 Earthing of commercial installation.</p> <p>3.5 Design electrical installation scheme of commercial complex.</p> <p>3.6 Erection, Inspection and testing of installation as per NEC</p> <p><b>Course Outcome: EE19 304.3      Teaching Hours :10 Marks: 12 (R-04, U-04, A-04 )</b></p>
4	<p><b>Topic Title: Industrial Installation</b></p> <p>4.1 Classification of industrial buildings Classification based on power consumption,</p> <p>4.2 Drawing of wiring diagram and single line diagram for single phase and three phase Motors.</p> <p>4.3 Design consideration in industrial installations Design procedure of installation-detailed steps</p> <p>4.4 Design electrical installation scheme of factory/ small industrial unit, Preparation of material schedule and detailed estimation</p> <p>4.5 Installation and estimation of agricultural pump and flourmill</p> <p><b>Course Outcome: EE19 304.4      Teaching Hours : 10 Marks: 10 (R-, U-04, A-06 )</b></p>
5	<p><b>Topic Title: Public Lighting Installation</b></p> <p>5.1 Classification of outdoor installations streetlight/ public lighting installation</p> <p>5.2 Street light pole structures. Selection of equipments, sources used in street light installations.</p> <p>5.3 Cables, recommended types and sizes of cable. Control of street light installation.</p> <p>5.4 Design, estimation and costing of streetlight</p>

	5.5 Preparation of tenders and abstracts.  <b>Course Outcome: EE19 304.5      Teaching Hours : 10 Marks: 12 (R-04, U-04, A-04 )</b>
6	<b>Topic Title: Distribution Lines and LT Substation</b> 6.1 Introduction to overhead and underground distribution line. 6.2 Materials used for distribution line HT and LV 6.3 Cables used for distribution line, factors determining selection of LT/ HT power Cables, cable laying and cable termination method according to IS 6.4 Design, estimation and costing of HT LT overhead line and underground cabling. 6.5 Types of 11 KV Distribution substations their line diagram, Estimation of load, Load factor, diversity factor and determination of rating of distribution Transformer. 6.6 Design, estimation and costing of outdoor and indoor 11 KV substation.  <b>Course Outcome: EE19 304.6      Teaching Hours : 10 Marks: 10 (R-02, U- 08, A- )</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Electric Installation and Safety	06	02	02	--	04
2	Estimation and Costing	14	04	04	04	12
3	Non-Industrial Installations	10	04	04	04	12
4	Industrial Installation	10	--	04	06	10
5	Public Lighting Installation	10	04	04	04	12
6	Distribution Lines and LT Substation	10	02	08	--	10
<b>Total</b>		<b>60</b>	<b>16</b>	<b>26</b>	<b>22</b>	<b>60</b>

**Legends:** R-Remember; U-Understand; A-Apply and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**List of Tutorials:**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 304.1	Draw sheet on circuit diagrams for various lamps and fans controlling circuit like Staircase and Go-down wiring, Distribution system,	02
2	3	EE19 304.3	Draw a sheet on different types of Earthing	02
3	3	EE19 304.2,3	Design electrical installation scheme for Flat/Independent bungalow / House: Draw Installation plan, single line diagram & wiring diagram Prepare material schedule & detailed estimate & costing	04
4	3	EE19 304.3	Design and draw wiring diagram for residential installation by using Inverter as backup supply	02
5	3	EE19 304.2,3	Design electrical Installation scheme for any one commercial Complex/Hospital/Drawing hall: Draw Installation plan, single line diagram & wiring diagram. Prepare material schedule & detailed estimate & costing	04
6	4	EE19 304.2,4	Design Electrical Installation scheme for agriculture pump room /Floor mill: Draw Installation plan, single line diagram & wiring diagram. Prepare material schedule & detailed estimate & costing	04
7	4	EE19 304.2,4	Design electrical Installation scheme for small unit/workshop/Machine Lab: Draw Installation plan, single line diagram & wiring diagram. Prepare material schedule & detailed estimate & costing	04
8	4	EE19 304.3	Draw Panel Wiring of the electrical laboratory / institute /control panel of electrical equipments.	02
9	5	EE19 304.5	Estimate with a proposal of the electrical Installation of streetlight scheme for small premises after designing.	02
10	6	EE19 304.6	Estimate with a proposal of the L.T. line installation. Prepare report and draw sheet	02
11	6	EE19 304.6	Estimate with a proposal of the 500 KVA, 11/0.433 KV outdoor substation and prepare a report	02
<b>Total</b>				<b>30</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Design Estimating and Costing	Raina K.B.; Dr. S. K. Bhattacharya New Age International Publisher First, Reprint 2010	ISBN: 978-81-224-0363-3
2	Electrical Estimating and Costing	Allagappan N. S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd,	ISBN 13: 9780074624784
3	Electrical Estimating and Costing.	Singh Surjit, Ravi Deep Singh, Dhanpat Rai and Sons.	ISBN 13:1234567150995
4	A Course in Electrical Installation Estimating and Costing	Gupta J.B. S.K. Kataria and Sons Reprint Edition,	ISBN 10: 935014279113: 978-9350142790.
5	Code of Practice for Electrical Wiring Installation	Bureau of Indian Standard. IS: 732-1989.	
6	National Electrical Code 2011	Bureau of Indian Standard. SP-30:2011.	

**E-References:**

1. [www.howstuffworks.com](http://www.howstuffworks.com)
2. [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)
3. [www.philips.com](http://www.philips.com)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 304.1	2	2	--	3	1	--	2	3	2	3
EE19 304.2	3	3	--	3	2	1	3	2	3	2
EE19 304.3	3	3	--	3	2	1	3	2	3	2
EE19 304.4	3	3	--	3	2	1	3	2	3	2
EE19 304.5	3	3	2	3	1	3	3	--	3	2
EE19 304.6	3	3	2	3	1	3	3	--	3	2

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. D.D. Rathod	Executive Engineer	MAHADISCOM
2	Prof. Jyothi Jagaldas	Selection Grade Lecturer	Saboo Siddiq Polytechnic Mumbai
3	Name of Faculty: Prof. S.B. Visvarupe A.K. Dhulshette Miss. A.V. Patil (Curriculum Content Designer)	HOD Electrical Engg. Selection Grade Lecturer Senior Grade Lecturer	Govt. Polytechnic Mumbai

Coordinator,

Curriculum Development,

Department of \_\_\_\_\_

Head of Department

Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering</b>										
Course Code:EE 19 305				Course Title: Utilization of Electrical Energy						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	-	2	6	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 test are to be conducted. First skill test at mid-term and second skill test at the end of the term.

### Rationale:

The electrical supervisors / technicians are expected to possess knowledge of utilization of electrical energy especially in the industry. Their main job functions are to supervise the operation & control of various electrical drives, electrical furnaces, etc. Railway is one of the major employers of Electrical Diploma holders therefore Diploma holder should also study the electrical traction and Electric Traction system. This course deals with utilization of electrical energy in various industries.

**Course Outcomes:** Student should be able to

EE19 305.1	Identify suitable methods of Electric Heating & Welding for specific applications.
EE19 305.2	Select suitable Electric Motor for specific applications.
EE19 305.3	Understand various types of load & Electric drive system.
EE19 305.4	Identify the types of electric supply system for Electric Traction and calculate the parameters of the Electric Traction.
EE19 305.5	Understand basic concept & types of Elevator & Escalators.

### Course Content Details:

Unit No	Topics / Sub-topics
1	<b>Electrical Heating</b> 1.1 Advantages of Electric Heating. 1.2 Modes of Transfer of Heat 1.3 Resistance Heating: Construction & Operation of Direct Resistance Heating - Salt Bath Furnace, Indirect Resistance Heating: Resistance Ovens, Requirements of Heating Element Material, Causes of Failure of

	<p>Heating Elements, Methods of Temperature Control, Applications of Resistance Heating, Design of Heating Element. (Simple Numerical problems on heating elements)</p> <p>1.4 Arc Heating - Construction &amp; Operation of Direct Arc Furnace, Indirect Arc Furnace. Applications of Arc Heating.</p> <p>1.5 Induction Heating - Construction &amp; Operation of Core Type Induction Furnaces: Ajax Wyatt Furnace, Coreless Induction Furnace, Applications of Induction Heating, High frequency eddy current heating. Radiant &amp; infrared heating, Estimation of Heat data. (Simple Numerical problems on rating of furnace.)</p> <p>1.6 Dielectric Heating: Principle of Dielectric Heating, Advantages of Dielectric Heating</p> <p>1.7 Limitations of Dielectric Heating, Applications of Dielectric Heating</p> <p><b>Course Outcome: EE19 305.1 Teaching Hours: 14 Marks: 14 (R- 2, U- 4, A-8)</b></p>
<b>2</b>	<p><b>Electric Welding</b></p> <p>2.1 Electric Welding: Principles of electric resistance welding.</p> <p>2.2 Methods of Electric Welding – Electric arc welding, resistance welding.</p> <p>2.3 Resistance Welding – Principles, Advantages, types of resistance welding.</p> <p>2.4 Electric Arc Welding- Formation &amp; Characteristics of electric arc, effects of arc length.</p> <p>2.5 Principle of electric arc welding: Types, advantages, disadvantages &amp; applications of all types.</p> <p>2.6 Comparison with resistance welding &amp; Electric Arc Welding</p> <p>2.7 Modern welding techniques like Ultrasonic, Laser, under water welding, IGBT controlled welding.</p> <p><b>Course Outcome: EE19 305.1 Teaching Hours: 10 Marks: 10 (R- 4, U- 6, A-0)</b></p>
<b>3</b>	<p><b>Electric Drives</b></p> <p>3.1 Definition and block diagram of Electric Drive</p> <p>3.2 Advantages and Disadvantages of Electric Drive.</p> <p>3.3 Factors Governing Selection of Electric Motors, Nature of Electric Supply - 3 phase &amp; 1 phase AC and DC, Types of Electric Drive.</p> <p>3.4 Nature of Load: Nature of the Mechanical Load, Matching of the Speed Torque Characteristics of the Motor with that of the Load, and Starting Conditions of the Load.</p> <p>3.5 Braking Characteristics - Plugging, Rheostatic Braking and Regenerative Braking, as Applied to DC Series and Three Phase Induction Motor.</p> <p>3.6 Mechanical Features - Type of Enclosure as per IS. Type of Bearings, Type of Transmission for Drive, Noise Level.</p> <p>3.7 Size of Motor - Load Conditions - Continuous Loads, Short Time Loads, Intermittent Loads, Continuous Operation with Short Time Loads and</p>



	<p>Continuous Operation with Intermittent Loads.  3.8 Factors affecting size of Motor (Simple numerical).  3.9 Standard Ratings  3.10 Load equalization meaning &amp; means of obtaining it (no calculations).  3.11 Duty Cycles &amp; estimation of rating or size of motor</p> <p><b>Course Outcome: EE19 305.2, EE19 305.3 Teaching Hours:14 Marks: 14 (R- 2, U- 4, A-8)</b></p>
<b>4</b>	<p><b>Electric Traction</b></p> <p>4.1 Introduction to Traction System, Requirements of an Ideal Traction System, Non-electric Traction Systems, Electric Traction Systems, Advantages and Disadvantages of Electric Traction Systems.  4.2 Systems of Track Electrification  4.3 Block diagram of AC locomotives by using three phase Induction Motor with description of various equipment and accessories  4.4 Single and compound catenary construction in railways.  4.5 Traction Mechanics: Units used in traction mechanics, Types of services, speed time curve, simplified speed time curve, Average speed and scheduled speed, Factors affecting schedule speed, Tractive effort, Specific energy consumption, Factors affecting specific energy consumption, coefficient of adhesion, simple numerical on simplified speed time curve  4.6 Working principal, advantages and disadvantages of Mono Rail and Metro Railways  4.7 Introduction of DMU and EMU</p> <p><b>Course Outcome: EE19 305.2, EE19 305.4 Teaching Hours: 13 Marks: 14 (R- 2, U- 6, A-6)</b></p>
<b>5</b>	<p><b>Elevators &amp; Escalators</b></p> <p>5.1 Introduction  5.2 Types of Electric Elevators  5.3 Types of Hoist Mechanism  5.4 Controlling Elevators  5.5 Components of Escalator  5.6 Working of escalator  5.7 Types of escalator  5.8 Advantages and Dis-advantages of Escalators  5.9 The Maharashtra Lifts, Escalators and Moving Walks Act,2017</p> <p><b>Course Outcome: EE19 305.5 Teaching Hours: 9 Marks: 8 (R- 2, U- 4, A-2)</b></p>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Electric Heating	2	4	8	14
2	Electric Welding	4	6	0	10
3	Electric Drives	2	4	8	14
4	Electric Traction	2	6	6	14
5	Elevators & Escalators	2	4	2	08
<b>Total</b>		<b>12</b>	<b>24</b>	<b>24</b>	<b>60</b>

**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/Tutorial	Hours
1	1	EE19 305.1	Prepare a report on electrical heating furnace after visiting industry / laboratory.	2
2	2	EE19 305.1	Prepare a report on welding transformer after visiting industry / laboratory.	2
3	2	EE19 305.2, EE19 305.3	Select the appropriate motors and justify the selection for given different load situations. (at least two)	4
4	3	EE19 305.4	Prepare a report on your visit to nearby electric traction sub-station.	4
5	4	EE19 305.5	Prepare a report by observing different types of elevators at various sites / locations.	4
6	4	EE19 305.5	Prepare a report by observing different types of escalators at various sites / locations.	4
7	4	EE19 305.2, EE19 305.4	Prepare a report on various equipment's and accessories used in AC Locomotives	4
8	1	EE19 305.1	Demonstration of dielectric heating oven and write report on it.	2
9	2	EE19 305.1	Demonstration on welding generator and write report on it.	2

10	4	EE19 305.2, EE19 305.4	Prepare a report by comparing Metro and Mono Rail for public transport.	2
11	2	EE19 305.1	Prepare a report on Ultrasonic, Laser & under water welding	2
12	2	EE19 305.1	Demonstration of ARC welding and noting down the specifications of equipment used	2
<b>Total</b>				<b>32</b>

**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	Art & Science of Utilisation of Electrical Energy	H. Pratab; Dhanpat Rai & Sons,2015	ISBN-13: 9788177001440
2	Utilisation of Electric Power & Electric Traction	J. B. Gupta; S. K. Kataria & Sons ,2013	ISBN-13: 9789350142585
3	Utilisation of Electric Power & Electric Traction	G. C. Garg; S. K. Khanna Publisher, New Delhi, edition	ISBN-10: 8174091645 ISBN-13: 9788174091642
4	Fundamental of Electrical Drives	G. K. Dubey; Narosa Publishing House, New Delhi, latest edition	ISBN, 8173190410, 9788173190414.
5	Modern Electric Traction	H. Pratab; Dhanpat Rai & Sons	ISBN-13: 1234567147206

### E-References:

1. <https://www.electrical4u.com>
2. <https://ndl.iitkgp.ac.in/>
3. <https://nptel.ac.in>
4. <https://swayam.gov.in>
5. [www.khanacademy.org](http://www.khanacademy.org)
6. [www.youtube.com](http://www.youtube.com)
7. [www.slideshare.net](http://www.slideshare.net)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 305.1	3	2	3	3	2	2	3	2	2	2
EE19 305.2	3	2	2	1	2	2	3	2	1	2
EE19 305.3	3	1	-	1	1	-	2	-	1	1
EE19 305.4	3	2	1	2	2	2	3	3	2	2
EE19 305.5	3	1	-	1	2	1	3	2	-	2

**PO statements:**

- 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.

**PSO statements:**

**PSO1:** The ability to operate, supervise, test and maintain the various machineries, electrical installations and power system equipments.

**PSO2:** The ability to carry out energy audit, prepare electrical estimates and costing and to read, interpret and implement electrical drawing.

**PSO3:** The ability to practice profession with attention to energy conservation, ethical principles, safety, environmental aspects and socially beneficial activities.

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr.Rahul H Shewale	Assistant Engineer	Mumbai Inspection Division Industry, Energy and Labour Dept. Govt Of Maharashtra Mumbai Central
2	Mr.Jayesh Mhatre	SSE/C/OHE/DR	Seewood electric traction substation, Navi Mumbai
3	Mr.L.S.Patil	Lecturer in Electrical Engineering	Govt. Polytechnic Nashik
4	Ms. Ashwini Patil	Lecturer in Electrical Engineering	Govt. Polytechnic, Mumbai
5	Dr. M. S. Narkhede	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 : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: EE 19 306				Course Title: AC Machines						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>04</b>	<b>02</b>	<b>02</b>	<b>08</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	-	<b>50</b>	<b>200</b>

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 mid-term and second skill test at the end of the term

### Rationale:

This is the subject aspire to teach facts , concepts, principle and procedure for operation and testing of electrical machine, such as 3-phase induction motors, 3-phase synchronous generators, 3-phase synchronous motors and 1-phase induction motors. Students will be able to analyze the characteristics of 3-phase AC Machines and 3-phase Synchronous Machines with qualitative parameters of these machines. They also learn applications of 1-phase induction motors.

These machines are used in various fields, industries and many more utilization systems. Knowledge gained by the students will be helpful in the study of technological subjects such as testing and maintenance of electrical machines, utilization of electrical energy, switchgear & protection, power electronics & drives, special machines. Learning & the skills obtained will be helpful in discharging duties such as supervisor, controller, R & D technician and machine maintenance engineer.

**Course Outcomes:** Student should be able to

EE19 306.1	Explain various types of three phase induction motors.
EE19 306.2	Demonstrate starters, speed control methods & circle diagram of three phase induction motor.
EE19 306.3	Interprets the three phase alternators.
EE19 306.4	Comprehend three phase synchronous motors.
EE19 306.5	Select single phase induction motors.

### Course Content Details:

Unit No	Topics / Sub-Topics
---------	---------------------

1	<p><b>Topic Title: Three Phase Induction Motors</b></p> <p>1.1 General information of three phase machines.  1.2 Working principle of 3-phase I.M.  1.3 Construction and types of 3- phase induction motor.  1.4 Comparison between squirrel-cage and slip-ring induction motor.  1.5 Production of rotating magnetic field.  1.6 Three phase induction motor speed, slip, frequency, rotor frequency and their relations. (Simple Numerical)  1.7 Equation of rotor induced emf, current, frequency, reactance, and impedance under steady and running condition. (Simple Numerical).  1.8 Torque equation of three phase induction motor. (Simple Numerical).  1.9 Starting and running torque of squirrel cage and slip ring induction motor.  1.10 Condition for maximum and starting torque.  1.11 Torque slip characteristics of three phase induction motor.  1.12 Effect of change in rotor circuit resistance on torque-slip characteristics.  1.13 Effect of change in supply voltage on torque-slip characteristics.  1.14 Torque Ratios (Numerical)  1.14.1 Starting torque to Maximum torque  1.14.2 Full load torque to Maximum torque  1.15 Power stages of three phase induction motor.  1.16 Relationship between rotor <math>Cu</math> loss, rotor input, rotor output (Numerical)</p> <p><b>Course Outcome: EE19 306.1 Teaching Hours : 16 hrs Marks:16 (R- 2, U-6, A-8)</b></p>
2	<p><b>Topic Title: Starting, Speed Control &amp; Circle Diagram of Three Phase Induction Motor</b></p> <p>2.1 Need of Starter.  2.2 Various starters used to start 3-phase IM.  2.2.1 Starting of squirrel cage and slip ring induction motor.  2.2.2 Compare starters with DOL starter (simple numerical)  2.3 Double cage 3-phase induction motor.  2.3.1 Construction  2.3.2 Concept of double cage  2.4 Speed control of three phase induction motor by--  2.4.1 Pole Changing method  2.4.2 Frequency Control method  2.4.3 By Stator Voltage Control method  2.4.4 Rotor Resistance Control method  2.5 I.M. as a generalized transformer.  2.6 Equivalent Circuit of 3-phase IM.  2.7 Construction of Circle Diagram.  2.7.1 Importance of circle diagram  2.7.2 No load test and Blocked rotor test on 3-phase IM  2.7.3 Construction of the circle diagram. (Numerical)  2.8 Applications of three phase induction motor.</p>

	<p><b>Course Outcome: EE19 306.2 Teaching Hours : 12 hrs Marks: 14 (R- 2, U-6, A-6)</b></p>
3	<p><b>Topic Title: Three Phase Alternator</b></p> <p>3.1 Construction of three phase Alternator.  3.1.1 Stator  3.1.2 Rotor - Smooth Cylindrical &amp; Projected type</p> <p>3.2 Advantages of stationary armature construction.</p> <p>3.3 Derivation of e.m.f. equation of Alternator. (Numerical)  3.3.1 Chording (Pitch) Factor  3.3.2 Distribution Factor</p> <p>3.4 Factors affecting the terminal voltage of 3-phase Alternator.  3.4.1 Armature resistance drop  3.4.2 Leakage reactance drop  3.4.3 Armature reaction drop</p> <p>3.5 Significance of Synchronous Reactance &amp; Synchronous Impedance.</p> <p>3.6 Armature reaction and their effects.</p> <p>3.7 Regulation of 3-phase Alternator &amp; various methods to find regulation.  3.7.1 Direct method (Numerical)  3.7.2 Synchronous impedance method (Numerical)  3.7.3 Magneto Motive Flux (MMF) method (Numerical)</p> <p>3.8 Need of Parallel Operation of 3-phase Alternator  3.8.1 Conditions to run 3-phase Alternators in parallel</p> <p>3.9 Synchronizing Methods.  3.9.1 Synchronoscope method  3.9.2 One dark two bright lamp method</p> <p><b>Course Outcome: EE19 306.3 Teaching Hours :14 hrs Marks:14 (R- 2, U-6, A-6)</b></p>
4	<p><b>Topic Title: Three Phase Synchronous Motors</b></p> <p>4.1 Construction of three phase synchronous motor.  4.2 Principle of operation.  4.3 Starting of synchronous motor.  4.3.1 Various methods of starting</p> <p>4.4 Synchronous Motor on load with constant excitation.  4.5 Effect of change of excitation at constant load.  4.6 Power flow within a synchronous motor.  4.7 V curve &amp; inverted V curve with their parameters.  4.8 Comparison between 3-phase induction motor &amp; 3-phase synchronous motor.  4.9 Applications of 3-phase synchronous motor.  4.10 Hunting or Surging or Phase Swinging.  4.11 Different torques of a synchronous motor.</p>



	<b>Course Outcome: EE19 306.4 Teaching Hours : 12 Marks:10 (R-4, U-6, A-0)</b>
<b>5</b>	<p><b>Topic Title: Single Phase Motors</b></p> <p>5.1 Broad classification of all 1-phase motors.            5.2 Double field revolving theory.            5.2.1 Split phasing principle of starting            5.3 Single phase induction motors &amp; their types.            5.4 Principle of working, schematic diagram and applications of 1-phase induction motors.            5.4.1 Resistance split phase            5.4.2 Capacitor split phase            5.4.3 Capacitor split phase &amp; run            5.4.4 Shaded pole            5.5 Comparison between 1-phase induction motor &amp; 3-phase induction motor.</p> <p><b>Course Outcome: EE19 306.5 Teaching Hours : 6 Marks:06 (R-2, U-4, A-0)</b></p>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Three Phase Induction Motors	16	02	06	08	16
2	Starting, Speed Control & Circle Diagram of Three Phase Induction Motor	12	02	06	06	14
3	Three Phase Alternator	14	02	06	06	14
4	Three Phase Synchronous Motors	12	04	06	00	10
5	Single Phase Motors	06	02	04	00	06
<b>Total</b>		<b>60</b>	<b>12</b>	<b>28</b>	<b>20</b>	<b>60</b>

**Legends:** R-Remember; U-Understand; A-Apply and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**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	EE19 306.1	To measure the value of slip of 3-phase induction motor by Tachometer method	02

2	1	EE19 306.1	To reverse the direction of rotation of 3-phase induction motor	02
3	1	EE19 306.1	To perform the direct load test on 3-phase induction motor	04
4	2	EE19 306.2	To use various types of starters to start and run 3-phase induction motor.	02
5	2	EE19 306.2	Study of Double Cage 3-phase induction motor	02*
6	2	EE19 306.2	Perform the No Load Test & Blocked Rotor Test on 3-Phase IM and construct the circle diagram to know its performance. (Determine the line current, power factor, & full load efficiency at rated output)	04
7	3	EE19 306.3	To perform O.C.C. of the 3-phase Alternator	02
8	3	EE19 306.3	To Determine Voltage Regulation of 3 Phase Alternator by Direct Loading.	02
9	3	EE19 306.3	To Determine voltage regulation of three-phase Alternator by Synchronous Impedance method ( $Z_s$ ).	04
10	3	EE19 306.3	To perform parallel operation of 3-phase alternators	04
11	4	EE19 306.4	To start Synchronous motor by any one method. To Plot V & Inverted V Curves of a Synchronous Motor.	04
		<b>Total</b>		

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Machines, Vol-I, II	G.C. Garg & P.S. Bimbhra, Khanna Book Publishing House, New Delhi.	ISBN: 978-9386173-447, 978-93-86173-607
2	Electrical Technology Vol-II	Theraja B.L., . S. Chand and Co. Ltd., New Delhi.	ISBN: 9788121924375
3	Electrical Machines.	Bhattacharya S. K., McGraw Hill Education, New Delhi.	ISBN: 9789332902855
4	Electrical Machines.	Kothari D. P. and Nagrath, I. J., McGraw Hill Education. New Delhi.	ISBN: 9780070699670
5	Principles of Electrical Machines.	Mehta V. K. and Mehta Rohit, . S. Chand and Co. Ltd., New Delhi.	ISBN: 9788121930888
6	Electrical Machines Theory and Practice.	Bandyopadhyay M. N., PHI Learning Pvt. Ltd., New Delhi.	ISBN: 9788120329973 Vi

**E-References:**

1. [www.nptelvideos.in/electricalengineering/m](http://www.nptelvideos.in/electricalengineering/m)
2. [www.electrical4u.com](http://www.electrical4u.com)
3. [www.electrical-engineering-portal.com](http://www.electrical-engineering-portal.com)
4. [www.learnerstv.com](http://www.learnerstv.com)

### CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 306.1	3	2	1	2	3	1	3	3	--	3
EE19 306.2	2	2	2	3	3	1	3	3	--	3
EE19 306.3	2	2	1	2	3	1	3	3	--	3
EE19 306.4	2	2	1	2	3	1	3	3	1	3
EE19 306.5	2	2	--	1	3	1	3	3	--	3

### Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Umesh Chendra Pal	Senior Manager, Electrical Design & Consultant	Thyssenkrupp Industrial Solution (formaly UHDE India)
2	Mr. Sandeep D. Tajane	Deputy Engineer, Testing Section Operation & Maintenance Dept. (North West Zone)	BEST Undertaking (Supply Division) Mumbai
3	Mr. Sunil Asthaputre	Selection Grade Lecturer	Govt. Polytechnic, Nasik
4	Mrs. R.U. Patil	Selection Grade Lecturer	VPM Polytechnic, Thane
5	Dr. P.N. Padghan	Selection Grade Lecturer	Govt. Polytechnic, Mumbai
6	Mr. A.K. Dhulshette	Selection Grade Lecturer	Govt. Polytechnic, Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering</b>										
Course Code: <b>EE 19 401</b>				Course Title: <b>Fundamentals of Power Electronics</b>						
Compulsory / Optional: <b>C</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>4</b>	<b>2</b>	<b>--</b>	<b>06</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	<b>-</b>	<b>-</b>	<b>150</b>

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:

Power Electronics devices and circuits nowadays, in addition to its traditional roles in industrial automation and high-efficiency energy systems are also having important role in energy conservation, renewable energy systems, bulk utility energy storage, electric and hybrid vehicles. This course aims to impart the knowledge and skills to use power devices and converters in various applications.

**Course Outcomes:** Student should be able to

EE19401.1	Select appropriate power semiconductor device for specific application.
EE19401.2	Select appropriate turn on and turn off circuit of SCR for specific application
EE19401.3	Use appropriate power converter for specific application and drive .
EE19401.4	Troubleshoot simple gate drive and protection circuits for power devices
EE19401.5	Troubleshoot simple power electronics circuit

### Course Content Details:

Unit No	Topics / Sub-topics
<b>1</b>	<b>Power Electronics Devices:</b>
	1.1 Introduction to Power Electronics Power Electronics definition, Block diagram of power electronic system, Power semiconductor devices classification, power semiconductor devices ratings and application, Ideal switch characteristic, Desirable characteristic of real switch,
	1.2 Structure, symbol, working and VI characteristic of power diode, Power Transistor, Power MOSFET and IGBT
	1.3 Thyristor family: Definition of thyristor, SCR Construction, symbol, working two transistor analogy &V-I characteristics Definitions: Holding current, latching current, break over voltage

	<p>Construction, symbol, V-I characteristics and application of LASCR, Triac, and Diac</p> <p>1.4 Phase control using TRIAC : Light dimmer.</p> <p><b>Course Outcome: EE19401.1 Teaching Hours: 12 Hrs Marks: (R-04 , U-06, A-00)</b></p>
3	<p><b>SCR turn on and turn off methods and protection circuits:</b></p> <p>2.1 SCR turn on methods: Voltage Triggering, Gate Triggering, dv/dt Triggering and Light Triggering, Temperature triggering. Gate triggering circuits for SCR - Circuit diagram, working principle, waveforms of</p> <ul style="list-style-type: none"> <li>• Resistor triggering</li> <li>• R-C triggering</li> <li>• UJT triggering.</li> </ul> <p>2.2 Thyristor Turn off methods.</p> <p>a) Natural Commutation</p> <p>b) Forced Commutation :</p> <ul style="list-style-type: none"> <li>• Class A- Self commutation by resonating load</li> <li>• Class B- Self commutation by LC circuit</li> <li>• Class C- Complementary commutation</li> <li>• Class D – Auxiliary commutation</li> <li>• Class E – external pulse commutation</li> </ul> <p>2.3 di/dt and dv/dt protection of SCR</p> <p><b>Course Outcome:EE19401.2 Teaching Hours : 8 Hrs Marks: (R-02, U-06, A-02 )</b></p>
3	<p><b>Phase Controlled Rectifier</b></p> <p>3.1 Difference between uncontrolled rectification and controlled rectification.</p> <p>3.2 Phase control: firing angle , conduction angle</p> <p>3.3 Circuit diagram, working, input output waveforms and equation for average output voltage of following (no derivation)</p> <p>Single Phase Fully Controlled Half Wave Converter - With Resistive Load, With RL Load and Freewheeling Diode , with RLE load.</p> <p>Single Phase Fully Controlled Full Wave Mid point Converter - With RL Load.</p> <p>Single Phase Fully Controlled Bridge Converter - With RL Load ,with RLE load</p> <p>Single phase semi converter: symmetrical and asymmetrical configuration with RL load</p> <p>3.4 Circuit diagram, working and input output waveforms of Three Phase Fully Controlled Bridge Converter- With RL Load.</p> <p>3.5 Comparison of 3 phase and 1 Phase Converters.</p> <p>3.6 Simple Numerical</p> <p>3.7 Application: DC drives, Speed control of DC series motor with single phase half and full controlled converter.</p> <p><b>Course Outcome: EE19401.3 Teaching Hours: 12 Hrs. Marks:(R-02 ,U-08 , A-02 )</b></p>

4	<p><b>Inverters</b></p> <p>4.1 Introduction. Classification of inverters according to nature of input source, method of commutation, connection of thyristor &amp; commutating component.</p> <p>4.2 Working principle &amp; operation of Basic and modified Series inverter , Basic Parallel inverter</p> <p>4.3 Circuit diagram , working ,waveforms of Single phase half bridge inverter Single phase full bridge inverter</p> <p>4.4 Voltage control in single phase inverters (PWM Inverters):Different Techniques</p> <p>4.5 Application: AC Drives Speed control of three phase Induction Motor with Variable frequency</p> <ul style="list-style-type: none"> <li>• Voltage source inverter fed induction motor drive.</li> <li>• Pulse width modulated inverter fed induction motor drive</li> </ul> <p><b>Course Outcome:EE19401.3 Teaching Hours: 12Hrs Marks:(R- 02,U- 06 , A-02)</b></p>
5	<p><b>Choppers</b></p> <p>5.1 Chopper Principle</p> <p>5.2 Control Techniques:</p> <ul style="list-style-type: none"> <li>• Constant Frequency System</li> <li>• Variable Frequency System</li> </ul> <p>5.3 Step down (buck) chopper Step Up Chopper(boost) and</p> <p>5.4 Circuit diagram and working of Class A, Class B, Class C, Class D and Class E choppers</p> <p>5.5 Application :Chopper based DC drive for separately excited DC motor.</p> <p><b>Course Outcome:EE19401.3 Teaching Hours :10 Hr. Marks:(R-02 , U- 08 ,A-02 )</b></p>
6	<p><b>Gate Drive ,Protection of devices and circuits</b></p> <p>6.1 Simple gate drive circuit for BJT and MOSFET</p> <p>6.2 Snubber circuit for transistors</p> <p>6.3 Temperature control in semiconductor devices: Heat transfer, Thermal resistance and thermal model, Heat sink specifications</p> <p>6.4 Electromagnetic Interference: Sources of EMI, Minimizing EMI generation, EMI shielding, EMI standard</p> <p><b>Course Outcome: EE19401.4 Teaching Hours :6 Hr. Marks:(R-00,U-04 ,A-02 )</b></p>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Power Electronics Devices	4	6	0	10
2	SCR turn on and turn off methods and protection circuits	2	6	2	10
3	Phase Controlled Rectifier	2	8	2	12
4	Inverters	2	6	2	10
5	Choppers	2	8	2	12
6	Gate Drive ,Protection of devices and circuits		4	02	06
<b>Total</b>		<b>12</b>	<b>38</b>	<b>10</b>	<b>60</b>

**List of experiments: Total 8 experiments(or turns) out of following experiments (or turns)**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19401.5	Construct circuit & verify the V-I characteristic of SCR.	2
2	1	EE19401.5	Construct circuit & verify the V-I characteristic of TRIAC.	2
3	1	EE19401.5	Construct circuit & verify the V-I characteristics of power MOSFET.	2
4	1	EE19401.5	Construct circuit & verify the V-I characteristics of power IGBT	2
5	1	EE19401.5	Construct the circuit of light dimmer	2
6	2	EE19401.5	Construct circuit & observe firing angle ( $\alpha$ ) control of R , RC or UJT triggering	2
7	3	EE19401.3	Observe the output of single phase fully controlled bridge rectifier using R load and RL load	2
8	6	EE19401.4	Control of speed of Induction motor using v/f method	2
9	4,5	EE19401.5	Microproject: to be submitted in group of 5 to 6 students  Construct boost converter using MOSFET on general purpose PCB ,use suitable IC for gate drive  OR  Construct Full bridge inverter using MOSFET on general purpose PCB ,use suitable IC for gate drive	16

			OR Construct Inverter using Arduino and MOSFET	
<b>Total</b>				<b>32</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year of Publication	ISBN
1	Power Electronics	Dr. P.S. Bimbhra, Khanna Publisher, 2012	978-81-7409-279-3
2	Power Electronics Essentials and Applications	L. Umanand, Wiley India Pvt. Ltd, 2009	978-81-265-1945-3
2	Power Electronics	M.D. Singh, K.B. Khanchandani, McGraw Hill, 2014	978-0-07-058389-4
3	Power electronics: devices, circuits, and applications	M.H.Rashid, Pearson Education Limited, 2014	978-0-273-76908-8
4	Power Electronics Devices Circuits and Industrial Applications	V.R. Moorthi, Oxford University Press, 2005	978-1-62-870877-6
6	Electronics Lab Manual (volume 2)	Navas, K. A, PHI learning Private Limited, 2018	978-9-38-802809-7

**E-References:**

1. <https://nptel.ac.in/course.html>
  - a. Fundamentals of Power Electronics Prof. Vivek Agarwal, IISc Bangalore
  - b. Power Electronics, Prof. Sabyasachi Sengupta, Prof. N.K. De, Prof. D.Prasad, Dr. D.Kastha IIT Kharagpur
  - c. Power Electronics, Prof. G.Bhuvaneshwari, IIT Delhi

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19401.1	3	3	-	3	1	-	-	2	2	2
EE19401.2	3	3	-	3	-	-	-	3	2	1
EE19401.3	3	3	1	3	-	3	3	3	2	1
EE19401.4	3	3	1	3	-	3	3	3	2	1
EE19401.5	3	3	1	3	-	3	3	3	2	1

**Industry Consultation Committee:**



Sr. No	Name	Designation	Institute/Organisation
1	Mr Kalpak Raut	Director , Kalpak Electro-tech	Kalpak Electro-tech, Badlapur.
2	Mr. Sandeep Ushkewar	Assistant Professor , Electrical Engineering	Shri Vile Parle Kelvani Mandal's Institute of technology Dhule
3	Mrs Nagargoje	Lecturer	Government Polytechnic, Thane
3	Name of Faculty (Curriculum Content Designer)	Mrs Vaishali Bhosale	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering</b>										
Course Code: EE 19 402				Course Title: Special Machines						
Compulsory / Optional: <b>O</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	2	--	6	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 mid term and second skill test at the end of the term

**Rationale:** In the changing scenario of today's highly automated world day by day the interest on special machines is increasing. These machines serve for several applications. Students are being introduced with special machines as these machines have wide applications in industry, robotic and automation. It is expected that the knowledge of construction, working principle, basic characteristics of these motor will make students understand the in an out of these machines, which will enable them to work comfortably in the highly changing industry.

**Course Outcomes:** Student should be able to

EE19 402.1	Explain the construction, working , starting methods, applications, advantages and disadvantages of 1 $\phi$ Induction Motor
EE19 402.2	Describe the construction and working of 1 $\phi$ synchronous motor
EE19 402.3	Describe working and phasor diagrams of AC Commutator (compensated and repulsion) motor.
EE19 402.4	Describe construction, working, classification and applications of LIM and stepping motor
EE19 402.5	Illustrate Principle of operation and applications of Advanced Electrical Machines

### Course Content Details:

Unit No	Topics / Sub-topics
01	<p><b>Single Phase Induction Motors:</b></p> <p>1.1 Constructional details 1.2 Revolving field theory 1.3 Classification 1.4 Starting methods for Split Phase, Shaded Pole, Repulsion, Reluctance motors 1.5 Comparison with 3<math>\phi</math> induction motors 1.6 Characteristics of split phase, shaded pole, repulsion, reluctance type 1<math>\phi</math> induction motor and their applications.</p> <p><b>Course Outcome: EE19 402.1    Teaching Hours :10    Marks: 14 (R-06 , U-04 , A-04 )</b></p>

<b>02</b>	<b>Single Phase Synchronous Motors:</b> Working principle, construction and applications of.... 2.1 1 $\phi$ Reluctance Motor 2.2 Hysteresis motor 2.3 2 $\phi$ servo motor 2.4 AC tachometers  <b>Course Outcome: EE19 402.2    Teaching Hours :08    Marks: 08 (R-02 , U-02 , A-04 )</b>
<b>03</b>	<b>AC Commutator Machines:</b> 3.1 Necessity/ advantages of AC commutator motors 3.2 EMFs induced in commutator windings ( $E_r$ and $E_t$ ) 3.3 Emfs produced by rotating magnetic field $E_{RT}$ 3.4 Torque Expression 3.5 Commutation in AC machines and EMF's under commutation 3.6 1 $\phi$ Series Motors. 3.7 Phasor Diagram & Simplified Phasor Diagram (no derivation) 3.8 Compensated AC series motor 3.9 Phasor Diagram & Simplified Phasor Diagram (no derivation) 3.10 Repulsion motor, Phasor Diagram & Simplified Phasor Diagram (no derivation)  <b>Course Outcome: EE19 402.3    Teaching Hours :09    Marks: 12 (R-06 , U-04 , A-02 )</b>
<b>04</b>	<b>Linear Induction and Stepper motors:</b> 4.1 Classification, Construction and Working of linear induction motor. 4.2 Comparison between LIM and RIM (Advantages, disadvantages of LIM) 4.3 Derivation of linear force 4.4 Applications of linear Induction motor 4.5 Construction and Working of Stepper motor 4.6 Variable reluctance type, Permanent magnet type & Hybrid stepper motor. 4.7 Applications of Stepper Motor  <b>Course Outcome: EE19 402.4    Teaching Hours :08    Marks: 12 (R-06 , U-04 , A-02 )</b>
<b>05</b>	<b>Advanced Electrical Machines:</b> 5.1 Synchronous Reluctance Motors, Constructional features – Types – Axial and radial air gap motors – Operating principle, Applications 5.2 Switched Reluctance Motors, Constructional features – Principle of operation, Applications 5.3 Permanent Magnet Brushless DC Motors, Principle of operation Types and Applications 5.4 Permanent Magnet Synchronous Motors, Principle of operation – EMF and torque equations, Applications 5.5 Amorphous core transformer 5.6 Introduction of soft starters  <b>Course Outcome: EE19 402.5    Teaching Hours :10    Marks: 14 (R-08 , U-04 , A-02 )</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Single Phase Induction Motors	06	04	04	14
2	Single Phase Synchronous Motors	02	02	04	08

3	AC Commutator Machines	06	04	02	12
4	Linear Induction and Stepper motors	06	04	02	12
5	Advanced Electrical Machines	08	04	02	14
<b>Total</b>		28	18	14	60

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

Sr. No.	Unit No.	COs	Experiment/Assignment	Approx. Hours
1	1	EE19 402.1	Plot torque speed characteristics of single-phase capacitor start induction run induction motor by conducting brake test on the motor	02
2	2	EE19 402.2	Plot torque speed characteristic of reluctance motor by conducting brake test on the motor	02
3	3	EE19 402.3	Plot torque speed characteristic of repulsion motor by conducting brake test on the motor	04
4	4	EE19 402.4	Demonstration of speed and reversal of direction of stepper motor	02
5	5	EE19 402.5	Demonstration of Permanent Magnet Brushless DC Motor	02
6	1	EE19 402.1	Plot torque speed characteristic of single-phase capacitor start and run induction motor by conducting brake test on the motor.	04
7	1	EE19 402.1	Plot torque speed characteristics of shaded pole induction motor by conducting brake test on the motor.	02
8	2	EE19 402.2	Plot torque speed characteristic of Hysteresis motor by conducting brake test on the motor	04
9	1	EE19 402.1	To change the direction of Repulsion motor	04
10	1	EE19 402.1	Dismantling and reassembling of single-phase motors used for ceiling fans or universal motor for mixer	04
				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	The Performance and Design of Alternating Current Machines	M.G.Say, CBS Publishers, New Delhi, 1 <sup>st</sup> Ebook Edition 2017	eISBN: 978-93-891-8507-2
2	Generalized theory of Electrical Machines	Dr. P. S. Bimbhra, Khanna Publishers, 6 <sup>th</sup> Edition	ISBN-13: 978-81-7409-225-0
3	Electrical Machines	S. K. Bhattacharya, Tata McGraw Hill, 3 <sup>rd</sup> Edition	ISBN-13:978-0-07-066921-5 ISBN-10: 0-07-066921-X
4	Performance & Design Of AC Commutator Motors	E Openshaw Taylor, Ah Wheeler & Co Ltd, 2000	ISBN-13:978-81-8561-481-6
5	A Text book of Electrical Technology – Volume II	BL Theraja & AK Theraja, S Chand; Twenty Third Edition (1 January 1959)	ISBN-978-81-2192-437-5

**E-References:**

1. <https://ndl.iitkgp.ac.in/>

*Special Machines (EE 19 402)*

(P19 Scheme)

2. <https://circuitglobe.com/working-principle-of-single-phase-induction-motor.html>
3. <https://www.elprocus.com/single-phase-induction-motor/>

### CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 402.1	3	3	2	-	3	-	1	3	1	1
EE19 402.2	3	3	2	-	3	-	1	3	1	1
EE19 402.3	3	3	3	-	3	-	1	3	1	1
EE19 402.4	3	3	3	-	3	-	1	3	1	1
EE19 402.5	3	3	3	-	3	-	1	3	1	1

### Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Kiran Wani	Sr Manager	Reliance communications Ltd, Nashik.
2	Mr Sanket Kalbere	Asst. Manager (Power)	KRajehja Corporation, Mumbai
3	Mr. K.L.Inamdar	COE	Pillai HOC Polytechnic, Rasayani, Raigad
4	Mrs. Papiya Chandra	LEE	MHSS Polytechnic, Byculla, Mumbai
5	Dr.Mahesh S.Narkhede	LEE	Govt. Polytechnic Mumbai
6	Dr.P.N.Padghan	LEE	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of Electrical Engineering  
I/C, Curriculum Development Cell

Head of Department  
Department of Electrical Engineering  
Principal

Programme : <b>Diploma in Electrical Engineering</b>										
Course Code: <b>EE 19 403</b>				Course Title: <b>Illumination Engineering</b>						
Compulsory / Optional: <b>O</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>4</b>	<b>2</b>	<b>-</b>	<b>6</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	<b>-</b>	<b>25</b>	<b>150</b>

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:

This course is designed to teach students various concepts of Illumination Engineering. Students shall apply the basic illuminations laws. The students should be able to apply the acquired knowledge in designing the schemes. With changing needs of the society students shall be able to fulfil the optimized solution considering the need of energy conservation. The students should be able to take care the needs of various sectors of the society in illumination area.

**Course Outcomes:** Student should be able to

EE 19 403.1	State the meaning of terms used in illumination engineering.
EE 19 403.2	Describe the working of different types of lamps with the applications.
EE 19 403.3	Explain Illumination Control & Control Circuits.
EE 19 403.4	Realize the requirements of the Illumination schemes for Interior , Outdoor & special applications.
EE 19 403.5	Prepare Illumination schemes for Interior application.

### Course Content Details:

Unit No	Topics / Sub-topics
<b>1</b>	<b>Fundamentals of Illumination:</b> 1.1.Fundamentals of Illumination 1.2.Illumination terminology: Illumination, Light intensity, Lumen, Lux 1.3.Laws of Illumination (Simple numerical) 1.4.Concept of Photometry 1.5.Measurement of Illumination 1.6.Features of good Illumination scheme

	1.7. Biological effect of artificial illumination , Light pollution
	<b>Course Outcome: EE 19 403.1 Teaching Hours : 08 Marks: 10 (R- 4, U- 4, A-2 )</b>
<b>2</b>	<p><b>Lamps &amp; Lighting calculation methods:</b></p> <p>2.1 Types of Lights</p> <ol style="list-style-type: none"> <li>Visible light</li> <li>Ultraviolet light</li> <li>Infrared light</li> </ol> <p>2.2 Construction, working principle advantages and disadvantages of all types of lamps</p> <ol style="list-style-type: none"> <li>Incandescent lamp</li> <li>ARC lamps – ac &amp; dc arc lamp</li> <li>Fluorescent lamp</li> <li>Mercury vapour lamp, HPMV lamp, Mercury iodide lamp</li> <li>Sodium vapour lamp</li> <li>Neon lamp, Neon Sign Tubes</li> <li>Halogen lamp</li> <li>CFL Lamps</li> <li>Metal halides lamp</li> <li>LED lamps</li> <li>Lasers</li> <li>Selection criterion for lamps</li> </ol> <p>2.3 Comparison between incandescent &amp; Florescent lamps</p> <p>2.4 Lighting schemes: selection of lamp, illumination efficiency, glare &amp; power consumption</p> <ol style="list-style-type: none"> <li>Direct &amp; Indirect</li> <li>Semi direct &amp; semi indirect</li> <li>General lighting scheme</li> </ol> <p>2.5 Lighting calculation methods</p> <ol style="list-style-type: none"> <li>Watt/m<sup>2</sup> method</li> <li>Lumens or light flux method</li> <li>Point to point method (simple numerical)</li> </ol> <p><b>Course Outcome: EE 19 403.2, EE 19 403.5</b>  <b>Teaching Hours :14 Marks: 12 (R- 4,U- 4, A-4 )</b></p>
<b>3</b>	<p><b>Illumination Control &amp; Control Circuits:</b></p> <p>3.1 Purpose of lighting control</p> <p>3.2 Working principle and operation of:</p> <ol style="list-style-type: none"> <li>Dimmer <ol style="list-style-type: none"> <li>Resistance type dimmer</li> <li>Salt water dimmer</li> </ol> </li> <li>Dimmer Transformer <ol style="list-style-type: none"> <li>Autotransformer dimmer</li> <li>Two winding transformer dimmer</li> </ol> </li> <li>Electronic Dimmer</li> </ol>

	<ul style="list-style-type: none"> <li>i) Thyristor operated dimmer</li> <li>ii) Triac operated dimmer</li> </ul> <p>3.3 Control of enhance lightning  3.4 Methods used for light control  3.5 Control circuits for lamps: single lamp controlled by single switch, two switches  3.6 Single lamp controlled by two-point method, three-point method &amp; four-point method.  3.1 Polar curve: its meaning and applications for designing the lamps</p> <p><b>Course Outcome: EE 19 403.3 Teaching Hours : 08 Marks: 08 (R- 4, U- 4, A-0 )</b></p>
<b>4</b>	<p><b>Illumination for Interior Applications:</b></p> <ul style="list-style-type: none"> <li>4.1 Standards for various situations in Interior Illumination</li> <li>4.2 Methods for Designing illumination schemes</li> <li>4.3 Design considerations for Interior location of Residential Commercial, Industrial premises</li> <li>4.4 Design Illumination scheme for different Interior locations of Residential, Commercial, Industrial unit</li> <li>4.5 Numericals on above sub topics</li> </ul> <p><b>Course Outcome: EE 19 403.4, EE 19 403.5  Teaching Hours : 12 Marks: 12 (R- 4, U- 4, A-4 )</b></p>
<b>5</b>	<p><b>Illumination for Outdoor Applications:</b></p> <ul style="list-style-type: none"> <li>5.1. General and specific requirements for lighting schemes of <ul style="list-style-type: none"> <li>a) Factory Lighting</li> <li>b) Street Lighting</li> <li>c) Flood Lighting</li> <li>d) Railway Platform Lighting</li> <li>e) Lighting for Advertisement / Hoardings</li> <li>f) Sports Lighting</li> </ul> </li> </ul> <p><b>Course Outcome: EE 19 403.4 Teaching Hours : 12 Marks: 12 (R- 4, U- 4, A-4 )</b></p>
<b>6</b>	<p><b>Lighting for Special Applications</b></p> <ul style="list-style-type: none"> <li>6.1.Lighting schemes and general requirements for: <ul style="list-style-type: none"> <li>a) Agricultural &amp; Horticultural applications</li> <li>b) Health Care Centers and Hospitals</li> <li>c) Decorative lighting</li> <li>d) Stage lighting</li> <li>e) Aquariums and Shipyards</li> </ul> </li> </ul> <p><b>Course Outcome: EE 19 403.4 Teaching Hours : 06 Marks: 06 (R- 4, U- 2, A-0 )</b></p>



**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Fundamentals of Illumination	4	4	2	10
2	Lamps & Lighting Accessories	4	4	4	12
3	Illumination Control & Control Circuits	4	4	0	08
4	Illumination for Interior Applications	4	4	4	12
5	Illumination for Outdoor Applications	4	4	4	12
6	Lighting for Special Applications	4	2	0	06
<b>Total</b>		<b>24</b>	<b>22</b>	<b>14</b>	<b>60</b>

**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	EE 19 403.1	Measure illumination by lux meter for different locations.	2
2	2	EE 19 403.2	Prepare a report on Market survey for various lighting accessories.	4
3	2	EE 19 403.2	Prepare a report on different lamps , their working & applications.	4
4	3	EE 19 403.3	Assignment to draw a control circuits for different situations as per requirement.	2
5	4	EE 19 403.4, EE 19 403.5	Design an Illumination scheme for a conference room of medium size.	4
6	4	EE 19 403.4, EE 19 403.5	Design an Illumination scheme for a workshop for fine work of medium size.	4
7	4	EE 19 403.4, EE 19 403.5	Design an Illumination scheme for a Electrical Machine Laboratory.	4
8	4	EE 19 403.4, EE 19 403.5	Design Illumination scheme for Residential Installation.	2
9	5	EE 19 403.4	Prepare a report on Illumination Scheme of Stadium.	2
10	5	EE 19 403.4	Prepare a report on Illumination Scheme of flood lighting.	2
11	5	EE 19 403.4	Prepare a report on Illumination Scheme of Street lighting.	2
12	5	EE 19 403.4	Prepare a report on Illumination Scheme of Railway platform.	2
13	6	EE 19 403.4	Prepare a report on Illumination Scheme of Agricultural & Horticultural applications.	2
14	6	EE 19 403.4	Prepare a report on Illumination Scheme of Aquariums and Shipyards.	2

15	6	EE 19 403.4	Prepare a report on Illumination Scheme of Health Care Centers and Hospitals.	4
<b>Total</b>				<b>34</b>

**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	Applied Illumination Engineering	Jack L Lindsey. The Fairmont Pres Inc.	ISBN-10: 0137428006 ISBN-13: 978-0137428007
2	Lighting Engineering and applied calculations	R.H.Simons & Robert Bean. Architectural Press	ISBN-0750650516
3	Handbook of Industrial Lighting	Butterworths, Styanley N Lyons	ASIN: B01D8T1N3C
4	Lighting Control Technology and Applications	Robert S Simpson. Focal Press	ISBN-10: 0240515668 ISBN-13: 978-0240515663
5	Energy Management in Illuminating systems	Kao Chen. CRC Press	ISBN-10: 0849326281 ISBN-13: 978-0849326288
6	Electrical Power System	Dr. S. L. Uppal ,Prof. S. Rao , Khanna Publisher, New Delhi.	ISBN-10: 8174092382 ISBN-13: 978-8174092380
7	A course in Electrical Power	Soni, Gupta, Bhatnagar , Dhanpat Rai & Sons	ISBN-10: 8177000209 ISBN-13: 978-8177000207

#### E-References:

- <https://www.electrical4u.com/electrical-engineering-articles/illumination-engineering/>
- <https://ndl.iitkgp.ac.in/>
- <https://nptel.ac.in>
- <https://swayam.gov.in>
- [www.khanacademy.org](http://www.khanacademy.org)
- [www.youtube.com](http://www.youtube.com)
- [www.bee-india.nic.in/ecourses.aec.edu.in](http://www.bee-india.nic.in/ecourses.aec.edu.in)

#### CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE 19 403.1	3	-	-	2	-	-	1	1	-	1
EE 19 403.2	3	1	-	-	-	-	3	2	-	3

EE 19 403.3	3	1	-	2	2	-	2	2	3	3
EE 19 403.4	3	2	2	1	2	2	2	3	3	3
EE 19 403.5	3	3	3	1	2	1	2	3	3	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr.Sujal Shah	Ex-Regional Manager	Xerox Modicorp Limited , Mumbai
2	Mr. Kuldeep Singh Rajput	Executive Engineer, MSETCL	Maharashtra State Electrical Transmission Company Ltd, Mumbai
3	Mr. Rajesh U. Shelke	HOD, Electrical Engineering	Govt. Polytechnic, Nashik
4	Mrs. Meenakshi Shirsat	Lecturer in Electrical Engineering	MSBTE, Mumbai
5	Mrs. J. D. Waghmare	Lecturer in Electrical Engineering	Govt. Polytechnic, Mumbai
6	Ms. Ashwini Patil	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

## EE 19 404 Arduino (17)

### 1. Overview of Arduino

**Outline:** Learning objectives of Arduino Prerequisites for learning Basic level Arduino tutorials Prerequisites for learning Intermediate level Arduino tutorials Who can use Arduino? Gli.

### 2. Electronic components & connections

**Outline:** Breadboard and its internal connections LED and its connections Tri-color LED Resistor Simple circuit using LED, resistor and breadboard Common mistakes when using breadboard.

### 3. Introduction to Arduino

**Outline:** About Arduino device Features of Arduino Components of Arduino board Description of Microcontrollers Few examples where a Microcontroller is used Installation of Arduino IDE o.

### 4. Arduino components & IDE

**Outline:** Set up a physical connection between Arduino and a computer Connect the Arduino board to the computer using the USB cable Various components available in Arduino hardware.

### 5. First Arduino Programme

**Outline:** Write an Arduino program to blink an LED Arduino program is saved as Sketch Default program environment with two empty functions - void setup - functi.

### 6. Arduino with Tricolor LED & Push button

**Outline:** Tricolor LED - Common Cathode Tricolor LED Other external devices that are required for this experiment Understand the connection circuit details Connect a tricolor LED to Ardu.

### 7. Arduino with LCD

**Outline:** Connect an LCD to Arduino board See the details of the circuit connection See how to do the soldering Setup the components as per th.

### 8. Display counter using Arduino

**Outline:** Connect an LCD and a Push button to Arduino board. Use the same circuit created earlier using Arduino and LCD Add a pushbutton and make a simple counter Learn the connection ci.

### 9. Seven Segment Display

**Outline:** Connect a seven segment display to Arduino board Types of seven segment display Connection details of common cathode seven segment display Connection details of common anode sev.

#### **10. Pulse Width Modulation**

**Outline:** About Pulse Width Modulation About duty cycle and frequency Formula to calculate the duty cycle Experiment to control the brightness of LED by varying the duty cycle Experiment.

#### **11. Analog & Digital Conversion**

**Outline:** About DHT11 sensor Arduino resolution concepts Circuit connection details of DHT11 sensor and Arduino Features of DHT11 Live setup of the connection Download the DHT11 Arduino.

#### **12. Wireless Connectivity to Arduino**

**Outline:** About ESP8266-01 WiFi module Various pins of ESP8266-01 WiFi module Circuit connection of ESP8266 - 01 module with Arduino Live setup of the connection Setup the read-write per.

#### **13. Assembly programming through Arduino**

**Outline:** Write an assembly program to display a digit on seven segment display Arduino - Assembly code reference Arduino ATmega328 Pin mapping Connection circuit details Installing AVR.

#### **14. Digital Logic Design with Arduino**

**Outline:** Write an assembly to verify the logical AND operation Use the m328Pdef.inc file that is available in the code files link of this tutorial. Explanation of the Source code for logi.

#### **15. AVR-GCC programming through Arduino**

**Outline:** Write an assembly program to display a digit on seven segment display Arduino - Assembly code reference Arduino ATmega328 Pin mapping Connection circuit details Installing AVR.

#### **16. Interfacing LCD through AVR-GCC programming**

**Outline:** Interface a LCD to Arduino board Pin connections details of the Arduino and LCD Image showing the connections Live set up of the connections Write an AVR-GCC program to display.

#### **17. Mixing Assembly & C-programming**

**Outline:** Combining Assembly and C programming Explanation of the circuit connections Live setup of the connection Assembly routine program which initialises and sets pin 13 of Arduino as.



**Government Polytechnic,  
Mumbai**

*Department of Electrical Engineering*

**P-19 Curriculum  
(Sandwich Pattern)**

**Semester-V  
(Course Contents)**

**GOVERNMENT POLYTECHNIC MUMBAI**  
(Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
**With effect from AY 2019-20**

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - V**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
EE 19 307	Switchgear & Protection	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 308	Testing & Maintenance of Electrical Equipment's	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 309	Project & Presentation	--	4	--	04	04	--	--	--	--	50*	50	100
EE 19 310	Electrical Energy Conservation & Audit	3	--	1	04	04	--	--	--	--	50*	50	100
EE 19 405	Industrial Automation	4	2	--	06	06	60	20	20	50*	--	--	150
EE 19 406	Electric Mobility (Optional)	3	--	1	04	04	60	20	20	--	25*	25	150
EE 19 407	Emerging Trends in Electrical Engineering (Optional)	3	--	1	04	04	60	20	20	--	25*	25	150
EE19 501	Entrepreneurship & Start-Ups	--	2	--	02	02	--	--	--	--	25*	25	50
EE 19 408	LaTeX# (Spoken Tutorial)	--	--	3	03#	03#	--	--	--	--	--	--	--
<b>Total</b>		<b>18</b>	<b>12</b>	<b>05</b>	<b>35</b>	<b>35</b>	<b>240</b>	<b>80</b>	<b>80</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>850</b>
<b>Total Contact Hours</b>					<b>35</b>								

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 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.

Department Coordinator,  
Curriculum Development,  
Dept. of Electrical Engineering

Head of Department  
Dept. of Electrical Engineering

In-Charge  
Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: EE 19 307				Course Title: Switchgear & Protection						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>04</b>	<b>02</b>	<b>00</b>	<b>06</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	--	--	<b>150</b>

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 mid-term and second skill test at the end of the term

### Rationale:

Electrical power system consists of generators, transformers, transmission and distribution lines. In case of fault, an automatic protective scheme comprising of circuit breakers and protective relays isolate the faulty section providing protection to the healthy section. Safety of machines/equipment and human beings is the major criteria of every protection scheme. It is also necessary at various levels to protect the power system from any electrical abnormalities. Diploma pass out students should develop skills of operating various controls and switchgear in power system to carry out remedial measures for faults/abnormalities in machines/equipment in power system using appropriate diagnostic instrument/devices. It is a core course and will help while working as a supervisor in substations, manufacturing industries & public service utilities.

**Course Outcomes:** Student should be able to

EE19 307.1	Identify various type of faults in power system.
EE19 307.2	Select suitable current interrupting device for various applications.
EE19 307.3	Explain the working of different protective relays.
EE19 307.4	Maintain the protection of alternator & transformer
EE19 307.5	Maintain the protection of motor, bus-bar & transmission line.

### Course Content Details:

Unit No	Topics / Sub-Topics
1	<p><b>Topic Title: Fundamentals of Protection.</b></p> <p>1.1 Describe the functions of basic elements of a protective system</p> <p>1.2 Express the various types of faults and abnormalities occurring in a power system.</p>



	<p>1.3 Explain the concept of the Backup protection.</p> <p>1.4 Calculate the short circuit currents of symmetrical faults. (Numerical)</p> <p>1.5 Outline the working of current limiting reactors and their arrangements.</p> <p>1.6 Protection zones</p> <p><b>Course Outcome: EE19 307.1 Teaching Hours :08 hrs Marks: 08 (R- 2, U-2, A-4)</b></p>
	<p><b>Topic Title: Current Interruption Devices</b></p> <p>2.1 Explain with sketches the operation of various isolators.</p> <p>2.2 Explain with sketches the terms related to fuse (Simple &amp; HRC)</p> <p>2.2.1 Explain different types of fuses.</p> <p>2.3 Explain characteristics of fuse &amp; state their applications.</p> <p>2.4 Explain with sketches arc formation, methods of arc extinction high resistance &amp; low resistance, related terms.</p> <p>2.4.1 Compare arc quenching in A.C. and D.C. Circuit Breaker.</p> <p><b>2</b> 2.5 Explain with sketches low tension circuit breakers &amp; their applications.</p> <p>2.5.1 Miniature CB (MCB), Moulded Case CB (MCCB), Residual Current CB (RCCB), Earth Leakage CB (ELCB) &amp; Air CB (ACB)</p> <p>2.6 Explain with sketches high tension circuit breakers &amp; their applications.</p> <p>2.6.1 Sulphur Hexafluoride CB (SF6CB), Vacuum CB (VCB) &amp; Air Blast CB (ABCB)</p> <p>2.7 Selection of current interrupting devices on the basis of various parameters.</p> <p>2.8 Comparison of current interrupting devices on the basis of various parameters.</p> <p>2.9 Explain the Insulation Coordination- Type1 &amp; Type2</p> <p>2.10 Lightning Arrester &amp; their types</p> <p><b>Course Outcome: EE19 307.2 Teaching Hours : 14 hrs Marks: 14 (R- 4, U-10, A-0)</b></p>
	<p><b>Topic Title: Protective Relays</b></p> <p>3.1 Explain the terms related to protective relays</p> <p>3.1.1 Fundamental quality requirements</p> <p>3.1.2 Basic relay terminology</p> <p>3.1.3 TSM &amp; PSM relay setting (Numerical)</p> <p>3.2 Explain the need of various types of relays in power system.</p> <p>3.3 Explain with sketches the various types of relays.</p> <p><b>3</b> 3.3.1 Electromagnetic disc relay operation</p> <p>3.3.2 Thermal relay</p> <p>3.3.3 Over voltage relay</p> <p>3.3.4 Over current relay</p> <p>3.3.4.1 Time current characteristic</p> <p>3.3.5 Block diagram and working of static relay</p> <p>3.3.6 Distance relay principle</p> <p>3.3.7 Directional relay operation with block diagram</p> <p>3.3.8 Differential relay operation (for voltage &amp; current)</p>

	<p>3.3.9 Microprocessor based relays</p> <p>3.3.9.1 Block diagram &amp; working</p> <p>3.3.9.2 Protection features</p> <p><b>Course Outcome: EE19 307.3 Teaching Hours :16 hrs Marks: 16 (R- 4, U-8, A-4)</b></p>
<b>4</b>	<p><b>Topic Title: Protection of Alternators &amp; Transformers</b></p> <p>4.1 Describe the causes of faults &amp; remedies occurred in alternators.</p> <p>4.2 Explain with sketches the various types of protective schemes in alternators.</p> <p>4.2.1 Differential protection : over current, earth fault, overheating &amp; field failure protection.</p> <p>4.2.2 Reverse power protection</p> <p>4.3 Calculate percentage of protected winding for the alternator.</p> <p>4.4 Describe the causes of faults &amp; remedies occurred in transformers.</p> <p>4.5 Explain with sketches the various types of protective schemes in transformers.</p> <p>4.5.1 Differential protection : over current, earth fault &amp; overheating protection.</p> <p>4.5.2 Limitations of differential protection</p> <p>4.6 Buchholz relay: construction, operation, merits &amp; demerits.</p> <p>4.7 Calculate the CT ratio of the transformer protection scheme.</p> <p>4.8 Introduction to Microprocessor based alternator &amp; transformer protection.</p> <p><b>Course Outcome: EE19 307.4 Teaching Hours :12 Marks: 12 (R-2, U-6, A-4)</b></p>
<b>5</b>	<p><b>Topic Title: Protection of Motors, Bus-bars &amp; Transmission Lines</b></p> <p>5.1 Describe the causes of faults &amp; remedies occurred in motors.</p> <p>5.2 Explain with sketches the various types of protective schemes in motors.</p> <p>5.2.1 Short circuit protection</p> <p>5.2.2 Over load protection</p> <p>5.2.3 Single phase preventer</p> <p>5.3 Describe the causes of faults &amp; remedies occurred in bus-bars.</p> <p>5.4 Explain with sketches the various types of protective schemes in bus-bars.</p> <p>5.4.1 Differential protection</p> <p>5.4.2 Fault bus protection</p> <p>5.5 Describe the causes of faults &amp; remedies occurred in transmission line.</p> <p>5.6 Explain with sketches the various types of protective schemes in transmission lines.</p> <p>5.6.1 Over current protection</p> <p>5.6.2 Distance protection</p> <p>5.6.3 Pilot wire protection</p> <p><b>Course Outcome: EE19 307.5 Teaching Hours :10 Marks: 10 (R-4, U-06, A-0)</b></p>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Fundamentals of Protection	08	02	02	04	08
2	Current Interruption Devices	14	04	10	00	14
3	Protective Relays	16	04	08	04	16
4	Protection of Alternators & Transformers	12	02	06	04	12
5	Protection of Motors, Bus-bars & Transmission Lines	10	04	06	00	10
<b>Total</b>		<b>60</b>	<b>16</b>	<b>32</b>	<b>12</b>	<b>60</b>

**Legends:** R-Remember; U-Understand; A-Apply and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**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	2	EE19 307.2	Identify various switchgears in the laboratory and write their specifications.	02
2	2	EE19 307.2	To identify the components of different types of isolators with their specifications. (through visits , video or model ).	02
3	2	EE19 307.2	To plot the inverse time characteristics of rewirable fuse.	04
4	2	EE19 307.2	Dismantle MCB / MCCB / ELCB and identify their various parts.	02
5	2	EE19 307.2	Demonstrate SF6 & Vacuum CB model (if possible Video)	02
6	3	EE19 307.3	Carry out Plug Setting Multiplier & Time Setting Multiplier of induction type electromagnetic relay.	04
7	3	EE19 307.3	Test numerical over current relay by performing load test (Inverse time current characteristic) using relay testing kit.	02
8	4	EE19 307.4	Simulate differential protection scheme for 3-phase alternator using the available kit.(winding failure, over excitation, under excitation, over load, low & high frequency, phase sequence etc.).	04
9	4	EE19 307.4	Simulate differential protection scheme for 3-phase transformer using the available kit. (L-G, L-L & Inter-turn faults).	02
10	5	EE19 307.5	Test the working of single phasing preventer for 3-phase induction motor and also simulate various protections available	02

			on the kit.	
11	5	EE19 307.5	Simulate transmission line protection using the impedance / distance relay for various faults using the available kit.	04
12	2	EE19 307.2	To identify the components of different types of lightning arresters with their specifications. (through visits, video or model).	02
<b>Total</b>				

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Principles of Power System	Mehta V.K.; Rohit Mehta., S. Chand and Co. Ltd., New Delhi. 2016	ISBN: 978-81-2192-496-2.
2	Switchgear and Protection	Rao Sunil S., . Khanna Publishers, New Delhi, 2015	ISBN: 978-81-7409-232-3.
3	Switchgear and Power System Protection	Singh R. P., PHI Learning, New Delhi, 2015	ISBN: 978-81-203-3660-5.
4	Switchgear and Protection	Gupta J. B., S.K. Kataria & Sons, New Delhi, 2015	ISBN: 978-93-5014-372-8.
5	Power System Protection and Switchgear	Ram Badri. Viswakarma D. N., McGraw-Hill, New Delhi, 2015	ISBN: 978-07-107774-X.
6	Switchgear and Protection	Veerapan, N., Krishnamurty D. N., S. Chand and Co. Ltd., New Delhi. 2014	ISBN: 978-81-2193-212-7.
7	Electrical Power Systems	Wadhwa C.L., New Age International, 2009	ISBN: 8122424686, 9788122424683
8	Power System Protection and Switchgear	Ravindranath B., Chander M. New Age International, Second	ISBN-10: 8122430325; ISBN-13: 978-8122430325

**E-References:**

1. [www.nptelvideos.in/electricalengineering/relays](http://www.nptelvideos.in/electricalengineering/relays)
2. [www.cgglobal.com](http://www.cgglobal.com)
3. [www.dreamtechpress.com/eBooks](http://www.dreamtechpress.com/eBooks)
4. [www.youtube.com/switchgears](http://www.youtube.com/switchgears)
5. [www.electrical4u.com](http://www.electrical4u.com)
6. [www.en.wikipedia.org](http://www.en.wikipedia.org)
7. [www.abb.co.in/ProductGuide/](http://www.abb.co.in/ProductGuide/)

**CO Vs PO and CO Vs PSO Mapping**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 307.1	3	3	1	2	2	1	3	2	1	3

EE19 307.2	3	2	1	3	2	1	3	2	1	3
EE19 307.3	3	2	1	3	3	1	3	2	1	3
EE19 307.4	1	2	1	3	3	1	3	3	1	3
EE19 307.5	1	2	1	3	3	1	3	3	1	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Umesh Chendra Pal	Senior Manager, Electrical Design & Consultant	Thyssenkrupp Industrial Solution (formally UHDE India)
2	Mr. Sandeep D. Tajane	Deputy Engineer, Testing Section Operation & Maintenance Dept. (North West Zone)	BEST Undertaking (Supply Division) Mumbai
3	Mr. S.N. Jawarkar	Selection Grade Lecturer	KJ Somaiya Polytechnic, Mumbai
4	Mrs. Anice Alias	Senior Lecturer	VPM Polytechnic, Thane
5	Dr. P.N. Padghan	Selection Grade Lecturer	Govt. Polytechnic, Mumbai
6	Mrs. J. D. Waghmare	Selection Grade Lecturer	Govt. Polytechnic, Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering</b>										
Course Code: EE19 308				Course Title: Testing and Maintenance of Electrical Equipment						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>4</b>	<b>2</b>	<b>-</b>	<b>6</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>			<b>150</b>

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:

This is a applied technology level course with application in industry, commercial buildings, public utility departments of government/municipal councils, residential buildings, electrical power generation, transmission and distribution sectors etc. After studying this course, a student will be able to inspect/test/trouble shoot electrical machines. They will be conversant about safety rules, safety of machines & persons, prevention of accident. Also students will be able to carry out routine and preventive maintenance of electrical equipment.

**Course Outcomes:** Student should be able to

EE19308.1	<b>State and practice safety measures &amp; precautions</b>
EE19308.2	<b>Test Transformer/ AC machine/Earthing as per IS code of practise</b>
EE19308.3	<b>Identify / Locate common troubles in electrical machines</b>
EE19308.4	<b>Plan &amp; carry out routine &amp; preventive maintenance</b>
EE19308.5	<b>Diagnosis and reconditioning of Insulating material</b>

### Course Content Details:

Unit No	Topics / Sub-topics
1	<b>Safety &amp; Prevention:</b> 1.1 Definition of terminology used in safety; safety, hazard, accident, major accident hazard, risk assessment, competency, responsibility, authority, accountability, monitoring, General Electrical Safety precautions( Dos & don'ts) for electrical supervisor 1.2 Meaning & causes of electrical accidents; factors on which severity of Shock depends

	<p>Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration, PPE used in the testing and maintenance</p> <p>1.3 Precautions to be taken to avoid fire due to electrical reasons, Types of fire extinguishers, operation of fire extinguishers</p> <p><b>Course Outcome: EE19308.1 Teaching Hours : 5 hrs Marks: 6 (R- 2, U-2, A-2)</b></p>
2	<p><b>General Introduction:</b></p> <p>2.1 Objectives of testing, Significance of Indian Standards, Concept of : tolerance, routine test, type test, special test and supplementary tests</p> <p>2.2 Concept of routine, preventive , breakdown &amp; predictive maintenance. Condition monitoring techniques. Advantages of preventive maintenance, procedure for developing preventive maintenance schedule, Factors affecting preventive maintenance schedule. Concept of TPM, Pillars of TPM</p> <p>2.3 Methods of Testing: direct, indirect and regenerative with advantages and applications</p> <p>2.4 Life Estimation of electrical equipment</p> <p>2.4 Earth resistance and earth resistivity, factors affecting earth resistance, earth resistivity of different soil composition, methods for reducing soil resistance</p> <p>2.5 Testing of earth resistance and earth pit electrode: Basic earth resistance test method, four terminal method, three terminal method, permissible resistance of the earthing required for different electrical installations, methods of reducing effective earth pit resistance.</p> <p>2.6 Earthing of electrical equipment as per IS code- IS 3043-1987: Objectives, classification of equipment according to degree of protection against electric shock.</p> <p><b>Course Outcome: EE19308.2, EE19308.4</b> <b>Teaching Hours : 09 Marks: 10 (R-2 , U- 4 , A- 4 )</b></p>
3	<p><b>Transformers:</b></p> <p>3.1 Enlist of type test, routine test &amp; special test as per I.S. 1980 -1989.</p> <p>3.2 Procedure for conducting following tests: Measurement of winding resistance, voltage ratio, polarity, no load losses, &amp; no load current, Impedance voltage, load losses, Insulation, resistance, Induced over voltage withstand test, Impulse voltage withstand test, Temperature rise test of oil &amp; winding, Partial Discharge test</p> <p>3.3 Preventive maintenance &amp; routine maintenance of distribution transformer as per I.S. 10028(part III): 1981.</p> <p>3.4 Periodic checks for replacement of oil, silica gel</p> <p>3.5 Causes of failure of transformer. Various types of faults(mechanical, electrical &amp; magnetic) and reason for occurrence</p> <p>3.6 Trouble shooting of three phase transformer and remedial measures</p> <p><b>Course Outcome: EE19308.2, EE19308.3, EE19308.4</b> <b>Teaching Hours : 20 Marks: 20 (R-4 , U- 8 , A- 8)</b></p>
4	<p><b>Rotating Machines:</b></p> <p>4.1 Enlist of type tests, routine tests &amp; special tests of 1 &amp; 3 phase Induction motors.</p> <p>4.2 Procedures of routine test on single phase and three phase induction motors as per IS7572:1984 and IS code 4029:2010 respectively (List to be provided )</p> <p>4.3 Routine, Preventive, &amp; breakdown maintenance of 1 &amp; 3 phase Induction motors</p>

	<p>as per IS 9001:1992</p> <p>4.4 Maintenance schedule of alternators &amp; synchronous machines as per IS 4884- 1968</p> <p>4.5 Causes of failure of induction motor, Various types of faults(mechanical, electrical &amp; magnetic) and reason for occurrences</p> <p>4.6 Trouble shooting of 1phase &amp; 3-phase induction motor with remedial measures</p> <p><b>Course Outcome: EE19308.02, EE19308.3, EE19308.4</b></p> <p><b>Teaching Hours : 18 Marks: 16 (R- 4, U-6 ,A- 6)</b></p>
5	<p><b>Insulation:</b></p> <p>5.1 Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958</p> <p>5.2 Measuring insulation resistance, Polarization Index, interpretation of the of insulation condition from measurement data.</p> <p>5.3 Insulating oil – Electrical and thermal properties of insulating oil, causes of deterioration of oil, testing of transformer oil as per IS 1866- 1961, purification of insulating oil</p> <p>5.4 Reconditioning of insulation medium : weakening agents which deteriorate properties of insulation medium, cleaning and drying, baking, re-varnishing, vacuum impregnation.</p> <p>5.6 Measures to be taken to maintain the insulation resistance of electrical machines to healthy level</p> <p><b>Course Outcome: EE19308.02, EE19308.05</b></p> <p><b>Teaching Hours : 08 Marks: 08 (R- 2 , U-2 , A- 4)</b></p>

### Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	<b>Safety &amp; Prevention</b>	2	2	2	06
2	<b>General Introduction</b>	2	4	4	10
3	<b>Transformers</b>	4	8	8	20
4	<b>Rotating machines</b>	4	6	6	16
5	<b>Insulation</b>	2	2	4	08
<b>Total</b>		<b>14</b>	<b>22</b>	<b>24</b>	<b>60</b>

### List of experiments: Total 10 experiments out of 14 experiments (or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19308.1	Demonstration of artificial respiration technique after electrocution	02



2	3	EE19308.2	Perform routine test on transformer as per latest IS code 2026-1981 ( minimum two test)	04
3	3	EE19308.3	Prepare trouble-shooting chart for three phase transformers	02
4	4	EE19308.4	Prepare maintenance schedules and carry out routine & preventive maintenance of electrical machines available in the institute	02
5	5	EE19308.2 EE19308.5	Perform insulation resistance (IR) test on motor / transformer as per IS code	02
6	1	EE19308.1	Demonstration of use of fire extinguisher in case of fire due to electrical abnormal conditions	02
7	2	EE19308.2	Measurement of resistance of earth pit electrode which is available at institute	02
8	4	EE19308.2	Perform routine test on 1- phase induction motor as per code IS7572:1984( minimum two test, other than IR test)	04
9	4	EE19308.2	Perform routine test on 3- phase induction motor as per code IS 4029:2010 ( minimum two test, other than IR test)	04
10	3	EE19308.2	Perform temperature rise test on transformer as per IS code	02
11	4	EE19308.2	Perform temperature rise test on motor as per IS code	02
12	5	EE19308.2 EE19308.5	Determine breakdown strength of transformer oil.	02
13	2	EE19308.2	Measurement of earth resistivity and locate best spot for earthing pit	04
14	4	EE19308.3	Troubleshoot the electrical motors available in the institute	02

**Note: Experiments No. 1 to 5, 8, 9, 14 are compulsory. Remaining 2 experiments are to be performed as per importance of the topic. Expert lectures to be arranged on the topics of energy meter testing and transformer oil testing (4hrs)**

#### References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Operation & Maintenance Of Electrical Machines (Volume I and II)	B.V.S.,Rao, Media Promoters & Publishers Ltd. Mumbai	9788185099194
2	Electrical Equipment Handbook: Troubleshooting and Maintenance 1st Edition	Philip Kiameh, McGraw Hill, 1 <sup>st</sup> edition, 2003	13: 9780071396035
3	Industrial safety , Concepts And Practices	K. T. Kulkarni. Pune Vidyarthi Griha	----
4	Design & Testing of Electrical Machines	M. V. Deshpande. PHI Learning Pvt. Ltd., 2010	8120336453, 9788120336452

5	Installation, Maintenance and Repair of Electrical Machines	M. Gupta, S.K. Kataria & Sons, Edition 2014	978-93-5014-546-3
6	Maintenance & Repairs	Rosenberg.,Mc GRAW-HILL, 1st Edition, May 2003	9780071396035
7	Preventive Maintenance of Electrical Apparatus	S.K. Sharotri, Glencoe/ , McGraw-Hill; 2ndEdition , June 1969	10: 007030839X 13: 978-0070308398

**E-References:** E references may be search on search engine or on the web portals. Few examples are listed below.

- <https://ndl.iitkgp.ac.in/>, [www.nptel.ac.in](http://www.nptel.ac.in)
- You tube Search link- Fire safety and Fire Extinguisher Operation
  - w4jHpHoYZhk
  - leRoRx4mobI
  - nkbVC0FnMUU
  - epGGwjjjoISM
- You tube Search link- CPR technique
  - [https://youtu.be/TbyV6Z\\_WQJQ](https://youtu.be/TbyV6Z_WQJQ)
  - wfpQuYeyG78
  - OaSovqEimyA
- [https://www.youtube.com/watch?v=A951LRFRL\\_M](https://www.youtube.com/watch?v=A951LRFRL_M) transformer manufacturing
- <https://www.youtube.com/watch?v=3osmO4FQ2Yg&t=232s> transformer manufacturing
- <https://www.youtube.com/watch?v=OzBMX84jTA> Tests on transformer
- <https://www.youtube.com/watch?v=4L0ch0-Paq8> Testing of power transformer
- <https://electrical-engineering-portal.com/>
  - transformer-maintenance-inspection-repair#energized-condition
  - troubleshooting-transformer-failure
  - testing-and-commissioning-procedure-for-motors
  - regular-motor-maintenance-to-avoid-failure-and-prolong-its-lifespan
  - maintenance-practice-electric-motors-generators
  - download-center/books-and-guides/automation-control/maintenance-induction-motors
  - download-center/books-and-guides/electrical-engineering/motors-installation
- <https://www.youtube.com/watch?v=ZbzYWLCzttk> vaccum dehydration system
- <https://www.youtube.com/watch?v=4-Jnh3fkmiI> Vaccum impregnation process.

### CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19308.1	3	3	2	2	3	3	3	3	3	3
EE19308.2	3	2	2	3	3	3	3	3	3	3
EE19308.3	3	3	3	3	3	3	3	3	3	3
EE19308.4	3	2	3	3	3	3	3	3	3	3
EE19308.5	3	2	3	3	3	3	3	3	3	3

**Industry Consultation Committee:**

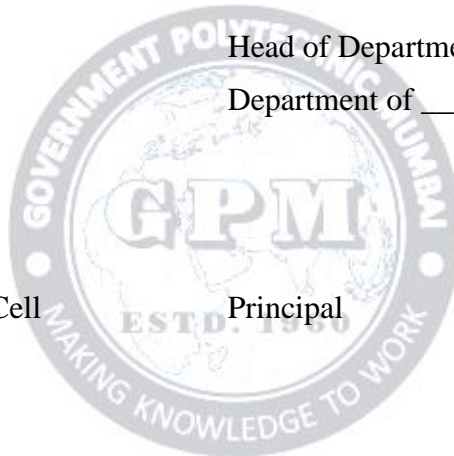
Sr. No	Name	Designation	Institute/Organisation
1	Mr. Bharat Kadam	Assistant Engineer	MSEDCL, Bhandup, Mumbai
2	Mr. Prakash Kadam	Unit Head	Pragati Electricals Thane
3	Prof. Dr. Dilip Lulekar	HOD, Electrical Engineering	Govt. polytechnic Nagpur
4	Prof. R. U. patil	Sr. Lecturer, Electrical Engineering	VPM Polytechnic Mumbai
5	Prof. Dr Mahesh Narkhede (Curriculum Content Designer)	Lecturer , Electrical Engineering	Govt. Polytechnic Mumbai
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Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering</b>										
Course Code: EE19 309				Course Title: Project & Presentation						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	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 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:

**The aim of the project is to provide an opportunity to the students to work on an open ended engineering problem. The students will be able to apply knowledge from different areas or courses, which they have studied in their curriculum to a real-world scenario. The scientific way of solving the problems and ability to apply it to find alternative solutions for the problems will help them in their professional life. This course will help to inculcate leadership skills, decision making, participative learning, resource management, cost considerations, documentation and report writing skills with effective communication**

**Course Outcomes:** Student should be able to

EE19309.1	Propose projects with innovative ideas in a clear and concise manner
EE19309.2	Identify and summarize an appropriate list of literature review, analyze previous work done and relate them to current project
EE19309.3	Plan and coordinate work in a group.
EE19309.4	Implement the skills acquired in the previous semesters to solve complex engineering problems.
EE19309.5	Test the designed project model and evaluate its performance.
EE19309.6	Communicate effectively in oral/ written format to present the working of their project/product.

### Course Content Details:

Each student of the project batch (maximum five) shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

### Area of selection for project :

These are only guidelines; any project related to Electrical Engineering depending upon the availability of projects may be included. Preference should be given to projects according to the local needs, practical oriented/industry sponsored/ solution to problems of

society/industry/national/international interest. Projects may be inter disciplinary.

1 Illumination Engineering , 2 Green building Codes, 3 Hybrid Vehicles, 4 Variable Voltage Variable frequency drives, 5 Traction new trends, 6 EHV Transmission, 7 Smart Grid Applications, 8 Computer application in testing and maintenance of electrical equipment , 9 Energy Conservation, Energy Audits, 10 Smart Metering, Electricity Theft Reduction, 11 Power Quality, 12 Renewable Energy, 13. Industry 4.0, 14. IOT, 15 Electrical Mobility, 16. Fuel Cells , 17 Lithium batteries and charging stations, 18 energy efficiency retrofitting of equipment, 13 Any other topics related to Electrical Engineering

Project Presentation (Term Work) :50 marks. Each student of the project batch shall present the topic of Project orally and/or through power point slides.

The Project Presentation marks of the Project shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairman. The student shall be evaluated based on:

Technical report : 15 marks

Presentation skill: 15 marks

Ability in the Question and Answer session: 10 marks.

Attendance and punctuality:10 marks

### 1. Activity plan

Sr.No.	Activity	Week No
1	Formation of group, Allocation of work responsibility to individual/team	1
2	Visits to Industries / Institutions / Market/field work/sites, Collection of Data /Survey/Analysis	2
3	Finalisation of project idea/title and its synopsis submission	3
4	Planning of execution of project activities with time frame	4
5	Design of Components, preparation of drawing, estimates wherever required, printed circuits design, its checking,	5,6
6	Fabrication, Assembling, Model/Prototype development, Testing as per project requirements	7,8,9,10
7	Consolidation of work allotted to individual or team	11
8	Presentation of initial draft: pre submission draft	12
9	Final Project Report: Printed: Submission: soft & Hard copy	13
10	Group presentation of project work at the time of final evaluation	15

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.

### 2. Project Execution:

1. Guide shall monitor the work and help the students from time to time.

2. A project diary is to be maintained by each student, giving details of planning, work executed, information collected etc., on weekly basis and the same should be validated from the guide on regular basis.
3. The guide should maintain a record of progressive / continuous assessment of project work and observe the progress of each group member on weekly basis.
4. The same shall be kept ready for submission to the external examiner before the final examination.

### 3. Project Report:

1. The student shall get the initial draft copy of the project approved from the Project Guide.
2. Structure: It shall be as follows

#### Project report structure

- Title page
- Inner title page (white)
- Certificate
- Certificate from Industry/winner in the competition
- Index/Content/Intent
- List of Abbreviations/Symbols
- List of Figures
- List of Graphs
- List of Tables
- List of if any other inclusion
- Abstract
- Introduction
- Literature Survey/Review
- System Development
- Performance Analysis
- Conclusion
- References
- Appendices
- Acknowledgement

#### 1. Introduction (2-3 pages)

- 1.1 Introduction
- 1.2 Need/Necessity/Motivation
- 1.3 Objectives

#### 2. Literature survey/review (5-10 pages)

Related information available in standard Books, Journals, Transactions, and Internet Websites.

#### 3. System development (20-25 pages)

- The reporting shall be presented in one or more chapters with appropriate chapter titles.
  - Experimental setups, procedures adopted, techniques developed, methodologies adopted. Important derivations/formulae
  - Figures and tables should be presented immediately following their first mention in the text.
4. **Performance analysis (5-15)**
    - **Test results**
  5. **Conclusions (1 page)**
    - 5.1. Conclusion
    - 5.2. Future Scope
    - 5.3. Applications/Utility
  6. **References (1-2 pages)**
    - Author, "Title", Name of Journal/Transactions/ Book, Edition/Volume, Publisher, Year of Publication, pp. \_.
    - In case of web pages complete web page address with assessing date has to be enlisted
    - List of references should be as per use in the text of the report
  7. **Appendices (5-7 pages)**
    - Related data or specifications or referred charts, details computer
    - Code/program, etc.
  8. **Acknowledgement ( 1 page)**
    - Expression of gratitude and thankfulness for helping in completion of the said task with names starting from Guide, HoD, Principal and related persons Signed by the candidate.
  9. **General Guidelines**
    - Text should be printed on front and correct side of the watermark on quality white bond paper
    - Paper size-A4
    - Font : Times new roman
    - Report heading :- All capital—16 font
    - Chapter heading :- All capital—14 font
    - Subchapter :- Title case-12 font
    - Sub-subchapter : – First alphabet capital case-12 font
    - Content : –Sentence case-12 font
    - Title of the Report should not be more than two lines
    - Spacing between lines-1.5
    - Left Margin-1.5”
    - Right Margin-1/2”
    - Top Margin-1”

**10 Flap**

Suitable flap with name of the candidate, Department, Institute, symbol of can be used with nylon strip

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Project Engineering: The Essential Toolbox for Young Engineers	Frederick B. Plummer Jr. Butterworth Heinemann ,UK,1 <sup>st</sup> Edition, 2007	
2			
3			
4			

**E-References:**

- <https://innovationenglish.sites.ku.dk/model/double-diamond-2/> The Double Diamond: Strategy + Execution of the Right Solution
- <https://www.mic.gov.in/> Institution's Innovation Council (IIC). Ministry of Human Resource Development (MHRD), Govt. of India

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19309.1										
EE19309.2										
EE19309.3										
EE19309.4										
EE19309.5										
EE19309.6										

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Bharat Kadam	Assistant Engineer	MSEDCL, Bhandup, Mumbai
2	Mr. Prakash Kadam	Unit Head	Pragati Electricals Thane
3	Prof. Dr. Dilip Lulekar	HOD, Electrical Engineering	Govt. polytechnic Nagpur



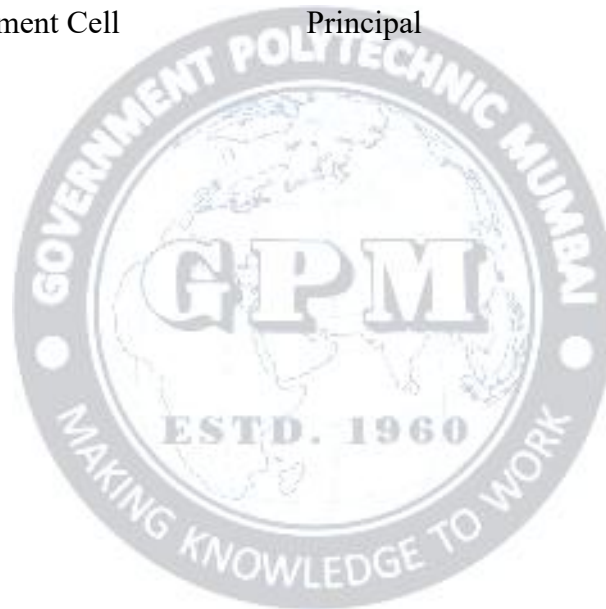
4.	Prof L.S Patil	Faculty, Electrical Engineering	Govt. polytechnic Nasik
5	Prof. V. U Bhosale (Curriculum Content Designer)	Faculty, Electrical Engineering	Govt. polytechnic Mumbai
4	Prof. I. N. Khuspe (Curriculum Content Designer)	Faculty, Electrical Engineering	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal



Programme: <b>Diploma in Electrical Engineering.</b>										
Course Code: EE 19 310				Course Title: Electrical Energy Conservation & Audit						
Compulsory / Optional: <b>C</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>03</b>	<b>--</b>	<b>01</b>	<b>04</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>50<sup>#</sup></b>	<b>50</b>	<b>100</b>

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 mid-term and second skill test at the end of the term

### Rationale:

The consumption of energy is increasing day by day which causes imbalance in energy generation and its consumption. Energy conservation is a scientific tool provided to minimize the energy imbalance. For implementing and monitoring effectiveness of the energy conservation methods and proper use of electrical energy, its audit is must. To maintain the growth of development, electricity generation will be required, generation should be increased by proper mix of conventional and non-conventional sources of energy. But at the same time its conservation and audit should be done to increase the efficiency of electrical power system. Hence electrical engineers must have knowledge of various methods of energy conservation and concept of energy audit and its implementation.

**Course Outcomes:** Student should be able to

EE19 310.1	Interpret energy conservation policies in India.
EE19 310.2	Implement energy conservation techniques in electrical machines.
EE19 310.3	Apply energy conservation techniques in electrical installations.
EE19 310.4	Use Co-generation and relevant tariff for reducing losses in facilities.
EE19 310.5	State the environment problems due to global warming.
EE19 310.6	Carryout energy audit for electrical system.

**Course Content Details:**

Unit No	Topics / Sub-topics
1	<p><b>Topic Title: Energy Conservation Basics.</b></p> <p>1.1 Energy scenario: Primary and Secondary Energy, Energy demand and supply, National and Maharashtra scenario.</p> <p>1.2 Energy conservation and Energy audit; concepts and difference.</p> <p>1.3 Energy Conservation Act 2001; relevant clauses of energy conservation.</p> <p>1.4 BEE and its Roles</p> <p>1.5 MEDA and its Roles</p> <p>1.6 Star Labeling: Need and its benefits.</p> <p><b>Course Outcome: EE19 310.1</b> <span style="float: right;"><b>Teaching Hours : 04 hrs</b></span></p>
2	<p><b>Topic Title: Energy Conservation in Electrical Machines.</b></p> <p>2.1 Need for energy conservation in induction motor and transformer.</p> <p>2.2 Energy conservation techniques in induction motor by:</p> <ol style="list-style-type: none"> <li>a) Improving Power quality.</li> <li>b) Motor survey</li> <li>c) Matching motor with loading.( simple numerical)</li> <li>d) Minimizing the idle and redundant running of motor.</li> <li>e) Operating in star mode.</li> <li>f) Rewinding of motor.</li> <li>g) Replacement by energy efficient motor</li> <li>i) Periodic maintenance</li> </ol> <p>2.3 Energy conservation techniques in Transformer.</p> <ol style="list-style-type: none"> <li>a) Loading sharing</li> <li>b) Parallel operation</li> <li>c) Isolating techniques.</li> <li>d) Replacement by energy efficient transformers.</li> <li>e) Periodic maintenance.</li> </ol> <p>2.4 Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC), Intelligent p. f. controller (IPFC)</p> <p>2.5 Energy efficient motor; significant features, advantages, applications and limitations.</p> <p>2.6 Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry type of transformer.</p> <p><b>Course Outcome: EE19 310.2</b> <span style="float: right;"><b>Teaching Hours : 10 hrs</b></span></p>
3	<p><b>Topic Title: Energy conservation in Electrical Installation systems.</b></p> <p>3.1 Aggregated Technical and commercial losses (ATC); Power system at state, regional, National and global level.</p> <p>3.2 Technical losses; causes and measures to reduce by:</p> <ol style="list-style-type: none"> <li>a) Controlling <math>I^2R</math> losses.</li> <li>b) Optimizing distribution voltage</li> </ol>

	<p>c) Balancing phase currents d) Compensating reactive power flow</p> <p>3.3 Commercial losses: pilferage, causes and remedies.</p> <p>3.4 Energy conservation equipment: Maximum Demand Controller , kVAR Controller, Automatic Power Factor controller (APFC).</p> <p>3.5 Energy Conservation in Lighting System</p> <p>a) Recommended Luminance levels b) Replacing Lamp sources. c) Using energy efficient luminaries. d) Using light controlled gears. e) Installation of separate transformer / servo stabilizer for lighting. f) Periodic survey and adequate maintenance programs.</p> <p>3.6 Energy Conservation techniques in fans, Electronic regulators.</p> <p><b>Course Outcome: EE19 310.3</b> <b>Teaching Hours :10hrs</b></p>
4	<p><b>Topic Title: Energy conservation through Cogeneration and Tariff.</b></p> <p>4.1 Co-generation and Tariff; concept, significance for energy conservation</p> <p>4.2 <b>Co-generation:</b></p> <p>a) Types of cogeneration on basis of sequence of energy use (Topping cycle, Bottoming cycle) b) Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogeneration, Reciprocating engine cogeneration). c) Factors governing the selection of cogeneration system. d) Advantages of cogeneration.</p> <p>4.3 <b>Tariff:</b></p> <p>a) Types of tariff structure: Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power factor tariff, Maximum Demand tariff, Load factor tariff and Availability Based Tariff (ABT).</p> <p>4.4 Recent MSEDCL tariffs for different consumers.</p> <p>4.5 Application of tariff system to reduce energy bill.</p> <p><b>Course Outcome: EE19 310.4</b> <b>Teaching Hours : 08 hrs</b></p>
5	<p><b>Topic Title: Energy and the Environment</b></p> <p>5.1 Environment and social concerns related to energy utilization 5.2 The green house effect 5.3 Global Warming and its effect on Pollution, Acid rains 5.4 Global Energy and environment Management</p> <p><b>Course Outcome: EE19 310.5</b> <b>Teaching Hours : 03 hrs</b></p>
6	<p><b>Topic Title: Energy Audit of Electrical System.</b></p> <p>5.1 Energy audit (definition as per Energy Conservation Act) 5.2 Energy audit instruments and their use.</p>

5.3 Questionnaire for energy audit projects. 5.4 Energy flow diagram (Sankey diagram) 5.5 Simple payback period, Energy Audit procedure (walk through audit and detailed audit). 5.6 Energy Audit report format	<b>Teaching Hours : 10hrs</b>
<b>Course Outcome: EE19 310.6</b>	

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Energy Conservation Basics.	04				
2	Energy Conservation in Electrical Machines.	10				
3	Energy conservation in Electrical Installation systems.	10				
4	Energy conservation through Cogeneration and Tariff.	08				
5	Energy and the Environment	03				
6	Energy Audit of Electrical System.	10				
<b>Total</b>		<b>45</b>				

**Legends:** R-Remember; U-Understand; A-Apply and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**List of Tutorials:**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 310.1	Identify star labelled electrical apparatus and compare the data for various star ratings.	01
2	2	EE19 310.2	Determine the '% loading' along with related efficiency for different loads of given Induction motor (30 to 110 percent in steps 10%).	01
3	2	EE19 310.2	Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.	01
4	2	EE19 310.2	Use APFC unit for improvement of p. f. of electrical load.	01
5	3	EE19 310.3	Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.	01
6	3	EE19 310.3	Determine the reduction in power consumption by replacement of lamps in a class room /laboratory.	01

7	3	EE19 310.3	Determine the reduction in power consumption by replacement of Fans and regulators in a class room / laboratory.	01
8	4	EE19 310.4	Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conservation and its impact on energy bill.	01
9	4	EE19 310.4	Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation	01
10	4	EE19 310.4	Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.	01
11	4	EE19 310.4	Estimate energy saving by improving power factor and load factor for given cases.	01
12	5	EE19 310.5	Prepare a sample energy audit questionnaire for the given industrial facility.	01
13	5	EE19 310.5	Prepare an energy audit report (Phase-I)	01
14	5	EE19 310.5	Prepare an energy audit report (Phase-II)	01
15	5	EE19 310.5	Prepare an energy audit report (Phase-III)	01
<b>Total</b>				<b>15</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors.	Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).	
2	Energy Technology	O.P. Gupta, Khanna Publishing House, New Delhi	
3	India - The Energy Sector.	Henderson P. D., University Press, Delhi, 2016.	ISBN: 978-0195606539
4	Energy Management Handbook	Turner, W. C., Fairmount Press, 2012.	ISBN: 9781304520708
5	Energy Management and Conservation.	Sharma K. V., Venkateshaiah P., I K International Publishing House Pvt. Ltd; 2011	ISBN: 9789381141298
6	Principles of Power System .	Mehta V. K., S. Chand & Co. New Delhi, 2016.	ISBN: 9788121905947
7	Energy Management.	Singh Sanjeev; Rathore Umesh, S K Kataria & Sons, New Delhi.	ISBN: 13:9789350141014.
8	Efficient Use and Management of Electricity in Industry.	Desai B. G.; Rana J. S.; A. Dinesh V.; Paraman R., Devki Energy Consultancy Pvt. Ltd.	

9	Energy Engineering And Management.	Chakrabarti Amlan, e-books Kindle Edition	
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**E-References:**

1. [www.bee-india.nic.in](http://www.bee-india.nic.in)
2. [www.mnes.nic.in](http://www.mnes.nic.in)
3. [www.energymanagertraining.com](http://www.energymanagertraining.com)
4. [www.greenbusiness.com](http://www.greenbusiness.com)
5. [www.worldenergy.org](http://www.worldenergy.org)
6. [www.mahaurja.com](http://www.mahaurja.com)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 310.1	2	3	1	--	3	--	3	1	2	3
EE19 310.2	3	3	3	3	1	1	3	2	2	3
EE19 310.3	3	3	3	3	1	1	3	2	2	3
EE19 310.4	3	3	3	3	3	1	3	2	3	2
EE19 310.5	1	2	--	--	3	--	2	--	--	2
EE19 310.6	3	3	3	1	3	3	3	2	3	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Pramod Daspute	BEE Certified Energy Auditor	M/S. ARS Energy Auditors,
2	Prof. S.V. Bhangale	HOD Electrical Engg.	Govt. Polytechnic Awasari
3	Name of Faculty: 1. Prof. S.B. Visvarupe 2. A.K. Dhulshette (Curriculum Content Designer)	HOD Electrical Engg. Selection Grade Lecturer	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering</b>										
Course Code: EE 19 405				Course Title: Industrial Automation						
Compulsory / Optional: <b>C</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>4</b>	<b>2</b>		<b>6</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>50*</b>	--	--	<b>150</b>

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 mid term and second skill test at the end of the term

**Rationale:** In changing economy now, a day more and more stress is being given up for increasing the throughput in industries. The basic tool for increasing the throughput is automation. The aim of this course is to develop Industrial automation related abilities in the technician to carry out the responsibilities in the industries related to automation. Diploma pass out employed in industry needs to operate, test and maintain the industrial drives and its power control. It is very essential for him to know the electrical logic, Input-Output devices, control supply, control devices and designing of control circuits. This course also covers design of electromagnetic control circuit, basics of PLC programming and introduction to SCADA and DCS, operation of hydraulic and pneumatic control systems.

**Course Outcomes:** Student should be able to

EE19 405.1	Explain significance of Automation.
EE19 405.2	Illustrate working of PLC
EE19 405.3	Understand ladder diagram development
EE19 405.4	Know the working of SCADA and DCS
EE19 405.5	Make use of Electrical Control System Components
EE19 405.6	Apply Electrical Actuators
EE19 405.7	Develop Hydraulic system and Pneumatics systems

**Course Content Details:**

Unit No	Topics / Sub-topics
<b>01</b>	<b>Introduction to Industrial Automation:</b>
	1.1 Importance of automation.
	1.2 Advantages of Automation
	1.3 Disadvantages of Automation
	1.4 Classes (Types) of Automation
	1.5 Requirements of Automation



	<p>1.6 General idea of control, manufacturing and assembly processes.</p> <p><b>Course Outcome:EE19 405.1 Teaching Hours:04 Marks:04 (R-02 , U-02 , A-00 )</b></p>
<b>02</b>	<p><b>Programmable logic controllers:</b></p> <p>2.1 Introduction, definition and history of the PLC.  2.2 PLC advantages and disadvantages.  2.3 Types of PLC-Fixed and modular.  2.4 List of PLC manufacturers.  2.5 PLC Specifications.  2.6 Comparison between PC and PLC.  2.7 PLC block diagram- Central processing unit, Power supplies, I/O modules, Programming devices, Memory.  2.8 Scan cycle of PLC.  2.9 List of remote digital and analog I/Os.  2.10 Comparison between Relay based and PLC based control systems.</p> <p><b>Course Outcome:EE19 405.2 Teaching Hours:10 Marks:10 (R-04 , U-06 , A-00 )</b></p>
<b>03</b>	<p><b>PLC programming:</b></p> <p>3.1 PLC programming languages.  3.2 Development of PLC ladder diagrams.  3.3 Basic concept and rules of ladder.  3.4 Classification of PLC instructions.  3.5 Bit type instructions- XIC, XIO, OTE, OTL, OUT, OSR.  3.6 Logical instructions- OR, AND, NOT, XOR.  3.7 Comparison instructions- EQU, NEQ, LES, LEQ, GRT, GERQ, LIM.  3.8 Timer instructions- TON, TOFF, RTO.  3.10 Counter instructions- CTU, CTD.  3.11 Scaling instructions- SCP.  3.12 Industrial process examples- Bottle filling plant, Starting of an Induction Motor with forward and reverse control, Traffic light control.</p> <p><b>Course Outcome: EE19 405.3 Teaching Hours :14 Marks: 12 (R-04 , U-02 , A-06 )</b></p>
<b>04</b>	<p><b>Introduction to advanced control systems:</b></p> <p>4.1 SCADA- brief introduction to hardware &amp; software used.  4.2 Distributed Control System (DCS)-brief introduction to hardware &amp; software used.</p> <p><b>Course Outcome: EE19 405.4 Teaching Hours :04 Marks:04 (R-02 , U-02 , A-00 )</b></p>
<b>05</b>	<p><b>Electrical control system components:</b></p> <p>5.1 The contactors- Working, Contact types according to application, position, Load utilization categories.  5.2 The solenoid- Types - AC/DC, construction, working, applications  5.3 Manual control switches- push buttons, selector switches – construction and working  5.4 Pilot switches- Construction, Working and Applications of Limit switches, proximity switches, photoelectric switch, temperature actuated switches, level control switch, pressure-sensing switch, Overload sensing switch.  5.6 Output devices – Applications of Contactors, Solenoid actuated valves, pilot lamps.  5.7 Control circuit development – Basics and Thumb rule  5.8 Control supply – control transformer – Definition, Use, specifications</p>

	5.9 Power and control circuits for Skip Hoist, Overhead Crane, conveyor belt, compressor motor
	<b>Course Outcome EE19 405.5 Teaching Hours:08 Marks:10 (R-04 , U-02 , A-04 )</b>
<b>06</b>	<b>Electrical Actuators:</b>
	6.1 Potentiometers – working and use as error detector
	6.2 Servomotors –ac and dc working principle.
	6.3 Synchros – transmitter, control transformer, use of as error detector.
	6.4 Stepper motor – PM & variable reluctance – working principle
	6.5 Tacho – generator
	6.6 Applications of above components as AC/DC control system.
	<b>Course Outcome: EE19 405.6 Teaching Hours :08 Marks:08 (R-02 , U-04 , A-02 )</b>
<b>07</b>	<b>Hydraulic and pneumatic systems:</b>
	7.1 Brief comparison between electrical, hydraulic and pneumatic control system-merits and demerits.
	7.2 Construction and working of different types of Hydraulic pumps – Hydrodynamic and Positive displacement (Gear, Lobe, Vane)
	7.3 Need of accumulator and types of filters in hydraulic circuits
	7.4 Components of Pneumatic system – Types of compressors, FRL unit and It's working.
	7.5 Pneumatic output devices - Working of Single acting, double acting cylinder, Gear Motor, Vane motor.
	7.6 Hydraulic and pneumatic control devices – Construction and working of different types of control valves (Globe, angle, spool, puppet). Classification and working of direction control valves, working of pressure control valve, working of flow control valves (plug, butterfly and ball).
	7.7 Examples of application of hydraulic circuit – shaper circuit, sequence circuit.
	<b>Course Outcome: EE19 405.7 Teaching Hours :12 Marks:12 (R-02 , U-04 , A-06 )</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Industrial Automation	02	02	00	04
2	Programmable logic controllers	04	06	00	10
3	PLC programming	04	02	06	12
4	Introduction to advanced control systems	02	02	00	04
5	Electrical control system components	04	02	04	10
6	Electrical Actuators	02	04	02	08
7	Hydraulic and pneumatic systems	02	04	06	12
<b>Total</b>		<b>20</b>	<b>22</b>	<b>18</b>	<b>60</b>

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

Industrial Automation (EE 19 405)

( P19 Scheme)

Sr. No.	Unit No.	COs	Experiment/Assignment	Hours
1	1	EE19 405.1	Watch the VDO given at the link <a href="https://youtu.be/0Z2z9kOgF2s?t=428">https://youtu.be/0Z2z9kOgF2s?t=428</a> . By observing this warehouse operation comment on the Automation techniques adopted by M/s. Maruti Suzuki Ltd.	02
2	2	EE19 405.2	Complete the “Study hardware and Software used in PLC” experiment in Programmable Logic Controller Lab of Electrical Engineering Department from virtual lab portal given by link <a href="https://portal.coepvlab.ac.in/vlab/">https://portal.coepvlab.ac.in/vlab/</a> . Take the print of the output.	02
3	3	EE19 405.3	To develop ladder diagrams for ON/OFF inputs to produce ON/OFF outputs.	02
4	4	EE19 405.4	Complete the “Study hardware and software platforms for DCS” experiment in the Industrial Automation Lab of Electrical Engineering Department from virtual lab portal given by link <a href="https://portal.coepvlab.ac.in/vlab/">https://portal.coepvlab.ac.in/vlab/</a> . Take the print of the output.	02
5	5	EE19 405.3, EE19 405.5	To develop a ladder diagram for DOL starter	02
6	6	EE19 405.6	To measure the step angle of given stepper motor	02
7	7	EE19 405.7	Identify various components of a pneumatically operated control valve	02
8	3	EE19 405.3	To develop ladder diagrams for logic gates - OR, AND, NOT, XOR, NOR , NAND	02
9	3	EE19 405.3	To develop ladder diagrams for traffic light control system using ON delay timer.	02
10	3	EE19 405.3	To develop any application using OFF delay timer	02
11	3	EE19 405.3	To develop ladder diagrams for counting objects using UP counter.	02
12	3	EE19 405.3	To develop any application using DOWN counter	02
13	3	EE19 405.3	To develop simple programmes for comparison instruction.	02
14	3	EE19 405.3	To implement PLC arithmetic instructions.	02
15	3	EE19 405.3	To develop a Container Filling Process Using PLC	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	Programmable Logic Controller	Vijay R.Jadhav, Second edition (2012), Khanna Publishers , Delhi	ISBN-978-81-7409-228-1
2	Hydraulics and Pneumatics	Andrew Parr, Butterworth-Heinemann Publishers, 28 <sup>th</sup> January 2011	ISBN-9780080966748

#### E-References:

Industrial Automation (EE 19 405)

( P19 Scheme)

1. [http://vlabs.iitb.ac.in/vlabs-dev/vlab\\_bootcamp/bootcamp/COEP\\_KNOWLEDGE\\_SEEKERS/labs/exp1/index.html](http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/COEP_KNOWLEDGE_SEEKERS/labs/exp1/index.html)
2. <https://ndl.iitkgp.ac.in/>
3. [www.plcmanual.com](http://www.plcmanual.com)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 405.1	1	1	1	-	1	-	1	3	1	1
EE19 405.2	1	1	2	-	1	-	1	3	1	1
EE19 405.3	3	3	3	-	3	-	1	3	1	1
EE19 405.4	3	3	3	-	3	-	1	3	1	1
EE19 405.5	3	3	3	-	3	-	1	3	1	1
EE19 405.6	3	3	3	-	3	-	1	3	1	1
EE19 405.7	3	3	3	-	3	-	1	3	1	1

**Industry Consultation Committee:**

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2	Mr Sanket Kalbere	Asst. Manager (Power)	KRajehja Corporation, Mumbai
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5	Dr.Mahesh S.Narkhede	LEE	Govt. Polytechnic Mumbai
6	Mr.A.K.Dhulshette	LEE	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of Electrical Engineering

Head of Department  
Department of Electrical Engineering

I/C, Curriculum Development Cell

Principal

Programme : <b>Diploma in Electrical Engineering</b>										
Course Code:EE19 406				Course Title: Electric Mobility						
Optional: <b>O</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>3</b>	<b>--</b>	<b>1</b>	<b>04</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>-</b>	<b>25*</b>	<b>25</b>	<b>150</b>

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:

Electric mobility is grabbing attention globally, National Electric Mobility Mission NEMMP 2020 lays the vision and provides the roadmap for achieving significant penetration of efficient and environmentally friendly electric vehicle (including hybrids) technologies (xEVs) in India by 2020, The government of India has set the target of achieving 100% Electric vehicles by 2030 , EV industry will generate 10 million new, additional jobs within a decade considering the fact we are introducing this course to keep our students future ready.

**Course Outcomes:** Student should be able to

EE19406.1	Identify types of electrical vehicles and hybrid electrical vehicle
EE19406.2	Explain dynamics of electrical vehicles
EE19406.3	Select electric motor for electrical vehicle application
EE19406.4	Explain key performance parameters of battery required for battery management
EE19406.5	Maintain electric charging station.
EE19406.6	Select appropriate drive for electrical vehicle application

### Course Content Details:

Unit No	Topics / Sub-topics
<b>1</b>	<p><b>Introduction to Electric and Hybrid Vehicles</b></p> <p>1.1 Historical journey of hybrid and electric vehicle.</p> <p>1.2 Types of different pollutants produced due to IC engine vehicle (ICEV) and their effect on human health</p> <p>1.3 Economic and environmental impacts of using Electrical vehicles.</p> <p>1.4 Classification, Vehicle configuration and challenges of electric vehicles:</p> <ul style="list-style-type: none"> <li>• Pure Electric Vehicle (PEV) : Battery Electric vehicle</li> <li>• Hybrid Electric vehicle (HVE)</li> <li>• Conventional HVE: Micro , Mild and Full hybrid , series hybrid. Parallel hybrid ,series</li> </ul>

	<p>parallel hybrid , complex hybrid.</p> <ul style="list-style-type: none"> <li>• Grid able HVE: plug in hybrid (PHEV), Range Extended (REV)</li> <li>• Fuel cell electric vehicle (FCEV)</li> </ul> <p>1.5 Solar electric vehicle: Solar electric power trains</p> <p>1.6 Electric bicycle: Introduction, Electric bicycle propulsion system, Electric bicycle power distribution list</p> <p><b>Course Outcome: EE19406.1 Teaching Hours : 10 hrs Marks: (R- 04, U-08, A-02)</b></p>
2	<p><b>Dynamics of electric and hybrid vehicles</b></p> <p>2.1 General description of vehicle movement, Rolling resistance and its equation, rolling resistance coefficient, factors affecting rolling resistance, typical values of rolling resistance</p> <p>2.2. Aerodynamic drag and its equation, typical values of drag coefficient, Grading resistance</p> <p>2.3 Grading resistance, Road resistance, Acceleration resistance, total driving resistance</p> <p>2.4 Dynamic equation</p> <p>2.5 Simple numerical (only equation no derivation)</p> <p><b>Course Outcome: EE19406.2 Teaching Hours : 08 Hrs Marks:(R- 00 , U-04 ,A-04 )</b></p>
3	<p><b>Selection of Electric Motors for EV and EHV</b></p> <p>3.1 Difference between the electrical motors for electrical vehicles and for other industrial purpose</p> <p>3.2 Classification of electrical motors used for EV applications: Induction Motor, Permanent magnet motor, switched reluctance motor. Construction working and control of permanent magnet motor.</p> <p>3.3 Construction working and control of switched reluctance motor</p> <p>3.3 factors to be considered for selection of motor</p> <p>3.4 Regenerative breaking in motors</p> <p>3.5 Configuration of motor layout: single motor configuration, dual motor configuration, In wheel motor configuration</p> <p><b>Course Outcome: EE19406.3 Teaching Hours: 07 Marks: (R-04 , U- 06 , A-02 )</b></p>
4	<p><b>Battery charging and Battery management System</b></p> <p>Electrochemical Batteries: lead-acid battery, nickel based batteries ,lithium-based batteries</p> <p>Battery parameters: Physical Dimensions, Voltage and current rating ,Capacity and power 'C' Rate, Battery Efficiency, Energy Density, Power Density ,Sate of charge (SOC),Depth of discharge (DoD),State of Health (SoH), Operating Temperature ,Lifetime</p> <p>Construction and working of lithium-based batteries</p> <p>Comparison of batteries with respect to specific energy, specific power, cycle life, cost</p> <p>Brief introduction of: Ultra capacitor, Ultra flywheel, Fuel cell</p> <p><b>Charging of EV and HVE</b></p> <p>AC charging</p> <p>DC Charging</p> <p>Battery swapping</p>

	Smart charging Wireless charging <b>Battery Management System</b> : Need of battery management system , Block diagram of BMS  <b>Course Outcome: EE19406.4, EE19406.5</b> <b>Teaching Hours:12 Hrs.</b> <b>Marks:(R- 02,U- 08, A04 )</b>
5	<b>Power electronics for EV and EHV</b> EV and EHV configuration based on power electronics Converter requirement for on board charger, battery pack, motor drive, auxiliary battery Commonly used DC to DC converter in EV and HVE Isolated converter Non isolated converter Unidirectional and bidirectional converter DC to AC converters: Three phase DC to AC converter, voltage control using sinusoidal PWM.  <b>Course Outcome: EE19406.6 Teaching Hours : 08 Hrs Marks:(R-02 , U-08, A-02)</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Electric and Hybrid Vehicles	4	8	2	14
2	Dynamics of electric and hybrid vehicles	0	4	4	08
3	Selection of Electric Motors for EV and EHV	4	6	2	12
4	Battery and Battery management System	2	8	4	14
5	Power electronics for EV and EHV	2	8	2	12
<b>Total</b>		<b>12</b>	<b>34</b>	<b>14</b>	<b>60</b>

**Indicative list of assignment to be covered in tutorials (Any six, use collaborative learning method)**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19406.1	<ul style="list-style-type: none"> <li>Search Electrical vehicle diagram on internet showing internal parts</li> <li>Take print out of the same</li> <li>Write function of each part.</li> </ul>	2
2	1	EE19406.1	<ul style="list-style-type: none"> <li>Search Hybrid Electrical vehicle diagram on internet showing internal parts</li> <li>Take print out of the same</li> <li>write function of each part</li> </ul>	2

3	1	EE19406.1	<ul style="list-style-type: none"> <li>• Search Plug in Hybrid Electrical vehicle diagram on internet showing internal parts</li> <li>• Take print out of the same</li> <li>• Write function of each part</li> </ul>	2
4		EE19406.3	<ul style="list-style-type: none"> <li>• Presentation in group of five/six on the</li> <li>• Characteristics of motors required for electric vehicles</li> <li>• Working and control of motors that can be used for EV applications</li> <li>• Regenerative braking</li> </ul>	2
5	3	EE19406.3	<ul style="list-style-type: none"> <li>• Compare electrical vehicles available in India with respect to Motor used, Power in KW, torque.</li> </ul>	2
6	4	EE19406.5	<ul style="list-style-type: none"> <li>• Visit to electrical vehicle charging station prepare the report on the following</li> <li>• Type of charging used.</li> <li>• Charging standard used.</li> <li>• Safety precautions followed.</li> <li>• Maintenance procedure followed.</li> </ul>	4
7	4	EE19406.5	<ul style="list-style-type: none"> <li>• Make a presentation on charging specifications used in India and charging standard used in world. Present the same in group of two</li> </ul>	2
8	4	EE19406.5	<ul style="list-style-type: none"> <li>• Make a presentation on startups working in battery swapping techniques. what are the advantages and challenges in battery swapping method? present the same in group of two</li> </ul>	2
9	5	EE19406.6	<ul style="list-style-type: none"> <li>• Prepare and run simulation for unidirectional DC to DC converter using scilab or any other environment</li> </ul>	2
10	5	EE19406.6	<ul style="list-style-type: none"> <li>• Prepare and run simulation for Bidirectional DC to DC converter using scilab or any other environment</li> </ul>	2
<b>Total</b>				

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition And Year Of Publication	ISBN
1	Modern Electric, Hybrid Electric, And Fuel Cell Vehicles, Fundamentals, Theory, And Design	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, CRC Press LLC ,2005	ISBN 0-8493-3154-4
2	Advanced Electric Drive Vehicles	Ali Emadi, CRC Press LLC ,2015	ISBN 978-1-4665-9770-9
3	Electric Vehicle Machines And Drives Design, Analysis And Application	K. T. Chau, IEEE Press, John Wiley & Sons Singapore Pte. Ltd.2015	ISBN 978-1-118-75252-4



4	Hybrid Vehicles And The Future Of Personal Transportation	A. E. Fuhs, CRC Press, 2009	ISBN-10: 1-4200-7534-9
5	Electric Vehicle Battery Systems	Sandeep Dhameja, Butterworth–Heinemann 2002	ISBN 0-7506-9916-7
6	Electric Vehicle Technology Explained	James Larminie ,John Lowry John Wiley & Sons Ltd,2003	ISBN 0-470-85163-5
7	Hybrid Electric Vehicles Principles and Applications With Practical Perspectives	Chris Mi ,Abul Masrur ,David Wenzhong 2011, John Wiley & Sons, Ltd	ePub ISBN: 978-1-119-97011-8
8	Power Electronics: Circuits, Devices and Applications	M. H. Rashid, , 4 <sup>th</sup> Edition, Pearson, 2013	ISBN 10: 0133125904
9	Power Electronics: Devices, Circuits and Industrial Applications	V. R. Moorthi, , Oxford University Press, 2005	ISBN10: 0195670922 / ISBN

**E-References:**

1. <https://nptel.ac.in/course.html>
  - a. Course on electric vehicles part 1 Prof Amit Jain IIT Delhi
  - b. Introduction to hybrid and electric vehicles Dr. Praveen Kumar ,Prof. S. Majhi IIT Guwahati
2. <https://www.edx.org/>
  - a. Electric Cars Technology
3. <https://emobility.araiindia.com/>
4. [https://afdc.energy.gov/vehicles/electric\\_basics\\_hev.html](https://afdc.energy.gov/vehicles/electric_basics_hev.html)
5. <https://makermax.ca/makermax-electricvehiclecourses/>

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19406.1	3	3	-	-	3	-	3	3	3	3
EE19406.2	3	3	-	-	-	-	-	1	-	-
EE19406.3	3	3	-	-	-	2	3	3	1	-
EE19406.4	3	-	-	-	-	-	-	-	-	-
EE19406.5	3	2	-	-	-	2	3	3	-	-
EE19406.6	-	3	-	2	-	-	-	3	1	-

**Industry Consultation Committee:**

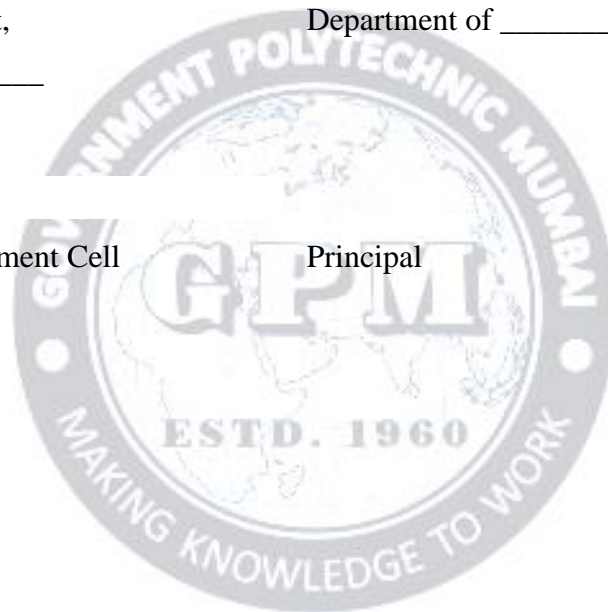
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Coordinator,  
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Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering (Sandwich Pattern)</b>										
Course Code: EE 19 407				Course Title: Emerging Trends in Electrical Engineering						
Compulsory / Optional: <b>O</b>										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
<b>03</b>	<b>--</b>	<b>01</b>	<b>04</b>	<b>60</b>	<b>20</b>	<b>20</b>	<b>--</b>	<b>25*</b>	<b>25</b>	<b>150</b>

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 mid-term and second skill test at the end of the term

### Rationale:

Rapid growth of technological area in each field is really a challenge to every individual. With this new technologies, new applications are coming out and we should meet all these society, industry & public sector demands up to the mark. So to survive our diploma engineers in this fast growing technology context this course will support them to come out with new techniques on their own. This course will help them to find the path that how to handle electrical smart work using IoT, intelligent motor controls, tariff & digitization beyond automation, smart grid, micro grid etc. This course gives them preliminary ideas to work in this areas.

**Course Outcomes:** Student should be able to

EE19 407.1	Recommend the applicable IoT technologies for the electrical systems.
EE19 407.2	Suggest the appropriate components for implementing a smart grid.
EE19 407.3	Encourage different electrical systems for a smart city.
EE19 407.4	Advise the relevant MCC or IMCC for the given applications.
EE19 407.5	Propose the applicable tariff & metering for the specified type of consumer.

### Course Content Details:

Unit No	Topics / Sub-Topics
<b>1</b>	<p><b>Topic Title: Industrial Revolutions &amp; IoT.</b></p> <p>1.1 Industrial Revolution with respect to the driving power.  1.1.1 Versions 1.0, 2.0, 3.0 &amp; 4.0  1.1.2 The driving energies / power to these revolutions.  1.1.3 Compare Industrial Revolutions</p> <p>1.2 Components of Industrial Revolution.  1.2.1 CPS - Cyber Physical Systems  1.2.2 IoT - Internet of Things</p>

	<p>1.2.3 Cloud Computing &amp; Cloud Manufacturing  1.2.4 Explain the importance of Industrial Revolution 4.0 w.r. t. specified components  1.3 Explain IoT Principle &amp; their Features.  1.4 IoT application areas in Electrical systems.  1.4.1 Building automation SCADA  1.4.2 Smart metering  1.4.3 Street light control (Public lighting)  1.5 IoT Initiatives in Distribution Power Systems.  1.5.1 Mobile Apps  1.5.2 Geo coordinates of the network as well as consumer premises  1.5.3 Various digital service platforms for consumers.</p> <p><b>Course Outcome: EE19 407.1 Teaching Hours : 08 hrs Marks: 08 (R- 2, U-4, A-2)</b></p>
2	<p><b>Topic Title: Smart Grid &amp; Micro-Grid</b></p> <p>2.1 Smart Grid.  2.1.1 Need and evolution.  2.2.2 Layout &amp; its Components with their functions  2.2.3 Advantages and Barriers  2.2.4 Smart Grid projects in India  2.2 Micro-Grid.  2.2.1 Need and formation of micro-grid  2.2.2 Layout and working of the micro-grid  2.3 Distributed Generation Systems(DGS)  2.3.1 Significance of the DGS in the present power scenario  2.3.2 Explain Distributed Generation Technologies  2.4 Smart Substation  2.4.1 Need and Layout of the smart substation  2.4.2 Components and their function used in smart substation  2.4.3 Typical specifications of the smart substation  2.4.4 Comparison of the smart substation and conventional substation</p> <p><b>Course Outcome: EE19 407.2 Teaching Hours : 12 hrs Marks: 12 (R- 4, U-4, A-4)</b></p>
3	<p><b>Topic Title: Smart City - Electrical Features</b></p> <p>3.1 Explain the relevant features of smart city.  3.1.1 List the Components for the features  3.1.2 Objective &amp; Challenges of smart city in India  3.2 E-Car.  3.2.1 Importance of E-vehicles related to environment &amp; energy transition  3.2.2 Basics of electric car &amp; its working principle  3.2.3 Types of electric cars  3.3 Explain the working of the charging station (block diagram).  3.4 Features of the fuel cell used in E-cars  3.4.1 Types of fuel cell  3.4.3 Limitations of the fuel cell  3.5 Barriers for the adoption of E-cars in the present scenario.  3.6 Smart Home.  3.6.1 Features &amp; Components</p>

	<p>3.6.2 List the control components used at home</p> <p>3.6.3 Explain the control principles (block diagram) of smart appliances</p> <p><b>Course Outcome: EE19 407.3 Teaching Hours :10 hrs Marks: 12 (R- 4, U-4, A-4)</b></p>
4	<p><b>Topic Title: Intelligent Motor Control Centers</b></p> <p>4.1 Traditional / Conventional Motor Control Center (MCC).</p> <p>4.1.1 Role of MCC (Need)</p> <p>4.1.2 List the components, their symbols &amp; their role in MCC</p> <p>4.1.3 Advantages &amp; Limitations of Traditional / Conventional MCC</p> <p>4.2 Intelligent / Smart MCCs (IMCCs).</p> <p>4.2.1 Need &amp; the requirements that lead to have IMCCs</p> <p>4.2.2 Roles &amp; functions of the components / devices used in IMCC</p> <p>4.2.2.1 Intelligent relays, fuses, control devices &amp; effective security</p> <p>4.2.2.2 Dedicated software</p> <p>4.2.3 Control by microprocessor /micro-controller based systems</p> <p>4.2.3.1 Networking / Technology replaces hard wiring</p> <p>4.2.3.2 Enhanced diagnostic / protective functionality</p> <p>4.2.4 Functional block diagram of the IMCC for any application</p> <p>4.3 Comparison between Traditional / Conventional MCC &amp; IMCC.</p> <p>4.4 Applications, Advantages &amp; Limitations of IMCC.</p> <p><b>Course Outcome: EE19 407.4 Teaching Hours : 14 Marks: 12 (R-2, U-6, A-4)</b></p>
5	<p><b>Topic Title: Tariff, Metering &amp; Bill Management</b></p> <p>5.1 Tariff.</p> <p>5.1.1 State terms related to tariff economics.</p> <p>5.1.1.1 Power Purchase, Power Purchase Agreements (PPA), Power purchase Cost</p> <p>5.2 Tariff Design.</p> <p>5.2.1 Key Factors for the tariff design.</p> <p>5.2.2 Major components of an electricity bill</p> <p>5.2.3 Various slabs in billing</p> <p>5.2.4 Electricity duty, tax on electricity &amp; cross subsidy</p> <p>5.3 Special Tariffs.</p> <p>5.3.1 Describe the terms: Average Billing Rate (ABR), Aggregate Revenue Requirement (ARR), Availability Based Tariff (ABT), Time of Day Tariff (ToD)</p> <p>5.3.2 Recent ToD structure</p> <p>5.2.3 Compare ABR &amp; ARR</p> <p>5.2.4 Explain the suitability of ABT for the type of consumer</p> <p>5.4 kVAh Tariff.</p> <p>5.4.1 Explain the working principle of kVAh meter</p> <p>5.4.2 kVAh billing method for HT &amp; LT consumers</p> <p>5.4.3 kVAh metering methodology</p> <p>5.4.4 kVAh based billing calculation</p> <p>5.5 Metering &amp; Bill Management</p> <p>5.5.1 Working of Net metering &amp; Gross metering</p> <p>5.5.2 MERC rules for Net metering bill (Regulations 2015)</p> <p>5.5.3 Application of Net metering for integration of micro-generators with grid system</p>

5.5.4 Differentiate between Net metering & Gross metering 5.5.5 Recent Meter Reading techniques: MRI / AMR reading
<b>Course Outcome: EE19 407.5    Teaching Hours :16    Marks: 16 (R-4, U-6, A-6)</b>

**Suggested Specifications Table (Theory):**

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Industrial Revolutions & IoT	08	02	04	02	08
2	Smart Grid & Micro-Grid	12	04	04	04	12
3	Smart City - Electrical Features	10	04	04	04	12
4	Intelligent Motor Control Centers	14	02	06	04	12
5	Tariff, Metering & Bill Management	16	04	06	06	16
<b>Total</b>		<b>60</b>	<b>16</b>	<b>24</b>	<b>20</b>	<b>60</b>

**Legends:** R-Remember; U-Understand; A-Apply and above levels (Bloom's revised Taxonomy)

**Notes:** This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

**Students Activities: Tutorial**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19 407.1	General survey about Industrial Revolutions	04
2	1	EE19 407.1	Use of IoT in electrical applications	04
3	1	EE19 407.2	Survey of Smart Grid projects in India	04
4	2	EE19 407.2	Layout & working of Micro-Grid system	02
5	2	EE19 407.2	Distributed Generation Systems & Smart Substation	02
6	2	EE19 407.3	General survey of smart city in India	04
7	3	EE19 407.3	E-car & charging stations in India	02
8	3	EE19 407.4	Visit report of IMCC.	04
9	3	EE19 407.5	Group discussion on special Tariff & Bill Management	04
<b>Total</b>				

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Fundamentals of Smart Grid Technology	Bharat Modi, AnuPrakash, Yogesh Kumar; S.K. Kataria & Sons; 2015 Edition	ISBN-10: 9350144859, 13: 978-9350144855
2	Smart Grid: Technology and Applications	JanakaEkanayake, Kithsiri Liyanage et al; Wiley; 2015 Edition	ISBN-10: 9788126557356, 13: 978-8126557356
3	Sustainable Smart Cities in India: Challenges and Future Perspectives	Sharma, Poonam, Rajput, Swati; Springer	ISBN 978-3-319-47145-7
4	Control of Electrical Machines	S K Bhattacharya; New Age International	ISBN 8122409970, 9788122409970
5	Handbook of Electrical Motor Control Systems	U.S. Eshwar; Tata Mcgraw-Hill Education	ISBN 0074601113, 9780074601112
6	Applied Intelligent Control of Induction Motor Drives	Keli Shi and Tze Fun Chan; Wiley	ISBN 10: 0470825561, 13:978-0470825563
7	Art of Reading Electricity Bill	Mr. Yogendra Talware; Strom Energie Pvt Ltd Pune	

**E-References:**

1. <http://www.slideshare.net.in> (Search with relevant key words)
2. [www.youtube.com](http://www.youtube.com) (Search with relevant key words)
3. [https://en.m.wikipedia.org/wiki/Technological\\_revolution#Potential\\_future\\_technological\\_revolutions](https://en.m.wikipedia.org/wiki/Technological_revolution#Potential_future_technological_revolutions) (general introduction to the new industrial revolution)
4. <https://www.plm.automation.siemens.com/global/en/our-story/glossary/industry-4-0/29278> (Industrial Revolution 4.0)
5. [https://www.industry.siemens.com/topics/global/en/digital-enterprisesuite/Documents/PDF/PLMportal\\_Industrie-40-Internet-revolutionizes-the-economy.pdf](https://www.industry.siemens.com/topics/global/en/digital-enterprisesuite/Documents/PDF/PLMportal_Industrie-40-Internet-revolutionizes-the-economy.pdf) (Industrial Revolution 4.0)
6. <https://www.trendmicro.com/vinfo/us/security/definition/industrial-internet-of-things-iiot> (Internet of Things)
7. <https://www.leverage.com/blogpost/difference-between-iiot-and-iiot>
8. <https://www.computradetech.com/blog/iiot-vs-iiot/>
9. <https://www.quora.com/Who-coined-the-term-internet-of-things>
10. <https://iiot-analytics.com/the-leading-industry-4-0-companies-2019/>
11. <https://www.mercindia.org.in/pdf/Order%2058%2042/Order-195%20of%202017-12092018.pdf> (MERC order on metering)

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 407.1	3	2	--	3	3	1	3	3	2	3
EE19 407.2	1	2	1	3	3	2	3	2	1	3
EE19 407.3	2	3	2	3	3	3	3	2	1	3
EE19 407.4	2	2	1	3	3	2	3	3	2	3
EE19 407.5	3	2	2	3	3	2	3	3	3	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1			
2	Mr. Pawankumar G. Tikar	Asst. Engineer (Infrastructure)	MSEDCL, Gadchiroli Division
3			
4	Mr. Abdul Jabbar	Selection Grade Lecturer	M.H.S.S. Polytechnic, Byculla, Mumbai
5	Dr. P.N. Padghan	Selection Grade Lecturer	Govt. Polytechnic, Mumbai
6	Dr. M. S. Narkhede	Selection Grade Lecturer	Govt. Polytechnic, Mumbai

Coordinator,  
Curriculum Development,  
Department of \_\_\_\_\_

Head of Department  
Department of \_\_\_\_\_

I/C, Curriculum Development Cell

Principal



<b>Programme : Diploma in Electrical Engineering</b>										
Course Code: EE 19 501				Course Title: Entrepreneurship and Start-ups						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	2	--	2	--	--	--	--	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 tests are to be conducted. First skill test at mid term and second skill test at the end of the term

**Rationale:** Entrepreneurs are often thought of as national assets to be refined, motivated and remunerated to the greatest possible extent. Entrepreneurs can change the way we live and work. If successful, their revolutions may improve our standard of living. In short, in addition to creating wealth from their entrepreneurial ventures, they also create jobs and the conditions for a flourishing society. This course will try to inculcate the values of Entrepreneurship and Start up among the students.

**Course Outcomes:** Student should be able to

EE19 501.1	Understand the dynamic role of entrepreneurship and small businesses.
EE19 501.2	Create business ideas / opportunities
EE19 501.3	Explain Financial Planning and Control
EE19 501.4	Illustrate Break Even Analysis
EE19 501.5	Choose Marketing Strategy
EE19 501.6	Explain New Product or Service development

### Course Content Details:

Unit No	Topics / Sub-topics
1	<p><b>Introduction to Management</b></p> <p>1.1 Introduction to Management, organisation structure            1.2 Difference between Management &amp; Administration            1.3 Concept of Scientific Management            1.4 Functions of management            1.5 Introduction to Human Resource Management            1.6 Staffing, training &amp; induction to staff.</p>

<b>2</b>	<p><b>Financial &amp; Project Management</b></p> <p>2.1 Importance of financial management  2.2 Financial organization and management  2.3 Budgets &amp; their analysis  2.4 Project management  2.5 CPM ,PERT analysis &amp; application  2.6 Break even analysis, KAIZEN ,6S.</p>
<b>3</b>	<p><b>Introduction to Entrepreneurship</b></p> <p>3.1 Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation  3.2 Types of Business Structures, differences between entrepreneur &amp; manager  3.3 Business Ideas and their implementation  3.4 Discovering ideas and visualizing the business  3.5 Activity map  3.6 Business Plan  3.7 Double Dimond Approach</p>
<b>4</b>	<p><b>Start ups</b></p> <p>4.1 Introduction, Idea to Start-up  4.2 Market Analysis – Identifying the target market,  4.3 Competition evaluation and Strategy Development,  4.4 Marketing and accounting,  4.5 Risk analysis</p>
<b>5</b>	<p><b>Planning for Startup</b></p> <p>5.1 Financing and Protection of Ideas  5.2 Financing methods available for start-ups in India  5.3 Communication of Ideas to potential investors – Investor Pitch  5.4 Patenting and Licenses</p>
<b>6</b>	<p><b>Strategies for Entrepreneurs</b></p> <p>6.1 Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy</p>

**Tutorial/Assignment:****Note: All assignments are compulsory**

Sr. No.	Unit No	COs	Title of tutorial/assignment	Hours
1	1	EE19 501.1	Interactive session with an Entrepreneur	02
2	2	EE19 501.2	Brain storming of ideas for start-up in current scenario	04
3	3	EE19 501.2	Identification of business opportunity	04
4	4	EE19 501.3	Financing the start up	04

5	4	EE19 501.3	Running the startup	04
6	4	EE19 501.4	Break even analysis	04
7	4	EE19 501.5	Marketing strategy	04
8	4	EE19 501.6	Preparing project report	04
<b>Total</b>				<b>30</b>

**References/ Books:**

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf, K & S Ranch Publication	ISBN – 978-0984999392
2	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries, Penguin UK	ISBN – 978-0670921607
3	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber, Headline Book Publishing	ISBN – 978-0755388974
4	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen, Harvard business	ISBN: 978-142219602

**E-References:**

1. <https://www.fundable.com/learn/resources/guides/startup>
2. <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/>
3. <https://www.finder.com/small-business-finance-tips>
4. <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>

**CO Vs PO and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
EE19 501.1	--	--	3	3	3	3	2	--	--	3
EE19 501.2	--	--	3	3	3	3	2	--	--	3
EE19 501.3	--	--	3	3	3	3	2	--	--	3
EE19 501.4	--	--	3	3	3	3	2	--	--	3
EE19 501.5	--	--	3	3	3	3	2	--	--	3
EE19 501.6	--	--	3	3	3	3	2	--	--	3

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Manoj Shinde	Director	Omnific Solutions, Navi Mumbai
2	Mr.Prashant Anwekar	Director	Innovative Energy Services, Mumbai
3	Mr.R.U.Shelke	HOD(Electrical)	Government Polytechnic, Nashik
4	Mr.Rahul Badhe	LEE	Shri.Shivajirao Jondhale Polyethnic, Asangaon, Thane
5	Mr.S.B.Vishwarupe	HOD(Electrical)	Govt. Polytechnic Mumbai
6	Dr.Mahesh S.Narkhede	LEE	Govt. Polytechnic Mumbai

Coordinator,  
Curriculum Development,  
Department of Electrical Engineering

Head of Department  
Department of Electrical Engineering

I/C, Curriculum Development Cell

Principal

EE 19 408 LaTeX (14)

**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 fi.

**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.

**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.

**5. Equations**

**Outline:** Equations Creating an equation Writing multiple equations Aligning multiple equations amsmath package \$ mode align environment intertext command Unnumbered align\* environ.

**6. Numbering Equations**

**Outline:** Numbering Equations amsmath numbering equations align environment nonumber command labelling equations with the label command cross referencing equations with the ref comma.

**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. newcommand 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 param.

## 12. newenvironment in LaTeX

**Outline:** What is an environment? Defining a new environment Defining  
environments with parameters Renewenvironment 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. newcommand.

## 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 Fo.



**Government Polytechnic,  
Mumbai**

*Department of Electrical Engineering*

**P-19 Curriculum  
(Sandwich Pattern)**

**Semester-VI  
(Course Contents)**

**GOVERNMENT POLYTECHNIC MUMBAI**  
 (Academically Autonomously Institute, Government of Maharashtra)  
**Teaching and Examination Scheme (P19)**  
 With effect from AY 2019-20

**Programme: Diploma in Electrical Engineering (Sandwich Pattern)**

**Term / Semester - VI**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
		L	P	TU	Total		Theory			PR	OR	TW	Total
							TH	TS1	TS2				
EE 19 311	In-Plant Training	--	40	--	40	20	--	--	--	--	100*	100*	200
	<b>Total</b>	--	<b>40</b>	--	<b>40</b>	<b>20</b>	--	--	--	--	<b>100</b>	<b>100</b>	<b>200</b>

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 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.

Department Coordinator,  
 Curriculum Development,  
 Dept. of Electrical Engineering

Head of Department  
 Dept. of Electrical Engineering

In-Charge  
 Curriculum Development Cell

Principal



Programme : <b>Diploma in Electrical Engineering.</b>										
Course Code: EE 19 311				Course Title: In-Plant Training						
Compulsory / Optional: C										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hr 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
-	40 <sup>^</sup>	--	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

(<sup>^</sup>) Twenty weeks Industrial Training

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 mid-term and second skill test at the end of the term

### 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 Implant training.

Implant 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 Implant training also provides an opportunity for the industries to contribute during the formative period of student's development.

**Course Outcomes:** Student should be able:

EE19 311.1	To gain first-hand experience of working as an engineering professional, including the technical application of engineering methods.
EE19 311.2	To work with other engineering professionals and to experience the discipline of working in a professional organization.
EE19 311.3	To develop technical, interpersonal and communication skills, both oral and written.
EE19 311.4	To develop insight into communication aspects of engineers with other professional groups.
EE19 311.5	To observe the functioning and organization of business and companies and prepare the reports
EE19 311.6	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	PSO3
EE19 311.1	2	3	3	3	3	3	3	2	1	2
EE19 311.2	2	3	3	3	3	3	3	2	2	2
EE19 311.3	2	-	2	3	3	3	3	2	2	2
EE19 311.4	2	-	2	3	3	3	3	3	3	3
EE19 311.5	2	-	2	3	3	3	3	1	1	1
EE19 311.6	3	1	3	3	3	3	3	1	1	1

**Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organisation
1			
2			
3			
4	Name of Faculty: Prof. S.B. visvarupe A.K. Dhulshette (Curriculum Content Designer)	HOD Electrical Engg. Deptt. Selection Grade Lecturer	Govt. Polytechnic Mumbai

Coordinator,

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Head of Department

Department of \_\_\_\_\_

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Principal