



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 [#]	--	--	--	--	--	--	--
	Total	18	12	05	35	35	240	80	80	150	150	150	850
Total Contact Hours					35								

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

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

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 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 : Diploma in Electrical Engineering (Sandwich Pattern)										
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
04	02	00	06	60	20	20	50*	--	--	150

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

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tests are to be conducted. First skill test at 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	Topic Title: Fundamentals of Protection. 1.1 Describe the functions of basic elements of a protective system 1.2 Express the various types of faults and abnormalities occurring in a power system.

	<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>Course Outcome: EE19 307.1 Teaching Hours :08 hrs Marks: 08 (R- 2, U-2, A-4)</p>
2	<p>Topic Title: Current Interruption Devices</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 & HRC)</p> <p>2.2.1 Explain different types of fuses.</p> <p>2.3 Explain characteristics of fuse & state their applications.</p> <p>2.4 Explain with sketches arc formation, methods of arc extinction high resistance & low resistance, related terms.</p> <p>2.4.1 Compare arc quenching in A.C. and D.C. Circuit Breaker.</p> <p>2.5 Explain with sketches low tension circuit breakers & their applications.</p> <p>2.5.1 Miniature CB (MCB), Moulded Case CB (MCCB), Residual Current CB (RCCB), Earth Leakage CB (ELCB) & Air CB (ACB)</p> <p>2.6 Explain with sketches high tension circuit breakers & their applications.</p> <p>2.6.1 Sulphur Hexafluoride CB (SF6CB), Vacuum CB (VCB) & 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 & Type2</p> <p>2.10 Lightning Arrester & their types</p> <p>Course Outcome: EE19 307.2 Teaching Hours : 14 hrs Marks: 14 (R- 4, U-10, A-0)</p>
3	<p>Topic Title: Protective Relays</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 & 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>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 & current)</p>

	<p>3.3.9 Microprocessor based relays</p> <p>3.3.9.1 Block diagram & working</p> <p>3.3.9.2 Protection features</p> <p>Course Outcome: EE19 307.3 Teaching Hours :16 hrs Marks: 16 (R- 4, U-8, A-4)</p>
4	<p>Topic Title: Protection of Alternators & Transformers</p> <p>4.1 Describe the causes of faults & 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 & 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 & 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 & overheating protection.</p> <p>4.5.2 Limitations of differential protection</p> <p>4.6 Buchholz relay: construction, operation, merits & demerits.</p> <p>4.7 Calculate the CT ratio of the transformer protection scheme.</p> <p>4.8 Introduction to Microprocessor based alternator & transformer protection.</p> <p>Course Outcome: EE19 307.4 Teaching Hours :12 Marks: 12 (R-2, U-6, A-4)</p>
5	<p>Topic Title: Protection of Motors, Bus-bars & Transmission Lines</p> <p>5.1 Describe the causes of faults & 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 & 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 & 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>Course Outcome: EE19 307.5 Teaching Hours :10 Marks: 10 (R-4, U-06, A-0)</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
Total		60	16	32	12	60

Legends: R-Remember; U-Understand; A-Aply 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 Electromechanical IDMT over current 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
Total				

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., Krishnamurthy 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
2. www.cgglobal.com
3. www.dreamtechpress.com/eBooks
4. www.youtube.com/switchgears
5. www.electrical4u.com
6. www.en.wikipedia.org
7. 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 : Diploma in Electrical Engineering										
Course Code: EE19308				Course Title: Testing and Maintenance of Electrical Equipment						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30 Mts)	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:

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

EE19308.01	State and practice safety measures & precautions
EE19308.02	Test Transformer/ AC machine/Earthing as per IS code of practise
EE19308.03	Identify / Locate common troubles in electrical machines
EE19308.04	Plan & carry out routine & preventive maintenance
EE19308.05	Diagnosis and reconditioning of Insulating material

Course Content Details:

Unit No	Topics / Sub-topics
1	<p>Safety & Prevention:</p> <p>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</p> <p>1.2 Meaning & causes of electrical accidents; factors on which severity of Shock depends Procedure for rescuing the person who has received an electric shock, methods of providing CPR and AED, 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>Course Outcome: EE19308.01 Teaching Hours : 5 hrs Marks: 6 (R- 2, U-2, A-2)</p>

2	<p>General Introduction:</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 & 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 Concept of Bathtub curve</p> <p>2.5 Earth resistance and earth resistivity, factors affecting earth resistance, earth resistivity of different soil composition, methods for reducing soil resistance</p> <p>2.6 Testing of earth resistance and earth pit electrode: 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>2.7 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>Course Outcome: EE19308.02, EE19308.04</p> <p>Teaching Hours : 09 Marks: 10 (R-2 , U- 4 , A- 4)</p>
3	<p>Transformers:</p> <p>3.1 Enlist of type test, routine test & 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, & no load current, Impedance voltage, load losses, Insulation Resistance test, Temperature rise test of oil & winding</p> <p>3.3 Preventive maintenance & 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 & magnetic) and reason for occurrence</p> <p>3.6 Trouble shooting of three phase transformer and remedial measures</p> <p>Course Outcome: EE19308.02, EE19308.03, EE19308.04</p> <p>Teaching Hours : 20 Marks: 20 (R-4 , U- 8 , A- 8)</p>
4	<p>Rotating Machines:</p> <p>4.1 List of type tests, routine tests & special tests pertaining to 1 & 3 phase Induction motors.</p> <p>4.2 Procedures of routine test on single phase (IS7572:1974(latest updated)) and three phase induction motors as per (IS code 4029:2010)- Measurement of dc resistance of windings(1&3 phase), measurement of insulation resistance(1&3 phase) No load test (1&3 phase), High voltage test(1phase), reduced voltage starting and running test (3 phase), temperature rise test(3 phase or three phase)</p> <p>4.3 Routine, Preventive, & breakdown maintenance of 1 & 3 phase Induction motors as per IS 900:1992latest updated</p> <p>4.4 Maintenance schedule of alternators & synchronous machines</p> <p>4.5 Causes of failure of induction motor, Various types of faults (mechanical, electrical & magnetic) and reason for occurrences</p> <p>4.6 Trouble shooting of 1phase & 3-phase induction motor with remedial measures</p> <p>Course Outcome: EE19308.02, EE19308.03, EE19308.04</p> <p>Teaching Hours : 18 Marks: 16 (R- 4, U-6, A- 6)</p>

5	Insulation:
	5.1 Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958
	5.2 Measuring insulation resistance, Dielectric Absorption Ratio, Polarization Index, interpretation of the of insulation condition from measurement data.
	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
	5.4 Reconditioning of insulation medium : weakening agents which deteriorate properties of insulation medium, cleaning and drying, baking, re-varnishing, vacuum impregnation.
	5.6 Measures to be taken to maintain the insulation resistance of electrical machines to healthy level during operation and non-operation period
Course Outcome: EE19308.02, EE19308.05	
Teaching Hours : 08 Marks: 08 (R- 2 , U-2 , A- 4)	

Suggested Specifications Table (Theory):

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

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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	EE19308.01	Demonstration of CPR & AED technique after electrocution	02
2	3	EE19308.02	Perform routine test on transformer as per latest IS code 2026-1981 (minimum two test)	04
3	3	EE19308.03	Prepare trouble-shooting chart for three phase transformers	02
4	4	EE19308.04	Prepare maintenance schedules and carry out routine & preventive maintenance of electrical machines available in the institute	02
5	5	EE19308.02 EE19308.05	Perform insulation resistance (IR) test on motor / transformer as per IS code	02
6	1	EE19308.01	Demonstration of use of fire extinguisher in case of fire due to electrical abnormal conditions	02

7	2	EE19308.02	Measurement of resistance of earth pit electrode which is available at institute	02
8	4	EE19308.02	Perform routine test on 1- phase induction motor as per code IS7572:1984(minimum two test, other than IR test)	04
9	4	EE19308.02	Perform routine test on 3- phase induction motor as per code IS 4029:2010 (minimum two test, other than IR test)	04
10	3	EE19308.02	Perform temperature rise test on transformer	02
11	4	EE19308.02	Perform temperature rise test on motor	02
12	5	EE19308.02 EE19308.05	Determine breakdown strength of transformer oil	02
13	2	EE19308.02	Measurement of earth resistivity and locate best spot for earthing pit	04
14	4	EE19308.03	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

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 Kiamah, McGraw Hill, 1 st edition, 2003	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, 1 st Edition, May 2003	9780071396035
7	Preventive Maintenance of Electrical Apparatus	S.K. Sharotri, Glencoe/ , McGraw-Hill; 2 nd Edition , 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.

1. <https://ndl.iitkgp.ac.in/>, for free books and resource material
2. <https://archive.org/details/gov.in> for different IS codes published by Bureau of Indian Standards
3. www.nptel.ac.in for video lectures
4. You tube Search link- Fire safety and Fire Extinguisher Operation, <https://youtu.be/w4jHpHoYZhk> ii) [leRoRx4mobI](https://youtu.be/leRoRx4mobI) iii) [nkbVC0FnMUU](https://youtu.be/nkbVC0FnMUU) iv) [epGGwjjoISM](https://youtu.be/epGGwjjoISM) v) [QK5dMp43NJE](https://youtu.be/QK5dMp43NJE)
5. You tube Search link- CPR technique , <https://youtube/>
i) [TbyV6Z_WQJQ](https://youtu.be/TbyV6Z_WQJQ) ii) [wfpQuYeyG78](https://youtu.be/wfpQuYeyG78) iii) [OaSovqEimyA](https://youtu.be/OaSovqEimyA) iv) [oK0sTid4ZV4](https://youtu.be/oK0sTid4ZV4)
6. https://www.youtube.com/watch?v=A951LRFRL_M= transformer manufacturing
7. <https://www.youtube.com/watch?v=3osmO4FQ2Yg&t=232s> transformer manufacturing
8. https://www.youtube.com/watch?v=_OzBMX84jTA Tests on transformer
9. <https://www.youtube.com/watch?v=4L0ch0-Paq8> Testing of power transformer
10. <https://electrical-engineering-portal.com/>
i) [transformer-maintenance-inspection-repair#energized-condition](https://electrical-engineering-portal.com/transformer-maintenance-inspection-repair#energized-condition)
ii) [troubleshooting-transformer-failure](https://electrical-engineering-portal.com/troubleshooting-transformer-failure)
iii) [testing-and-commissioning-procedure-for-motors](https://electrical-engineering-portal.com/testing-and-commissioning-procedure-for-motors)
iv) [regular-motor-maintenance-to-avoid-failure-and-prolong-its-lifespan](https://electrical-engineering-portal.com/regular-motor-maintenance-to-avoid-failure-and-prolong-its-lifespan)
v) [maintenance-practice-electric-motors-generators](https://electrical-engineering-portal.com/maintenance-practice-electric-motors-generators)
vi) [download-center/books-and-guides/automation-control/maintenance-induction-motors](https://electrical-engineering-portal.com/download-center/books-and-guides/automation-control/maintenance-induction-motors)
vii) [download-center/books-and-guides/electrical-engineering/motors-installation](https://electrical-engineering-portal.com/download-center/books-and-guides/electrical-engineering/motors-installation)
11. <https://www.youtube.com/watch?v=ZbzYWLCzttk> vaccum dehydration system
12. <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
EE19308.01	3	3	2	2	3	3	3	3	3	3
EE19308.02	3	2	2	3	3	3	3	3	3	3
EE19308.03	3	3	3	3	3	3	3	3	3	3
EE19308.04	3	2	3	3	3	3	3	3	3	3
EE19308.05	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	Lecturer , Electrical Engineering	Govt. Polytechnic Mumbai

	(Curriculum Content Designer)		
6	I. N. Khuspe (Curriculum Content Designer)	Lecturer , Electrical Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____

Head of Department
Department of _____

I/C, Curriculum Development Cell

Principal



Programme : Diploma in Electrical Engineering										
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 st Edition, 2007	
2			
3			
4			

E-References:

1. <https://innovationenglish.sites.ku.dk/model/double-diamond-2/> The Double Diamond: Strategy + Execution of the Right Solution
2. <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

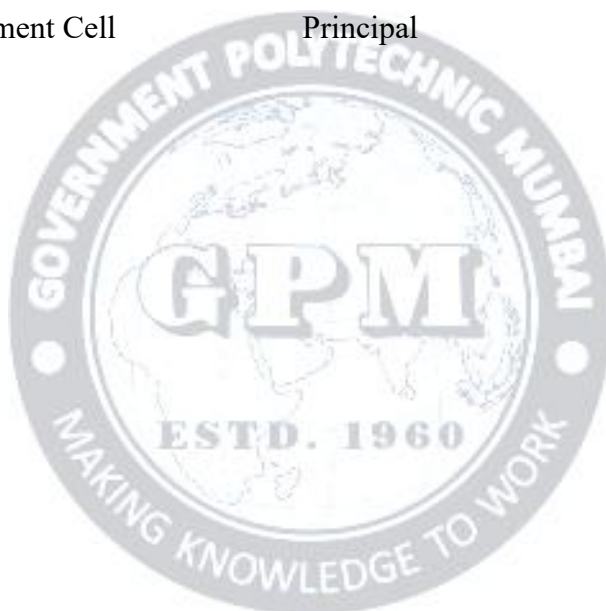
4.	Prof L.S Patil	Faculty, Electrical Engineering	Govt. polytechnic Nasik
5	Prof. V. U Bhosale (Curriculum Content Designer)	Faculty, Electrical Engineering	Govt. polytechnic Mumbai
4	Prof. I. N. Khuspe (Curriculum Content Designer)	Faculty, Electrical Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____

Head of Department
Department of _____

I/C, Curriculum Development Cell

Principal



Programme: Diploma in Electrical Engineering.										
Course Code: EE 19 310				Course Title: Electrical Energy Conservation & Audit						
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
03	--	01	04	--	--	--	--	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 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>Topic Title: Energy Conservation Basics.</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>Course Outcome: EE19 310.1 Teaching Hours : 04 hrs</p>
2	<p>Topic Title: Energy Conservation in Electrical Machines.</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> <ul style="list-style-type: none"> a) Improving Power quality. b) Motor survey c) Matching motor with loading.(simple numerical) d) Minimizing the idle and redundant running of motor. e) Operating in star mode. f) Rewinding of motor. g) Replacement by energy efficient motor i) Periodic maintenance <p>2.3 Energy conservation techniques in Transformer.</p> <ul style="list-style-type: none"> a) Loading sharing b) Parallel operation c) Isolating techniques. d) Replacement by energy efficient transformers. e) Periodic maintenance. <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>Course Outcome: EE19 310.2 Teaching Hours : 10 hrs</p>
3	<p>Topic Title: Energy conservation in Electrical Installation systems.</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> <ul style="list-style-type: none"> a) Controlling I^2R losses. b) Optimizing distribution voltage

	<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>Course Outcome: EE19 310.3 Teaching Hours :10hrs</p>
4	<p>Topic Title: Energy conservation through Cogeneration and Tariff.</p> <p>4.1 Co-generation and Tariff; concept, significance for energy conservation</p> <p>4.2 Co-generation:</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 Tariff:</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 MSSEDCL tariffs for different consumers.</p> <p>4.5 Application of tariff system to reduce energy bill.</p> <p>Course Outcome: EE19 310.4 Teaching Hours : 08 hrs</p>
5	<p>Topic Title: Energy and the Environment</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>Course Outcome: EE19 310.5 Teaching Hours : 03 hrs</p>
6	<p>Topic Title: Energy Audit of Electrical System.</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
	Course Outcome: EE19 310.6 Teaching Hours : 10hrs

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				
Total		45				

Legends: R-Remember; U-Understand; A-Applied 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
Total				15

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
2. www.mnes.nic.in
3. www.energymanagertraining.com
4. www.greenbusiness.com
5. www.worldenergy.org
6. 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 : Diploma in Electrical Engineering										
Course Code: EE 19 405				Course Title: Industrial Automation						
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 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
01	Introduction to Industrial Automation: <ul style="list-style-type: none"> 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

	1.6 General idea of control, manufacturing and assembly processes.
	Course Outcome:EE19 405.1 Teaching Hours:04 Marks:04 (R-02 , U-02 , A-00)
02	Programmable logic controllers: <ul style="list-style-type: none"> 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. Course Outcome:EE19 405.2 Teaching Hours:10 Marks:10 (R-04 , U-06 , A-00)
03	PLC programming: <ul style="list-style-type: none"> 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. Course Outcome: EE19 405.3 Teaching Hours :14 Marks: 12 (R-04 , U-02 , A-06)
04	Introduction to advanced control systems: <ul style="list-style-type: none"> 4.1 SCADA- brief introduction to hardware & software used. 4.2 Distributed Control System (DCS)-brief introduction to hardware & software used. Course Outcome: EE19 405.4 Teaching Hours :04 Marks:04 (R-02 , U-02 , A-00)
05	Electrical control system components: <ul style="list-style-type: none"> 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

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

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
Total		20	22	18	60

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 https://youtu.be/0Z2z9kOgF2s?t=428 . 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 https://portal.coepvlab.ac.in/vlab/ . 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 https://portal.coepvlab.ac.in/vlab/ . 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 th 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
2. <https://ndl.iitkgp.ac.in/>
3. 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:

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

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

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

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	Summarize the various Electric Vehicles for the clean environment
EE19406.2	Explain the dynamics of electric vehicles
EE19406.3	Select suitable electric motor for electrical vehicle
EE19406.4	Maintain battery charging and energy storage management
EE19406.5	Make use of power electronic devices in Electric Vehicles

Course Content Details:

Unit No	Topics / Sub-topics
1	Electric and Hybrid Vehicles: History, Environmental Impact & Types 1.1 Historical journey of Hybrid and Electric Vehicle. 1.2 Types of different pollutants produced due to IC engine vehicle (ICEV) and their effect on human health 1.3 Economic and environmental impacts of using Electrical Vehicles. 1.4 Classification, Vehicle configuration and challenges of Electric Vehicles: 1.4.1 Pure Electric Vehicle (PEV): Battery Electric vehicle

	<p>1.4.2 Hybrid Electric vehicle (HVE)</p> <p>1.4.3 Conventional HVE: Micro, Mild and Full hybrid, Series Hybrid. Parallel Hybrid, Series Parallel Hybrid, Complex Hybrid.</p> <p>1.4.4 Gridable HVE: Plug in Hybrid (PHEV), Range Extended (REV)</p> <p>1.4.5 Fuel Cell Electric Vehicle (FCEV)</p> <p>1.5 Solar Electric Vehicle: Solar electric power trains</p> <p>Course Outcome: EE19406.1 Teaching Hours: 10 Hrs Marks: (R- 04, U-08, A-02)</p>
2	<p>Dynamics of Electric and Hybrid Vehicles</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 (only equation no derivation)</p> <p>2.5 Electrical Propulsion Systems: Drive Systems</p> <p>Course Outcome: EE19406.2 Teaching Hours: 07 Hrs Marks:(R- 00, U-04, A-04)</p>
3	<p>Electric Motors Used for EV and EHV</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.</p> <p>3.2.1 Construction working and control of induction motor</p> <p>3.2.2 Construction working and control of permanent magnet motor.</p> <p>3.2.3 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 EV</p> <p>3.5 Configuration of motor layout: single motor configuration, dual motor configuration, In wheel motor configuration</p> <p>Course Outcome: EE19406.3 Teaching Hours: 10 Marks: (R-04, U- 08, A-02)</p>
4	<p>Battery Charging and Energy Storage Management</p> <p>4.1 Electrochemical Batteries: lead-acid battery, nickel-based batteries, lithium-based batteries</p> <p>4.2 Battery Parameters: Physical Dimensions, Voltage and Current rating, Capacity and Power 'C' Rate, Battery Efficiency, Energy Density, Power Density, State of Charge (SoC), Depth of Discharge (DoD), State of Health (SoH), Operating Temperature, Lifetime</p>

	4.3 Construction and working of lithium-based batteries 4.4 Comparison of batteries with respect to specific energy, specific power, cycle life, cost 4.5 Brief introduction of Ultra Capacitor, Ultra Flywheel, Fuel Cell 4.6 Charging of EV and HVE 4.6.1 AC charging 4.6.2 DC Charging 4.6.3 Battery Swapping 4.6.4 Smart Charging 4.6.5 Wireless Charging 4.7 Battery Management System (BMS): Need of battery management system, Block diagram of BMS Course Outcome: EE19406.4 Teaching Hours: 10 Hrs Marks:(R- 02, U- 08, A-04)
5	Use of Power Electronics in EV and EHV 5.1 EV and EHV configuration based on power electronics 5.2 Converter requirement for on board charger, battery pack, motor drive, auxiliary battery 5.3 Commonly used DC to DC converter in EV and HVE 5.3.1 Isolated converter 5.3.2 Non Isolated converter 5.3.3 Unidirectional and Bidirectional converter 5.4 DC to AC converters: Three phase DC to AC converter, Voltage Control using sinusoidal PWM. Course Outcome: EE19406.5 Teaching Hours: 08 Hrs Marks:(R-02, U-06, A-02)

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Electric and Hybrid Vehicles Electric and Hybrid Vehicles: History, Environmental Impact & Types	4	8	2	14
2	Dynamics of Electric and Hybrid Vehicles	0	4	4	08
3	Electric Motors Used for EV and EHV	4	8	2	14
4	Battery Charging and Energy Storage Management	2	8	4	14
5	Use of Power Electronics in EV and EHV	2	6	2	10
Total		12	34	14	60

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"> Search Electrical vehicle diagram on internet showing internal parts Take print out of the same Write function of each part. 	2
2	1	EE19406.1	<ul style="list-style-type: none"> Search Hybrid Electrical vehicle diagram on internet showing internal parts Take print out of the same write function of each part 	2
3	1	EE19406.1	<ul style="list-style-type: none"> Search Plug in Hybrid Electrical vehicle diagram on internet showing internal parts Take print out of the same Write function of each part 	2
4		EE19406.3	<ul style="list-style-type: none"> Presentation in group of five/six on the Characteristics of motors required for electric vehicles Working and control of motors that can be used for EV applications Regenerative braking 	2
5	3	EE19406.3	<ul style="list-style-type: none"> Compare electrical vehicles available in India with respect to Motor used, Power in KW, Torque. 	2
6	4	EE19406.4	<ul style="list-style-type: none"> Visit to electrical vehicle charging station prepare the report on the following Type of charging used. Charging standard used. Safety precautions followed. Maintenance procedure followed. 	4
7	4	EE19406.4	<ul style="list-style-type: none"> Make a presentation on charging specifications used in India and charging standard used in world. Present the same in group of two 	2
8	4	EE19406.4	<ul style="list-style-type: none"> 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 	2
Total				

References/ Books:

Sr. No.	Title	Author, Publisher, Edition & 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 th 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
5. <https://makermx.ca/makermx-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	2	3	3
EE19406.2	3	3	-	-	-	-	-	1	-	-
EE19406.3	3	3	1	1	2	2	3	3	1	3
EE19406.4	3	-	-	1	-	-	2	2	-	1
EE19406.5	3	2	-	-	-	2	3	3	-	-

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1	Dr. V.N. Kalkhambkar	Head, Department of Electrical Engineering	Rajaram Babu Institute of Technology Sakharale
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3	Mrs Vaishali Bhosale	Lecturer, Electrical Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____

Head of Department
Department of _____

I/C, Curriculum Development Cell

Principal

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

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

Note: For Minimum passing marks under various heads, refer, examination rule 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	Advice 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
1	Topic Title: Industrial Revolutions & IoT. 1.1 Industrial Revolution with respect to the driving power. 1.1.1 Versions 1.0, 2.0, 3.0 & 4.0 1.1.2 The driving energies / power to these revolutions. 1.1.3 Compare Industrial Revolutions 1.2 Components of Industrial Revolution. 1.2.1 CPS - Cyber Physical Systems 1.2.2 IoT - Internet of Things

	<p>1.2.3 Cloud Computing & Cloud Manufacturing</p> <p>1.2.4 Explain the importance of Industrial Revolution 4.0 w.r. t. specified components</p> <p>1.3 Explain IoT Principle & their Features.</p> <p>1.4 IoT application areas in Electrical systems.</p> <p>1.4.1 Building automation SCADA</p> <p>1.4.2 Smart metering</p> <p>1.4.3 Street light control (Public lighting)</p> <p>1.5 IoT Initiatives in Distribution Power Systems.</p> <p>1.5.1 Mobile Apps</p> <p>1.5.2 Geo coordinates of the network as well as consumer premises</p> <p>1.5.3 Various digital service platforms for consumers.</p> <p>Course Outcome: EE19 407.1 Teaching Hours : 08 hrs Marks: 08 (R- 2, U-4, A-2)</p>
2	<p>Topic Title: Smart Grid & Micro-Grid</p> <p>2.1 Smart Grid.</p> <p>2.1.1 Need and evolution.</p> <p>2.2.2 Layout & its Components with their functions</p> <p>2.2.3 Advantages and Barriers</p> <p>2.2.4 Smart Grid projects in India</p> <p>2.2 Micro-Grid.</p> <p>2.2.1 Need and formation of micro-grid</p> <p>2.2.2 Layout and working of the micro-grid</p> <p>2.3 Distributed Generation Systems(DGS)</p> <p>2.3.1 Significance of the DGS in the present power scenario</p> <p>2.3.2 Explain Distributed Generation Technologies</p> <p>2.4 Smart Substation</p> <p>2.4.1 Need and Layout of the smart substation</p> <p>2.4.2 Components and their function used in smart substation</p> <p>2.4.3 Typical specifications of the smart substation</p> <p>2.4.4 Comparison of the smart substation and conventional substation</p> <p>Course Outcome: EE19 407.2 Teaching Hours : 12 hrs Marks: 12 (R- 4, U-4, A-4)</p>
3	<p>Topic Title: Smart City - Electrical Features</p> <p>3.1 Explain the relevant features of smart city.</p> <p>3.1.1 List the Components for the features</p> <p>3.1.2 Objective & Challenges of smart city in India</p> <p>3.2 E-Car.</p> <p>3.2.1 Importance of E-vehicles related to environment & energy transition</p> <p>3.2.2 Basics of electric car & its working principle</p> <p>3.2.3 Types of electric cars</p> <p>3.3 Explain the working of the charging station (block diagram).</p> <p>3.4 Features of the fuel cell used in E-cars</p> <p>3.4.1 Types of fuel cell</p> <p>3.4.3 Limitations of the fuel cell</p> <p>3.5 Barriers for the adoption of E-cars in the present scenario.</p> <p>3.6 Smart Home.</p> <p>3.6.1 Features & 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>Course Outcome: EE19 407.3 Teaching Hours :10 hrs Marks: 12 (R- 4, U-4, A-4)</p>
4	<p>Topic Title: Intelligent Motor Control Centers</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 & their role in MCC</p> <p>4.1.3 Advantages & Limitations of Traditional / Conventional MCC</p> <p>4.2 Intelligent / Smart MCCs (IMCCs).</p> <p>4.2.1 Need & the requirements that lead to have IMCCs</p> <p>4.2.2 Roles & functions of the components / devices used in IMCC</p> <p>4.2.2.1 Intelligent relays, fuses, control devices & 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 & IMCC.</p> <p>4.4 Applications, Advantages & Limitations of IMCC.</p> <p>Course Outcome: EE19 407.4 Teaching Hours : 14 Marks: 12 (R-2, U-6, A-4)</p>
5	<p>Topic Title: Tariff, Metering & Bill Management</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 & 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 & 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 & LT consumers</p> <p>5.4.3 kVAh metering methodology</p> <p>5.4.4 kVAh based billing calculation</p> <p>5.5 Metering & Bill Management</p> <p>5.5.1 Working of Net metering & 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
Course Outcome: EE19 407.5	Teaching Hours :16 Marks: 16 (R-4, U-6, A-6)

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
Total		60	16	24	20	60

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
Total				

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 (Search with relevant key words)
3. https://en.m.wikipedia.org/wiki/Technological_revolution#Potential_future_technological_r_evolutions (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 (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
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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

Programme : Diploma in Electrical Engineering										
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	Introduction to Management <ul style="list-style-type: none"> 1.1 Introduction to Management, organisation structure 1.2 Difference between Management & Administration 1.3 Concept of Scientific Management 1.4 Functions of management 1.5 Introduction to Human Resource Management 1.6 Staffing, training & induction to staff.

2	Financial & Project Management 2.1 Importance of financial management 2.2 Financial organization and management 2.3 Budgets & their analysis 2.4 Project management 2.5 CPM ,PERT analysis & application 2.6 Break even analysis, KAIZEN ,6S.
3	Introduction to Entrepreneurship 3.1 Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation 3.2 Types of Business Structures, differences between entrepreneur & 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
4	Start ups 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
5	Planning for Startup 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
6	Strategies for Entrepreneurs 6.1 Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy

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
Total				30

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/](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

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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.