MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Fundamentals of Electrical Engineering**
(Course Code: ..... **)**

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	Second

1. RATIONALE

Technologists in electrical engineering are expected to handle electrical machines, instruments, devices and equipment's. Besides this, operations about power system, protection scheme and controls must be studied and developed by the students. The basic aim of this course is that, the student must learn the basic concepts, rules and laws of electric and magnetic circuits and practical's thereof. The basic concepts of electrical engineering in this course will be very useful for understanding of other higher level subjects in further study.

2. COMPETENCY

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

- **Use basic principles of electrical engineering in different applications**.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Determine various parameters used in electric circuit.
b. Use of basic laws of electrical engineering.
c. Make use of capacitor in different conditions.
d. Use principles of magnetism.
e. Use principles of electromagnetism.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	2	2	8	70	30*	25	25	150

***(*):** Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

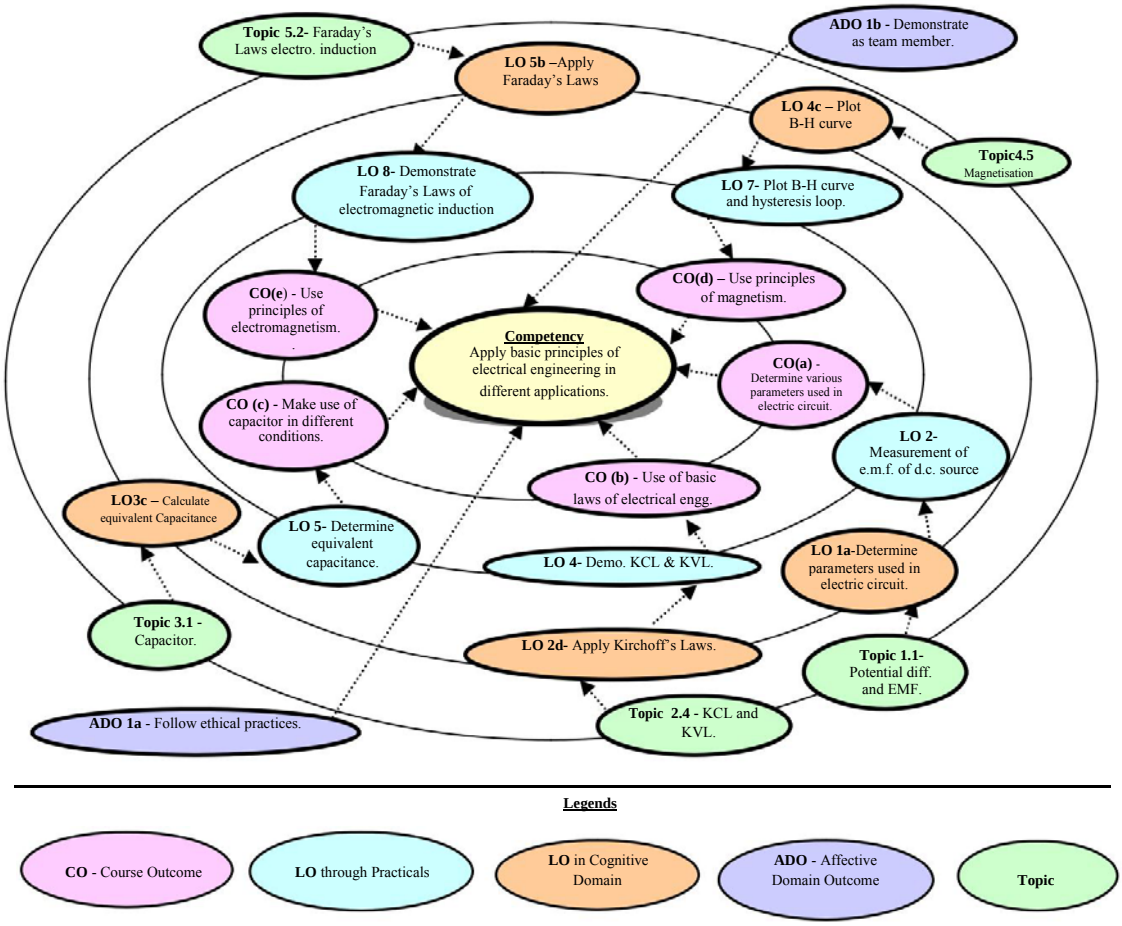

Figure 1 - Course Map

6. SUGGESTED PRACTICALS / EXERCISES

The practical's/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Trace your electrical engineering laboratory: a. Draw layout of electrical laboratory. b. Prepare Charts of electrical safety and demonstrate the operation of fire extinguishing equipments. c. Demonstrate and use electric tools such as pliers, screw driver, insulation cutter, tester	I	02*
2	Measure of e.m.f. of d.c. source and to calculate its internal resistance by connecting it to an external load. Part I	I	02
3	Measure of e.m.f. of d.c. source and to calculate its internal resistance by connecting it to an external load. Part II	I	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
4	Determine the equivalent resistance of Series connection.	II	02*
5	Determine the equivalent resistance of Parallel connection.	II	02
6	Use Kirchhoff's current law and Kirchhoff's voltage law to determine currents and voltages in electric circuits. Part I	II	02
7	Use Kirchhoff's current law and Kirchhoff's voltage law to determine currents and voltages in electric circuits. Part II	II	02
8	In the series connected circuits determine the equivalent capacitance.	III	02*
9	In the parallel connected circuits determine the equivalent capacitance.	III	02
10	Determine the time constant of RC circuit analytically and graphically including plotting the charging and discharging curves of a capacitor(C) through resistor (R). Part I	III	02
11	Determine the time constant of RC circuit analytically and graphically including plotting the charging and discharging curves of a capacitor(C) through resistor (R). Part II	III	02
12	For the given magnetic material find the B-H curve and hysteresis loop. Part I	IV	02*
13	For the given magnetic material find the B-H curve and hysteresis loop. Part II	IV	02
14	For the given magnetic material find the B-H curve and hysteresis loop. Part III	IV	02
15	Use Faraday's first law of electromagnetic induction to analyse the behaviors of statically induced e.m.f. and Dynamically induced e.m.f. in the given circuit. Part I	V	02*
16	Use Faraday's first law of electromagnetic induction to analyse the behaviors of statically induced e.m.f. and Dynamically induced e.m.f. in the given circuit. Part II	V	02
	Total		**32**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year.
- 'Organizing Level' in 2nd year.
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	D. C. Ammeter range (0-5A), Portable analog PMMC type as per relevant BIS standard	I
2	D,C. Voltmeter Range (0-150/300V), Portable analog PMMC type as per relevant BIS standard	I
3	D,C. Voltmeter Range (0-15/30/75 V), Portable analog PMMC type as per relevant BIS standard	II
4	Rheostat (0-250 Ohm,2A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	II
5	Rheostat (0-90 Ohm,5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	III
6	Rheostat (0-35 Ohm,10A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	IV
7	Rheostat (0-350Ohm,1.5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	V
8	D. C. Supply, A 230 V d.c. supply (with inbuilt rectifier to convert a.c.to d.c)	V
9	Oil filled capacitor, 10 to 100μF Oil filled capacitor with rated voltage up to 500V	V
10	Electrolyte type capacitor, 10 to 100μF electrotype capacitor with rated voltage up to 500V	V
11	Galvanometer, (50mV-0-50mV) PMMC type analog portable galvanometer	V

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Basic Electrical Parameters	1a. Distinguish the features of the given electric parameters. 1b. Explain the given terms. 1c. Describe the given effect of the electric current with a relevant application. 1d. Calculate work, power and energy for given circuit.	1.1 Direct Current (DC), Alternating Current (AC), Voltage Source and Current Source: Ideal and Practical. 1.2 Electric Current, Electric Potential, Potential Difference (P D), Electro-Motive-Force (EMF). 1.3 Electrical Work, Power and Energy. 1.4 Resistance, Resistivity, Conductivity, Effect of Temperature on Resistance. 1.5 Types of Resistor and their Application 1.6 Heating Effect, Magnetic Effect, Chemical Effect of Electric current.
Unit – II D.C. Circuits	2a. Apply Ohm's law to calculate internal resistance of a given circuit. 2b. Distinguish the given two parameters 2c. Calculate equivalent resistance for a given circuit. 2d. Apply Kirchhoff's laws to determine current and voltage in the given circuit.	2.1 Ohm's Law, Internal resistance of source, internal voltage drop, Terminal Voltage. 2.2 Resistance in Series, Resistance in Parallel. 2.3 Active, Passive, Linear, Non-linear Circuit, Unilateral Circuit and Bi-lateral Circuit, Passive and Active Network, Node, Branch, Loop, Mesh. 2.4 Kirchhoff's Current Law, Kirchhoff's Voltage Law.
Unit- III Capacitors	3a. Describe the construction of the given type of capacitor. 3b. Describe the working of the capacitor in given circuit. 3c. Calculate equivalent capacitance in given d.c. circuit. 3d. Plot charging and discharging curves for a given capacitor.	3.1 Capacitor, Parallel Plate Capacitor. 3.2 Various connections of capacitor. 3.3 Energy Stored in Capacitor. 3.4 Charging and Discharging of Capacitor. 3.5 Breakdown voltage and Di-electric strength. 3.6 Types of Capacitor and Application.
Unit– IV Magnetic Circuits	4a. Distinguish the given terms related to a magnetic circuit. 4b. Calculate various parameters of a given magnetic circuit. 4c. Plot B-H curve and hysteresis loop of a given magnetic materials. 4d. Compare the performance of the given series and parallel magnetic circuit.	4.1 Magnetic lines of force, flux, flux density, magnetic flux intensity. 4.2 Magneto-Motive-Forces (MMF), Ampere Turns (AT), Reluctance, Permeance, reluctivity. 4.3 Electric and Magnetic circuit: Series Magnetic and Parallel Magnetic Circuit. 4.4 Magnetization Curve (B - H Curve) 4.5 Magnetic Hysteresis, Hysteresis Loop., Applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit– V Electromagnetic Induction	5a. Describe the use of Faraday's laws of electromagnetic induction in the given application. 5b. Distinguish between the given type of e.m.fs. 5c. Apply Faraday's laws to calculate induced e.m.f. in given circuit. 5d. Calculate self inductance and energy stored in magnetic field in given circuit.	5.1 Development of Induced e.m.f. and Current, Faraday's Laws of Electromagnetic Induction. 5.2 Static and dynamic emf, Lenz's Law, Fleming's Right hand rule. 5.3 Self Inductance, Coefficient of Self-inductance (L), Mutual inductance, Coefficient of Mutual inductance (M), self induced e.m.f. and mutually induced e.m.f, Coefficient of Coupling. 5.4 Inductance in series. 5.5 Types of inductor, their application and Energy Stored in Magnetic Field.

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic Electrical Parameters	11	02	06	04	12
II	D. C. Circuits	13	02	03	07	12
III	Capacitors	11	02	03	07	12
IV	Magnetic Circuits	13	02	04	08	14
V	Electromagnetic Induction	16	04	06	10	20
Total		**64**	**12**	**24**	**44**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Illustrate situations wherein electrical energy is required.
b. Prepare models in the form of mini-projects.
c. Prepare power point presentation related to basics of electrical engineering.
d. Prepare a chart of electric circuit elements and relevant industrial application.
e. Prepare question bank referring old MSBTE question papers.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

a. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practical's, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Types of Electrical equipment**: Prepare chart showing real-life examples indicating various types of electrical equipment
b. **Resistance**: Collect photographs of resistances and prepare models of simple series circuit and parallel circuit.
c. **Capacitance:** Collect photographs of capacitance and prepare models of simple series circuit and parallel circuit.
d. **Inductance:** Collect photographs of inductance and prepare models of simple series circuit and parallel circuit.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	A Text Book of Electrical Technology Vol-I	Theraja, B. L. Theraja, A. K.	S.Chand and Co. New Delhi 2014 ISBN: 9788121924405
2	Basic Electrical Engg.	Mittle, V. N.	Tata McGraw-Hill, New Delhi ISBN : 978-0-07-0088572-5
3	Electrical Technology	Hughes, Edward	Pearson Education, New Delhi ISBN-13: 978-0582405196
4	Fundamentals of Electrical Engineering	Saxena, S. B. Lal	Cambridge University Press, New Delhi ISBN : 9781107464353
5	Basic Electrical and Electronics Engineering	Jegathesan, V.	Wiley India, New Delhi ISBN : 97881236529513

14. SOFTWARE/LEARNING WEBSITES

a. www.youtube.com
b. www.nptel.ac.in
c. www.wikipedia.com
d. www.electricaltechnology.org
e. www.howstuffworks.com
f. www.electrical4u.com