Program Name : **Electrical Engineering Program Group**

Program Code : **EE/EP/EU**

Semester : **Fourth**

Course Title : **Electric Power Transmission and Distribution**

Course Code : **22419**

1. RATIONALE

In industry, to operate and maintain electric transmission and distribution systems by the electrical engineering diploma holder (also called technologist), the knowledge of its various components of the power system and their functions is one of the main duties and hence quite important. This course is intended to develop such skills to not only to maintain the proper functioning of the power system but also to diagnose and rectify the general problems related problems of associated to the transmission and distribution system.

2. COMPETENCY

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

- **Maintain the proper functioning of the electrical transmission and distribution systems.**

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. Interpret the nomal operation of the electric transmission and distribution systems.
b. Maintain the functioning of the medium and high voltage transmission system.
c. Interpret the parameters of the extra high voltage transmission system.
d. Maintain the functioning of the low voltage AC distribution system.
e. Maintain the components of the transmission and distribution lines.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	2	-	5	3	70	28	30*	00	100	40	--	--	--	--	--	--	

(*): 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, PrOs,UOs,ADOs 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.

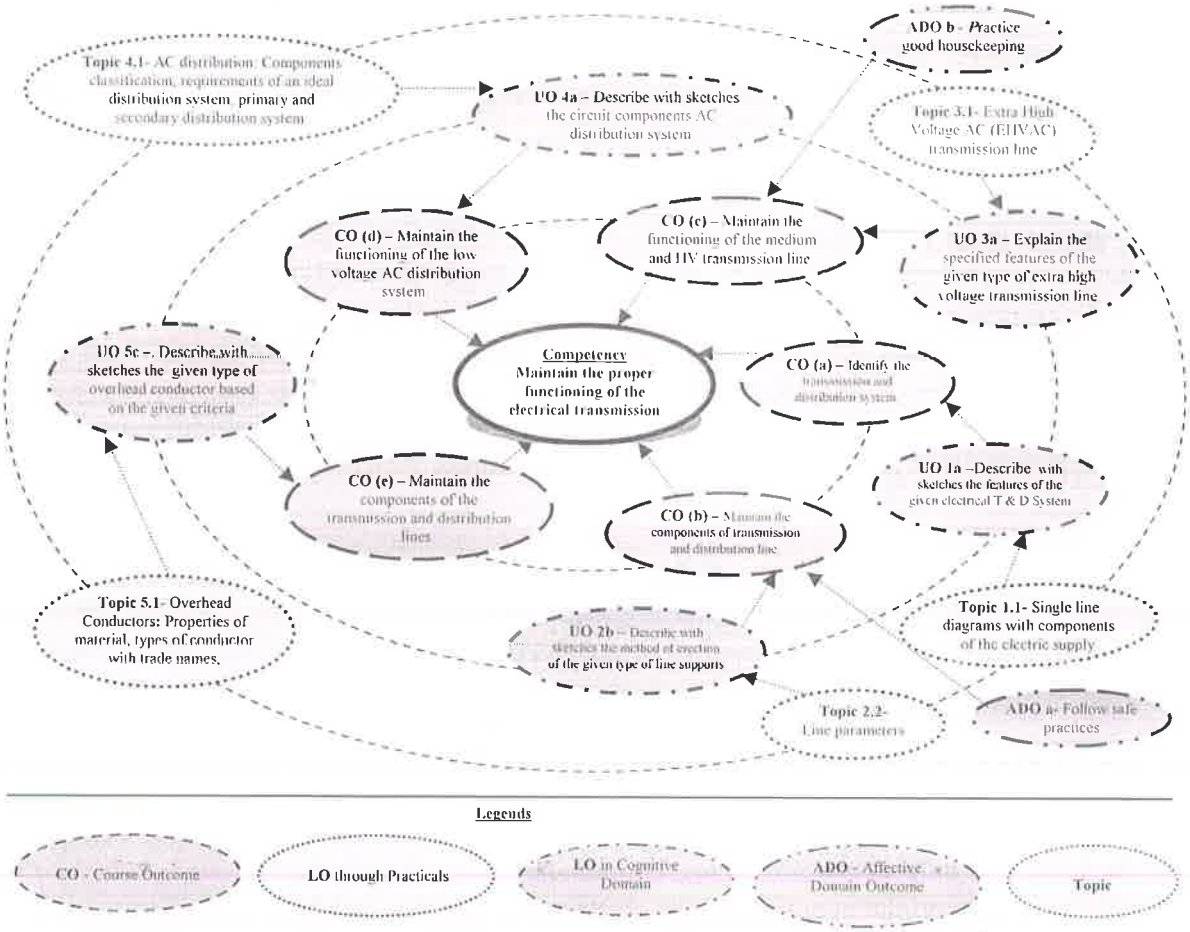

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable -

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not applicable -

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of Transmission and Distribution	1a. Describe with sketches the features of the given type of electric supply system. 1b. Interpret the implicagions of ghe voltage levels in the given transmission system. 1c. Explain the given charactistic (s) of the specified high voltage	1.1 Single line diagrams with components of the electric supply transmission and distribution systems. 1.2 Classification of transmission lines : Primary and secondary transmission; standard voltage level used in India. 1.3 Classification of transmission lines: based on type of voltage, voltage level, length and others

Unit	Unit Outcomes (in cognitive domain)	Topics and Sub-topics
	transmission line. 1d. Describe with sketches the construction method of the given type of transmission/ disribtion line.	1.4 Characteristics of high voltage for power transmission. 1.5 Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV. 1.6 Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV
Unit– II Transmission Line Parameters and Performance	2a. Describe with sketches the given line parameters and types of specified lines. 2b. Interpret the performance of the specified short line. 2c. Interpret the performance of the specified medium line. 2d. Describe the need for transposition of conductors. 2e. Explain specified effects occurring in the given type of transmission line.	2.1 **Line Parameters:** Concepts of R, L and C of line parameters and types of lines. 2.2 **Performance of short line:** Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor. 2.3 **Performance of medium line:** representation, nominal 'T', nominal 'π' and end condenser methods. 2.4 Transposition of conductors and its necessity. 2.5 Skin effect and proximity effect.
Unit– III Extra High Voltage Transmission	3a. Explain the specified features of the given type of extra high voltage transmission line. 3b. Explain the specified effects occurring in the given type of high voltage transmission line. 3c. Describe with sketches the layout of given HVDC transmission line as per the given criterion. 3d. Explain the given feature of the Flexible AC Transmission line. 3e. Explain the features of given wireless transmission of electrical power.	3.1. **Extra High Voltage AC (EHVAC) transmission line:** Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. Ferranti and Corona effect. 3.2. **High Voltage DC (HVDC) Transmission Line:** Necessity, components, advantages, limitations and applications. Layout of monopolar, bi-Polar and homo-polar transmission lines. Lines in India. 3.3. Features of EHVAC and HVDC transmission line. 3.4. Flexible AC Transmission line: Features, d types of FACTS controller. 3.5. New trends in wireless transmission of electrical power.
Unit –IV A.C Distribution System	4a. Describe with sketches the circuit components of the AC distribution system. 4b. Describe the factors to be considered for design of specified feeder and	4.1. AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system. 4.2. Feeder and distributor, factors to be considered in design of feeder and

Unit	Unit Outcomes (in cognitive domain)	Topics and Sub-topics
	distributor. 4c. Describe with sketches the types of different schemes for given type of distribution system. 4d. Calculate the sending end and receiving end voltage of the given AC distribution system. 4e. Describe with sketches the components and their functions for the given type of distribution sub-station. 4f. Describe with sketches the single line diagram of a given type of distribution sub-station.	distributor. 4.3. Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications. 4.4. Voltage drop, sending end and receiving end voltage. 4.5. Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications. 4.6. Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station, symbols and functions of their components.
Unit-V Components of Transmission and Distribution Line	5a. Describe with sketches the given type of overhead conductor based on the given criteria. 5b. Describe with sketches the method of erection of the given type of line supports. 5c. Describe with sketches the types and properties of specified line insulator(s). 5d. Calculate the string efficiency for the specified string of the given type of insulator. 5e. Describe with sketches the specified underground cable based on the given criteria.	5.1 **Overhead Conductors:** Properties of material, types of conductor with trade names, significance of sag. 5.2 **Line supports:** Requirements, types of line structures and their specifications, methods of erection. 5.3 **Line Insulators:** Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string efficiency for string of three suspension insulator, methods of improving string efficiency. 5.4 **Underground Cables:** Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above 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	Basics of Transmission and Distribution	06	02	04	04	10
II	Transmission Line Parameters and Performance	12	04	04	08	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
III	Extra High Voltage Transmission	06	04	04	06	14
IV	A.C Distribution System	12	02	06	08	16
V	Components Transmission and Distribution Line	12	02	06	06	14
	Total	**48**	**14**	**24**	**32**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of UOs. 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: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report based on transmission line network in Maharashtra.
b. Collect the information on components of transmission line.
c. Evaluate transmission line performance parameters of a given line.
d. Library /Internet survey of electrical high voltage line and HVDC lines.
e. Visit to 33/11 KV and 11KV/400V Distribution Substation and write a report

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***.
e. Use Flash/Animations to explain various aspects of transmission and distribution system.
f. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably 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. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. 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. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a model showing:
   i. Single line diagram of electric supply system.
   ii. Single line diagram of a given distribution system.
   iii. Short line and medium transmission line.
   iv. Write a report on the same by giving the details of lines in Maharashtra State.
b. Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.
c. Prepare a power point presentation:
   i. Extra High Voltage AC Transmission line.
   ii. High Voltage DC Transmission line.
   iii. Flexible AC Transmission line.
   iv. New trends in wireless transmission of electrical power.
d. Collect information on:
   i. A.C Distribution System adjacent to your institute.
   ii. Draw a layout diagram of 11KV/400 V substation in your campus/ adjacent substation.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Principles of Power System	Mehta, V.K.	S.Chand and Co. New Delhi ISBN : 9788121924962
2	A Course in Electrical Power	Soni;Gupta; Bhatnagar	Dhanpat Rai and Sons New Delhi ISBN : 9788177000207
3	A Course in Power Systems	Gupta,J.B.	S.K. Kataria and sons New Delhi ISBN: 9788188458523
4	A Textbook of Electrical Technology Vol. III	Theraja, B.L.; Theraja, A.K.	S.Chand and Co. New Delhi ISBN : 9788121924900
5	A Course in Electrical Power	Uppal,S.L.	S.K.Khanna Publisher New Delhi ISBN : 9788174092380
6	Electrical Power Transmission and Distribution	Sivanagaraju S.; Satyanarayana S.	Pearson ISBN : 8131707911, 9788131707913
7	Electrical Power System: A First Course	Ned Mohan	Wiley India Pvt. Ltd. New Delhi ISBN:9788126541959
8	Power System Analysis and Design	Gupta, B.R.	S.Chand and Co. New Delhi ISBN : 9788121923388
9	Electrical Power Distribution System	Kamraju, V.	Tata Mc.Graw Hill, New Delhi ISBN : 9780070151413

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://energy.gov/sites/prod/files/2013/07/f2/Transmission_Woodall_0.pdf
b. www.tpud.org/.../An_Introduction_to_Electric_Power_Transmission_Presentation.pdf
c. https://en.wikipedia.org/wiki/Electric_power_transmission
d. www.nct-tech.edu.lk/Download/.../Performance%20of%20Transmission%20Lines..pd...
e. https://www.electrical4u.com/performance-of-transmission-line/
f. https://www.slideshare.net/SumitKumar58/ppt-of-ehv-ac-transmission
g. https://www.slideshare.net/SameerGupta8/hvdc-vs-hvac
h. https://www.slideshare.net/sagnikroychowdhury/hvdc-presentation-13232932
i. http://www.nct-tech.edu.lk/Download/Technology%20Zone/Distribution % 20 Systems% 20-%20General..pdf
j. https://www.slideshare.net/surajprasad12/distribution-systems-44252619
k. https://www.slideshare.net/pbknprabhakaran/power-transmission-distribution
l. https://www.slideshare.net/gsgindia/construction-ehv-transmission-line
m. www.nptelvideos.in/electrical power