

Program Name : Electrical Engineering Program Group
Program Code : EE/EP/EU
Semester : Sixth
Course Title : Electrical Estimating and Contracting
Course Code : 22627

1. RATIONALE

The wiring installations are important aspects of any electrical installations. This course will empower the students with the necessary principles of planning, electrical bylaws, supply system and method of installations. This course will also help the students to work as contractors, an entrepreneur and execute different electrical installations work.

2. COMPETENCY

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

- Plan electrical installations with their cost estimates.

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:

- Interpret various electrical diagrams.
- Prepare estimate of domestic and commercial electrical installations.
- Prepare estimate of industrial electrical installations.
- Prepare estimate of overhead and underground distribution lines.
- Prepare estimate of public lighting installations.
- Prepare quotation, tender and other related documents.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
Max	Min	Max	Min		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

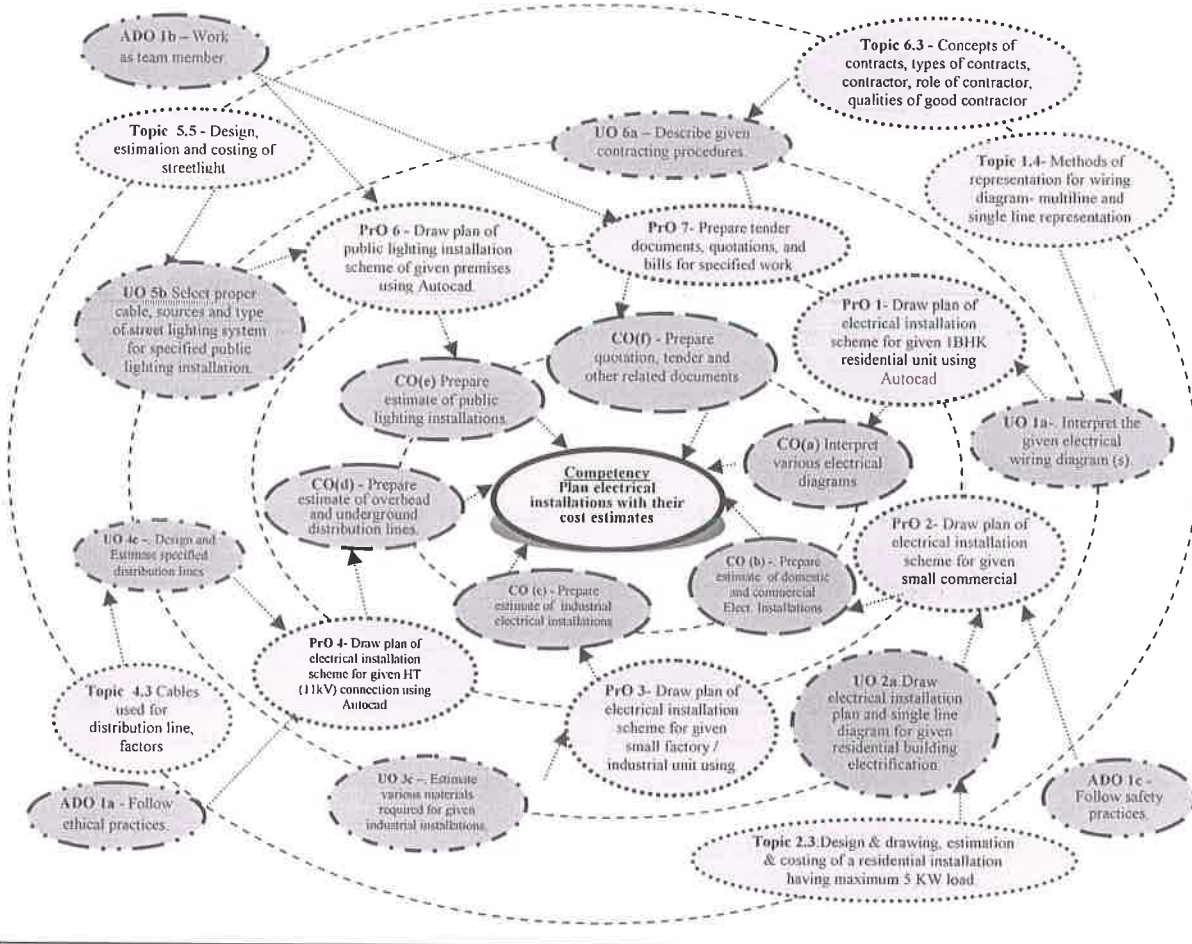
(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

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.





Legends

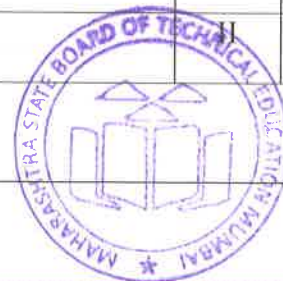


Figure 1 - Course Map

6. SUGGESTED PRACTICALS / EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Draw plan of electrical installation scheme for 1BHK residential unit using Auto-cad and prepare list of materials required.	II	
	1a. Draw the symbols of installation components on the plan showing their location.	II	01#
	1b. Draw the installation wiring route diagram for the plan.	II	01*
	1c. Draw single line wiring diagram of residential installation	II	01#
	1d. Prepare list of materials required.	II	01*



2	Draw plan of electrical installation scheme for small commercial unit using Auto-cad. Also, determine rating of main and sub-distribution board.	II	
	2a. Draw the symbols of installation components on the plan showing their location.	II	01*
	2b. Draw the installation wiring route diagram for the plan	II	01#
	2c. Draw single line wiring diagram of commercial installation.	II	01*
	2d. Determine rating of main and sub distribution board.	II	01*
	# any one * Compulsory		
3	Draw plan of electrical installation scheme for small factory / industrial unit using Auto-cad and type and rating of starter, protective relay.	III	
	3a. Draw the symbols of installation components, starter and motor on the plan showing their location.	III	02*
	3b. Draw the installation wiring route diagram for the plan.	III	01*
	3c. Draw single line wiring diagram of industrial installation.	III	01*
	3d. Determine type and rating of starter, protective relay.		01*
4	Draw plan by using Auto-cad and Estimate the size/ rating of electrical installation system for HT (11kV) scheme.	IV	-
	4a. Draw the symbols of installation components along with equipments (i.e. Transformer, CT, PT and ACB) on the plan showing their location.	IV	02*
	4b. Draw the installation wiring route diagram for the plan.	IV	01*
	4c. Draw single line wiring diagram of HT (11kV) installation.	IV	02*
	4d. Estimate the size/ rating of electrical installation system for HT (11kV) scheme.	IV	02*
5	Draw plan of electrical service installation scheme for LT (415V) line connection using Auto-cad. Prepare the list material required.	IV	
	5a. Draw single line wiring diagram of Overhead service connection.	IV	02*



	5b. List the components required for Overhead service connection.	IV	01*
	5c. Draw single line wiring diagram of Underground service connection.	IV	02#
	5d. List the components required for Underground service connection.	IV	01#
	# any one * Compulsory		
6	Design public lighting installation scheme and Draw plan for the designed lighting scheme using Auto-cad.	V	-
	6a. Draw plan showing location of street lamp post and stay wire.	V	02*
	6b. Draw connection wiring diagram of street lamp post installation.	V	02*
7	Prepare tender documents, quotations, and bills for specified work.	VI	02*
		Total	32

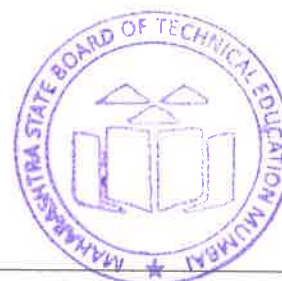
Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practicals 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. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Drawing using AutoCAD	40
2	Understanding line diagram	25
5	Answer to sample questions	25
6	Submission of report in time	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a) Follow safety practices.
- b) Practice good housekeeping.
- c) Practice energy conservation.
- d) Work as a leader/a team member.
- e) Follow ethical Practices.



The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organisation Level' in 2nd year
- 'Characterisation 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	PrO. No.
1	NIL	-

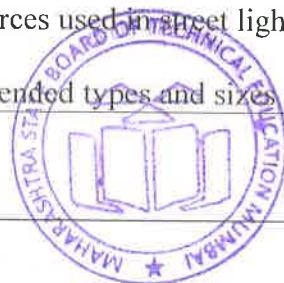
8. UNDERPINNING THEORY COMPONENTS

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 Electrical Wiring Diagram/ (s)	1a. Draw the diagram/(s) of specified electrical installation. 1b. Convert the given wiring diagram into single line diagram. 1c. Explain the specified method of representation of wiring diagram. 1d. Convert the specified single line diagram into the wiring diagram. 1e. Describe the requirements of NEC 2011 related to the given electrical installation.	1.1 Electrical symbols used in electrical diagrams as per Indian standard, multiline and single line representation of conductors. 1.2 Electrical diagrams, their Classification. Definition of wiring and circuit (Schematic) diagram according to IS: 2042(Part-I)-1962. 1.3 Methods of representation for the wiring diagram- multiline and single line representation, conversion of multiline representation into single line and vice versa 1.4 Fundamental principles for electrical installations, Safety in electrical work, permit to electrical work, safety instruction and safety practices 1.5 Scope and features of National Electrical Code 2011 (NEC 2011), Types of electrical installation- Non industrial and industrial, Standard value of voltages and their limits,
Unit – II Domestic and commercial Installations	2a. Draw electrical installation plan and single line diagram for the given residential building electrification. 2b. Draw electrical installation plan and	2.1 Domestic Dwellings/Residential Buildings, its classification, Necessity and reading of Civil Engineering building drawing. Interpretation of electrical installation plan and electrical diagrams. 2.2 General requirements and inspection of electrical installation according to IS: 732-



	<p>single line diagram for the given commercial building electrification.</p> <p>2c. Estimate materials required for the given domestic and commercial installations.</p> <p>2d. Estimate materials required for the specified residential service connection.</p>	<p>1982.</p> <p>2.3 Design and drawing, estimation and costing of a residential installation having maximum 5 KW load.</p> <p>2.4 Design consideration of electrical installation in commercial buildings. Design electrical installation scheme of commercial complex such as drawing halls, and auditorium.</p> <p>2.5 Residential building Service Connection- types Underground and overhead. Calculation of Material required for service connection.</p>
Unit- III Industrial Installations	<p>3a. Compare the installations on the given points.</p> <p>3b. Draw an installation plan, wiring diagrams and single line diagrams for the given industrial installations.</p> <p>3c. Design the given industrial installation.</p> <p>3d. Estimate various materials required for the given industrial installations.</p>	<p>3.1 Classification of industrial buildings, Classification based on power consumption, Difference between non-industrial and industrial load, General characteristics of industrial building, selection of wiring system</p> <p>3.2 Drawing of wiring diagram and single line diagram for single phase and three phase motors.</p> <p>3.3 Design consideration in industrial installations.</p> <p>3.4 Design electrical installation scheme and preparation of small industrial unit having total aggregate three -phase load of 30 KW, agricultural pump and flourmill.</p> <p>3.5 Erection, Inspection and testing of installation as per part 1 section 13 of NEC 2011.</p>
Unit- IV Distribution Lines	<p>4a. Draw the diagram for the given three phase three wire and three phase four wire system by using different types of insulators.</p> <p>4b. Draw the given pole structures.</p> <p>4c. Design the specified distribution lines.</p> <p>4d. Prepare the estimate for the specified distribution lines.</p>	<p>4.1 Introduction to overhead and underground distribution line.</p> <p>4.2 Materials used for distribution line HT (11KV) and LT (415 V)</p> <p>4.3 Cables used for distribution line, factors determining selection of LT/ HT power cables, and cable termination methods.</p> <p>4.4 Design, estimation and costing of HT (11KV), LT (415 V) overhead line and underground cabling.</p>
Unit- V Public Lighting Installation	<p>5a. Draw the installation plan, single line diagram and the other related drawings of specified public lighting installation.</p> <p>5b. Select the suitable cable, sources and type of street lighting system for specified public lighting</p>	<p>5.1 Classification of outdoor installations, streetlight/ public lighting installation</p> <p>5.2 Terminology used according to NEC 2011 – Terms related to highway, lighting installation, photometric terms, luminaries etc. Aim of public lighting installation, classification of roads, standard layout of roads.</p> <p>5.3 Street light pole structures. Selection of equipments, sources used in street light installations.</p> <p>5.4 Cables, recommended types and sizes of cable.</p>



	<p>installation with justification.</p> <p>5c. Prepare the list of the given materials required for the given public lighting installations.</p> <p>5d. Design the specified public lighting installations.</p> <p>5e. Prepare an estimate for the specified public lighting installation.</p>	<p>On off Control of equipments of street light installation.</p> <p>5.5 Design, estimation and costing of streetlight.</p>
Unit– VI Contracting	<p>6a. Describe purposes of the given types of estimates and contracts.</p> <p>6b. Decide the type of estimate for the given work.</p> <p>6c. Describe the given contracting procedures.</p> <p>6d. Prepare tender documents, quotations, and bills for the specified work.</p> <p>6e. Compare tenders and quotations on the given criteria.</p> <p>6f. Explain the specified actions for e-tendering.</p>	<p>6.1 Purpose of estimating and costing, Qualities of good estimator, essential elements of estimating and costing.</p> <p>6.2 Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate, Factors to be considered while preparation of detailed estimate and economical execution of work.</p> <p>6.3 Concepts of contracts, types of contracts, contractor, role of contractor, qualities of good contractor</p> <p>6.4 Type of tender, tender notice, preparation of tender document, and method of opening of tender; e-tendering.</p> <p>6.5 Quotation, quotation format, comparison between tender and quotation. Comparative statement, format of comparative statement. Order format, placing of purchasing order</p> <p>6.6 Principles of execution of works, planning, organizing and completion of work, Billing of work.</p>

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	Electrical Wiring Diagram/ (s)	04	02	00	04	06
II	Domestic and commercial Installations	14	02	08	08	18
III	Industrial Installations	10	02	04	08	14
IV	Distribution Lines	08	02	04	08	14
V	Public Lighting Installations	08	02	02	08	12



Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
VI	Contracting	04	02	00	04	06
Total		48	12	18	40	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 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:

- Prepare abstract of Indian standards related to industrial and non-industrial installations.
- Use E- tab for small assignments.
- Summarize given section of National Electrical Code (NEC), 2011 required for electrical installation.
- Prepare report on market survey of various electrical accessories, wires and cables (specification, manufacturer, quality, cost)
- Collect any one electrical drawing of existing electrical installation and prepare estimate for the same.
- Collect information of tender published in newspaper or of e-tender related to industrial or non-industrial electrical installation and fill necessary documents.
- Prepare power point presentation for acquiring electrical installation work.

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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '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.
- 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 COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Use Flash/Animations to explain various theorems in circuit analysis
- 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 is given here. Similar micro-projects could be added by the concerned faculty:

- Electrical Diagrams:** Prepare a report on existing electrical drawing.
- Domestic and commercial Installations:** Collect civil engineering drawing and prepare estimation for the same.
- Industrial Installations:** Collect industrial installation plan and prepare estimation for the same using softwares as E-tab etc.
- Distribution Lines:** Collect existing installation plan of distribution lines and prepare estimation for the same.
- Public Lighting Installations:** Collect existing installation plan of street lighting scheme and prepare estimation for the same.
- Contracting:** Collect any tender document related to electrical installation and fill all related documents.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electrical Wiring Estimating and Costing	Uppal, S.L. C.G. Garg	Khanna Publisher New Delhi, ISBN 9788174092403
2	Electrical Design Estimating and Costing	Raina, K.B. Dr. Bhattacharya, S.K.	New Age International Publisher, First, Reprint 2010, ISBN: 978-81-224-0363-3
3	Electrical Estimating and Costing	Singh, Surjit Ravi Deep Singh,	Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
4	Electrical Estimating and Costing	Allagappan, N. S.Ekambarram,	Tata Mc-Graw Hill Publishing Co. Ltd, First Edition, 2000, ISBN:9780074624784
5	A Course in Electrical Installation Estimating and Costing	J.B. Gupta	S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
6	SP-30:2011, National Electrical Code, 2011	-	Bureau of Indian Standard.
7	IS: 732-1989, Code of Practice for Electrical Wiring Installation	-	Bureau of Indian Standard.
8	Handbook of e-tab		

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- <https://ask-the-electrician.com/wiringdiagrams.html>



- b) <https://www.btechguru.com/courses--nptel--electrical-engineering-video-lecture--ee.ht..>
- c) <https://www.electricaltechnology.org/2013/09/electrical-wiring.htm>
- d) <https://www.howstuffworks.com/search.php?terms=electrical%20installatio>
- e) <https://www.electrical4u.com/electrical-engineering-articles/utilities/>
- f) <http://www.neca-neis.org/the-standards>
- g) <http://www.metlabs.com/product-safety/2011-national-electrical-code-nec-updates-standard-for-the-safe-installation-of-electri>

