SCHEME : K

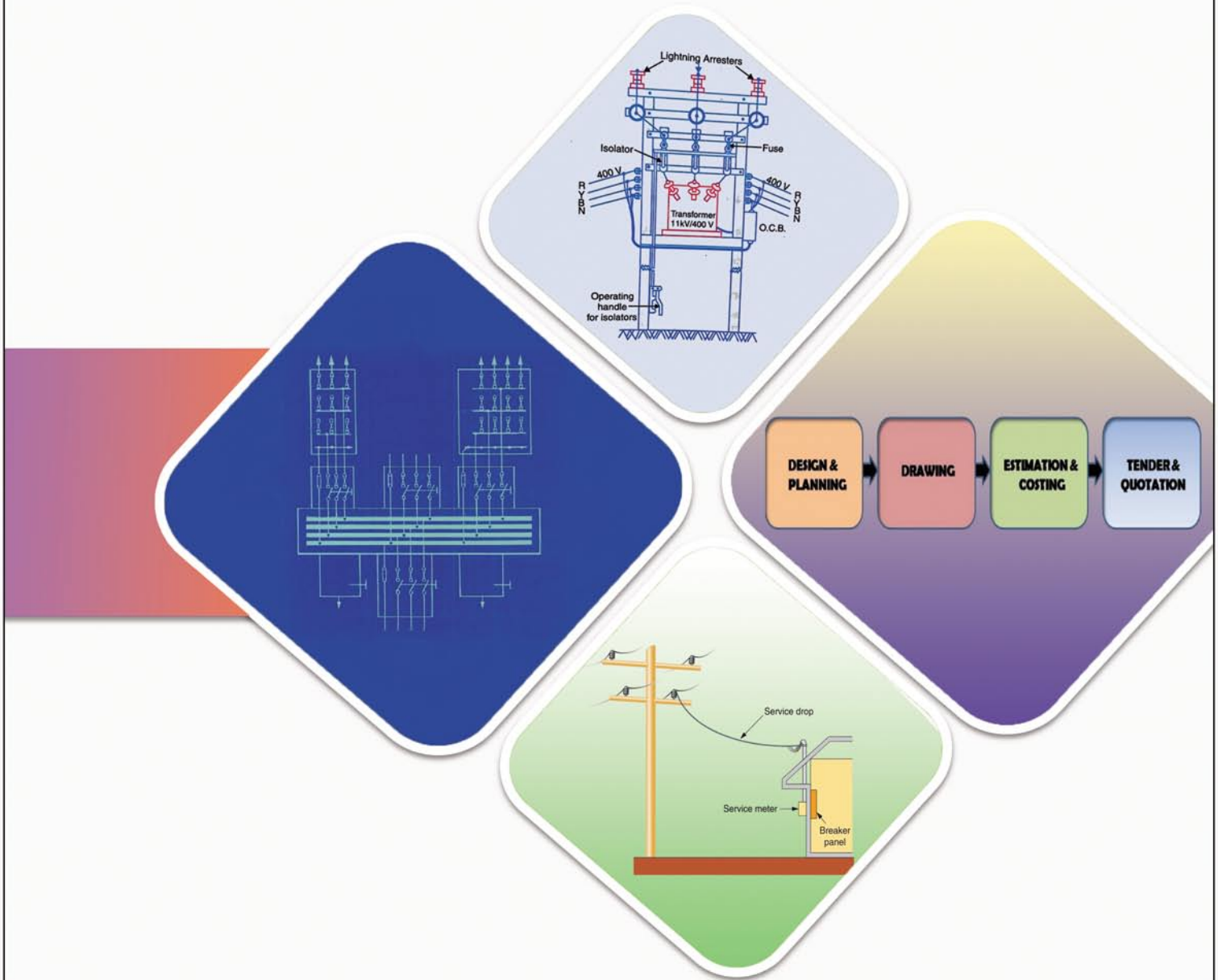
Name : _____

Roll No. : _____ Year : 20___ 20___

Exam Seat No. : _____

LABORATORY MANUAL FOR

ELECTRICAL ESTIMATING AND CONTRACTING (314325)



ELECTRICAL ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the following:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well-designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual For

ELECTRICAL ESTIMATING

AND

CONTRACTING

(314325)

Semester – IV

(EE/EP)

Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education, Mumbai

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

4th Floor, Government Polytechnic Building, 49, Kherwadi, Bandra (East), Mumbai- 400051.

MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION
Certificate

This is to certify that Mr. /Ms …….....

Roll No. ……., of Fourth Semester of Diploma in ….…….…… of Institute, ……..……

(Code : ……) has completed the term work satisfactorily in course **Electrical Estimating and Contracting (314325)** for the academic year 20…….to 20…….. as prescribed in the curriculum.

Place: …….. **Enrollment No: ……..**

Date: ……. **Exam Seat No: ……**

Subject Teacher **Head of department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much-needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher, instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through "chalk and duster" activity in the classroom situation. Accordingly, the 'K' scheme laboratory manual development team designed the practicals to focus on the outcomes, rather than the traditional age-old practice of conducting practicals to 'verify the theory" (which may become a by-product along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the industry/employer expected outcome, course level learning outcome, laboratory learning outcome, which serve key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centred lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

The electrical diploma holder has to work in industry as technical person in middle level management. He/She has to work as production, maintenance, testing engineer in various industries like power generation, transmission, distribution, traction etc. and has to explores important aspects of wiring installations, covering planning of electrical installation and contracts, adherence to electrical bylaws, understanding supply systems, implementing effective installation methods, and mastering the estimation of electrical wiring, installations, and contracting. This course provides students with holistic knowledge to pursue careers as contractors and entrepreneurs and empowers them to successfully execute a wide range of electrical wiring installation projects with confidence and proficiency.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Program Outcomes (POs) to be achieved through this course learning

- **PO 1. Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, sciences and engineering fundamentals with electrical engineering specialization to solve the engineering problems.
- **PO 2. Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
- **PO 3. Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of system components or processes to meet specified needs.
- **PO 4. Engineering tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- **PO 5. Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- **PO 6. Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- **PO 7. Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

List of relevant expected psychomotor domain skills

This Lab manual intends to develop expected psychomotor domain skills of students. The skills mentioned below will be developed through the experiments performed in this Laboratory**.**

1. To use the vocabulary of Tender and Contracting to prepare tender documents and quotation bills.
2. To understand and draw of plan of different types of electrical installation.
3. Ability to prepare estimation and costing for the given electrical installation.
4. Ability to use standard symbol, clearances and protective system for the given electrical installation.

Practical Course Outcome matrix

Course level learning outcomes (COs)

CO1 -Prepare generic tender document, quotation, comparative statement and supply order.
CO2 -Prepare estimate of domestic and commercial electrical installation.
CO3 -Prepare estimate of industrial electrical installation.
CO4 -Prepare estimate of public lighting installation.
CO5 -Prepare estimate of overhead and underground distribution lines.

Sr. No.	Title of the Practical	CO1	CO2	CO3	CO4	CO5
1	*Preparation of a quotation.	✓	-	-	-	-
2	*Preparation of a comparative statement.	✓	-	-	-	-
3	*Preparation of the purchase order.	✓	-	-	-	-
4	Preparation of the tender document.	✓	-	-	-	-
5	*Design the electrical installation system for one BHK unit and carry out an estimation.	-	✓	-	-	-
6	*Domestic installation drawing using suitable software (mentioned in Practical No.5).	-	✓	-	-	-
7	*Design an electrical installation system for a commercial unit and carry out an estimation.	-	✓	-	-	-
8	*Commercial installation drawing using suitable software (mentioned in Practical No.7)	-	✓	-	-	-
9	*Design an electrical installation system for small industrial installation and carry out an estimation.	-	-	✓	-	-
10	Commercial installation drawing using suitable software (mentioned in Practical No.9)	-	-	✓	-	-
11	*Design an electrical installation system for street of mall premises and carry out an estimation.	-	-	-	✓	-
12	*Design an electrical installation system for a low-tension (LT) distribution line (415 volts) and carry out an estimation.	-	-	-	-	✓
13	Design an electrical installation system for a high-tension (HT) distribution line (11 KV) and carry out an estimation.	-	-	-	-	✓

Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each experiment involve students in performance of each experiment.
3. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
4. Teachers should give opportunity to students for hands on experience after the demonstration.
5. Teacher is expected to share the skills and competencies to be developed in the students.
6. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
7. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.

Instructions for Students

1. Listen carefully the lecture given by teacher about subject, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make record all programs.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and gain confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual.
6. Student shall refer technical magazines.
7. Student should develop habit to submit the practicals on date and time.
8. Student should well prepare while submitting write-up of exercise.
9. Attach/paste separate papers wherever necessary.

Content Page

List of Practical's and Progressive Assessment Sheet

Sr. No.	Title of the Practical	Page no.	Date of Performance	Date of Submission	Assessment Marks (25)	Dated sign. of Teacher	Remarks (If any)
1.	*Preparation of a quotation.	1					
2.	*Preparation of a comparative statement.	8					
3.	*Preparation of the purchase order.	14					
4.	Preparation of the tender document.	20					
5.	*Design the electrical installation system for one BHK unit and carry out an estimation.	26					
6.	*Domestic installation drawing using suitable software (mentioned in Practical No.5).	35					
7.	*Design an electrical installation system for a commercial unit and carry out an estimation.	41					
8.	*Commercial installation drawing using suitable software (mentioned in Practical No.7)	49					

9.	*Design an electrical installation system for small industrial installation and carry out an estimation.	55					
10.	Commercial installation drawing using suitable software (mentioned in Practical No.9)	65					
11.	*Design an electrical installation system for street of mall premises and carry out an estimation.	72					
12.	*Design an electrical installation system for a low-tension (LT) distribution line (415 volts) and carry out an estimation.	79					
13.	Design an electrical installation system for a high-tension (HT) distribution line (11 KV) and carry out an estimation.	87					
Total							

Note: Out of above suggestive LLOs -

'*' Marked Practicals (LLOs) are mandatory.

Minimum 80% of above list of lab experiment are to be performed.

Judicial mix of LLOs is to be performed to achieve desired outcomes.

Practical No. 1: Preparation of a quotation.

I Practical Significance

Every diploma electrical engineer must have the knowledge to prepare/accept quotations for any specified work. The student gains the idea of application and costing of main, auxiliary, protective, energy efficient equipment required to carry out the installation

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installation.

III Course Level Learning Outcome(s)

Prepare generic tender document, quotation, comparative statement and supply order.

IV Laboratory Learning Outcome(s)

Prepare a quotation from the given enquiry.

V Relevant Affective Domain related outcome(s)

Follow standard operating procedure observing ethics.

VI Relevant Theoretical Background

After receiving requisition from various departments, purchase department issues letters to several registered supplies for calling rate list. Issuing registered postal letters to various reputed suppliers for their competitive rates is called 'calling of quotation'. The quotation is called in two ways:

A) By issuing individual letters by registered post letters to suppliers.
B) By newspapers advertisement which is called tender notice.
   The advertisement through newspaper are called 'Public Tender' or 'Open Tender' and the quotation called quotations called from registered suppliers are called 'limited tender'. The issue of quotation through
   The Quotation is a fixed price offer, which once accepted by customer, cannot be modified or changed.

VII Sample Quotation preparation from given enquiry

Prepare Quotation for supply of electrical wiring accessories.

Note:
1. The Bidder must quote only single Make & Model.

2. The bidder must quote their quotation only in below said format on the letter of firm otherwise quotation will be REJECTED.

Sr. No	Details of items	Unit	Quoted make.	Qty	Unit rate (exclusive of GST)	Total Amount (exclusive of GST)
A	B	C	D	E	F	G=E*F
1	Supplying 4.0 sq. mm ISI marked, FRLS PVC insulated, single core copper conductor cable (RED). Make: Finolex / Polycab / RRKabel	meter		200.00		
2	Supplying 4.0 sq. mm ISI marked, FRLS PVC insulated, single core copper conductor cable (BLACK). Make: Finolex / Polycab / RRKabel	meter		200.00		
3	Supplying 4.0 sq. mm ISI marked, FRLS PVC insulated, single core copper conductor cable(GREEN). Make: Finolex / Polycab / RRKabel	meter		200.00		
4	Supplying 2.5 sq. mm ISI marked, FRLS PVC insulated, single core copper conductor cable (RED). Make: Finolex / Polycab / RRKabel	meter		400.00		
5	Supplying 2.5 sq. mm ISI marked, FRLS PVC insulated, single core copper conductor cable (BLACK). Make: Finolex / Polycab / RRKabel	meter		400.00		
6	Supplying 2.5 sq. mm ISI marked, FRLS PVC insulated, single core copper conductor cable(GREEN). Make: Finolex / Polycab / RRKabel	meter		400.00		
7	Supplying 20 mm dia. ISI marked, PVC conduit. Make: AKG / BEC / Polycab	meter		100.00		
8	Supplying 20 mm PVC bends. Make: AKG / BEC / Polycab	each		20.00		
9	Supplying 20mmX12mm sizes of ISI marked (IS:14927 P - II) PVC casing capping. Make: AKG / BEC / Polycab	r.mtr.		100.00		
10	Suppyling PVC 6Amp SS combine box 6module. Make: SSK / Northwest / Anchor	each		30.00		

11	Supplying PVC strip connectors	each		50.00		
	Total amount in figure (exclusive of GST):					
	Total amount in words (exclusive of GST):					
	Total amount in figure (inclusive of GST):					
	Total amount in words (inclusive of GST):					

VIII Required Resources/apparatus/equipment with specification

Sr. No	Name of Resources	Suggested Plan	Quantity
1	Newspaper /Online/Electrical Contractor	Prepare quotation with consultation with electrical contractor for tender	1
2	Computer with required specifications.	To type the quotation	1
3	Laser jet multifunction printer	To take the print of quotation on the letter head of the Firm	1

IX Precautions to be followed

1. Follow safety rules/ norms pertaining to all electrical installation.
2. Follow IE rules and regulations pertaining to all electrical installation.
3. Carry out market survey on the requirement of accessories mentioned in the tender while preparing quotation.

X Procedure

1. The staff member suggest/provide different tender notification to prepare quotation and bill.
2. Prepare quotation/Bill of quotation for the given tender, mentioning technical specification with costing.

XI Assumption and Calculation (Preparation of quotation as per IE standard and Market rates)

(Use Blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of result

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions (Note: - Teacher should provide various questions related to practical-sample given)

1. Differentiate between BID and Quotation.
2. State Significances of BOQ (Bills of Quantities) in tendering.

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	Collection of standard formats of tender and quotation	20
2	Selection of work execution for quotation	20
3	Preparation of quotation for the stated work	25
4	Practices of following ethics	15
5	Answer to sample questions	10
6	Submitting the journal in times	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Preparation & Making (15)	**Understanding (10)**	**Total (25)**	

Practical No. 2: Preparation of a comparative statement.

I Practical Significance

Every diploma electrical engineer must have the knowledge to prepare comparative statement for given enquiry. The student gains the knowledge to choose selective contractor/supplier, ensuring higher quality and reliability of the work.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installation.

III Course Level Learning Outcome(s)

Prepare generic tender document, quotation, comparative statement and supply order.

IV Laboratory Learning Outcome(s)

Prepare a comparative statement from a minimum of three quotations.

V Relevant Affective Domain related outcome(s)

Follow standard operating procedure observing ethics.

VI Relevant Theoretical Background

Comparative statement is prepared by the office purchase clerk after opening the quotation for making a comparison of rate quoted by different suppliers. The suppliers which has quoted the lowest rates can be directly from the single page. The comparative statement thus prepared is thoroughly checked u by a committee comprising of purchase officer, accounts officers and the technical advisor, the rates and terms of supply offered by each supplier.

Comparative statement is an important document to evaluate the offers received against an enquiry. Utmost care must be exercised while preparing the comparative statement (comparative price statement) of tenders. Any deviation from the tendered specification, delivery conditions, and assistance etc., stipulated by the tenderers should be highlighted.

Procedure to prepare comparative statement:

1. After opening the quotation, the purchase clerk prepares a comparative statement.
2. A committee of purchase officer, technical advisor and an account officer is constituted to examine in details, the rated and terms of supply offered by each supplier.
3. The lowest rated by each of supplier are marked for issue of supply order after ensuring that the items offered for supply is exactly as per specification

VII Sample Comparative statement for enquiry

Comparative Statement

Name of Office of Purchase officer Date……

……

Quotation Notice No…… Due Date of Opening……Time…….

Approved Requisition No……

No. of suppliers offered quotation……

Sr. No.	Complete specification of items	Quantity	M/s A …. ….	M/s B …. ….	M/s C …. ….	M/s D …. ….	Recom-mendation

1. Name and Sign of person who prepared the statement

……

2. Name and Sign of Inspection Officer

……

3.Name and Sign of Chief Purchase Officer

……..

4. Account officer

…….

seal

VIII Required Resources/apparatus/equipment with specification

Sr. No	Name of Resources	Suggested Plan	Quantity
1	Newspaper /Online/Electrical Contractor	Prepare comparative price statement for enquiry	1
2	Computer with required specifications.	To type the comparative statement	1
3	Laser jet multifunction printer	To take the print of comparative statement	1

IX Precautions to be followed

1. Review all document thoroughly by the officer.
2. Ensure all bidders are being evaluated on the same parameters.
3. Ensure all necessary licenses and certifications are in place for all bidders.
4. Ensure all data and comparison points are properly documented and justified.

X Procedure

Note: The staff member suggest/provide enquiry to prepare a comparative statement from a minimum three quotation for enquiry.

1. Collect three quotations from contractor/suppliers for enquiry.
2. Compare all quantities as per requirement.
3. Prepare a comparative statement from a minimum three quotation for enquiry.

(Use blank sheet to prepare comparative statement)

XI Assumption and Calculation (Preparation of comparative statement)

(Use Blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of result

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions (Note: - Teacher should provide various questions related to practical-sample given)

1. State the methods of opening of tender.
2. State the ways of inviting tenders.

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	Collection of standard formats of enquiry and Comparative statement	20
2	Selection of work execution for comparative statement	20
3	Preparation of comparative statement for the enquiry	25
4	Practices of following ethics	15
5	Answer to sample questions	10
6	Submitting the journal in times	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Preparation & Making (15)	**Understanding (10)**	**Total (25)**	

Practical No.3: Preparation of the purchase order.

I Practical Significance

Diploma electrical engineer must have the knowledge to prepare a purchase order from comparative statement. The student gains the idea of application and costing of main, auxiliary, protective, energy efficient equipment required to carry out the installation.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare generic tender document, quotation, comparative statement and supply order.

IV Laboratory Learning Outcome(s)

Prepare a quotation from the given enquiry.

V Relevant Affective Domain related outcome(s)

Follow standard operating procedure observing ethics.

VI Relevant Theoretical Background

The Tender Evaluation Statement shall be signed by the Purchase Assistant who has prepared the statement and shall be vetted and countersigned by officers of Purchase Department, and approved by the Purchase Manager.

It is normal to accept the lower offer conforming to the requirements in regard to specifications, delivery and other terms. When for valid reasons, it is necessary to accept a tender other than the lowest, the reasons for overlooking the lowest offer must be clearly recorded.

VII Sample of Purchase Order

All the Purchase orders must carry the following information:

1. Purchase order number and date.
2. Detailed specifications of the items as quoted by the supplier/agreed additional specifications, if any.
3. Value of the purchase order.
4. Name of the suppliers.
5. Due date of delivery.
6. Quantity of items ordered.
7. Taxes if any to be specified in the order.
8. Dispatch details as agreed to.

9. Mode of payment as agreed to, advance, discount etc.
10. Inspection system as agreed to.

Sample of Purchase order given below:

Purchase Order Template

Company Name Here

Company Phone: 555-555-555555
Website: www.templatesmob.com
Email: abc@example.com
Company Address Goes Here
City, State, Zip Code

Purchase Order

Dated As: _____
Purchase Order #: _____

Shipped To:

Name: _____
Company Name: _____
Address: _____
_____
City, State, Zip Code _____
Phone: _____

Shipped From:

Name: _____
Company Name: _____
Address: _____
_____
City, State, Zip Code _____
Phone: _____

Description	Qty.	Unit Price	Total Price
		SUBTOTAL	
		TAX	
		TOTAL	000000.00

Additional Notes:

_____
_____
_____
_____

_____
[Signatures of Authorized Person]
[Write Designation Here]

_____
[Signatures of Authorized Person]
[Write Designation Here]

VIII Required Resources/apparatus/equipment with specification

Sr. No	Name of Resources	Suggested Plan	Quantity
1	Newspaper/Online/ Electrical Contractor	Prepare quotation with consultation with electrical contractor for tender	1
2	Computer with required specifications.	To type the purchase order	1
3	Laser jet multifunction printer	To take the print of purchase order	1

IX Precautions to be followed

1. Check the quoted price against market rates or previous contracts.
2. Include all necessary legal clauses.
3. Assign a unique Purchase order number for tracking and reference purpose.
4. Verify suppliers' details (Business credentials, financial stability, legal requirements etc.)

X Procedure

Note: The staff member suggest/provide enquiry to prepare a purchase order from the comparative statement.

The Purchase officer place the order for large scale purchases after approval of quotation from comparative statement, then administrative officer' and account officer's approval is necessary to available funds before issue of supply order.

1. Analysis Comparative statement of given enquiry.
2. Approve the quotation of the supplier/contractor which satisfied all your requirements.
3. Prepare a purchase order of the enquiry with specific terms and condition.

(Use blank sheet to prepare Purchase Order)

XI Result

……

……

……

XII Interpretation of result

……

……

……

XIII Conclusion and recommendation

……

……

……

XIV Practical related questions (Note: - Teacher should provide various questions related to practical-sample given)

1. Explain how the market survey is done while purchasing material for your institute?
2. What is preliminary estimate or rough cost or abstract estimate?

……

……

……

……

……

……

……

……

……

……

……

……

……..

XV References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://gem.gov.in/

XVI Suggested Assessment Scheme

Performance Indicators		Weightage
1	Collection of standard formats of enquiry and Purchase order	20
2	Selection of work execution for Purchase order	20
3	Preparation of Purchase order for the enquiry	25
4	Practices of following ethics	15
5	Answer to sample questions	10
6	Submitting the journal in times	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Preparation & Making (15)	**Understanding (10)**	**Total (25)**	

Practical No.4: Preparation of the tender document.

I Practical Significance

Diploma electrical engineer must have the knowledge to prepare tender documents for any specified work based on locality of installation. The student gains the idea of application and costing of main, auxiliary, protective, energy efficient equipment required to carry out the installation.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare generic tender document, quotation, comparative statement and supply order.

IV Laboratory Learning Outcome(s)

LLO 4.1 Prepare tender document for purchase of electrical machines costing more than five lakhs.

LLO 4.2 Use GeM portal for searching of software, tools/equipment for procurement.

V Relevant Affective Domain related outcome(s)

Follow standard operating procedure observing ethics.

VI Relevant Theoretical Background

GeM is a short form of one stop **Government e-Market Place** hosted by DGS&D where common user goods and services can be procured. GeM is dynamic, self-sustaining and user friendly portal for making procurement by Government officers.

Public procurement forms a very important part of Government activity and reform in Public Procurement is one of the top priorities of the present Government. Government e-Marketplace (GeM - gem.gov.in) is a very bold step of the Government with the aim to transform the way in which procurement of goods and services is done by the Government Ministries and Departments, Public Sector Undertakings and other apex autonomous bodies of the Central Government.

Tender Notice

The information to be made available for certain heavy purchases through the newspaper is called 'Tender Notice'.

Tender notice is given for large scale purchases or for purchases of costly equipment such as installation of power wiring in a large industry, for installation of sub-station etc. Tender notice contains information of material to be purchased i.e. specification, its approximate cost, quantity, last date for receipt of sealed tenders, cost of tender from and the earnest money to be deposited along with tender document.

Tender notification to be published in newspaper.

(Sample of tender notice is given for reference)

MATERIAL MANAGEMENT CELL

Name of Company----------

Tender No. ----------

Date:

BID / TENDER NOTICE

The Chief Engineer, Material Management Cell (MMC), on behalf of (Name of company of purchaser), hereby invites sealed bids from New Vendors for procurement of 11KV, 22 KV/0.433 KV, 10 KVA, 16 KVA & 25 KVA Three Phase Distribution Transformers with Energy Efficiency Level II as per IS 1180:2014 under HVDS. Entire bidding document is available online on http://www.(Company website) Tender/ e-tender as per date indicated below. Any changes in the

Bid Schedule, corrigendum etc. shall also be notified via Company website. Prospective bidders are therefore requested to regularly check the website for any updates.

Tender No. ----------

Estimated Tender Cost: Rs. 175.00 Crores

Tender Fee: Rs 25,000.00 + 18% GST

The bidder should submit non-refundable Bid Fee of Rs 25,000.00 + 18% GST paid through online payment only, prior to the dead line for submission of bids as per the procedure led by the (Company Name). Earnest Money Deposit: The bid must be accompanied with EMD @ 0.5% of estimated tender cost for an amount equal to Indian Rs. 87.00 Lakhs (Rs. Eighty Seven Lakhs only). The EMD shall be denominated in Indian Rupees only. The EMD can be paid online or should be submitted in original in the form of a Demand Draft or an Unconditional Bank Guarantee from any Nationalized / Scheduled Bank in favor of the (Company name) payable as mentioned in details in Tender Document (Section-I). The scanned copy of the online payment receipt / Demand Drafts / BG should be uploaded (in e tendering) and the Demand Drafts should be submitted to this office on or before submission date and time.

Calendar of Events Event Begin	**Date and Time**
Begin Sale of Bid Document	28.05.2018
Date and time of submission of Bids	02.07.2018 up to 15.00 hrs
Date and time of Bid Opening	02.07.2018 at 16.00 hrs

Brief Scope of Work:

Procurement of 11 & 22 KV/0.433 KV, 10 kVA, 16 kVA, & 25 kVA, three phase Distribution Transformers with energy efficiency Level II as per IS 1180:2014 for the paid pending agriculture consumers under High Voltage Distribution System (HVDS) Scheme.

The quantity for procurement is as below.

11KV/0.433 KV, 10 KVA – 27,320 nos.

11KV/0.433 KV, 16 KVA – 8,900 Nos.

11KV/0.433 KV, 25 KVA – 760 Nos.

22KV/0.433 KV, 10 KVA – 1,680 Nos.

22KV/0.433 KV, 16 KVA – 100 Nos.

22KV/0.433 KV, 25 KVA – 40 Nos.

The actual quantity of the transformers that will be procured may vary depending upon the site requirement. The quantity mentioned as above against various capacities can undergo change. However, the minimum assured quantity for procurement shall be 50% of the total tendered quantity as mentioned above. The list of various destination sites / stores Centers of the Purchaser is enclosed as Annexure K.

Qualifying Requirements:

1. The bidder shall be an Original Equipment Manufacturer (OEM) of distribution transformer and possess valid BIS license.

2. The bidder should have in-house testing facilities for conducting acceptance tests in accordance with the procedures laid down in IS: 2026/1977 amended up to date.

THE CHIEF ENGINEER
(Name and Complete address of company)

VII Required Resources/apparatus/equipment with specification

Sr. No	Name of Resources	Suggested Plan	Quantity
1	Newspaper/Online/ Electrical Contractor	Prepare quotation with consultation with electrical contractor for tender	1
2	Computer with required specifications.	To use GeM portal To type the tender document	1
3	Laser jet multifunction printer	To take the prints	1

VIII Precautions to be followed

1. Follow safety rules/ norms pertaining to all electrical installation.
2. Follow IE rules and regulations pertaining to all electrical installation.
3. Follow standard format while preparing tender.
4. Carry out market survey on the requirement of equipements mention in the tender while preparing quotation.

IX Procedure

Note: Use GeM portal for searching of software, tools/equipment for procurement.

1. Prepare tender document for purchase of electrical machines costing more than five lakhs as suggested/ provided by staff member in standard format.
2. Specify all the terms and conditions in the tender notice as per the installation work.

(Use blank sheet to prepare Tender Document)

X Result

……

……

……

XI Interpretation of result

……

……

……

XII Conclusion

……

……

……

XIII Practical related questions (Note: - Teacher should provide various questions related to practical-sample given)

1. What is the difference between a tender and quotation?
2. What is EMD?

……

……

……

……

……

……

……

……

XIV References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://gem.gov.in/

XV Suggested Assessment Scheme

Performance Indicators		Weightage
1	Collection of standard formats of Tender document	20
2	Selection of work execution for Tender document	20
3	Preparation of Tender document	25
4	Practices of following ethics	15
5	Answer to sample questions	10
6	Submitting the journal in times	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Preparation & Making (15)	**Understanding (10)**	**Total (25)**	

Practical No.5: Design an electrical installation system for one BHK domestic unit and carry out an estimation.

I Practical Significance

Every diploma electrical engineer must have to know the necessary material and the cost to be incurred on it before starting the installation. Students gains the knowledge of drawing of the work, complete details of the necessary material with its costing and the sequence of operation to be performed.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of domestic and commercial electrical installations.

IV Laboratory Learning Outcome(s)

LLO 5.1 Calculate total load for given domestic installation.

LLO 5.2 Draw electrical installation plan from given civil engineering drawing.

LLO 5.3 Calculate number of subcircuits, ratings of main switch and distribution board.

LLO 5.4 Draw single line diagram of distribution board for given installation.

LLO 5.5 Carry out estimation for above given domestic installation.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

- Meaning and purpose of symbols used to represent electrical equipment in given electrical installation system.
- Application and need of electrical accessories and protective devices based on type of installation.
- Determining the Size/Rating of distribution board, wires and protective equipment.
- IE rules pertaining to electrical installation.

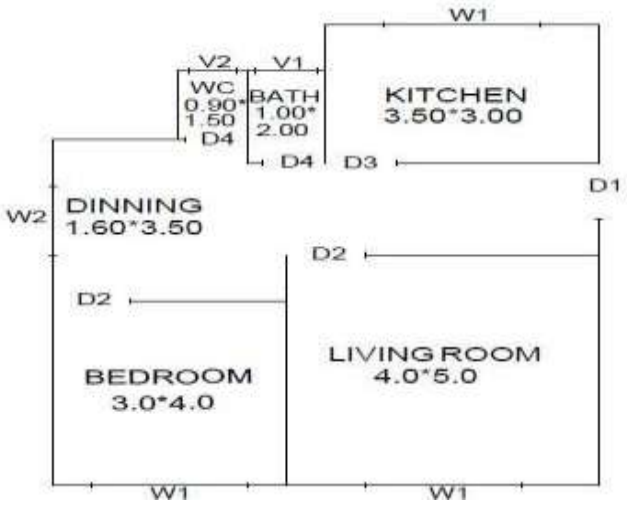
VII Plan layout/ Wiring diagram /Work Situation

a. Civil Engineering drawing for 1 BHK domestic unit.

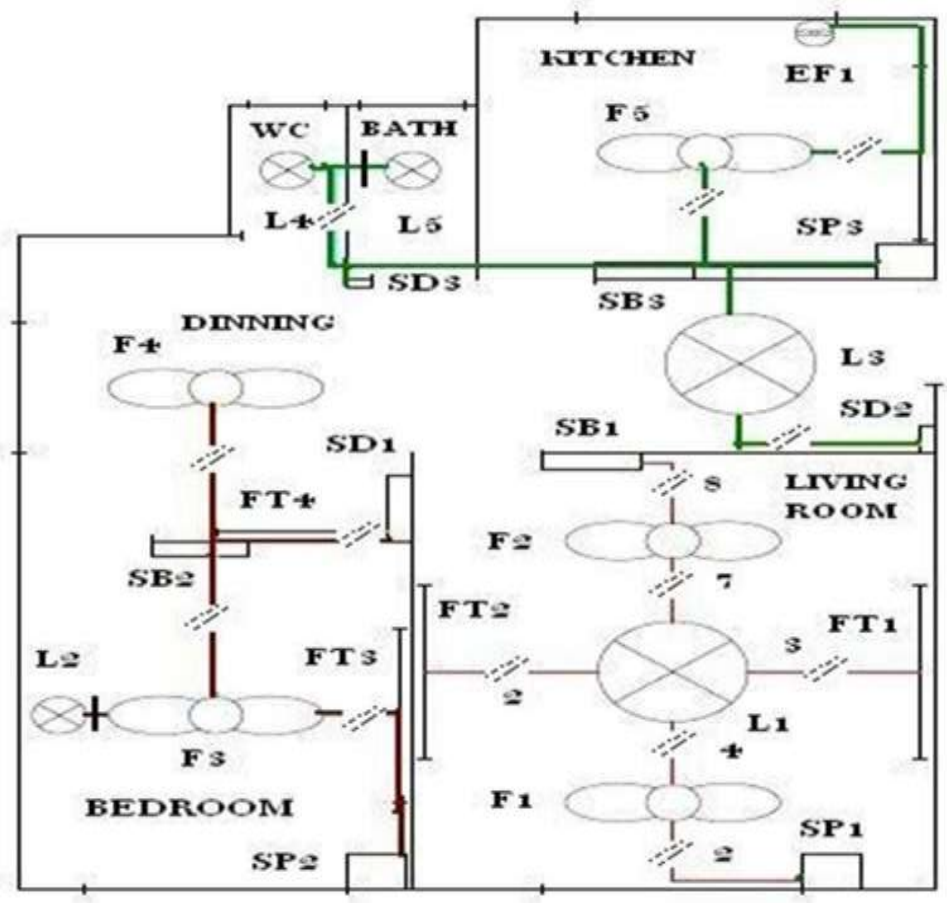
D1, D2, D3 and D4: Doors of similar dimensions.

• W1 and W2: Windows of similar dimensions.

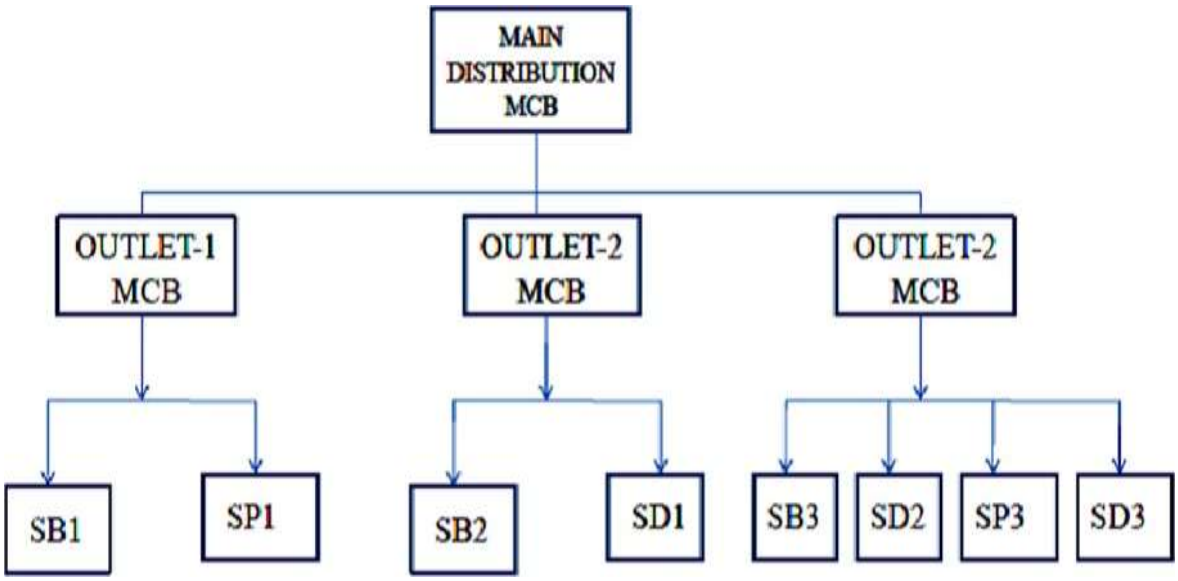
• V1, V2: Ventilation openings/ window



b. Labeled drawing representing location of electrical installation components, sub-distribution board by standard electrical symbol in civil engineering drawing.



c. Single line diagram representing distribution board and sub-circuit for the provided 1 BHK domestic unit.



Step by step procedure of Estimation and costing of residential installation

1. Find out the total electrical load for the given residential installation.
2. Differentiate this total electrical load in lighting load and power load.
3. Make the no. of lighting sub circuit for lighting load.
   No of Lighting Sub circuits= Total Electrical lighting load/ 800W OR
   Total No of lighting point= No of Lighting Sub circuits /10
4. Make the no. of power sub circuits for power load.
   No of power Sub circuits= Total electrical power load/1000 or 2000 W
5. Find out total power consumption of every lighting and power sub circuits.
6. Find out rated Input current for every lighting and power sub circuit.
   $P = VI \cos\phi$
   P = Input power for every sub circuit
   V = voltage = 230 V
   I = Input current for every sub circuit
7. Determine the size of wire required for every sub circuit by considering starting surge and future expansion.
8. Draw the single line diagram.
9. Mark the batten on plan layout.
10. Find out the total length of conduit /casing capping required for every sub circuit and whole residential installation.
11. Find out the total length and size of wire required for every sub circuit.

12. List out the material required for whole residential installation.
13. Find out cost of material and labour in estimation chart.
14. Find out the total cost of estimation with profit margin and contingencies charges.
15. Find out per point charges.
16. Draw the circuit diagram.

VIII Required Resources/apparatus/equipment with specification

Sr. No	Name of Resources	Provided/Suggested to opt for the Plan	Quantity
1	Civil Consultant /Contractor / Plan of your own flat	Plan of one BHK flat	1

IX Precautions to be followed

1. Use standard electrical symbols as per IE rule to represent the electrical installation accordingly.
2. Segregate wiring installation with proper suitable colour based on distribution outlets.
3. Clearly specify the position/location/spacing of points and distribution board with proper labelling /numbering.
4. Segregate power and lighting installation with separate colour/notation/markings.

X Procedure

Note: The staff member has to provide/ suggest civil plan of one BHK with electrical points. (A sample plan of one BHK is given above for reference).

1. Draw electrical installation plan of one BHK from given civil engineering drawing.
2. Calculate total load for given domestic installation.
3. Calculate number of subcircuits, ratings of main switch and distribution board.
4. Draw single line diagram of distribution board for given installation.
5. Carry out estimation for given one BHK installation.

XI Assumption and Calculations (Use blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of Result

……

……

……

XIV Conclusion

……

……

……

XV Practical related questions (Note: - Teacher should provide various questions related to practical-sample given)

1. Write IE rule pertaining to domestic installation system.
2. Describe the procedure for selecting the size /rating of wire and MCB.

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://www.electricaltechnology.org/2013/09/electrical-wiring.html
4. https://ask-the-electrician.com/wiringdiagrams.html

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	Calculation of total load	20
2	Draw electrical installation plan	10
3	Calculation of number of sub circuits, ratings of main switch and distribution board.	20
4	Single line diagram of distribution board for given installation.	15
5	Estimation for given domestic installation.	20
6	Answer to question	10
7	Submitting the journal in times	5
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing & Design (15)	**Understanding (10)**	**Total (25)**	

Practical No.6: Domestic installation drawing using suitable software (mentioned in Practical No. 5)

I Practical Significance

Every diploma electrical engineer must have the knowledge of electrical drawing software for making the drawing of various electrical installations and identify the symbolic representation of appliances/ equipment, distribution board and their position / location as per IE rules.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of domestic and commercial electrical installations.

IV Laboratory Learning Outcome(s)

LLO 6.1 Draw electrical installation plan from given civil engineering drawing using suitable drawing software.

LLO 6.2 Draw single line diagram of distribution board for given installation using suitable drawing software.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

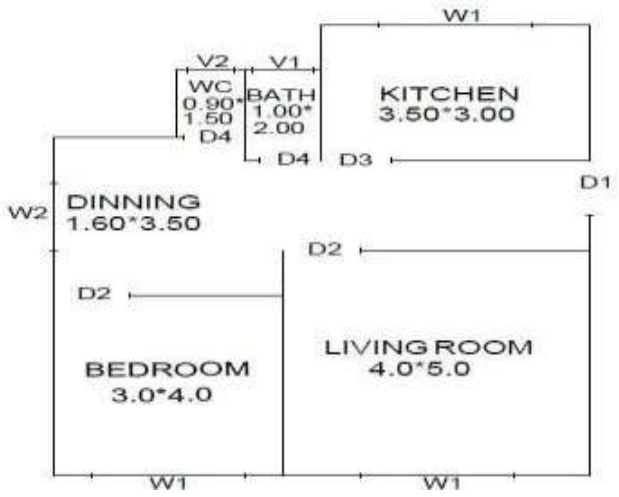
VI Relevant Theoretical Background

Plan layout/ Wiring diagram /Work Situation

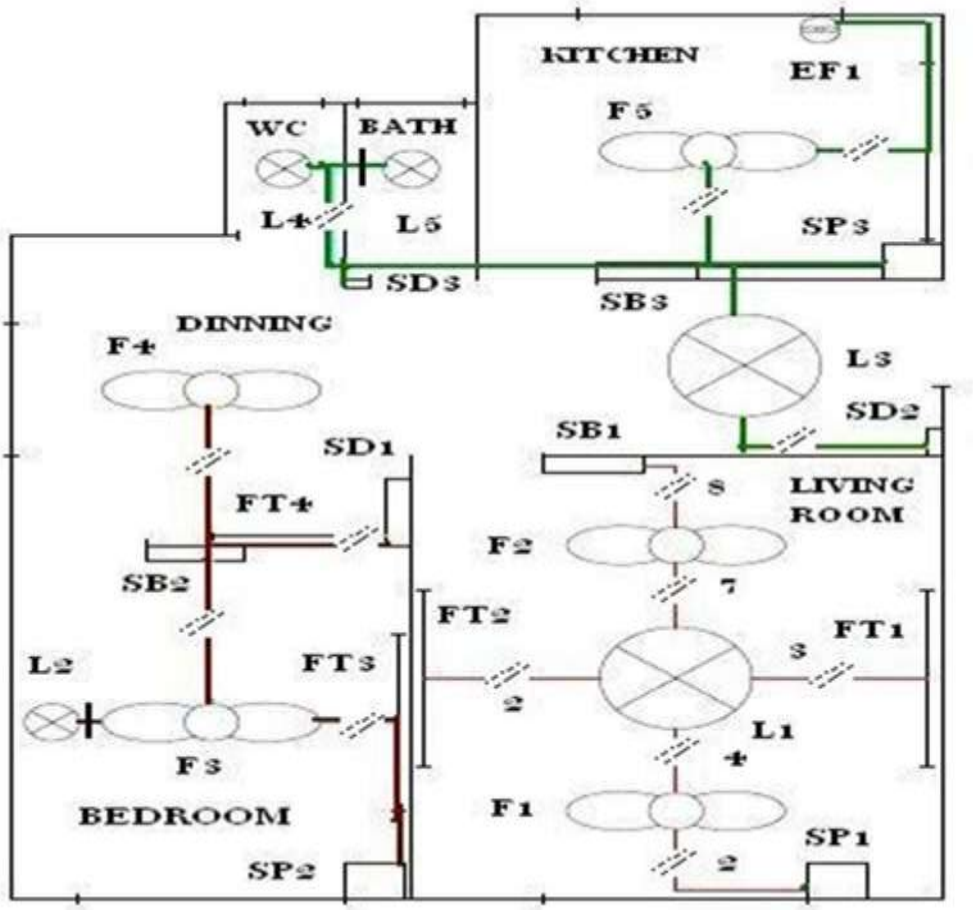
a. Civil Engineering drawing for 1 BHK domestic unit.

D1, D2, D3 and D4: Doors of similar dimensions.

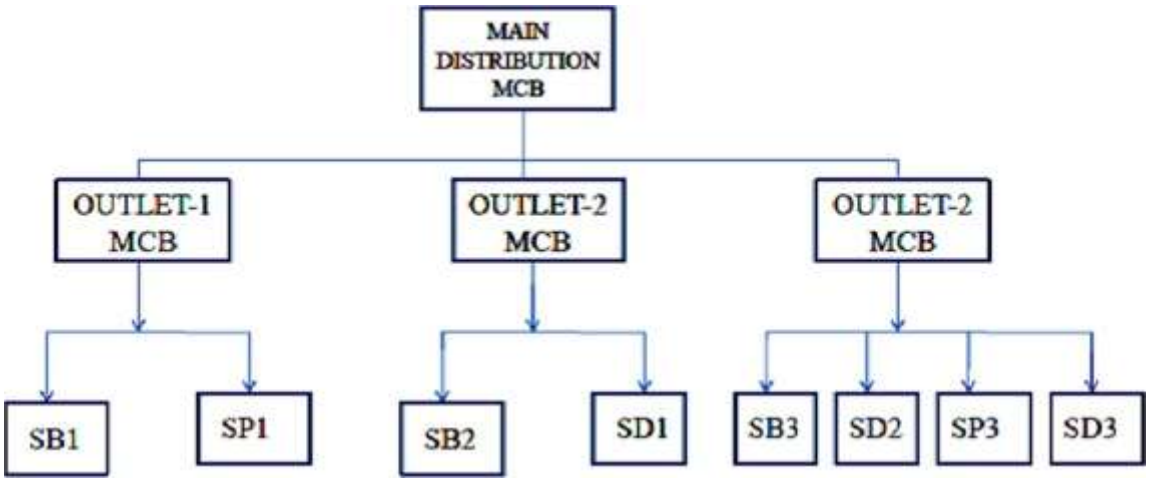
- W1 and W2: Windows of similar dimensions.
- V1, V2: Ventilation openings/ window



b. Labeled drawing representing location of electrical installation components, sub-distribution board by standard electrical symbol in civil engineering drawing.



c. Single line diagram representing distribution board and sub-circuit for the provided 1 BHK domestic unit.



VII Required Resources/apparatus/equipment with specification

Sr. No	Name of Resources	Provided/Suggested to opt for the Plan	Quantity
1	Civil Consultant /Contractor / Plan of your own flat	Plan of one BHK flat(Same as Practical No-5)	1
2	All in One Computer with open - source drawing software	To draw installation drawing	--
3	Laser jet multifunction printer	--	--

VIII Precautions to be followed

1. Use standard electrical symbols as per IE rule to represent the electrical installation accordingly.
2. Segregate wiring installation with proper suitable colour based on distribution outlets.
3. Clearly specify the position/location/spacing of points and distribution board with proper labelling /numbering.
4. Segregate power and lighting installation with separate colour/notation/markings.
5.

IX Procedure

Note: The staff member has to provide/ suggest civil plan of one BHK as given for Practical No.5

1. Refer one BHK plan used in practical No-5.
2. Draw electrical installation plan from given civil engineering drawing using suitable drawing software.
3. Draw single line diagram of distribution board for given installation using suitable drawing software.
4. Mention the title of drawing and software used for drawing while printing the drawing.

X Drawing using suitable drawing software

a. Paste electrical installation plan from given civil engineering drawing using suitable drawing software.

b. Paste single line diagram of distribution board for given installation using suitable drawing software.

XI Result(s)

……

……

……

XII Interpretation and assumption

……

……

……..…..

XIII Conclusion

……

……

……

XIV Practical related questions (Note: - Teacher should provide various questions related to practical-sample given)

1. What is IEC standard? Why it is important?
2. Write the significance of electrical symbols in electrical drawing.

XV References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://www.electricaltechnology.org/2013/09/electrical-wiring.html
4. https://ask-the-electrician.com/wiringdiagrams.html

XVI Suggested Assessment Scheme

Performance Indicators		Weightage
1	Selection of proper software for drawing	20
2	Drawing of electrical installation plan	30
3	Single line diagram of distribution board using software	30
4	Answer to sample questions	10
5	Submission of report in time	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing Skill (15)	**Understanding (10)**	**Total (25)**	

Practical No. 7: Design an electrical installation system for a commercial unit and carry out estimation.

I Practical Significance

Every diploma electrical engineer must have the knowledge of drawing the installation plan and wiring diagram and prepare an Estimate of Commercial electrical installations and identify the symbolic representation of appliances/equipment, distribution board and their position / location as per IE rules. The safety norms must be known while carrying out installation in electrical system.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of domestic and commercial electrical installations.

IV Laboratory Learning Outcome(s)

LLO 7.1 Calculate total load for given commercial installation.
LLO 7.2 Draw electrical installation plan from given civil engineering drawing.
LLO 7.3 Calculate number of sub circuits, ratings of main switch and distribution board.
LLO 7.4 Draw single line diagram of distribution board for given installation.
LLO 7.5 Carry out estimation for above given commercial installation.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for Industrial Installation.

VI Relevant Theoretical Background

Steps to be followed for Commercial Installation

- Find out the type of load and total electrical load for the given commercial installation.
- Differentiate this total electrical load in lighting load and power load.
- Make the no. of lighting sub circuit for lighting load.

$$No\ of\ Lighting\ Sub\ circuits = \frac{Total\ Electrical\ Lighting\ Load}{800W}$$

OR

$$No\ of\ Lighting\ Sub\ circuits = \frac{Total\ No.\ of\ Lighting\ points}{10}$$

- Make the no. of power sub circuit for power load.

$$No\ of\ Power\ Sub\ circuits = \frac{Total\ Electrical\ Power\ Load}{1000W\ or\ 2000W}$$

OR

$$No\ of\ Power\ Sub\ circuits = \frac{Total\ No.\ of\ Power\ points}{2}$$

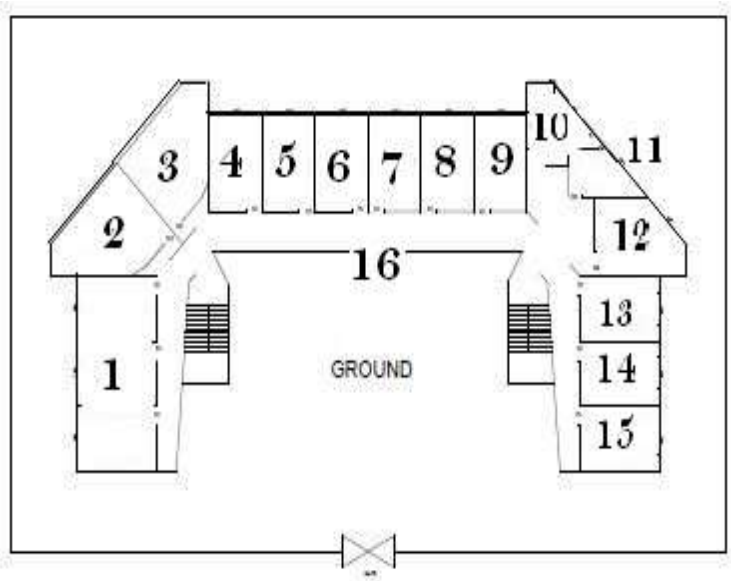
- Find out total power consumption of every lighting and power sub circuits.
- Find out rated Input current for every lighting and power sub circuit.

P = V1 cosΦ
P = Input power for every sub circuit
V = voltage = 230 V
I = Input current for every sub circuit

- Determine the size of wire required for every sub circuit by considering overload starting surge and future expansion.
- Draw the single line diagram.
- Draw installation plan showing location of electrical points, switch board, main board, energy meter, distribution board etc.
- Find out the total length of conduit required for every sub circuit and whole commercial installation.
- Find out the total length and size of wire required for every sub circuit.
- List out the material required for whole commercial installation.
- Find out cost of material and labour in estimation chart.
- Find out the total cost of estimation with profit margin and contingencies charges.
- Find out per point charges.
- Draw the circuit diagram.

VII Plan Layout/ Wiring Diagram/ Work Situation

a. Draw the installation plan of small commercial unit, representing location of installation components, wiring/ conduit route diagram joining the equipments with respective distribution board through shortest route.
b. Draw single line diagram of electrical installation for any one of the switch board.
c. Plan of Primary School:



NOTATION USED:

1	**Library**
2,3	**Lavatory**
4 to9	**Classroom**
10	**Staffroom**
11	**Principal Cabin**
12	**Office**
13,14,15	**Laboratory**
16	**Verandah**

Note: The staff member has to provide/ suggest to opt any commercial unit to group of students. (A sample plan of School is given for reference).

d. Draw labelled drawing representing location of installation components for the provided/ suggested to opt for the small commercial unit. (Use blank sheet if space is not sufficient)

e. Draw single line diagram of distribution board for given commercial installation. (Use blank sheet if space is not sufficient)

VIII Required Resources/apparatus/equipment with specification:

Sr. No.	Name of Resource	Specification	Remark
1	Civil consultant / Contractor/ Plan of any Small factory/ Cottage Industrial unit	Plan of Small Commercial Unit	1

IX Precautions to be followed:

1. Use standard symbols as per IE rule to represent the electrical installation accordingly.
2. Segregate wiring installation with proper colour based on distribution outlets.
3. Clearly specify the position/location of points and distribution board with proper labeling.
4. Segregate power and lighting installation with separate colour.
5. Use ferrules to label the terminals of the cable/ wire.
6. Follows safety rule/ norms pertaining to industrial installation.

X Procedure

1. Collect the plan and requirement of electrical points/ load from the client/contractor/ civil consultant.
2. Draw the Installation plan clearly indicating the position of door, windows, entrance, emergency exit and refuge area.
3. Draw the appliances and distribution board, power points and light point and emergency backup circuit by representing with symbols and colour coding/labeling.
4. Draw conduit route to join all the points with respective main distribution and sub distribution board with shortest accessible route.
5. Find out the total length of conduit, total length of wire required for every sub circuit and whole commercial installation.
6. List out the material required for whole commercial installation.
7. Find out cost of material and labour in estimation chart with profit margin and contingencies charges.

XI Assumption and Calculations (Made while determining/ deciding the size/rating of wire, conduit and RCCB/ MCCB/ MCB) (should be as per IE rules and regulations)

(Use blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of result

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Determine size and rating of wire, MCCB and RCCB.
2. Write IE rule pertaining to commercial installation system.
3. Describe the procedure to determine the size of backup or emergency supply.
4. Differentiate between electrical power duct and L.V duct.

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://ask-the-electrician.com/wiringdiagrams.html
4. https://www.btechguru.com/courses--nptel--electrical-engineering-video-lecture--ee.ht..
5. https://www.electricaltechnology.org/2013/09/electrical-wiring.htm
6. https://www.howstuffworks.com/search.php?terms=electrical%20installation

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	Calculation of total load	20
2	Draw electrical installation plan	10
3	Calculation of number of sub circuits, ratings of main switch and distribution board.	20
4	Single line diagram of distribution board for given installation.	15
5	Estimation for given domestic installation.	20
6	Answer to question	10
7	Submitting the journal in times	5
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing & Design (15)	**Understanding (10)**	**Total (25)**	

Practical No. 8: Commercial installation drawing using suitable software (mentioned in Practical No.7)

I Practical Significance

Every diploma electrical engineer must have the knowledge of drawing the installation plan and wiring diagram using a suitable drawing software and prepare an Estimate of Commercial electrical installations and identify the symbolic representation of appliances/equipment, distribution board and their position / location as per IE rules. The safety norms must be known while carrying out installation in electrical system.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of domestic and commercial electrical installations.

IV Laboratory Learning Outcome(s)

LLO 8.1 Draw electrical installation plan from given civil engineering drawing using suitable drawing software.

LLO 8.2 Draw single line diagram of distribution board for given installation using suitable drawing software.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for Commercial Installation.

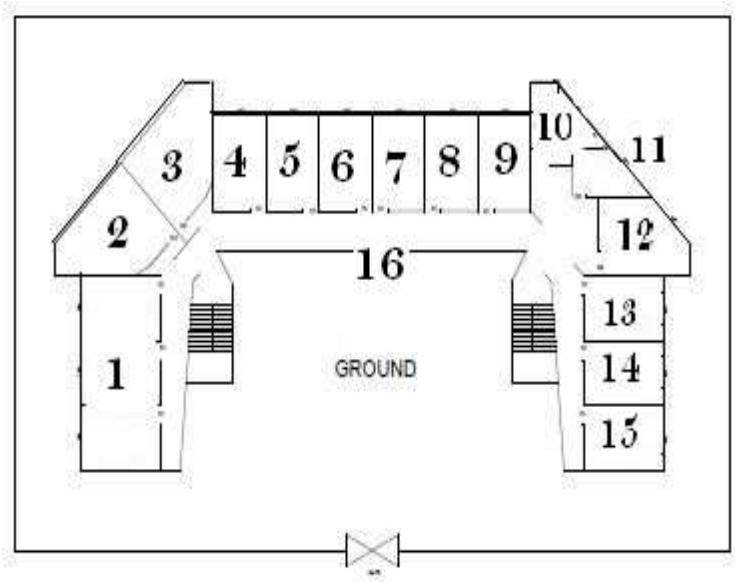
VI Relevant Theoretical Background

- Meaning and purpose of symbols used to represent electrical equipment in given electrical installation system.
- Application and need of electrical accessories and protective devices based on type of installation.
- Determining the Size/Rating of distribution board, wires and protective equipment.
- IE rules pertaining to all type of electrical installation.
- Knowledge of suitable drawing software.

VII Plan Layout/ Wiring Diagram/ Work Situation

a. Paste the installation plan of small commercial unit, drawn by suitable drawing software.
b. Paste the single line diagram of electrical installation for any one of the switch board drawn by a suitable drawing software.

c. Plan of Primary School:



NOTATION USED:

1	**Library**
2,3	**Lavatory**
4 to9	**Classroom**
10	**Staffroom**
11	**Principal Cabin**
12	**Office**
13,14,15	**Laboratory**
16	**Verandah**

Note: The staff member has to provide/ suggest to opt any commercial unit to group of students. (A sample plan of School is given for reference).

d. Draw labelled drawing representing location of installation components for the provided/ suggested to opt for the small commercial unit using software.

e. Draw single line diagram of distribution board for given commercial installation using software.

VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource	Specification	Remark
1	Civil consultant / Contractor/ Plan of any Small factory/ Cottage Industrial unit	Plan of Small Commercial Unit	1
2	Any Suitable Drawing Software	---	--

IX Precautions to be followed

1. Use standard symbols as per IE rule to represent the electrical installation accordingly.
2. Segregate wiring installation with proper colour based on distribution outlets.
3. Clearly specify the position/location of points and distribution board with proper labeling.
4. Segregate power and lighting installation with separate colour.
5. Use ferrules to label the terminals of the cable/ wire.
6. Follows safety rule/ norms pertaining to industrial installation.

X Procedure

1. Collect the plan and requirement of electrical points from the client/ contractor/civil consultant.
2. Draw the stated / collected plan in software, clearly indicating the position of door, windows, entrance, emergency exit, refuge area etc.
3. Draw the appliances, distribution board, power points, light point and emergency backup circuit components by representing with symbols and colour coding/proper labeling.
4. Draw conduit route to join all the points with respective main distribution and sub distribution board with shortest accessible route.
5. Mark the number of conductors in respective conduit.
6. Draw single line diagram of distribution board for given installation using suitable drawing software.

XI Result

……

……

……

XII Interpretation of result

……

……

……

XIII Conclusion and recommendation

……

……

……

XIV Practical related questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Compare Residential and Commercial Electrical Installation.
2. Write the significance of electrical symbols specifically used in commercial installation drawing.

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XV References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://ask-the-electrician.com/wiringdiagrams.html
4. https://www.electricaltechnology.org/2013/09/electrical-wiring.htm
5. https://www.howstuffworks.com/search.php?terms=electrical%20installation
6. https://www.electrical4u.com/electrical-engineering-articles/utilities/
7. http://www.neca-neis.org/the-standards

XVI Suggested Assessment Scheme

Performance Indicators		Weightage
1	Selection of proper software for drawing	20
2	Drawing of electrical installation plan	30
3	Single line diagram of distribution board using software	30
4	Answer to sample questions	10
5	Submission of report in time	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing Skill (15)	**Understanding (10)**	**Total (25)**	

Practical No. 9: Design an electrical installation system for small industrial installation and carry out an estimation.

I Practical Significance

Every diploma electrical engineer must have the knowledge of drawing the installation plan and wiring diagram and prepare an Estimate of Small factory/ Industrial electrical installations and identify the symbolic representation of appliances/equipment, starter, main and sub- distribution board and their position / location as per IE rules. The safety norms and PPE's to be known while carrying out installation work in industrial electrical system.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of industrial electrical installations.

IV Laboratory Learning Outcome(s)

LLO 9.1 Calculate total load for given industrial installation.
LLO 9.2 Draw electrical installation plan from given civil engineering drawing.
LLO 9.3 Calculate size of cable, ratings of main switch and distribution board.
LLO 9.4 Draw single line diagram of distribution board for given installation.
LLO 9.5 Carry out estimation for above given industrial installation.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for Industrial Installation.

VI Relevant Theoretical Background

While Preparing Estimate of industrial Installation following steps are to be followed.

- Find out output power of every machine in watts.

  1 HP = 735.5 w

  1 BHP = 746 w

  1 KVA = 1000 VA. Assume P.f.

- Find out Input power of every machine by assuming the efficiency of every machine.

$$\text{Input Power of Machine} = \frac{\text{Input Power of Machine}}{\text{Efficiency of Machine}}$$

- Find out Input current of every machine for 1-ph machine.

  Input power = V I cos Φ

  Where, V = Input voltage = 230V, Cos Φ = P.f., I = Input current

  If the machine is 3-ph

  Input power = $\sqrt{3}\ V_L\ I_L \cos \Phi$

Where, V_L = Line voltage = 400V, I_L = Line current or Input current, Cos Φ = P.f.

- Find out size and core of cable required for every machine. size of cable is decided by starting current. Which is assumed two times Input current to sustain starting surge, overload momentary short circuit and future expansion.
- Determine size of conduit pipe required for the wiring. The size of conduit pipe selected should be of sufficient diameter, so the cables can be pulled in the conduit conveniently.
- Determine the rating of main switch/MCB. The main switch/MCB for power wiring in the industrial unit is decided on the bases of total current required in the industrial unit, including starting current of the highest rating motor plus full load current of remaining motors to be controlled from it.
- Determine size and rating of distribution board. The selection of distribution board depends on the number of sub circuits, fed from the distribution board.
- Find out total Electrical load of given factory.
- Determine the Input current required for whole factory.

  $P = \sqrt{3}\ V_L\ I_L \cos Ø$
- Determine the size & core of Input cable required for whole factory. To decide the size of current is assumed two times rated Input current for future expansion, overload starting surge and momentary short circuit.
- List out the material required for factory electrification.
- Make the estimation chart for material and labor also.
- Find out total cost of estimation by assuming contingencies changes and profit margin.

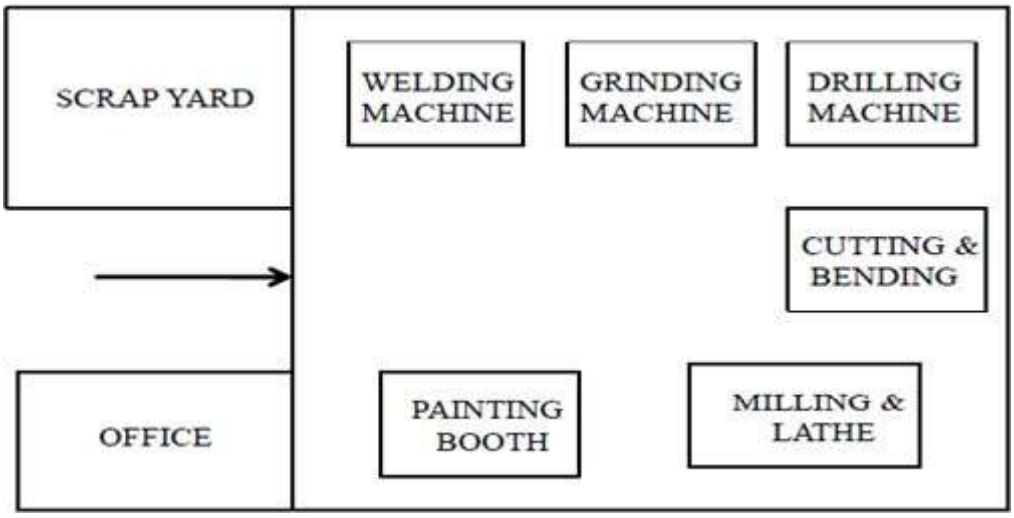
VII Plan Layout/ Wiring Diagram/ Work Situation

a. Draw Installation plan of Small factory/ Industrial unit representing location of installation components, starter and motor by standard electrical symbols.

b. Draw wiring diagram of electrical installation.

NOTE: The staff member has to provide/ suggest to opt a plan of any industrial unit (Ex. Flour mill, Irrigation pump, Tool making workshop Etc.) to respective group.

The sample plan is given below for reference.

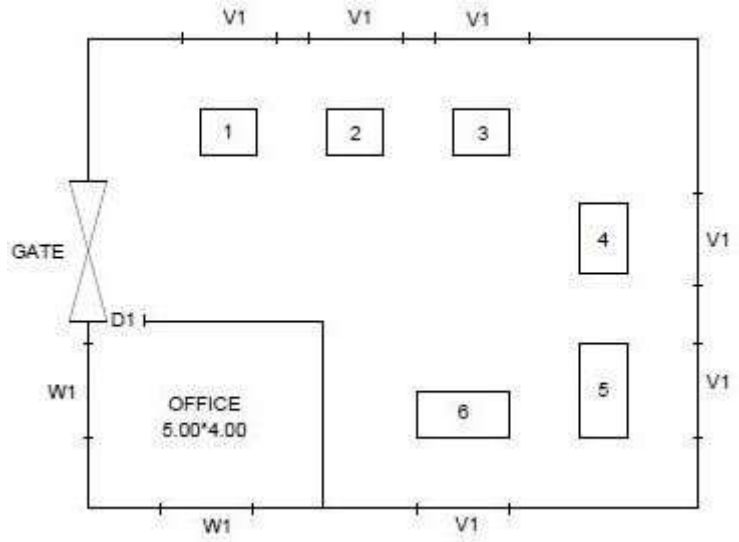


The following are the rating of machines given below, select proper protective equipment, cable and distribution board to carry out the installation. Draw the layout wiring diagram by following IE rules relevant to clearance, safety and maintenance.

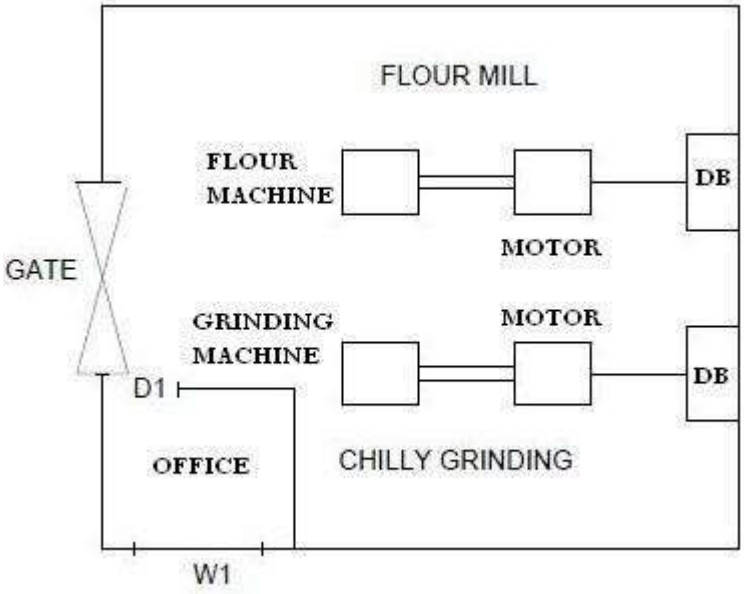
Sr. No.	Name of Machine	Rating
1	Welding Machine	1Ph, 230V, 5KVA
2	Grinding Machine	1Ph, 230V, 2.5HP
3	Drilling Machine	1Ph, 230V, 2HP
4	Cutting and Bending Machine	3Ph, 5HP
5	Milling and Lathe	3Ph, 5HP
6	Painting Booth	1Ph, 1HP

NOTE: The staff member provides and explains the sequence of operation & rating of motor for two plans given.

Plan B: Tool Making Workshop.



Plan C: Flour & Chilly Grinding Mill.



d. Draw labelled drawing representing location of installation components, starter and motor by standard electrical symbols.

e. Draw wiring diagram of electrical installation.

VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource	Specification	Remark
1	Civil consultant / Contractor/ Plan of any Small factory/ Cottage Industrial unit	Plan of Small factory/ Cottage Industrial unit	1

IX Precautions to be followed

1. Use standard symbols as per IE rule to represent the electrical installation accordingly.
2. Segregate wiring installation with proper colour based on distribution outlets.
3. Clearly specify the position/location of points and distribution board with proper labeling.
4. Segregate power and lighting installation with separate colour.
5. Use ferrules to label the terminals of the cable/ wire.
6. The installation of electrical machine must match with sequence of operation and finishing of product.
7. Follows safety rule/ norms pertaining to industrial installation.

X Procedure

1. Collect the plan and requirement of electrical points/ load from the client/contractor/ civil consultant.
2. Draw the Installation plan clearly indicating the position of door, windows, entrance, emergency exit and refuge area.

3. Draw the appliances and distribution board, power points and light point and emergency backup circuit by representing with symbols and colour coding/labeling.
4. Draw conduit route to join all the points with respective main distribution and sub distribution board with shortest accessible route.
5. Calculate Input current and starting current of the motor.
5. Select the size of cable and conduit, rating of MCB, rating of main switch, size of distribution board.
6. List out the material required for factory electrification.
7.Make the estimation chart for material and labor also.
8.Find out total cost of estimation by assuming contingencies changes and profit margin.

XI Assumption and Calculations (Deciding the size/rating of Cable, conduit pipe, MCCB, Distribution board and Protective relay).

(Use blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of result

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Determine rating of starter and relay and suggest its type for the given plan.
2. State the different protective systems used in industrial installation with their specific applications.

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://ask-the-electrician.com/wiringdiagrams.html
4. https://www.btechguru.com/courses--nptel--electrical-engineering-video-lecture--ee.ht..
5. https://www.electricaltechnology.org/2013/09/electrical-wiring.htm
6. https://www.howstuffworks.com/search.php?terms=electrical%20installation
7. https://www.electrical4u.com/electrical-engineering-articles/utilities/
8. http://www.neca-neis.org/the-standards

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	Calculation of total load	20
2	Draw electrical installation plan	10
3	Calculation of number of sub circuits, ratings of main switch and distribution board.	20
4	Single line diagram of distribution board for given installation.	15
5	Estimation for given domestic installation.	20
6	Answer to question	10
7	Submitting the journal in times	5
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing & Design (15)	**Understanding (10)**	**Total (25)**	

Practical No. 10: Commercial installation drawing using suitable software (mentioned in Practical No. 9).

I Practical Significance

Every diploma electrical engineer must have the knowledge of any drawing software for making the drawing of Small factory/ Industrial electrical installations and identify the symbolic representation of appliances/equipment, starter, main and sub- distribution board and their position / location as per IE rules. The safety norms and PPE's to be known while carrying out installation work in industrial electrical system

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of industrial electrical installations.

IV Laboratory Learning Outcome(s)

LLO 10.1 Draw single line diagram of distribution board for given installation using suitable drawing software

V Relevant Affective Domain related outcome(s)

Follow I.E. rules for Industrial Installation.

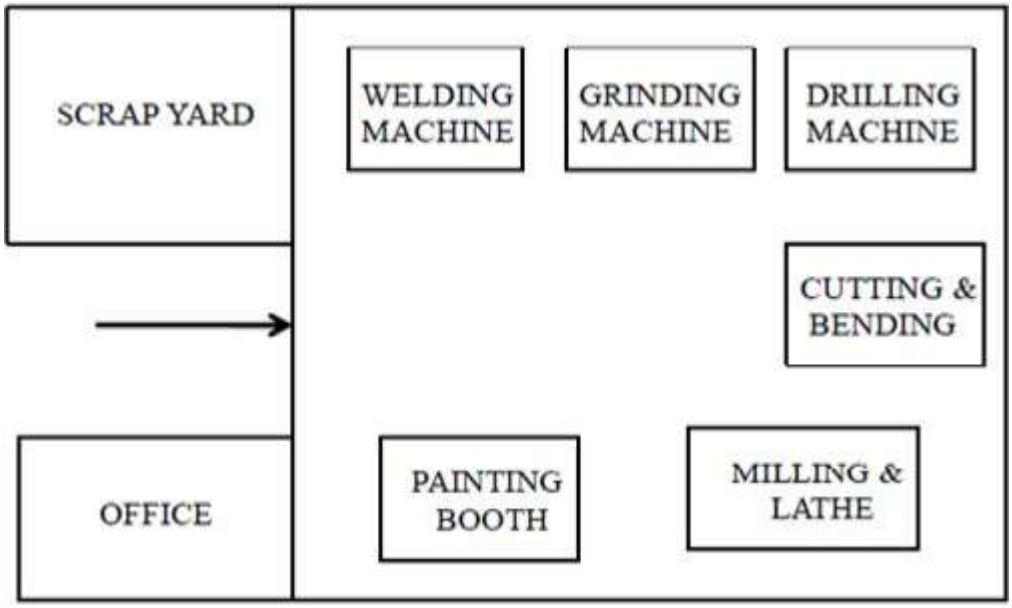
VI Relevant Theoretical Background

- Meaning and purpose of symbols used to represent electrical equipment in given electrical installation system.
- Application and need of electrical accessories and protective devices based on type
- of installation.
- IE rules pertaining to all type of electrical installation.
- Standard Illumination level required for different public lighting scheme.
- Significance and design procedure of public lighting scheme.

VII Paste the provided/ suggested to opt the plan of Small factory/ Industrial unit whose electrical plan has to be drawn by using any open source drawing software.

NOTE: The staff member has to provide/ suggest to opt a plan of any industrial unit (Ex. Flour mill, Irrigation pump, Tool making workshop Etc.) to respective group. The sample plan is given below for reference.

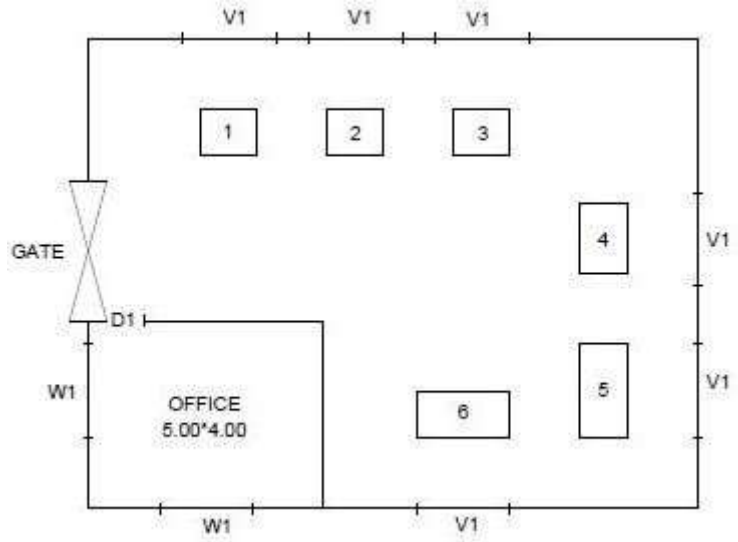
Plan A: Fabrication Workshop



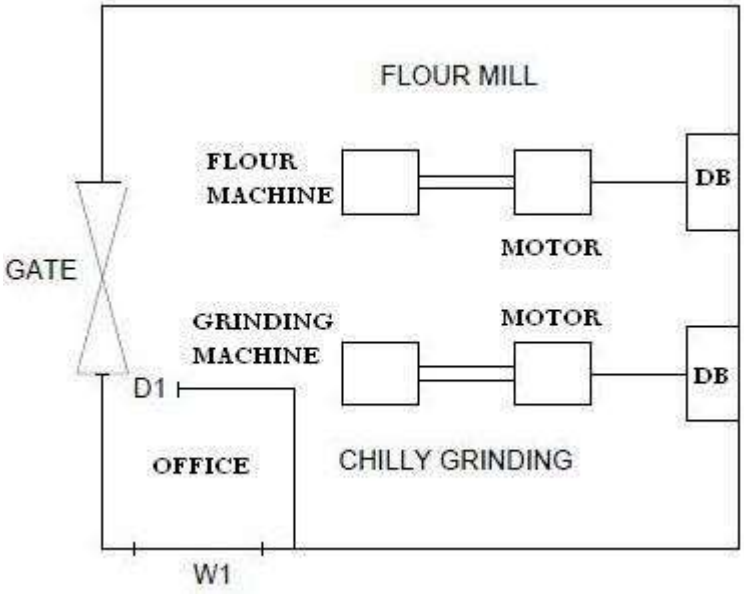
The following are the rating of machines given below, select proper protective equipment, cable and distribution board to carry out the installation. Draw the layout wiring diagram by following IE rules relevant to clearance, safety and maintenance.

Sr. No.	Name of Machine	Rating
1	Welding Machine	1Ph, 230V, 5KVA
2	Grinding Machine	1Ph, 230V, 2.5HP
3	Drilling Machine	1Ph, 230V, 2HP
4	Cutting and Bending Machine	3Ph, 5HP
5	Milling and Lathe	3Ph, 5HP
6	Painting Booth	1Ph, 1HP

Plan B: Tool Making Workshop.



Plan C: Flour & Chilly Grinding Mill.



d. Draw labelled drawing representing location of installation components, starter and motor by standard electrical symbols.

e. Draw single line diagram of distribution board for given installation using suitable drawing software.

VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource	Specification	Remark
1	Textbook/ Any public lighting design journal	Numerical on public lighting scheme	1
2	A suitable Drawing software	---	---

IX Precautions to be followed

1. Use standard symbols as per IE rules to represent the electrical installation accordingly.
2. Segregate wiring installation with proper colour based on distribution outlets.
3. Clearly specify the distance between lamppost, height of the pole, angle of inclination of lamp etc.
4. Follow safety rules/ norms pertaining to public lighting installation.

X Procedure

1. Collect the plan and requirement of electrical points/ load from the client/ contractor/ civil consultant.
2. Draw the plan in auto-cad, clearly indicating the position of door, windows, entrance, emergency exit and refuge area.
3. Draw the appliances and distribution board, power points and light point and emergency backup circuit by representing with symbols and colour coding/labeling.

4. Draw conduit route to join all the points with respective main distribution and sub distribution board with shortest accessible route.
5. Mark the number of conductors in respective conduit.
6. Draw electrical wiring diagram based on step 4 and 5.

XI Result

……

……

……

XII Interpretation of result

……

……

……

XIII Conclusion and recommendation

……

……

……

XIV Practical related questions (Note:- Teacher should provide various questions related to practical-sample given)

1. Write IE rule pertaining to industrial installation system.
2. Differentiate between commercial and industrial installation

……

……

……

……

……

……

……

……

……

……

……

XV References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://ask-the-electrician.com/wiringdiagrams.html
4. https://www.btechguru.com/courses--nptel--electrical-engineering-video-lecture--ee.ht..
5. https://www.electricaltechnology.org/2013/09/electrical-wiring.htm
6. https://www.howstuffworks.com/search.php?terms=electrical%20installation
7. https://www.electrical4u.com/electrical-engineering-articles/utilities/
8. http://www.neca-neis.org/the-standards

XVI Suggested Assessment Scheme

Performance Indicators		Weightage
1	Selection of proper software for drawing	40
2	Drawing of electrical installation plan	20
3	Single line diagram of distribution board using software	20
4	Answer to sample questions	10
5	Submission of report in time	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing Skills (15)	**Understanding (10)**	**Total (25)**	

Practical No. 11: Design an electrical installation system for street lights of small premises and carry out an estimation.

I Practical Significance

Every diploma electrical engineer must have the knowledge about the significance of public lighting scheme. The knowledge of preparing complete Estimation of given public lighting installations by using standard symbol to represent equipment, distribution board etc. and their position / location as per IE rules.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of public lighting installations.

IV Laboratory Learning Outcome(s)

LLO 11.1 Draw a layout diagram for streetlights installation from a given civil engineering drawing.
LLO 11.2 Draw the details of a streetlight pole and layout as per NEC 2023.
LLO 11.3 Select the size of cable by calculating voltage drop.
LLO 11.4 Carry out the estimation for given streetlight installation.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for Public Lighting Installation.

VI Relevant Theoretical Background

The main objective of street lighting are

1. To make the traffic and obstructions on the road clearly visible for safety purpose.
2. To make the street more attractive.
3. To make the community value of the street.

Following are the some of materials required for street lighting Installation for small premises.

1. Light Fixtures: LED street light fixtures that meet the desired coverage and illumination equipment.
2. Poles: Sturdy and corrosion-resistant poles to support the light fixtures at appropriate heights.
3. Electrical Wiring: High-quality electrical wiring and connectors to safely transmit power to the light fixtures.
4. Power Supply: Electrical transformers and distribution panels to provide a reliable power supply to the street lights.
5. Lighting Controls: Smart lighting control systems, including sensors, timers, and programmable controllers, for automated and efficient operation.

6. Mounting Hardware: Brackets, clamps, and other mounting hardware to secure the light fixtures to the poles.
7. Shields and Diffusers: Light shields and diffusers to control light direction, reduce glare, and ensure uniform distribution.
8. Surge Protection Devices: Surge protectors to safeguard the lighting system against power surges and voltage fluctuations.
9. Weatherproof Enclosures: Enclosures to protect electrical components and connections from the elements

VII Plan Layout/ Wiring Diagram/ Work Situation

Note: The staff member required to suggest/ provide different numerical on public lighting scheme

a. Draw a layout diagram for streetlights installation from a given civil engineering drawing.

b. Draw the details of a streetlight pole and layout as per NEC 2023.

(Sample wiring diagram is given for reference)

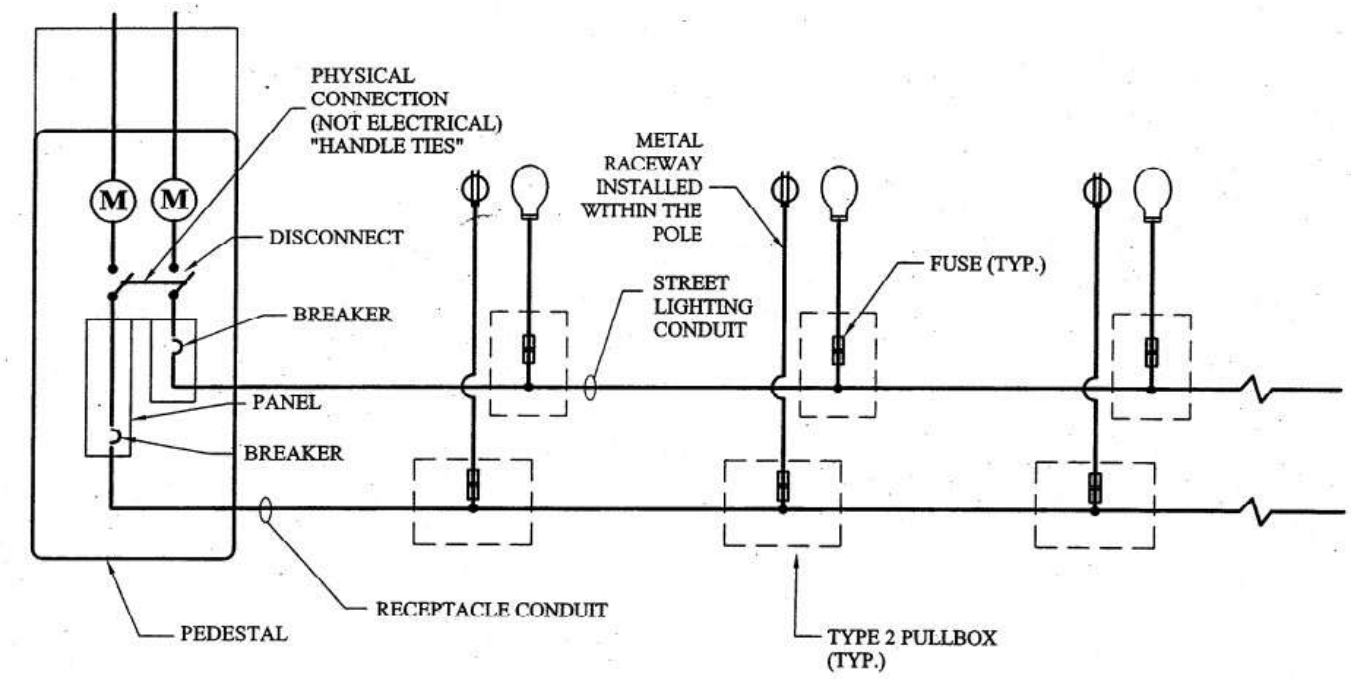


Fig 11.1: Single line diagram of Twinkle street lighting

VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource	Specification	Remark
1	Textbook/ Any public lighting design journal	Numerical on public lighting scheme	1

IX Precautions to be followed

2. Use standard symbols as per IE rules to represent the electrical installation accordingly.
2. Segregate wiring installation with proper colour based on distribution outlets.
3. Clearly specify the distance between lamppost, height of the pole, angle of inclination of lamp etc.
4. Follow safety rules/ norms pertaining to public lighting installation.
5. Follow IE rules and regulations pertaining to public lighting installation.

X Procedure

1. Calculate the number of lampposts required for given road lighting.

2. Follow the sample procedure given below to determine the necessary information to design street lighting.

3. Draw lighting scheme, clearly indicating the span and position of lamppost.

4. Calculate the size of cable required for street lighting.

5. Prepare the complete Estimation table for the given street light installation.

6. Show the position of distribution board.

XI Assumption and Calculations (Spacing between lamppost, height of pole, size of Cable & rating of lamp).

(Use blank sheet if space is not sufficient)

XII Result(s)

……

……

……

XIII Interpretation of results

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions (Note:- Teacher should provide various questions related to practical-sample given)

1. List out the illumination level required for different public lighting scheme.
2. Write IE rule pertaining to above electrical installation system.
3. Differentiate between Flood lighting and Road lighting.
4. Discuss the factors consider while installation of lighting in tunnels.

……

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://www.electrical4u.com/lamps-types-and-performance-comparison/
4. https://www.youtube.com/watch?v=IoMXX6xct1g

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	Layout Diagram for streetlights installation	40
2	Understanding line diagram	20
3	Select the size of cable by calculating voltage drop	20
4	Answer to sample questions	10
5	Submission of report in time	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing & Design (15)	**Understanding (10)**	**Total (25)**	

Practical No. 12: Design an electrical installation system for a low-tension (LT) distribution line (415 volts) and carry out estimation.

I Practical Significance

Every diploma electrical engineer must familiar with requirements of LT equipment, protective accessories, their function, location for drawing electrical installations as per IE rules. The safety norms to be known followed strictly while carrying out installation.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of overhead and underground distribution lines.

IV Laboratory Learning Outcome(s)

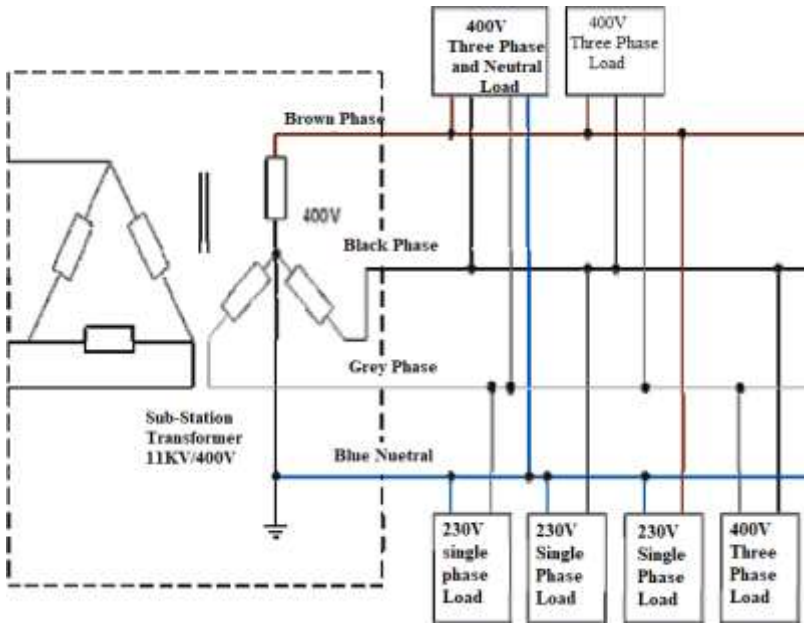
LLO 12.1 Draw layout diagram for low-tension (LT) line from given data.
LLO 12.2 Carry out the estimation for low-tension (LT) line.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for LT distribution Line Installation.

VI Relevant Theoretical Background

LT distribution Line refers to Low Tension or Low Voltage lines. Voltage Level of LT lines is up to 400V to 1kV. The 415 volt, 3 phase 4 wires LT Supply Line Commence from 11/0.4kV Substation to various Load centres. For distribution of electrical energy in Urban and rural areas to homes and small Industries, a 400V LT distribution line is popularly installed. Materials required for LT line are Poles, Cross arms, Insulators, ACSR Conductors, 8 SWG Earth wire, Stay set, Guard Wire, Lightning Arresters etc.

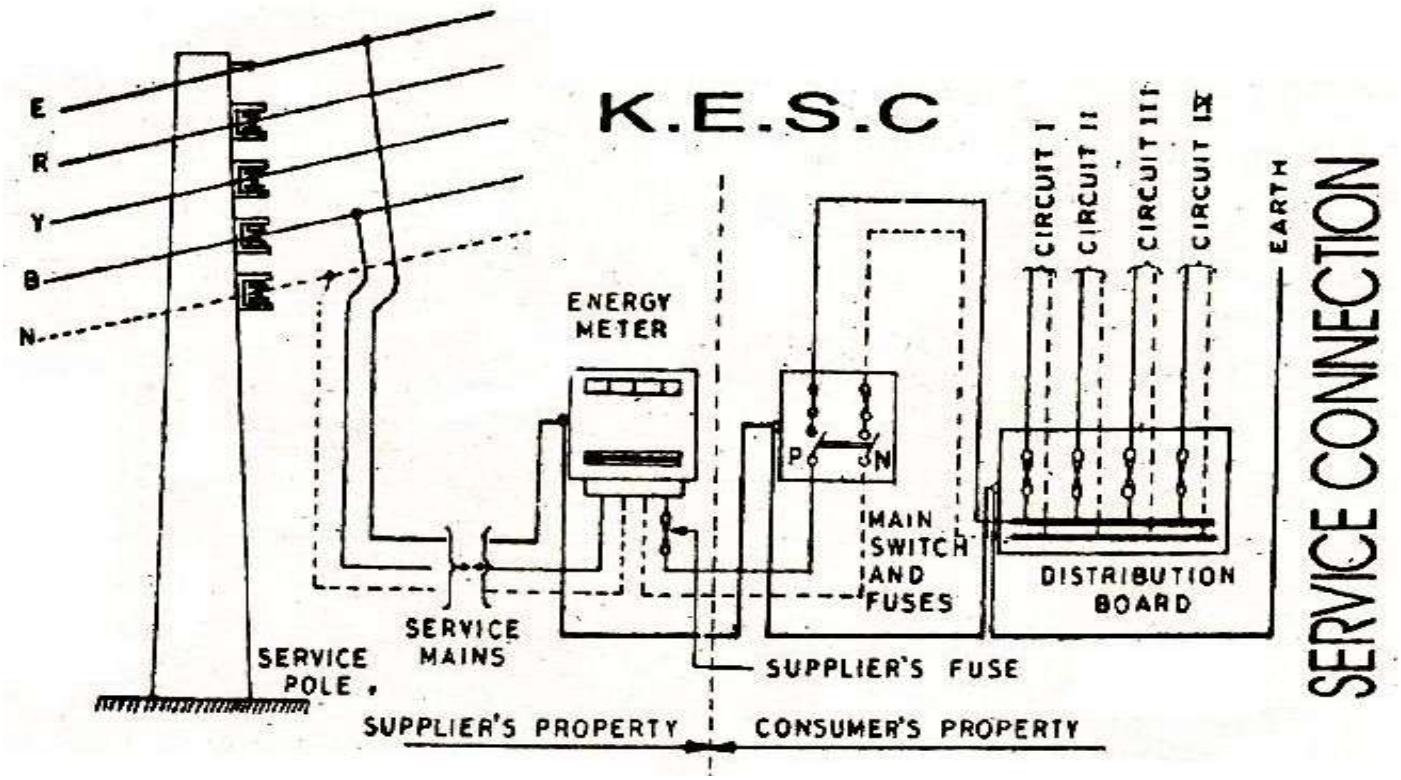


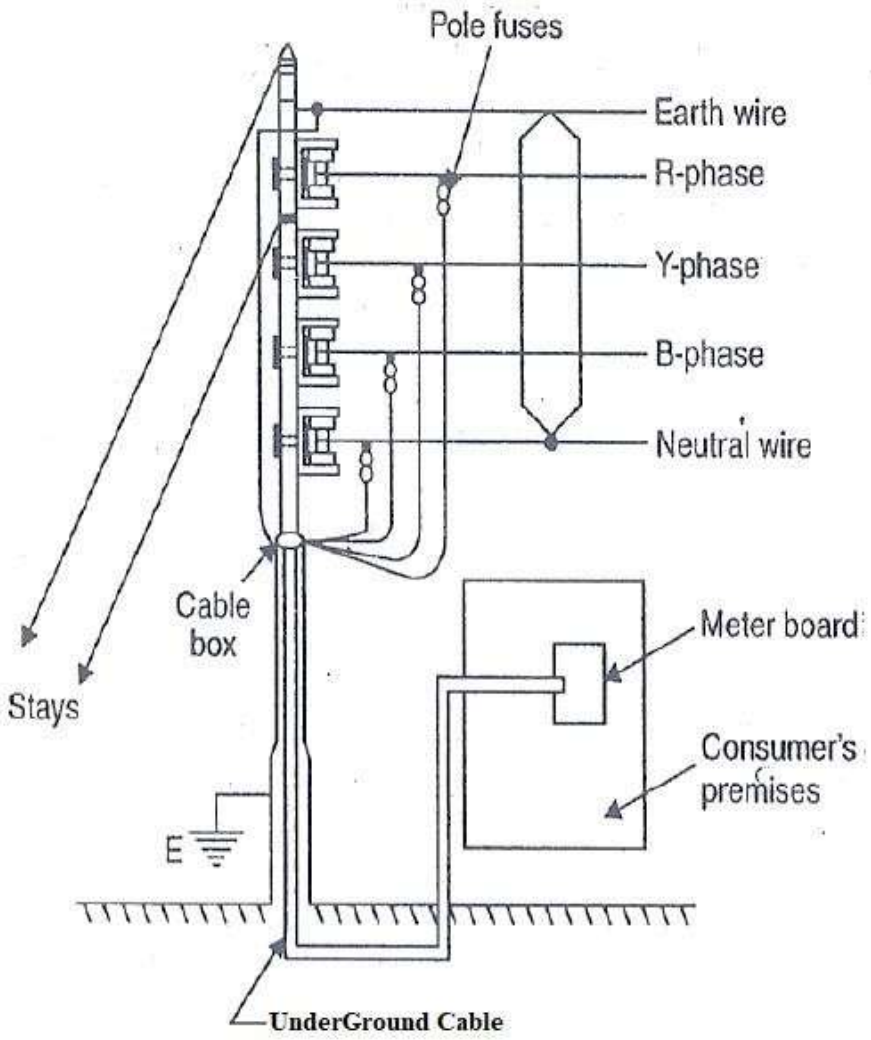
VII Plan Layout/ Wiring Diagram/ Work Situation

NOTE: ***The staff member has to provide/suggest to opt a plan of any LT distribution line to respective group. The sample Wok Situation is given below for reference.***

Estimate the quantity of materials required for erecting an LT distribution line and for giving service connection to the a tubewell owner. A tubewell owner wants 3 phase 4 wire power connection to his 10 BHP motor from an 25kVA, 11kV/0.4kV pole mounted transformer. The pole mounted transformer is 400m away from the tube well.

OR any other Work Situation suggested by subject Teacher


K.E.S.C
E
R
Y
B
N
ENERGY METER
P
N
MAIN SWITCH AND FUSES
CIRCUIT I
CIRCUIT II
CIRCUIT III
CIRCUIT IV
EARTH
DISTRIBUTION BOARD
SERVICE CONNECTION
SERVICE POLE
SERVICE MAINS
SUPPLIER'S FUSE
SUPPLIER'S PROPERTY
CONSUMER'S PROPERTY



VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource	Specification	Remark
1	Client/ HT Installation plan from Industry/Commercial	HT installation scheme (Indoor / Outdoor)	

IX Precautions to be followed

1. Use standard symbols as per IE rule to represent the electrical installation accordingly.
2. Use ferrules to labelling the terminals of the cable/ wires.
3. Specify proper clearance/ distance between the equipment as per IE rules.
4. Follows safety rule/ norms pertaining to industrial installation.
5. Use sign boards/ safety symbols.

X Procedure

1. Collect the information about connected load of the client/ consumer.
2. Choose size and rating of cable, distribution board and fuse.
3. Select shortest route to convey power from distribution pole/ terminal to consumer premises.
4. Based on locality and type of consumer select service connection.
5. Draw service connection diagram.
6. Carry out the estimation for low-tension (LT) line.

XI Assumption, Calculations and Material Table required for the Estimation of LT Distribution Line

(Use blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of result

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions (Note:- Teacher should provide various questions related to practical-sample given)

1. Determine the rating of CT, PT and circuit breaker for 500 kVA, 11KV transformer.
2. State IE rule pertaining to HV installation system.
3. Describe the procedure to determine the size of transformer and cable.
4. State the factors considered while selecting site for HT substation installation.
5. Describe the function of Lightning arrestor and drop fuse.
6. State specific requirements for Indoor and Outdoor substation.

……

……

……

……

……

……

……

……

……

……

……

……

………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://www.electrical4u.com/types-of-electrical-insulator-overhead-insulator/
4. https://www.electrical4u.com/electrical-engineering-articles/utilities/
5. http://www.neca-neis.org/the-standards

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	layout diagram for low-tension (LT) line from given data	40
2	Understanding line diagram	20
3	Selection of service mains and rating of D. B	20
4	Answer to sample questions	10
5	Submission of report in time	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing & Design (15)	**Understanding (10)**	**Total (25)**	

Practical No. 13: Design an electrical installation system for a high-tension (HT) distribution line (11 kV) and carry out an estimation.

I Practical Significance

Every diploma electrical engineer must be well aware of the various component of HV installation system with their location and application, this helps him to prepare plan layout drawing of given HV installation. He can execute the work at utmost care ensuing the IE rules and safety norms.

II Industry/Employer Expected Outcome(s)

Carry out estimation and costing of various electrical wiring installations.

III Course Level Learning Outcome(s)

Prepare estimate of overhead and underground distribution lines.

IV Laboratory Learning Outcome(s)

LLO 13.1 Draw layout diagram for high-tension (HT) line from given data.
LLO 13.2 Carry out the estimation for high-tension (HT) line.

V Relevant Affective Domain related outcome(s)

1. Follow safety electrical rules for HT Distribution Line Installation.

VI Relevant Theoretical Background

HT distribution Line refers to High Tension or High Voltages. Voltage Level of HT lines is 1kV to 11kV. It may be HT & LT distribution but the following accessories must be used in the overhead distribution system.

Main components for (HT or LT) overhead Distribution lines:

Line Supports: Usually electric pole or towers are called as supports. The main function is to supports the conductor so as to keep it of a suitable label above the ground. Generally for LT distribution we used 8m or 9m PCC (pre-stress cement concrete) or RCC (rein forced cement concrete) and also rail pole of 9m & 10m height. Similarly for HT distribution we used 9m PCC or RCC pole & rein forced of height 12 m.

Conductor materials: The conductor is one of the important items of the overhead transmission line. The proper choice of material and size of the conductor is of considerable importance. The conductor material used for transmission and distribution of electric power should have the following properties:

i. High electrical conductivity.
ii. High tensile strength in order to withstand mechanical stresses.
iii. Low cost so that it can be used for long distances.
iv. Low specific gravity so that weight per unit volume is small.

All conductors used for overhead lines are preferably stranded in order to increase the flexibility. In distribution line conductor plays a vital role to transmit or circulate the electric current. Hence conductor is a medium of electric supply system. Generally, we use AAC (All Aluminium conductor) & ACSR (Aluminium conductor steel reinforced) as the overhead conductor in the distribution line. The ACSR conductor of size not less than 6/1×2.11 mm should be used for service lines.

Cross Arms: Cross arm is a cross piece fitted to the pole top at the end portion by means of brackets known as pole brackets for supporting insulators in a suitable spacing. Generally, in the distribution line we use MS Channel, Angle iron, U- shaped, V-shaped or zig-zag shape cross arms are used.

Pole brackets & clamps- Pole brackets are used to hold the cross arms with the poles. The brackets may be of the channels or angle iron and may be of pipe brackets. Clamps are made up off flat iron & are used for fixing as well as holding service line, stay wire, earth wire, shackle Insulators and cross arms etc.

Guys and Stays: Stay is basically used to provide support to the line poles where they are unbalanced irrection. Generally, stay is done at an angle of 45 degree or not less than 30 degree. For HT line this stay angle may vary from 45 degree to 60 degree. Guy is a tensioned cable designed to add stability to a free-standing structure. They are used commonly for stay wire, ship masts, radio masts, wind turbines, utility poles, and tents.

Span length: The horizontal distance between the two adjacent pole is called as span length. Depending on the supplied voltage of the distribution line as Well as transmission line we have following spans for the various types of supports. 1. Wooden pole span is 40m to 50m. 2. Steel tubular pole span is 50m to 80m. 3. RCC and PCC pole span is 80m to 200m. 4. Steel towers span is 200m to 400m.

Line insulators: The main function of the insulator in distribution line is to avoid the direct contact of the charged conductor with the earth. The commonly used material for the overhead line insulator is porcelain, toughed glass & ceramics. Types of insulators. Pin type insulator- This type of insulators is generally used in 240V, 440V, 11KV & 33KV. Disc type insulator. It is two types depending upon its uses

i-suspension insulator

ii-strain insulator

If the disc insulators are arranged in vertically then it is called as suspension insulator. If the disc insulator is arranged in horizontally then it is called as strain insulator. Generally, disc insulators are used 11KV onwards. Shackle Insulator-These insulators are used only in LT line in 440V at the tapping pole, dead end pole and deviation pole. They are also used in street light purpose.

Lighting Arrester: It is a device which protects all the electrical equipment's from damage due to surge Voltage of lighting. Hence all the overhead conductors are also connected lighting arrester at the substations, grids etc. similarly all the modern protective devices must be connected with this lighting arrester.

Phage Plate: To identify the colour code of overhead conductors such as red (R), yellow (Y), & blue(B) such Phase plates are attached with the supports.

Danger Plate: This plate is placed at a height of 2.4m from the ground on the support. This plate contains supplied voltage which is written in English, Hindi & in local language. This plate is used aware the human being.

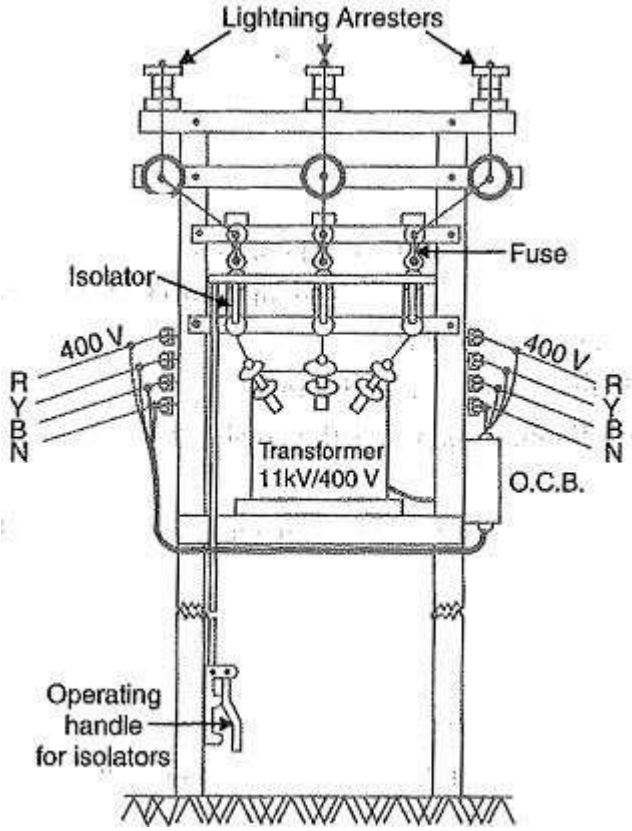
Anti –Climbing Wire: This wire is provided around the poles at a height of about 2.5 m from the ground for at least 1m. It is use not to climb any unauthorized person.

Bird Guards: These are the wooden pieces of size about 10cm x12.5cm x15cm, in case of metal poles are fitted under the insulators. Bird guards are used to avoid the short circuit or earth fault due to sitting of birds which may short circuit live conductors or any one line conductor with earth.

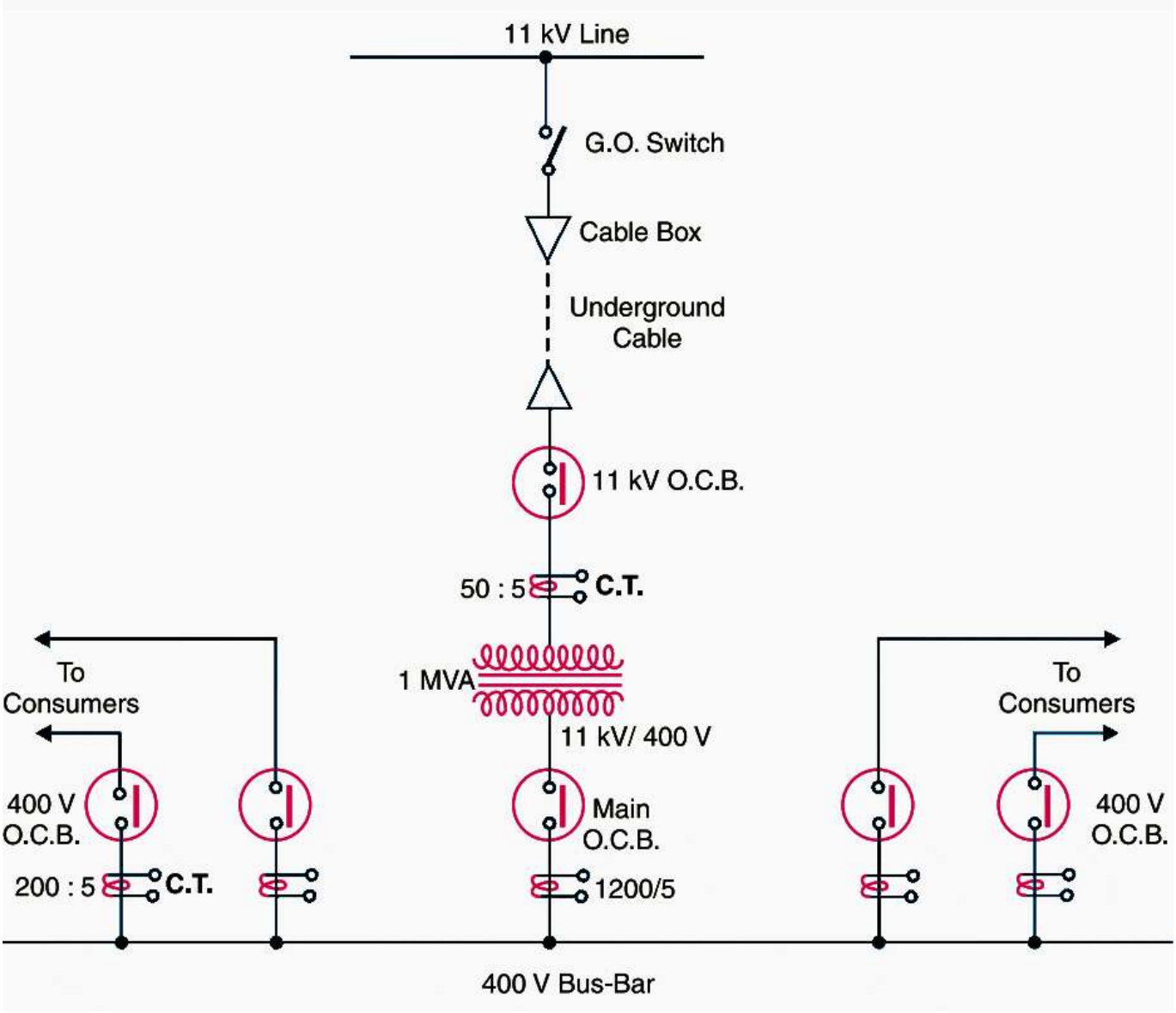
Jumpers: Jumpers are the conductors which are used to continuity supply line from one point to another point by jumpering. Jumpers are generally used in DP structure & where disconnection of supply line is exiting.

Guard Wire: It is provided for the safety of the life, installation and communication circuit. The guarding for 11KV lines provided at road crossing, canal crossing, railway crossing, crossing over LT lines or communication lines.

VII Actual Circuit diagram used in laboratory with equipment Specifications



HT (11kV) installation



VIII Required Resources/apparatus/equipment with specification:

Sr. No.	Name of Resource	Specification	Remark
1	Client/ HT Installation plan from Industry/Commercial	HT installation scheme (Indoor / Outdoor)	
2	Computer	Suitable for software	
3	Any proprietary or open-source drawing Software	_	

IX Precautions to be followed:

1. Use standard symbols as per IE rule to represent the electrical installation accordingly.
2. Use ferrules to labelling the terminals of the cable/ wires.
3. Specify proper clearance/ distance between the equipment as per IE rules.
4. Follows safety rule/ norms pertaining to industrial installation.
5. Use sign boards/ safety symbols.

X Procedure

1. Collect the plan and requirement of H.T distribution line from the client/ contractor/ civil consultant/ as suggested by staff member.
2. Calculate number of poles required.
3. Draw single line diagram showing pole locations.
4. Calculate number of cross arms required.
5. Calculate number of Insulators required.
6. Calculate the length of overhead conductor required.
7. Select the size of overhead conductor.
8. Select the size of other required materials.
9. Prepare material table including cost of material, labour charges and profit margin.

XI Assumption and Calculations (Deciding the size/rating CT, PT, Distribution board)

(Use blank sheet if space is not sufficient)

XII Result

……

……

……

XIII Interpretation of result

……

……

……

XIV Conclusion and recommendation

……

……

……

XV Practical related questions (Note:- Teacher should provide various questions related to practical-sample given)

1. Determine the rating of CT, PT and circuit breaker for 500 kVA, 11KV transformer.
2. State IE rule pertaining to HV installation system.
3. Describe the procedure to determine the size of transformer and cable.
4. State the factors considered while selecting site for HT substation installation.
5. Describe the function of Lightning arrestor and drop fuse.
6. State specific requirements for Indoor and Outdoor substation.

……

……

……

……

……

……

……

……

……

……

……

……

XVI References/Suggestions for further reading

1. Surjit Singh, Ravi Deep Singh, Electrical Estimating and Costing Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
2. J.B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
3. https://www.electrical4u.com/types-of-electrical-insulator-overhead-insulator/

XVII Suggested Assessment Scheme

Performance Indicators		Weightage
1	layout diagram for low-tension (HT) line from given data.	40
2	Understanding line diagram	20
3	Selection of protective equipment and accessories	20
4	Answer to sample questions	10
5	Submission of report in time	10
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Drawing & Design (15)	**Understanding (10)**	**Total (25)**	