

# **CURRICULUM**

**Technical School Leaving Certificate**

## **Electrical Engineering**

**(18 months program)**



Council for Technical Education and Vocational Training

## **Curriculum Development Division**

**Sanothimi, Bhaktapur**

**Developed in 1997**

**First Revision, 2010**

**Second Revision, 2016**

## Table of Content

<b>Introduction</b> .....	2
<b>Title:</b> .....	2
<b>Aims</b> .....	2
<b>Objectives</b> .....	2
<b>Program Description</b> .....	2
<b>Course Duration:</b> .....	3
<b>Entry criteria:</b> .....	3
<b>Group size:</b> .....	3
<b>Medium of Instruction:</b> .....	3
<b>Pattern of Attendance:</b> .....	3
<b>Instructors' Qualification:</b> .....	3
<b>Teacher and Student Ratio:</b> .....	3
<b>Instructional Media and Materials:</b> .....	3
<b>Teaching Learning Methodologies:</b> .....	3
<b>Evaluation Details:</b> .....	4
<b>Grading System:</b> .....	4
<b>Certificate Awarded:</b> .....	4
<b>Job Opportunity:</b> .....	4
<b>Course Structure</b> .....	5
<b>Applied Math</b> .....	7
<b>Bench Work</b> .....	10
<b>Electrical Installation</b> .....	14
<b>Repair and Maintenance</b> .....	18
<b>Engineering Drawing and Computer Application</b> .....	22
<b>Electro-Technology</b> .....	30
<b>Motor Installation and Control System</b> .....	36
<b>Power Distribution System</b> .....	39
<b>Basic Electronics</b> .....	43
<b>Entrepreneurship Development</b> .....	47
<b>On the Job Training (OJT)</b> .....	51

## **Introduction**

Nepal Government, Ministry of Education implemented the Letter grading system in SLC. The door of TSLC program is open for those who have appeared 10th grade exam and achieved any GPA and any grade in any subject. Focusing on such students the curriculum of TSLC of 29 months and 15 months have been converted into 18 months.

The world is using many electrical appliances and equipment. We cannot imagine the world without Electrical devices. Nepal is lacking to produce basic level Electrical workforce in the country, especially in the grass root level of rural and urban communities. Training of this level in electrical field, called TSLC in Electrical Engineering presently becomes the one of the major responsibilities of CTEVT. In this context a well-developed curriculum is a fundamental pre-requisite for the training program.

Mostly the trained candidates are employed in the the world of work, national and international organizations working as a basic level electrical workforce and rest are employed in NGOs and INGOs, which are working in the national/international labour market and some of them work as entrepreneurs emphasizing on the preventive care and repair and maintenance of electrical devices.

## **Title:**

The title of the programme is TSLC in Electrical Engineering

## **Aims**

- To produce competent work force in electrical engineering able to provide services in different community.

## **Objectives**

After the completion of the training program the trainees will be able to:

- Familiarize with basic electrical engineering
- Install basic electric appliances.
- Perform basic electrical functions
- Repair and maintain electrical devices and machines.
- Find fault in electrical system's appliances and machines.
- Repair and maintain faults of electrical system
- Perform simple calculation related to electrical works.
- Familiarize with electrical and electronics components related with electrical system
- Familiarize with basic computer and computerized drawing system

## **Program Description**

This course is based on the job required to perform by a basic level electrical technician as an electrical sub-overseer. This program offers 100% absolutely general electrical courses. The fundamental subjects related to electrical engineering such electrical installation, motor installation and control, power transmission and distribution, basic electronics, repair and maintenance, electro-technology, Engineering Drawing, Entrepreneurships Development and Computer Application are offered to produce basic level competent electrical engineering work force.

The program is designed on the basis of 20% theory and 80% practical classes. The provision of On-the- Job Training (OJT) is included to establish a linkage with employers and provide hands on work experience to students and promote employability of graduates.

**Course Duration:**

This course will be completed within 18 months (40 hrs/week X 39 weeks a year = 1560 hrs.) class plus 6 months (40 hrs/week X 24 weeks = 960 hrs. on the job training (OJT).

**Entry criteria:**

Individuals with following criteria will be eligible for this program:

- SLC with any grade and any GPA (Since 2072 SLC).
- SLC appeared (Before 2072 SLC)
- Pass entrance examination administered by CTEVT

**Group size:**

The group size will be maximum 40 (forty) in a batch.

**Medium of Instruction:**

The medium of instruction will be in English and/or Nepali language.

**Pattern of Attendance:**

The students should have minimum 90% attendance in theory classes and practical/performance to be eligible for internal assessments and final examinations.

**Instructors' Qualification:**

- Instructors should have bachelor degree in Electrical Engineering or Diploma in Electrical Engineering with minimum 5 years practical based experiences.
- The demonstrator should have Diploma in Electrical Engineering with minimum 2 years practical based experiences.
- Good communicative/instructional skills

**Teacher and Student Ratio:**

- Overall at institutional level: 1:10
- Theory: 1:40
- Practical: 1:10
- Minimum 75% of the teachers must be fulltime

**Instructional Media and Materials:**

The following instructional media and materials are suggested for the effective instruction, demonstration and practical.

- Printed media materials (assignment sheets, handouts, information sheets, procedure sheets, performance check lists, textbooks, newspaper etc.).
- Non-projected media materials (display, photographs, flip chart, writing board etc.).
- Projected media materials (multimedia/overhead transparencies, slides etc.).
- Audio-visual materials (films, videodiscs, videotapes etc.).
- Computer-based instructional materials (computer-based training, interactive video etc.)

**Teaching Learning Methodologies:**

The methods of teaching for this curricular program will be a combination of several approaches such as;

- Theory: lecture, discussion, assignment, group work, question-answer.
- Practical: demonstration, observation, simulation, guided practice and self-practice.

**Evaluation Details:**

- The ratio between the theory and practical tests will be as per the marks given in the course structure of this curriculum for each subject. Ratio of internal and final evaluation is as follows:

S.N.	Particulars	Internal Assessment	Final Exam	Pass %
1.	Theory	50%	50%	40%
2.	Practical	50%	50%	60%

- There will be three internal assessments and one final examination in each subject. Moreover, the mode of assessment and examination includes both theory and practical or as per the nature of instruction as mentioned in the course structure.
- Every student must pass in each internal assessment to appear the final exam.
- Continuous evaluation of the students' performance is to be done by the related instructor/ trainer to ensure the proficiency over each competency under each area of a subject specified in the curriculum.
- The on-the-job training is evaluated in 500 full marks. The evaluation of the performance of the student is to be carried out by the three agencies; the concerned institute, OJT provider industry/organization and the CTEVT Office of the Controller of Examinations. The student has to score minimum 60% for successful completion of the OJT.

**Grading System:**

The grading system will be as follows:

<u>Grading</u>	<u>Overall marks</u>
Distinction	80% or above
First division	75% to below 80%
Second division	65% to below 75%
Third division	Pass aggregate to below 65%

**Certificate Awarded:**

The council for technical education and vocational training will award certificate in “**Technical School Leaving Certificate in Electrical Engineering**” to those graduates who successfully complete the requirements as prescribed by the curriculum.

**Job Opportunity:**

The graduate will be eligible for the position equivalent to Non-gazetted 2nd class/level 4 (technical) as Electrical Sub-Overseer or as prescribed by the Public Service Commission or the concerned authorities. The graduate is eligible for registration with the professional council in the grade as mentioned in the related professional council Act (if any).

### Course Structure

S N	Subject Title	Nature	Hours / week	Total class or hrs.			Full Marks		
				Th.	Pr.	Total	Th.	Pr.	Total
1	Applied math	T	2	78	0	78	50	0	50
2	Bench Work	P	2	0	78	78	0	50	50
3	Electrical Installation (Domestic, Industrial & Commercial)	P	9	0	351	351	0	220	220
4	Repair & Maintenance	P	7	0	273	273	0	170	170
5	Engineering Drawing and Computer Application	T+P	5	39	156	195	30	100	130
6	Electro Technology	T	4	156	0	156	100	0	100
7	Motor Installation & Control System	P	4	0	156	156	0	100	100
8	Power Distribution System	P	2	0	78	78	0	50	50
9	Basic Electronics	T+P	3	39	78	117	30	50	80
10	Entrepreneurship Development	T	2	30	48	78	20	30	50
	<b>Total:</b>		40	390	1170	1560	230	770	1000

On the job training	P	6 Months	960	500
<b>Total Hours (Inhouse+OJT)</b>		<b>18 months</b>	<b>2520</b>	<b>1500</b>

## **Subject**

- 1. Applied Math**
- 2. Bench Work**
- 3. Electrical Installation (Domestic, Industrial & Commercial)**
- 4. Repair & Maintenance**
- 5. Engineering Drawing and Computer Application**
- 6. Electro-Technology**
- 7. Motor Installation & Control System**
- 8. Power Distribution System**
- 9. Basic Electronics**
- 10. Entrepreneurship Development**

## Applied Math

**Course Nature: Theory**  
**Full Marks: 50**

**Class per week: 2 hrs.**  
**Total Class: 78 hrs.**

<b>Description:</b>	This course provides skill and knowledge to solve the numerical problem related to the TSLC in Electrical Engineering course.
<b>Objectives:</b>	At the end of the course the participants will be able to: <ul style="list-style-type: none"> <li>▪ Calculate and convert units.</li> <li>▪ Interpret graphical representation.</li> <li>▪ Calculate electrical parameters.</li> <li>▪ Apply and calculate different laws related to electrical fields.</li> <li>▪ Apply fundamental of AC circuits calculation.</li> <li>▪ Apply the different types of electrical machines' related calculation.</li> </ul>

S.N.	Skills	Contents	Time Hours
1.	Calculate Workshop : <ul style="list-style-type: none"> <li>• Length</li> <li>• Area</li> <li>• Volume</li> <li>• Trigonometry</li> <li>• Conversion units</li> </ul>	<b>Units and measurement</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• SI units</li> <li>• Pythagorus theorem</li> <li>• Temperature</li> <li>• Formulae</li> </ul>	5
2.	<ul style="list-style-type: none"> <li>• Calculate work, power and energy</li> <li>• Calculate cost per unit.</li> </ul>	<b>Work, power and energy</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Joule's law of electric heating</li> <li>• SI units</li> <li>• Unitary method</li> <li>• Formulae</li> </ul>	4
3.	<ul style="list-style-type: none"> <li>• Calculate simple linear equation</li> </ul>	<b>Linear equation</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Method</li> </ul>	2
4.	<ul style="list-style-type: none"> <li>• Calculate scalar and vector quantity</li> </ul>	<b>Scalar and vector quantity</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Speed</li> <li>• Velocity</li> <li>• Acceleration</li> <li>• Formulae</li> </ul>	2
5.	Calculate : <ul style="list-style-type: none"> <li>• Resistance</li> <li>• Voltage</li> <li>• Current</li> <li>• Power</li> </ul>	<b>Fundamental of Electricity</b> <ul style="list-style-type: none"> <li>• Law of resistance</li> <li>• Ohm's law</li> <li>• Kirchhoff's law</li> <li>• Resistivity</li> <li>• Resistance in series and parallel circuit</li> <li>• Formulae</li> </ul>	6
6.	Calculate : <ul style="list-style-type: none"> <li>• Self induction</li> <li>• Mutual induction</li> </ul>	<b>Electromagnetic induction</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Faraday's law</li> </ul>	5

	<ul style="list-style-type: none"> <li>Induced e.m.f.</li> <li>Inductance</li> </ul>	<ul style="list-style-type: none"> <li>Lenz's law</li> <li>series/parallel inductive circuit</li> <li>Formulae</li> </ul>	
7.	Calculate : <ul style="list-style-type: none"> <li>Capitance</li> <li>Charge and potential difference</li> <li>Energy store</li> </ul>	<b>Capacitance</b> <ul style="list-style-type: none"> <li>Coulomb's law</li> <li>Charging and discharging</li> <li>series/parallel capacitive circuit</li> <li>Formulae</li> </ul>	4
8.	Calculate: <ul style="list-style-type: none"> <li>Cycle</li> <li>Time period</li> <li>Frequency</li> <li>Average value</li> <li>Effective value/RMS</li> </ul>	<b>A.C Fundamental</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>Formulae</li> </ul>	6
9.	Calculate: <ul style="list-style-type: none"> <li>resistance/capacitance/inductance</li> <li>R-L, R-C and R-L-C circuit</li> <li>Impedance</li> <li>Power factor</li> <li>Phase angle</li> <li>Active/reactive and apparent power</li> </ul>	<b>A.C. circuit</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>Pure resistive/capacitive/inductive circuit</li> <li>Effect of power factor (low/high)</li> <li>Series and parallel circuit</li> <li>Formulae</li> </ul>	7
10.	Calculate : <ul style="list-style-type: none"> <li>Power</li> <li>Current</li> <li>Voltage</li> </ul>	<b>Poly-phase circuit</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>Work, power, energy in delta/star connection</li> <li>Two watt meter method</li> </ul>	6
11.	Calculate: <ul style="list-style-type: none"> <li>Input/output voltage</li> <li>No. of turns in primary/secondary</li> <li>Transformation ratio</li> <li>Losses and efficiency</li> <li>E.m.f. calculation</li> </ul>	<b>Transformer</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>E.m.f. equation</li> <li>Transformation ratio</li> <li>Formulae</li> </ul>	8
	Calculate: <ul style="list-style-type: none"> <li>Generator emf and terminal voltage</li> <li>Armature current and field current</li> <li>Losses and efficiency</li> </ul>	<b>DC generator</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>E.m.f. equation</li> <li>Formulae</li> </ul>	6
	Calculate: <ul style="list-style-type: none"> <li>Phase and line voltage</li> <li>Voltage regulation.</li> <li>Efficiency</li> </ul>	<b>Synchronous generator</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>Formulae</li> </ul>	5
	Calculate: <ul style="list-style-type: none"> <li>Synchronous speed.</li> <li>Back e.m.f.</li> <li>Mechanical power</li> </ul>	<b>Synchronous motor</b> <ul style="list-style-type: none"> <li>Introduction</li> <li>Formulae</li> </ul>	4

	Calculate: <ul style="list-style-type: none"> <li>• Synchronous speed</li> <li>• Back e.m.f.</li> <li>• Slip, Normal speed</li> </ul>	<b>Induction motor</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Working principle</li> <li>• Formulae</li> </ul>	4
	Calculate tariff <ul style="list-style-type: none"> <li>• Domestic</li> <li>• Commercial</li> </ul>	<b>Tariff</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Ratio and proportion</li> <li>• Percentage</li> <li>• Formulae</li> </ul>	4
		<b>Total</b>	<b>78</b>

**Reference Books:**

- Electrical Technology - B.L. Thereja
- Basic Electrical Engineering – M. L. Anwani
- Basic Electrical Engineering Vol. 1 & 2 – P.S. Dhogal

## Bench Work

**Course Nature: Practical**

**Class per Week: 2 hrs.**

**Full marks: 50**

**Total Class: 78 hrs.**

<b>Description:</b>	This subject provides skill and knowledge to perform basic mechanical work. Which consists of filling, measuring, marking, sawing, punching, drilling, tapping, cutting, folding, riveting, bending, gas welding etc.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>▪ Identify hazards</li> <li>▪ Apply safety rules.</li> <li>▪ Use and care mechanical tools, instrument and machines.</li> <li>▪ Perform basic operation related to mechanical work, such as: measure, mark, cut, bend, file, drill, rivet according to the specification .</li> <li>▪ Perform sheet metal works.</li> <li>▪ Perform gas welding.</li> </ul>

S.N.	Objectives/Skills	Contents	Time Hours		
			Th.	Pr.	Total
1.	Perform filling	<b>Filling</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Tools/materials</li> <li>• Importance &amp; Applications</li> <li>• Process</li> <li>• Safety precautions</li> </ul>	1	17	18
2.	Perform measuring and marking	<b>Measuring &amp; marking</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Tools/materials</li> <li>• Importance &amp; Applications</li> <li>• Process</li> <li>• Safety precautions</li> </ul>	1	2	3
3.	Perform the punching	<b>Letter/number/centre punch</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types &amp; size</li> <li>• Tools/materials</li> <li>• Importance &amp; Applications</li> <li>• Process</li> <li>• Safety precautions</li> </ul>	1	4	5
4.	Perform the sawing	<b>Sawing</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Tools/materials</li> <li>• Importance &amp; Applications</li> <li>• Process</li> <li>• Safety precautions</li> </ul>	1	5	6
5.	Perform the drilling	<b>Drilling</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types &amp; Parts</li> <li>• Tools/materials</li> </ul>	2	10	12

		<ul style="list-style-type: none"> <li>• Importance &amp; Applications</li> <li>• Process</li> <li>• Method of selection RPM and drill bit size</li> <li>• Safety precautions</li> </ul>			
6.	Perform Tapping.	<b>Thread cutting (Tapping)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and uses</li> <li>• Procedure of tapping</li> <li>• Applications</li> <li>• Safety precautions</li> </ul>	1	5	6
7.	Perform Sheet metal work (figure cutting)	<b>Sheet metal</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Tools and materials</li> <li>• Application</li> <li>• Safety precautions</li> </ul>	2	5	7
		<b>Folding</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and uses</li> <li>• Methods</li> <li>• Safety precautions</li> </ul>	2	10	12
		<b>Riveting</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and application</li> <li>• Types</li> <li>• Uses</li> <li>• Methods</li> </ul>	2	7	9
		<b>Total</b>	<b>13</b>	<b>65</b>	<b>78</b>

**Reference Book:**

- Work Shop Technology (Volume I & II) – Hajra & Chaudhary

### Required Tools and Equipments

• Bench Vice	• Metal Chisel
• Bench Cleaning Brush	• Metal Scissor
• Anvil	• Micro meter
• C- Clamp	• Number punch
• Center punch	• Oil Cane
• Chipping Hammer	• Pin Punch
• Clamp	• Pipe Vice
• Divider	• Pliers
• Draft Punch	• Rivet Punch
• Drill Machine with drill bit	• Safety Gloves
• File Brush	• Safety Goggles
• Files	• Screw Driver
• Gas Lighter	• Spanner
• Hack saw With Blade	• Steel ruler
• Hammer	• Taps Set
• Hand Shield	• Tongs
• Helmet	• Try square
• Leather Apron	• Vernier caliper
• Letter punch	• V-block
• Mallet	• Welding Machine
• Marking scribe	• Wire Brush

### Material List

• G I pipe	• MS black sheet
• MS flat	• PVC pipe
• Rivet	• Sheet metal
• Steel strip	• U channel
• V channel	• Welding rod
• Welding gas	

## **Safety Rules**

### **Work shop safety rules**

1. Keep the work shop neat and clean.
2. Wear workshop/lab apron.
3. Wear covered footwear, never use rubber chappals.
4. Don't run, sought, smoke inside the workshop.
5. Never place sharp materials such as scribers and scraps on the floor.
6. Place heated work piece under the board.
7. Store the inflammable materials such as oil, grease etc, away from the working place.

### **Hand tools Safety Rules**

1. The right tools should be used and handled carefully.
2. Place the tools in the proper place in a perfect manner.
3. Never use files, screw drivers, scrapers etc. without handle.
4. Check up hammer, see it is well wedged or not, don't use a cracked handle.
5. Remove oil substances on the face of the hammer and no top of the chisel while working.
6. Wear goggles and place chipping screen while chipping.
7. Don't use mushroom head chisels.
8. Never store more tools in the working place than required.

### **Machine Safety Rules**

1. Don't start any machine before getting instruction or permission.
2. Never operate a new machine unless you know thoroughly of its mechanism and working conditions.
3. Ensure that metal body of electrical machine is earthed.

## Electrical Installation

**Course Nature: Practical**  
**Full mark: 220**

**Class per week: 9 hrs.**  
**Total Class: 351**

<b>Subject 3: Electrical Installation</b>	
<b>Description:</b>	This subject provides skill and knowledge related to electrical installation. It also covers classification of wiring, selection of materials, simple design and installation of domestic, industrial and commercial building.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>▪ Select electrical tools, equipment, materials, accessories, fitting and safety device as per drawing.</li> <li>▪ Install panel board, capacitor bank, cable tray, lightning arrestor, PABX, telephone distribution board.</li> <li>▪ Interpret lay out and wiring diagram,</li> <li>▪ Perform board wiring and brick wall wiring.</li> <li>▪ Instal supporting accessories (PVC conduit, metal box, distribution box, L.T. cable etc.)</li> <li>▪ Perform wiring system and electrical safety test,</li> <li>▪ Connect and control single &amp; three phase motor system</li> </ul>

S.N.	Objectives/Skill	Contents	Time Hours		
			T	Pr.	Total
1.	Handle electrical tools and equipment.	<b>Tools and equipment for Electrical installation</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance &amp; use</li> <li>• Safety</li> </ul>	3	11	14
2.	Select the electrical materials	<b>Electrical materials</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> </ul>	3	11	14
3.	Select the electrical accessories	<b>Electrical accessories</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance &amp; use</li> </ul>	3	11	14
4.	Select protective device.	<b>Protective device</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance &amp; use</li> </ul>	3	11	14
5.	Provide first aid services Perform simulation first aid to simulated electrocuted person	<b>First aid</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and application</li> <li>• Process</li> </ul>	1	3	4

6.	Install electrical fitting	<b>Electrical fitting</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance &amp; use</li> <li>• Process</li> <li>• Safety</li> </ul>	5	20	25
7.	Interpret lay out and circuit diagram	<b>Electrical diagram</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> </ul>	1	4	5
8.	Perform joints . <ul style="list-style-type: none"> <li>• conduit</li> <li>• wire and cable</li> </ul>	<b>Joint</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Advantages</li> </ul>	3	11	14
9.	Perform board wiring. <ul style="list-style-type: none"> <li>• One way switching</li> <li>• Two way switching</li> <li>• Intermediate switching.</li> <li>• Call bell circuit</li> <li>• Go down circuit</li> <li>• Power and light socket/light indicator</li> <li>• Fuse and protective devices.</li> </ul>	<b>Wiring</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Controlling and protective devices</li> <li>• Importance and use</li> <li>• Process</li> <li>• safety</li> </ul>	6	62	68
10	Perform wiring on brick wall (surface and concealed) Install <ul style="list-style-type: none"> <li>• Main switch</li> <li>• Install DB</li> <li>• KWH meter</li> <li>• Fan and fan regulator/dimmer</li> <li>• corridor lighting</li> <li>• Lay the pipe in concrete slab on building.</li> </ul>	<b>Wiring</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of wiring system</li> <li>• Merits and demerits</li> <li>• Importance and use</li> <li>• Process</li> <li>• Concept and importance of estimating and costing of installation</li> <li>• Safety</li> </ul>	8	30	38
11	Install supporting materials (surface and conceal) <ul style="list-style-type: none"> <li>• PVC conduit</li> <li>• metal box</li> <li>• distribution board</li> <li>• cable tray</li> </ul>	<b>Supporting materials</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Process</li> <li>• safety</li> </ul>	6	24	30
12	Perform Laying of L.T. cable.	<b>LT cable</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Process</li> <li>• safety</li> </ul>	2	8	10
13	Perform earthing and install lightning arrestor.	<b>Earthing and lightning arrestor</b>	3	12	15

		<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and application</li> <li>• Types</li> <li>• Process of earthing</li> </ul>			
14	Install PABX, telephone distribution board and tag.	<b>PABX telephone distribution board and tag.</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and application</li> <li>• color code and tag termination method.</li> <li>• Process</li> <li>• safety</li> </ul>	2	20	22
15	Connect single and three phase supply by using change over switch	<b>Supply connection (single &amp; three phase)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and application</li> <li>• Process</li> <li>• safety</li> </ul>	3	16	19
16	Test electrical safety: <ul style="list-style-type: none"> <li>• Insulation test.</li> <li>• Earth test</li> <li>• Continuity test</li> </ul>	<b>Electrical safety test</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and application</li> <li>• Process</li> <li>• safety</li> </ul>	2	8	10
17	Operate isolating switch: <ul style="list-style-type: none"> <li>• MCB</li> <li>• MCCB</li> <li>• ACB</li> </ul>	<b>Isolating switches</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and application</li> <li>• Process</li> <li>• safety</li> </ul>	2	8	10
18	Perform circuit test. <ul style="list-style-type: none"> <li>• Open</li> <li>• Close</li> <li>• Short</li> </ul>	<b>Circuit test</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and application</li> <li>• Process</li> <li>• safety</li> </ul>	2	4	6
19	Identify energy conservation and perform solar home system installation	<b>Solar home system</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and application</li> <li>• Components</li> <li>• Process</li> <li>• Safety</li> </ul>	4	15	19
		<b>Total</b>	<b>62</b>	<b>289</b>	<b>351</b>

**Reference Books:**

- Electrical Wiring – Ramu subedi.
- Viduit Bitaran – Sambhu Prasad Upadhyia.
- Fundamental of Electricity – Bbinod and Shreekrishna Panthi.

## Required tools and equipment

• Metal electrical tool box	• Augur/barma
• Allen key set	• Measuring tape
• Flat pliers	• Cable cutter
• Cable drawer	• Chisel
• Spanner set	• Ttry square/bottom
• Clamp on meter	• Combinational pliers
• Crimping tools	• Cutting pliers
• Earth resistance tester	• Extension ladder (sliding type)
• File different size/ models	• Finishing towel (Ruksa)
• Hand drill machine	• Folding ladder
• Screw driver set	• Hammer
• Marking scriber	• Hand grinder
• Hand hacksaw frame with blade	• Level pipe
• Nose pliers	• Phase tester
• Frequency meter	• Pipe cutter
• Megger	• Pulling spring
• Multi meter	• Shovel
• Ammeter(AC/DC)	• Soldering lead, paste and flux
• Voltmeter (AC/DC)	• Sprit level
• Ohm meter	• Wire stripper/cable stripper
• Phase tester	• Whole saw cutter
• Plumb bob	• Soldering iron with stand

## Materials list

• All types of one way switch	• Bracket holder
• Ceiling rose	• Dimmer switch
• Floating switch	• Fluorescent lamp holder
• Lamp holder	• Lux switch/photo switch
• Main switch	• Pendent holder
• Push bottom switches	• Rotary switch
• Screw type bulb holder	• Socket outlet terminal
• Starter holder	• Surface tumbler switch
• Timer.	• Two way switch
• MCB, MCCB, ACB, OCB, ELCB	• Complete solar home system set 35 W

## Repair and Maintenance

**Course nature: Practical**  
**Full Marks: 170**

**Class per Week: 7 hrs.**  
**Total hours: 273 hrs.**

<b>Subject: 4: Repair &amp; Maintenance</b>	
<b>Description:</b>	This course provides skill and knowledge of domestic and commercial electrical appliances and equipment. The fundamental facts of preventive and post fault maintenance have been emphasized in this course. This course also provides skill and knowledge to repair and maintenance of single, three phase electrical motor, their rewinding, transformer and D.C. motor.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>▪ Repair and maintenance of domestic appliances.</li> <li>▪ Repair and maintenance of Industrial machine and tools.</li> <li>▪ Develop simple lay out and wiring diagram of different types of electric machine/equipment and appliances.</li> <li>▪ Disassemble and assemble various types of electrical machine and equipment.</li> <li>▪ Perform basic maintenance of transformer</li> <li>▪ Perform single phase and three phase motor rewinding.</li> <li>▪ Apply safety precautions for electrical repair and maintenance work.</li> </ul>

S.N.	Skill	Contents	Time hrs		
			Th	Pr.	Total
1.	Repair/maintenance electrical appliances and accessories (Immersion heater/rod, Iron, kettle and hot plate)	<p>Concept of preventive and corrective maintenance</p> <p><b>Immersion heater, rod heater, Iron, Kettle, Hotplate, heating element</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	2	12	14
2.	Repair/maintain Rice Cooker, oven, geyser.	<p><b>Electrical Cooker, oven, Geyser, heating element</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	2	12	14
3.	Repair and maintain electrical toaster.	<p><b>Electrical toaster</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and</li> </ul>	1	6	7

		function <ul style="list-style-type: none"> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>			
4.	Repair and maintain fan heater/electrical hair dryer	<b>Fan heater, Hair dryer</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	1	6	7
5.	Repair and maintain vacuum cleaner.	<b>Vacuum cleaner</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	1	6	7
6.	Repair and maintain mixture/grinder.	<b>Mixture/grinder</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	1	6	7
7.	Repair and maintain portable drill machine.	<b>Drill machine</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	1	6	7
8.	Repair and maintain table fan, ceiling fan/exhaust fan.	<b>Fan</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Working principle and function</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	1	6	7
9.	Repair and maintain Domestic/Commercial/ Industrial installation	<b>Electrical Installation</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process</li> </ul>	4	17	21

		<ul style="list-style-type: none"> <li>• connection diagram</li> <li>• Fault finding &amp; remedies</li> <li>• Log book/ work report</li> </ul>			
<b>10.</b>	Repair and maintain AC single phase motor.	<b>AC single phase motor</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process of repair and maintenance</li> <li>• Process of dismantle and assemble</li> <li>• Size/types</li> <li>• connection diagram</li> <li>• calculation of turns and size</li> <li>• Rewinding and installing process of coil</li> <li>• Log book/ work report</li> </ul>	4	38	42
<b>11.</b>	Repair and maintain AC three phase motor (Balance)	<b>AC three phase motor (Balance)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process of repair and maintenance</li> <li>• Process of dismantle and assemble</li> <li>• Size</li> <li>• connection diagram</li> <li>• calculation of turns and size</li> <li>• Rewinding and installing process of coil</li> <li>• Log book/ work report</li> </ul>	4	45	49
<b>12.</b>	Repair and maintain AC three phase motor (Unbalance)	<b>AC three phase motor (Unbalance)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process of repair and maintenance</li> <li>• Process of dismantle and assemble</li> <li>• Size</li> <li>• connection diagram</li> <li>• calculation of turns and size</li> <li>• Rewinding and installing process of coil</li> <li>• Log book/ work report</li> </ul>	4	45	49
<b>13.</b>	Repair and maintain Generator Set	<b>Generator</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Types of generator</li> <li>• Process of maintenance</li> </ul>	2	19	21

		<ul style="list-style-type: none"> <li>• Trouble shooting</li> </ul>			
14.	Repair and maintain single phase low voltage transformer.	<b>Single phase low voltage transformer</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Parts/components</li> <li>• Importance and use</li> <li>• Process</li> <li>• connection diagram</li> <li>• calculation of turns and size</li> <li>• Binding and installing process</li> <li>• Log book/ work report</li> </ul>	2	12	14
15.	Repair and maintain Invertors, converters, solar panel, D.C. battery.	<b>Invertors, converters, solar penal</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process</li> <li>• connection diagram</li> <li>• Log book/ work report</li> </ul>	2	5	7
<b>Total</b>			<b>32</b>	<b>241</b>	<b>273</b>

**Reference Books:**

- Electrical installation by Heinz Graff
- Industrial Wiring by J.A. Faindery

**Required tools and equipment**

• Adjustable wrench	• Allen key set
• Ammeter(AC/DC)	• Cable knife
• Combination pliers	• Cutter pliers
• File different size/ models	• Flat pliers
• Hammer	• Hand hacksaw with blade
• Line tester	• mallet
• Marking scriber	• Measuring tape
• Metal electric tool box set	• Micro miter
• Multi meter	• Nose pliers (flat and round)
• Ohm meter	• Screw driver set (star and philips)
• Slide wrench	• Soldering iron with stand
• Soldering lead	• Soldering paste/flux
• Standard wire gauge	• Voltmeter (AC/DC)
• Wire stripper	

**Safety Precaution:**

- Never use broken handle tools
- Use always insulated tools
- Beware of live wires.

## Engineering Drawing and Computer Application

**Course nature: Practical**  
**Full Marks: 130**

**Class per Week: 1+4**  
**Total hours: 195**

<b>Subject 5: Engineering Drawing &amp; Computer Application</b>	
<b>Description:</b>	This course provides skill and knowledge on drawing instrument, standard drawing symbol, lettering, lines, scales, geometrical drawing, electric circuit diagram of domestic, commercial & Industrial installation This course also covers layout diagram & connection diagram of electrical appliance, machines service drop cable in transmission & distribution system using computer aided design.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>▪ Draw line, curve and plan of geometrical solids.</li> <li>▪ Sketch freehand and three dimensional objects.</li> <li>▪ Read, interpret Electrical symbols to use in different circuit diagram.</li> <li>▪ Read, interpret and draw electrical connection diagram in transmission &amp; distribution system.</li> <li>▪ Draw the development diagram of single phase &amp; three phase motors' component, equipment, &amp; machines.</li> <li>▪ Use Computer Aided Drafting (CAD) Software</li> <li>▪ Use AUTOCAD as electrical drafting tool.</li> <li>▪ Construct 2D Engineering Drawing using AUTOCAD.</li> <li>▪ Annotate a drawing with Text, Dimensioning.</li> <li>▪ Edit drawing using CAD Software</li> </ul>

S.N.	Skill	Contents	Time hrs		
			Th.	Pr.	Total
<b>Geometrical Engineering Drawing</b>					
1.	Handle basic drawing tools/instruments	<b>Drawing tools &amp; instruments</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use.</li> <li>• Handling techniques</li> <li>• precautions</li> </ul>	2	2	4
2.	Prepare drawing sheet with title block.	<b>Drawing sheets and title block</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and size</li> <li>• Importance and use.</li> <li>• Border lines</li> </ul>	1	2	3
3.	Draw free hand sketches. <ul style="list-style-type: none"> <li>• Straight lines (horizontal, vertical and inclined)</li> <li>• Circles</li> <li>• Arcs &amp; curves</li> </ul>	<b>Free hand sketch</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Concept and importance of sketching</li> <li>• Difference between sketch and drawing</li> <li>• Handling techniques</li> </ul>	1	3	4

4.	Apply different scales (linear and non-linear)	<b>Scale</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Representative fraction</li> </ul>	1	2	3
5.	Draw different types of lines.	<b>Lines</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> </ul>	1	1	2
6.	Write lettering <ul style="list-style-type: none"> <li>• English</li> </ul>	<b>Lettering</b> <ul style="list-style-type: none"> <li>• introduction</li> <li>• Importance and use</li> <li>• Types and size</li> <li>• process.</li> </ul>	1	2	3
7.	Construct regular geometrical figure: <ul style="list-style-type: none"> <li>• Rectangle</li> <li>• Square</li> <li>• Triangle</li> <li>• circle</li> </ul>	<b>Geometrical figures</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Drawing process</li> </ul>	1	2	3
8.	Construct regular polygons. <ul style="list-style-type: none"> <li>• Pentagon</li> <li>• Hexagon</li> <li>• Octagon</li> </ul>	<b>Regular polygon</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Process</li> </ul>	1	3	4
9.	Draw an ellipse	<b>Ellipse</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Process</li> <li>• Method</li> </ul>	1	2	3
10	Perform the dimension the drawing objects.	<b>Dimensioning</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Process</li> </ul>	1	1	2
11	Draw orthographic projection. <ul style="list-style-type: none"> <li>• First angle</li> <li>• Third angle</li> </ul>	<b>Projection</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of projection</li> <li>• Importance</li> <li>• Difference between first and third angle projection</li> <li>• Introduction, uses and types of sectional drawing</li> <li>• Process</li> </ul>	3	13	16
12	Draw isometric views.	<ul style="list-style-type: none"> <li>▪ <b>Isometric projection</b></li> <li>• Introduction</li> <li>• Importance</li> <li>• Process</li> </ul>	2	6	8

<b>Electrical Engineering Drawing</b>					
13.	Draw electrical symbols	<b>Electrical Symbols</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process</li> </ul>	1	2	3
14.	Draw the electrical diagram <ul style="list-style-type: none"> <li>• Lay out</li> <li>• Wiring</li> <li>• Connection</li> </ul>	<b>Electrical diagram</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process</li> </ul>	1	3	4
15.	Draw complete diagram of domestic, commercial building system with architectural building plan and cost calculation.	<b>Building drawing</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance</li> <li>• Material estimating and costing</li> <li>• Process</li> </ul>	3	14	17
16.	Draw Motor control system diagram <ul style="list-style-type: none"> <li>• DOL</li> <li>• Star/Delta</li> <li>• Forward/reverse</li> <li>• Two place</li> </ul>	<b>Motor control and power diagram.</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and use</li> <li>• Process</li> </ul>	2	20	22
17.	Draw winding diagram of different types motor and connection diagram of single phase motor.	<b>winding diagram of motors and connection diagram of single phase motor.</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of motors</li> <li>• Types of winding</li> <li>• Types of layer</li> <li>• Importance and use</li> <li>• Name plate</li> <li>• Parts of motor</li> </ul>	2	10	12
18.	Draw single line diagram of generation, transmission and distribution system.	<ul style="list-style-type: none"> <li>• Single line diagram of power supply system</li> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Nepal Electrical authority (NEA) rule, regulation and standard.</li> </ul>	2	2	4
<b>Computer application and auto CAD</b>					
19.	Familiarize with computer application	<b>Computer application</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Process</li> <li>• Operation <ul style="list-style-type: none"> <li>▪ MS Word</li> <li>▪ MS Excel</li> <li>▪ E-mail/ internet</li> </ul> </li> </ul>	6	10	16

20.	Start up Computer Aided Drafting (CAD) software	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Enlist different types of CAD software.</li> <li>▪ System requirement for CAD</li> <li>▪ Startup CAD from start menu</li> <li>▪ Interpret CAD graphics window including screen layout, pull-down menus, screen icons, command line and dialogue boxes.</li> <li>▪ Modify display</li> <li>▪ Introduce and arrange toolbar</li> <li>▪ Managing unit/limit</li> <li>▪ Start, organize and save file</li> </ul>	1	1	2
21.	Set up a Drawing	<ul style="list-style-type: none"> <li>▪ Explain how to start drawing from scratch, using wizard and, using and creating a template file.</li> <li>▪ Describe setting preferences (units, angle, direction, area)</li> </ul>	0.25	2	2.25
22.	Manage Toolbar	<ul style="list-style-type: none"> <li>▪ Standard tool bar</li> <li>▪ Draw tool bar</li> <li>▪ Modify toolbar</li> <li>▪ Dimensioning tool bar</li> <li>▪ Other</li> </ul>	0.25	0.5	0.75
23.	Draw lines	<ul style="list-style-type: none"> <li>▪ Different system Relative , Cartesian and absolute coordinate system.</li> <li>▪ Start and end point of a line</li> <li>▪ Different methods of drawing a line in CAD</li> <li>▪ Options available in drawing line in CAD (Undo, Close)</li> </ul>	1.50	1.00	2.5
24.	Draw rectangle	<ul style="list-style-type: none"> <li>▪ Corner points (first and other)</li> <li>▪ Options available in drawing rectangle (chamfer, fillet)</li> <li>▪ Chamfer distance</li> <li>▪ Fillet radius</li> </ul>	0.25	0.50	0.75
25.	Draw arc	<ul style="list-style-type: none"> <li>▪ Identify arc among various types of geometric shapes.</li> <li>▪ Describe different options for drawing arc (3 points method, Start Center method, Start End method, Center Start method)</li> </ul>	0.25	0.75	1
26.	Draw circle	<ul style="list-style-type: none"> <li>▪ Describe different options for drawing arc (Center Radius method, Center Diameter method, 2P method, 3P method, Tan, Tan Radius method, Tan, Tan, Tan method)</li> </ul>	0.25	0.50	0.75
27.	Draw polygon	<ul style="list-style-type: none"> <li>▪ Describe different options for drawing polygon (center, edge)</li> </ul>	0.25	0.50	0.75

28.	Manage lines	<ul style="list-style-type: none"> <li>▪ Line properties</li> <li>▪ Line weight</li> <li>▪ Line color</li> <li>▪ Line loading</li> </ul>	0.25	0.50	0.75
29.	Draw an Isometric drawing	<ul style="list-style-type: none"> <li>▪ Concept Isometric snap and rectangular snap</li> <li>▪ Setting of isometric snap</li> </ul>	0.50	1.00	1.5
30.	Draw Ellipse	<ul style="list-style-type: none"> <li>▪ Ellipse in rectangular snap <ul style="list-style-type: none"> <li>• Center Radius method</li> <li>▪ Center Diameter method</li> </ul> </li> <li>▪ Ellipse in isometric snap</li> </ul>	0.50	0.75	1.25
31.	Relocate object using Move command	<ul style="list-style-type: none"> <li>▪ Different methods of selecting objects for editing such as window, crossing, fence, all ... <ul style="list-style-type: none"> <li>• Base point</li> <li>▪ Second point of displacement</li> </ul> </li> </ul>	0.25	0.50	0.75
32.	Relocate object using rotate command	<ul style="list-style-type: none"> <li>▪ Define rotation angle</li> <li>▪ Explain Reference Point.</li> </ul>	0.25	0.50	0.75
33.	Duplicate object using Copy command	<ul style="list-style-type: none"> <li>▪ Differentiate Multiple copy and Single copy.</li> <li>▪ Explain the procedure for duplicating object using copy command.</li> </ul>	0.25	0.50	0.75
34.	Duplicate object using Mirror command	<ul style="list-style-type: none"> <li>▪ State the purpose of Mirror.</li> <li>▪ Explain First point and Second point of mirror line</li> <li>▪ Second point of mirror line</li> <li>▪ Describe options available in mirror command</li> </ul>	0.25	1.00	1.25
35.	Duplicate object using Offset command	<ul style="list-style-type: none"> <li>▪ Describe options available for <ul style="list-style-type: none"> <li>▪ Offset distance</li> <li>▪ Through</li> </ul> </li> </ul>	0.25	1.00	1.25
36.	Duplicate object using Array command	<ul style="list-style-type: none"> <li>▪ Differentiate Rectangular Array and Polar Array</li> <li>▪ Explain Rows, Columns and Distance, Center point, number, angle and rotation</li> </ul>	0.25	1.00	1.25
37.	Modify object using Break command	<ul style="list-style-type: none"> <li>▪ Define break line</li> <li>▪ Break the selected object between two points</li> </ul>	0.25	0.5	0.75
38.	Modify object using Explode command	<ul style="list-style-type: none"> <li>▪ Define explode</li> <li>▪ Break a compounded object into its component object</li> </ul>	0.25	0.5	0.75

39.	Modify object using Trim command	<ul style="list-style-type: none"> <li>▪ Define Cutting edge</li> <li>▪ Explain the options available for trimming object (project, edge, undo)</li> </ul>	0.25	0.50	0.75
40.	Modify object using Extend command	<ul style="list-style-type: none"> <li>▪ Define Boundary edge</li> <li>▪ State the procedure for modifying object using Extend command.</li> </ul>	0.25	1.00	1.25
41.	Modify object using Fillet command	<ul style="list-style-type: none"> <li>▪ Differentiate Chamfer and Fillet.</li> <li>▪ Explain the options available for filleting object i.e. fillet radius</li> </ul>	0.25	0.50	0.75
42.	Modify object using chamfer command	<ul style="list-style-type: none"> <li>▪ Explain the options available for chamfering object i.e. Distance, angle</li> </ul>	0.25	0.50	0.75
43.	Create a Layer	<ul style="list-style-type: none"> <li>▪ Define Layer.</li> <li>▪ Explain different attributes and properties of a Layer (Line type, line weight, Global Scale Factor, Current Object Scale, Names, Of/Off, Freeze/Thaw, Lock/unlock, Color, Plot style, Plot/don't plot)</li> <li>▪ Explain the procedure for creating a layer.</li> </ul>	0.75	2.00	2.75
44.	Create text and text styles.	<ul style="list-style-type: none"> <li>▪ Differentiate Single line text [TEXT] and Multiline Text [MTEXT]</li> <li>▪ Explain Style name, Font Name, Style and Height</li> <li>▪ Describe Font effect, Width factor and Oblique angle</li> <li>▪ Explain the procedure for creating text styles.</li> </ul>	0.50	1.00	1.5
45.	Edit text	<ul style="list-style-type: none"> <li>▪ Multiline Text Editor <ul style="list-style-type: none"> <li>• Character</li> <li>• Properties</li> <li>• Line spacing</li> <li>• Find/replace, import text</li> <li>• Layer and symbol</li> </ul> </li> </ul>	0.25	1.00	1.25
46.	Hatch the sectional area	<ul style="list-style-type: none"> <li>▪ Define hatching.</li> <li>▪ Differentiate ISO Hatch Pattern, User Defined Hatch Pattern, Pre-Defined Hatch and Associative Hatch</li> <li>▪ Explain Boundary set, copying of hatch properties, pick point, hatch angle, scale, pattern, and object selection.</li> <li>▪ modify the hatched pattern</li> </ul>	0.50	2.00	2.5

47.	Create Block	<ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Name</li> <li>▪ Pick point</li> <li>▪ selection</li> </ul>	0.25	1.00	1.25
48.	Add dimensions to a drawing	<ul style="list-style-type: none"> <li>▪ Interpret dimension elements (dimension text, lines and arrowheads, leader, extension lines, units, tolerance and center marks)</li> <li>▪ Describe dimension types (linear, aligned, ordinate, radius, diameter, angular, baseline and continue)</li> <li>▪ Dimension dialog box <ul style="list-style-type: none"> <li>▪ Lines and arrow</li> <li>▪ Dimension and text</li> <li>▪ Fit</li> <li>▪ Unit</li> <li>▪ Tolerances</li> </ul> </li> <li>▪ Modify Dimension style</li> <li>▪ Dimension in isometric drawing</li> </ul>	0.50	1.00	1.5
49.	Configure Plotters/Printers	<ul style="list-style-type: none"> <li>▪ Define Plotter Manager</li> <li>▪ Explain Plot Style Manager</li> <li>▪ State the Printer/Plotter Installation process</li> </ul>	0.5	1.0	1.5
50.	Plot drawing	<ul style="list-style-type: none"> <li>▪ Explain paper size and paper units, drawing orientation, plot area and plot scale, plot offset.</li> <li>▪ Describe the procedure for printing a drawing.</li> </ul>	0.5	1.0	1.5
51.	Prepare the following drawings and submit (e-copy and hard copy both) using CAD software. ( Project Work) <ul style="list-style-type: none"> <li>• Draw Isometric/ Oblique drawing</li> <li>• Draw Orthographic drawing</li> <li>• Dimensioning in Orthographic and Isometric drawing.</li> <li>• Create Electrical Symbol.</li> <li>• Layout and wiring diagram.</li> <li>• Civil /Architectural/Electrical plan</li> <li>• Motor control system.</li> </ul>		0	23.0	23
<b>Total</b>			<b>44</b>	<b>190</b>	<b>195</b>

**References Books:**

- Electrical Engineering Drawing - Gupta
- Electrical Estimating and Costing - A K Shawney
- Electric Circuit Diagram -GTZ Handout
- Motor Rewinding - Rosenberg
- Electro Westernman table
- Engineering Drawing – N.D. Bhatta
- Engineering Drawing - W. J Lujadhar
- आधारभूत कम्प्युटर परिचय भाग १, २ र ३ - कमल भट्टराई
- Kognet learning solution, *Simple steps in AutoCAD*, Dream tech press, India
- George Omura, *Mastering AutoCAD 2013 and AutoCAD LT 2013*, India

**Required Tools and Instrument**

	• Auto CAD software
• Compass	• Computer
• Drawing Board	• Drawing sheet
• Drawing sheet/paper	• Eraser
• Pencil	• Protector
• Rotary Pen (set) etc	• Ruler
• Set square	• T square
• Tape	•

## Electro-Technology

**Course nature: Theory**  
**Full Marks: 100**

**Class per Week: 4**  
**Total hours: 156**

<b>Subject 6: Electro-technology</b>	
<b>Description:</b>	This subject provides to equip selected general SLC graduates with Electro-Technology knowledge required for performing electrical installation of domestic, commercial and industrial complexes.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>▪ Apply personal, equipment, machine, tools and workplace safety including electrical rules.</li> <li>▪ Identify tools, equipment, machines, materials used in electrical system</li> <li>▪ Apply the standard terms and terminologies used by electricians.</li> <li>▪ Explain SI definitions, constitution of matter, and fundamental laws of electricity and electromagnetism.</li> <li>▪ Explain the basic concept and utilization of power generation, transmission and distribution</li> <li>▪ Explain, define and solve problems in D.C. and A.C. single and three phase circuits.</li> <li>▪ Explain and apply the principles of operation, function and construction of electrical machines.</li> <li>▪ Explain and apply electrical measuring instrument and measurement.</li> <li>▪ Explain and apply switchgear, control and protection devices</li> </ul>

S.N.	Skills	Contents	Time hrs.
1.	Apply electricity rules and regulations	<b>Electricity rules and regulation</b> <ul style="list-style-type: none"> <li>• Concept of electrical energy development in Nepal</li> <li>• Rules for – consumer, standard voltage for distribution</li> <li>• Concept of NEA code of practice</li> </ul>	2
2.	Explain: <ul style="list-style-type: none"> <li>• Modern theory of electron</li> <li>• Structure of Atom</li> </ul>	<b>Constitution of matter</b> <ul style="list-style-type: none"> <li>• Concept of modern electron theory: Matter, Molecule, Atom, Protons, Neutrons, Electrons</li> <li>• Structure of Atom</li> </ul>	3
3.	Explain advantages and application of A.C. and D.C.	<b>Fundamental SI definitions</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and Application</li> <li>• Advantages and disadvantages</li> </ul>	6
	Define : <ul style="list-style-type: none"> <li>• EMF and P.D.</li> <li>• Current, voltage, resistance and power</li> <li>• Cells and battery</li> </ul>	<ul style="list-style-type: none"> <li>• Current, Voltage and Resistance and their measuring units</li> <li>• Cells and batteries</li> <li>• EMF and potential difference</li> </ul>	

4.	<p>Explain :</p> <ul style="list-style-type: none"> <li>• Law of conservation of energy</li> <li>• Ohm's law</li> <li>• Kirchhoff's law and their application</li> <li>• Laws of resistance</li> <li>• Specific resistance</li> <li>• Effect of temperature on resistance</li> <li>• Connection of cells and battery</li> </ul>	<p><b>Laws of electricity</b></p> <ul style="list-style-type: none"> <li>• Law of conservation of energy</li> <li>• Ohm's law</li> <li>• Kirchhoff's laws</li> <li>• Laws of resistance</li> <li>• Specific resistance</li> <li>• Effect of temperature on resistance, temperature co-efficient of resistance</li> <li>• Connection of cells and battery</li> <li>• Effects of electric current</li> </ul>	20
5.	<p>Explain</p> <ul style="list-style-type: none"> <li>• Conductor and insulator</li> <li>• Metal and non-metal</li> <li>• Ferrous/non ferrous metal</li> </ul>	<p><b>Engineering materials</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Properties</li> </ul>	8
6.	<p>Explain and compare :</p> <ul style="list-style-type: none"> <li>• Resistances in series and parallel</li> <li>• Relation of voltage, current, resistance, and power in series and parallel circuits</li> </ul>	<p><b>Electrical circuits</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Comparison</li> <li>• Relation of voltage, current, resistance, and power in series and parallel circuits</li> </ul>	12
7.	<p>Explain work, energy and power in electric circuit and their measuring units</p>	<p><b>Work, power and Energy</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Measuring units in M.K.S. and F.P.S. system</li> </ul>	4
8.	<ul style="list-style-type: none"> <li>• Explain the importance of magnetism in electricity</li> <li>• Define magnetic terms and their measuring units</li> </ul>	<p><b>Magnetism Electromagnetism</b></p> <ul style="list-style-type: none"> <li>• Importance of magnetism in electricity</li> <li>• Magnetism terms- magnetic poles, magnetic axis, magnetic field, magnetic lines of force, magnetic flux, magnetic field strength, magnetic force (MMF) magnetic field intensity, reluctance, permeability</li> <li>• Properties of lines of force</li> <li>• Dimagnetic, Paramagnetic, Ferromagnetic materials</li> </ul>	16

	<ul style="list-style-type: none"> <li>• Explain electromagnetism and its laws</li> <li>• Explain magnetic losses</li> </ul>	<ul style="list-style-type: none"> <li>• Advantages of electro-magnetism</li> <li>• Laws of electromagnetism</li> <li>• Faraday's law of electromagnetic induction</li> <li>• Comparison between electric circuit and magnetic circuit</li> <li>• Self and mutual inductance</li> <li>• Eddy current and Hysteresis loss</li> </ul>	
9.	<p>Define:</p> <ul style="list-style-type: none"> <li>• Period, Cycle or frequency</li> <li>• Amplitude, Peak</li> <li>• Instantaneous and R.M.S. values</li> <li>• Form factor, in phase, out of phase</li> <li>• Inductance and inductive reactance</li> <li>• Capacitance and capacitive reactance</li> </ul>	<p><b>AC definition and circuit</b></p> <ul style="list-style-type: none"> <li>• Comparison between A.C. and D.C.</li> <li>• Definition of : <ul style="list-style-type: none"> <li>○ Period</li> <li>○ Cycle or frequency</li> <li>○ Amplitude</li> <li>○ Peak</li> <li>○ Instantaneous and R.M.S. values,</li> <li>○ Form factor, peak factor in phase, out of phase</li> <li>○ Inductance and inductive reactance</li> <li>○ Capacitance and capacitive reactance,</li> </ul> </li> </ul>	20
	<p>Explain and solve simple A.C. circuits</p> <ul style="list-style-type: none"> <li>• Poly phase A.C.</li> </ul>	<ul style="list-style-type: none"> <li>• Condensers in series and parallel</li> <li>• Impedance</li> <li>• Addition of vectors</li> <li>• Pure resistive, inductive and capacitive circuit in A.C</li> <li>• Impedance triangle and power factor</li> <li>• Cause of low power factor in industrial areas and its improvement</li> <li>• Single and three phase circuits</li> </ul>	
10.	<p>Explain the basic concept of energy sources and power generation in Nepal</p>	<p><b>Generation, transmission, distribution and Utilization of Electrical power</b></p> <ul style="list-style-type: none"> <li>• Sources of electrical Energy in Nepal:</li> <li>• Production of power sources: <ul style="list-style-type: none"> <li>• Solar and wind power station</li> <li>• Hydroelectric power station</li> <li>• Diesel and thermal power station etc.</li> </ul> </li> <li>• Power development of Nepal</li> <li>• Total Power Generation of Nepal</li> </ul>	20
	<p>Describe basic concept in sub-station and sub-station equipment</p>	<p>Concept of sub-station:</p> <ul style="list-style-type: none"> <li>• Sub-station equipment</li> <li>• Circuit breakers</li> <li>• Isolators</li> <li>• Bus-bars</li> <li>• Lightning arrestors</li> <li>• Types of sub-station</li> </ul>	

		<ul style="list-style-type: none"> <li>• Pole type sub station</li> <li>• Out door sub station</li> <li>• Indoor sub station</li> <li>• Switchgear, control and protection devices</li> </ul>	
	Explain transmission system	<ul style="list-style-type: none"> <li>• Importance of transmission system</li> <li>• Concept of tower, pole, hardware and Insulators</li> <li>• Advantages of H.V. Transmission</li> </ul>	
	Describe distribution system and service connection	<ul style="list-style-type: none"> <li>• Methods of power distribution</li> <li>• Comparison between overhead line and Underground cable</li> <li>• Domestic service connection and its components (feeder, distributor, service mains)</li> <li>• Poles, insulators, stay set and other accessories</li> <li>• Voltage ranges</li> <li>• Conductor spacing and sag</li> </ul>	
	Explain utilization of electric power Explain illumination and its units Control and protection	<ul style="list-style-type: none"> <li>• Utilization of electrical energy</li> <li>• Agricultural sector</li> <li>• Industrial sector</li> <li>• Domestic sector</li> <li>• Commercial sector</li> <li>• Transportation sector</li> <li>• Concept of illumination</li> <li>• Luminous flux, intensity</li> <li>• Candle power and solid angle</li> <li>• Concept of energy efficiency</li> <li>• Relays</li> <li>• Lighting arrestor</li> <li>• System earthing</li> <li>• Equipment earthing</li> </ul>	
<b>11.</b>	<b>Electrical Machines</b> Define and explain the basic construction and working of electrical machines	<p>Definition, Basic construction, working principles and types of :</p> <ul style="list-style-type: none"> <li>• D.C. generator and its types</li> <li>• Alternator</li> <li>• Transformer</li> <li>• EMF equation of transformer</li> <li>• Transformer ratio</li> <li>• Transformer tests and losses</li> <li>• Parallel operation of alternator and transformer</li> </ul> <p><b>D.C and A.C. Motors</b> <b>(Definition, Basic construction, working principles)</b></p> <ul style="list-style-type: none"> <li>• Single phase</li> <li>• Three phase motors</li> <li>• Split phase motor</li> </ul>	25

		<ul style="list-style-type: none"> <li>• Synchronous motors</li> <li>• Capacitor start induction motor</li> <li>• Capacitor start capacitor run motors</li> <li>• Universal and sheded pole motors</li> <li>• Permanent capacitor motors</li> <li>• Principle of induction motor</li> <li>• Torque formula</li> <li>• Motor speed and sleep</li> </ul>	
<b>12.</b>	Explain and apply electrical measuring instrument and measurement	<p><b>Electrical measuring instruments</b></p> <ul style="list-style-type: none"> <li>• Concept of measuring units of electrical quantities</li> <li>• Types of measuring Instrument</li> </ul> <p>Basic Construction of measuring instruments on the basis of:</p> <ul style="list-style-type: none"> <li>• Working principles</li> <li>• Construction</li> <li>• Measurement</li> </ul> <p>Basic Concept of different torques</p> <p>Construction and working principles of:</p> <ul style="list-style-type: none"> <li>• Megger</li> <li>• Earth tester</li> <li>• Single and Three phase Energy meter</li> <li>• Watt meters</li> <li>• Power factor meter</li> <li>• Frequency meter</li> <li>• Synchroscope</li> <li>• Lux meter</li> </ul> <p>Increasing range of measuring instruments</p> <ul style="list-style-type: none"> <li>• Concept and use of C.T. and P.T.</li> <li>• Measurement of specific gravity of electrolyte in battery</li> </ul>	20
		<b>Total</b>	<b>156</b>

**References Books:**

- Basic Electrical Engineering - M.L.Anwani
- Text Book of Electrical Engineering – B. L. Theraja
- Installation Servicing and Maintenance – S.N.Bhattacharya
- Generation, transmission and utilization of electrical power – A. T. Star
- Generation, transmission and utilization of electrical power – A. K. Showny
- Basic electrical engineering volume I and II – P.S. Dhogal
- NEA Rules and Standards
- Skill Standards for Building and Industrial Electrician Level 1, 2 & 3– NSTB, CTEVT

**Required Materials**

- Board Markers
- Paper Markers
- Charts
- Demonstration kit
- Graphs
- Overhead projectors
- Photographic visuals etc.

## Motor Installation and Control System

**Course nature: Practical**  
**Full Marks: 130**

**Class per Week: 5 hrs.**  
**Total Class: 195 hrs.**

<b>Subject 7: Motor Installation and Control System</b>	
<b>Description:</b>	This subject provides skill and knowledge related to motor installation and control system of single and three phase electrical system.
<b>Objectives:</b>	At the end of the course the participants will be able to: <ul style="list-style-type: none"> <li>• Interpret connection diagram of three phase induction motors.</li> <li>• Connect three phase induction motors with various control and protection arrangements.</li> <li>• Connect and start three phase induction motor using PLC</li> </ul>

S.N.	Skill	Related Technical Knowledge	Time Hours		
			Th.	Pr.	Total
1.	Install DOL starter to control induction motor.	<b>3-Phase starter/single phase (Relay,contractor,switch,multi-meter and MCB)</b> <ul style="list-style-type: none"> <li>•Introduction</li> <li>•Types</li> <li>•Importance and uses</li> <li>•Function</li> <li>• Advantages and limitations</li> <li>• Procedure</li> <li>• Control and power circuit diagram</li> <li>• Log Book/work report</li> </ul>	3	14	17
2.	Install forward/reverse starter to control 3 phase induction motor (two direction motor.	<b>3-Phase starter (forward/reverse)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>•Types</li> <li>•Importance and uses</li> <li>•Function</li> <li>• Advantages and limitations</li> <li>• Procedure</li> <li>• Control and power circuit diagram</li> <li>• Log Book/work report</li> </ul>	4	21	25
3.	Install star/delta starter (manual) to control 3 phase induction motor.	<b>3-Phase starter (star/delta)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>•Types</li> <li>•Importance and uses</li> <li>•Function</li> <li>• Advantages and limitations</li> <li>•Procedure</li> <li>• Control and power circuit diagram</li> <li>• Log Book/work report</li> </ul>	4	22	26
4.	Install star/delta starter (semi-auto) to control 3 phase induction motor.	<b>Star/delta semi- automatic</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>•Types</li> </ul>	4	22	26

		<ul style="list-style-type: none"> <li>● Importance and uses</li> <li>● Function</li> <li>● Advantages and limitations</li> <li>● Procedure</li> <li>● Control and power circuit diagram</li> <li>● Log Book/work report</li> </ul>			
5.	Install star/delta starter (automatic) to control 3 phase induction motor.	<b>Star/delta automatic</b> <ul style="list-style-type: none"> <li>● Introduction</li> <li>● Types</li> <li>● Importance and uses</li> <li>● Function</li> <li>● Advantages</li> <li>● Procedure</li> <li>● Control and power circuit diagram</li> <li>● Log book/work report</li> </ul>	4	21	25
6.	Install slip ring starter to control slip ring motor.	<b>3-Phase starter slip ring motor (Compact)</b> <ul style="list-style-type: none"> <li>● Introduction</li> <li>● Types</li> <li>● Importance and uses</li> <li>● Function</li> <li>● Advantages and limitations</li> <li>● Procedure</li> <li>● Control and power circuit diagram</li> <li>● Log book/work report</li> </ul>	2	14	16
7.	Install PLC starter for 3 phase induction motor control (DOL starter)	<b>3 phase starter ( PLC, Relay, Contractor, switch)</b> <ul style="list-style-type: none"> <li>● Introduction</li> <li>● Types</li> <li>● Importance and uses</li> <li>● Function</li> <li>● Advantages and limitations</li> <li>● Procedure</li> <li>● Control and power circuit diagram</li> <li>● Log book/work report</li> </ul>	4	17	21
		<b>Total</b>	<b>25</b>	<b>131</b>	<b>156</b>

**Reference Books:**

- Basic Electrical Engineering- A.L Anwani
- Basic Electrical Engineering- M.L Anwani
- Basic Electrical Engineering- P.S. Dhogal

## Required Tools and Equipment

• Ammeter	• Cable Drum (Extension Cord)
• Clamp on Meter	• Combination Plier
• Crimping tools	• DC Shunt Motor
• Electrical Knife	• Frequency Meter
• Hammer	• Long Nose Plier
• Marking Scriber	• Measuring Tape
• Meggar meter	• Phase Tester
• Programmable Logic Control (PLC)	• Portable drill Machine
• Safety Gloves	• Screw Driver set
• Side cutter	• Single Phase Induction Motor
• Slide wrench	• Slip ring Induction motor
• Tacho meter	• Three Phase Induction Motor
• Voltmeter	• Wire Striper

## Required Materials

• Bi metal relay	• Cable Shoe
• Cable Tie	• Cartridge fuse
• Connector	• Contactor
• DOL Starter	• ELCB
• Flexible Wire	• Indicator
• Nut bolts	• PVC Insulated Wire
• Screws	• Selector Switches
• SP MCB	• Time Relay Switch
• TP MCB	•

## Power Distribution System

**Course nature: Practical**  
**Full Marks: 50**

**Class per Week: 2 hrs.**  
**Total Class: 78 hrs.**

<b>Subject 8: Power Distribution System</b>	
<b>Description:</b>	This subject provides skill and knowledge related to the overhead primary distribution line 11KV and secondary distribution line 400/230V, construction of the distribution system and service connection to the customers.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>• Apply safety rules, tools and equipment.</li> <li>• Follow NEA distribution rules and regulations.</li> <li>• Follow 11KV &amp; 400/230V overhead line construction standards of NEA.</li> <li>• Familiarize with 11 KV and 400V/230V distribution System.</li> <li>• Select proper ACSR conductors &amp; ABC cables.</li> <li>• Familiarize with pole erection</li> <li>• String ACSR conductors on 11KV and 400/230V poles.</li> <li>• Install fitting accessories of ABC Cable &amp; ACSR conductors.</li> <li>• Install Stay on poles of 11 KV and 400/230 V lines.</li> <li>• Install earthing on pole mounted transformers.</li> <li>• Demonstrate 11 KV primary and 400/230V secondary distribution lines, Pole mounted transformers.</li> <li>• Connect service line to the consumers.</li> </ul>

S.N.	Skills	Contents	Time hrs.		
			Th.	Pr.	Total
Unit 1.	<b>Overhead Line Construction</b>				
1.	Interpret occupational documentation.	<ul style="list-style-type: none"> <li>• Electrical drawing symbols and legends</li> <li>• Drawings, specifications and standards</li> <li>• NEA distribution rules &amp; regulations and 11 KV and 400/230 V overhead line construction standards.</li> </ul>	1	2	3
2.	Draw the single line diagram of distribution lines.	<ul style="list-style-type: none"> <li>• Electrical drawing standards</li> <li>• Symbols and legends</li> <li>• Process</li> <li>• Single line diagram of 11 KV feeders &amp; 400/230 distribution lines</li> <li>• NEA distribution rules &amp; regulations</li> <li>• NEA 11 KV and 400V/230V overhead line construction standards.</li> </ul>	1	4	5

3.	Perform route clearance.	<b>Route clearance</b> <ul style="list-style-type: none"> <li>• Importance</li> <li>• Tool &amp; equipment for clearing routes</li> <li>• Process</li> <li>• Safety</li> </ul>	1	2	3
4.	Install Guy wire on 11 KV & 400V/230V pole	<b>Guy wire installation</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and size of guy wire</li> <li>• Use of guy wire on 11 KV</li> <li>• Fitting accessories</li> <li>• Tools used</li> <li>• Process</li> <li>• Safety</li> </ul>	1	4	5
5.	String the Aluminum conductors steel Reinforced (ACSR) 11 KV & 400V/230V.	<b>ACSR conductors</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and size</li> <li>• Current carrying capacity</li> <li>• Commercial names</li> <li>• Advantages and disadvantages</li> <li>• Fitting accessories</li> <li>• Tools used</li> <li>• Process</li> <li>• Safety</li> </ul>	1	4	5
6.	String the Aerial Bundle Conductors (ABC) cable (11 KV & 400V/230V)	<b>Aerial Bundle Conductors (ABC) cable</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Size</li> <li>• Importance and use</li> <li>• Single and double suspension clamp of proper sizes</li> <li>• Anchor clamp</li> <li>• Fitting accessories</li> <li>• Tools used</li> <li>• Process</li> <li>• Safety</li> </ul>	1	4	5
7.	Introduce and Demonstrate pole mounted distribution transformer	<b>Transformer connection</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Size and capacity</li> <li>• Use</li> <li>• Process</li> <li>• Protective devices (D.O. fuse)</li> <li>• Gang operating switch</li> <li>• Lighting arrester</li> <li>• Channels of proper sizes</li> <li>• MCCB of proper capacity on the LT line of the transformer</li> <li>• Four core cable of proper for connection from LT side of the</li> </ul>	2	6	8

		transformer to the MCCB <ul style="list-style-type: none"> <li>• Safety</li> </ul>			
8.	Install earthing on the pole mounted transformer	<b>Earthing</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Type</li> <li>• Importance and use</li> <li>• Earthing materials</li> <li>• Measurement of earth</li> <li>• Process</li> <li>• resistance</li> </ul>	1	6	7
9.	Repair and maintain overhead line 380 V/11KV	<b>Repair and Maintenance of Overhead line 380 V/11KV</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Type</li> <li>• Importance</li> <li>• Testing and commissioning Process</li> </ul>	2	10	12
<b>Unit 2</b>		<b>Overhead Line Construction 400/230V</b>			
10.	Install/binding(pin, scale, disk insulator) D-iron and Shackle insulators on poles	<b>D-iron and shackle insulators</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Use</li> <li>• Fitting accessories</li> <li>• Tools used</li> <li>• Process</li> <li>• Safety</li> </ul>	2	12	14
<b>Unit 3</b>		<b>Underground cables</b>			
11.	<ul style="list-style-type: none"> <li>• Perform cable joint</li> <li>• Lay underground cable</li> </ul>	<b>Cable joint</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Importance and use</li> <li>• Components of cable joints</li> <li>• Cable joint material for overhead cable joint (Reychem)</li> <li>• Cable jointing materials for underground (straight through joint)</li> <li>• Process</li> <li>• Application</li> <li>• Use of trench</li> <li>• Process of trench</li> </ul>	2	4	6

Unit 4.	<b>Consumers' Service Line Construction 400/230Volts.</b>				
12.	Install & connect single phase and three phase consumers' service lines as per NEA's distribution rules and standards	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types, sizes</li> <li>• Consumer service lines</li> <li>• Concentric cables</li> <li>• Importance and use</li> <li>• Process</li> <li>• Wall bracket</li> <li>• Shackle insulator</li> <li>• NEA distribution rules &amp; regulations</li> <li>• Insulated connector for connection of concentric cable on ABC cable</li> <li>• Safety</li> </ul>	1	4	5
<b>Total</b>			<b>16</b>	<b>62</b>	<b>78</b>

**Reference Books:**

- NEA distribution rules and regulations
- 11 KV and 400/230 V construction standard of NEA
- Transmission and Distribution – Raina

**Required Tools & Equipment:**

• Insulated Tools	• Long rubber gloves
• Helmet	• Rubber shoes
• Safety belt	• Normal Sun glass
• Wooden or fiber laffer	• Insulatd cross spanner
• Mechanical dynamometer	• Shrink on end cap
• come along clamp for ABC cable	• Cable tensioner
• Mounting wedge	• Sabel
• Earth Tester	• Pik
• Come along clamp for ACSR conductor	• Other tools & equipment as per need

## Basic Electronics

**Course nature: Practical**  
**Full Marks: 80**

**Class per Week: 3 hrs.**  
**Total class: 117 hrs.**

<b>Subject 9 : Basic Electronics</b>	
<b>Description:</b>	This subject provides skill and knowledge related to basic electronics. This consists of simple electronics projects, simple design and general concept of digital electronics. It also covers electronics components used in electronics circuits.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>▪ Describe various electronics components.</li> <li>▪ Interpret their characteristics and applications.</li> <li>▪ Calculate the value of electronics components.</li> <li>▪ Test electronics components.</li> <li>▪ Design electronic circuits using diodes.</li> <li>▪ Construct voltage regulator with transistor and zener diode.</li> <li>▪ Construct NOT, AND, OR, NAND, NOR Logic gate in IC.</li> <li>▪ Apply safety precaution during electronics works.</li> </ul>

S.N.	Skills	Contents	Time Hours		
			Th.	Pr.	Total
1.	Calculate and check the value of fixed and variable resistor.	<b>Calculate the value of Resistor (Multi-meter and color code)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Purpose</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Function</li> <li>• Setting procedure</li> <li>• Advantage</li> <li>• Log book/ Work report</li> </ul>	2	12	14
2.	Check the value of capacitance	<b>Capacitor</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Advantage</li> <li>• Procedure</li> </ul>	2	8	10
3.	Check the value of Inductance	<b>Inductor</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Advantage</li> <li>• Procedure</li> </ul>	2	8	10
4.	Measure voltage and current in series and parallel circuit.	<b>Series and Parallel circuits</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Connection procedure</li> </ul>	2	12	14

5.	Perform silicon/germanium diode characteristic.	<b>Semiconductor diode</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Function</li> </ul> <b>Biases</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Advantage</li> <li>• Connection</li> </ul> <b>DC power supply, V/I curve</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Connection</li> </ul>	2	8	10
6.	Characterize Zener diode.	<b>Zener Diode</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses/application</li> <li>• Function</li> <li>• Advantage</li> </ul> <b>V/I curve</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> </ul>	2	5	7
7.	Perform bridge rectifier circuits.	<b>Rectifier Circuits</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Function</li> <li>• Connection</li> <li>• Advantage</li> <li>• Procedure</li> </ul> <b>Transformer (6-0-6), oscilloscope</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses</li> <li>• Types</li> <li>• Connection</li> <li>• Procedure</li> </ul>	2	8	10
8.	Perform transistor biasing plot and its characteristics.	<b>Transistor, biasing, data, amplification switching</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses/application</li> <li>• Types</li> <li>• Function</li> <li>• Advantage</li> <li>• Connection</li> <li>• Procedure</li> </ul>	4	10	14

9.	Construction voltage regulators with transistor and zener diode.	<b>Soldering Iron, Lead, PCB plate/matrix board, FeCl3</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Function</li> <li>• Advantage</li> <li>• Procedure</li> </ul>	2	12	14
10.	Perform NOT, OR, AND, NAND, NOR, Logic gate in IC	<b>Logic Gate ICs</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Importance and uses</li> <li>• Types</li> <li>• Function</li> <li>• Circuit diagram</li> <li>• Advantage</li> <li>• Procedure</li> </ul> <b>DC supply to the gate, bread board</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses</li> <li>• Advantage</li> <li>• Importance</li> </ul>	2	12	14
		<b>Total</b>	<b>22</b>	<b>95</b>	<b>117</b>

**Reference Books:**

- Principle of Electronics- V.K. Meheta
- Saral Basic Electronics- Hari Bahadur Paudel
- Four in one practical books- Ram Chandra Tiwari
- Digital Fundamental- Floyed

### Required tools and equipment

• Analogue multimeter	• Combination Plier
• Crimping Tools	• DC Ammeter
• DC power supply	• DC Voltmeter
• Digital IC Trainer	• Digital multimeter
• Di-soldering Pump	• Function Generator
• Jewelry screw driver set	• LCR Meter
• Line Tester	• Nose Plier
• Oscilloscope	• Portable drill machine Screw Driver
• Side Cutter	• Small dusting brush
• Soldering Iron	• Step Down Transformer
• Wire striper	•

### Materials List

• AC Cord	• Bread Board
• Color coded Wires	• Connection Wires
• Desoldering wire	• Digital IC
• Extension Cord	• Fixed Inductor
• Fixed Resistor	• Jumper
• Non Polar Capacitor	• NPN Transistor
• PCB Plate	• PNP Transistor
• Polar Capacitor	• Rectifier Diode
• Soldering lead, flux	• Soldering stand
• Tweezers	• Variable Capacitor
• Variable Inductor	• Variable Resistor
• Zener Diode	

# Entrepreneurship Development

**Total: 78 hrs**  
**Class/week: 2**

**Program: Electrical Engineering**  
**Subject: Entrepreneurship Development**

## Course description

This course is designed to impart the knowledge and skills on formulating business plan and managing small business in general. This course intends to deal with exploring, acquiring and developing enterprising competencies, identification of suitable business idea and developing of business plan.

## Course objectives

After completion of this course students will be able to:

1. Define business and entrepreneurship
2. Explore entrepreneurial competencies
3. Analyze business ideas and viability
4. Formulate business plan
5. Learn to manage small business

S.No.	Skills	Contents	Time (hrs)		
			T	P	Tot
<b>Unit 1: Introduction to Entrepreneurship</b>			5.75	4.08	9.83
1	Introduce business	Introduction of business: <ul style="list-style-type: none"> <li>• Definition of business/enterprise</li> <li>• Types of business</li> <li>• Classification of business</li> <li>• Overview of MSMEs(Micro, Small and Medium Enterprises) in Nepal</li> </ul>	1.5		1.5
2	<b>Define entrepreneur/entrepreneurship</b>	<u>Definition of entrepreneur:</u> <ul style="list-style-type: none"> <li>• Definition of entrepreneur</li> <li>• Definition of entrepreneurship</li> <li>• Entrepreneurship development process</li> </ul>	0.5	0.5	1.0
3	<b>Describe entrepreneur's characteristics</b>	<u>Entrepreneur's characteristics:</u> <ul style="list-style-type: none"> <li>• Characteristics of entrepreneurs</li> <li>• Nature of entrepreneurs</li> </ul>	0.67	0.83	1.5

4	Assess entrepreneur's characteristics	<u>Assessment of entrepreneur's characteristics:</u> <ul style="list-style-type: none"> <li>List of human characteristics</li> <li>Assessment of entrepreneurial characteristics</li> </ul>	0.5	1.0	1.5
5	Compare entrepreneur with other occupations	<u>Entrepreneur and other occupations:</u> <ul style="list-style-type: none"> <li>Comparison of entrepreneur with other occupations</li> <li>Types and styles of entrepreneurs</li> </ul>	1.0		1.0
6	Differentiate between entrepreneur and employee	<u>Entrepreneur and employee:</u> <ul style="list-style-type: none"> <li>Difference between entrepreneur and employee</li> <li>Benefit of doing own business</li> </ul>	0.5	0.5	1.0
7	Assess "Self"	<u>"Self" assessment:</u> <ul style="list-style-type: none"> <li>Understanding "self"</li> <li>Self disclosure and feedback taking</li> </ul>	0.6	0.4	1.0
8	<b>Entrepreneurial personality test:</b> <ul style="list-style-type: none"> <li>Assess "Self" inclination to business</li> </ul>	<u>Entrepreneurial personality test:</u> <ul style="list-style-type: none"> <li>Concept of entrepreneurial personality test</li> <li>Assessing self entrepreneurial inclination</li> </ul>	0.67	0.83	1.5
<b>Unit 2: Creativity and Assessment</b>			<b>6.5</b>	<b>4.0</b>	<b>10.5</b>
9	Create viable business idea	<u>Creativity:</u> <ul style="list-style-type: none"> <li>Concept of creativity</li> <li>Barriers to creative thinking</li> </ul>	1.67	0.33	2.0
10	Innovate business idea	<u>Innovation:</u> <ul style="list-style-type: none"> <li>Concept of innovation</li> <li>SCAMPER Method of innovation</li> </ul>	0.83	0.67	1.5
11	Transfer ideas into action	<u>Transformation of idea into action:</u> <ul style="list-style-type: none"> <li>Concept of transferring idea into action</li> <li>Self assessment of creative style</li> </ul>	1.0	0.5	1.5
12	Assess personal entrepreneurial competencies	<u>Personal entrepreneurial competencies:</u> <ul style="list-style-type: none"> <li>Concept of entrepreneurial competencies</li> <li>Assessing personal entrepreneurial competencies</li> </ul>	0.5	1.0	1.5
13	Assess personal risk taking attitude	<u>Risk taking attitude:</u> <ul style="list-style-type: none"> <li>Concept of risk</li> </ul>	1.5	1.0	2.5

		<ul style="list-style-type: none"> <li>• Personal risk taking attitude</li> <li>• Do and don't do while taking risk</li> </ul>			
14	Make decision	<p><b><u>Decision making:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of decision making</li> <li>• Personal decision making attitude</li> <li>• Do and don't do while making decision</li> </ul>	1.0	0.5	1.5
<b>Unit 3: Identification and Selection of Viable Business Ideas</b>			<b>0.83</b>	<b>3.42</b>	<b>4.25</b>
15	<p>Identify/ select potential business idea</p> <ul style="list-style-type: none"> <li>• Analyze strength, Weakness, Opportunity and Threat (SWOT) of business idea</li> </ul>	<p><b><u>Identification and selection of potential business:</u></b></p> <ul style="list-style-type: none"> <li>• Sources of business ideas</li> <li>• Points to be considered while selecting business idea</li> <li>• Business selection process</li> <li>• Potential business selection among different businesses</li> <li>• Strength, Weakness, Opportunity and Threats (SWOT) analysis of business idea</li> <li>• Selection of viable business idea matching to "self"</li> </ul>	0.83	3.42	4.25
<b>Unit 4: Business Plan</b>			<b>16.67</b>	<b>36.58</b>	<b>53.25</b>
16	Assess market and marketing	<p><b><u>Market and marketing:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of market and marketing</li> <li>• Marketing and selling</li> <li>• Market forces</li> <li>• 4 Ps of marketing</li> <li>• Marketing strategies</li> </ul>	1.33	0.75	2.08
17	<p><b>Business exercise:</b></p> <p>Explore small business management concept</p>	<p><b><u>Business exercise:</u></b></p> <ul style="list-style-type: none"> <li>• Business exercise rules</li> <li>• Concept of small business management</li> <li>• Elements of business management <ul style="list-style-type: none"> <li>• Planning</li> <li>• Organizing</li> <li>• Executing</li> <li>• Controlling</li> </ul> </li> </ul>	1.58	1.67	3.25
18	Prepare market plan	<p><b><u>Business plan/Market plan</u></b></p> <ul style="list-style-type: none"> <li>• Concept of business plan</li> <li>• Concept of market plan</li> <li>• Steps of market plan</li> </ul>	2.0	2.0	4.0
19	Prepare production plan	<p><b><u>Business plan/Production plan:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of production plan</li> </ul>	1.25	1.5	2.75

		<ul style="list-style-type: none"> <li>• Steps of production plan</li> </ul>			
20	Prepare business operation plan	<p><b><u>Business plan/Business operation plan:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of business operation plan</li> <li>• Steps of business operation plan</li> <li>• Cost price determination</li> </ul>	2.5	2.67	5.17
21	Prepare financial plan	<p><b><u>Business plan/Financial plan:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of financial plan</li> <li>• Steps of financial plan</li> <li>• Working capital estimation</li> <li>• Pricing strategy</li> <li>• Profit/loss calculation</li> <li>• BEP and ROI analysis</li> <li>• Cash flow calculation</li> </ul>	4.5	7.5	12.0
22	Collect market information /prepare business plan	<p><b><u>Information collection and preparing business plan:</u></b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Market survey <ul style="list-style-type: none"> <li>· Precaution to be taken while collecting information</li> <li>· Sample questions for market survey</li> <li>· Questions to be asked to the customers</li> <li>· Questions to be asked to the retailer</li> <li>· Questions to be asked to the stockiest/suppliers</li> </ul> </li> <li>• Preparing business plan</li> </ul>	2.0	13.0	15.0
23	Appraise business plan	<p><b><u>Business plan appraisal:</u></b></p> <ul style="list-style-type: none"> <li>• Return on investment</li> <li>• Breakeven analysis</li> <li>• Cash flow</li> <li>• Risk factors</li> </ul>	0.5	5.5	6.0
24	Maintain basic book keeping	<p><b><u>Basic book keeping:</u></b></p> <ul style="list-style-type: none"> <li>• Concept and need of book keeping</li> <li>• Methods and types of book keeping</li> <li>• Keeping and maintaining of day book and sales records</li> </ul>	1.0	2.0	3.0
<b>Total:</b>			<b>30</b>	<b>48</b>	<b>78</b>

**Text book:**

क) प्रशिक्षकहरूका लागि निर्मित निर्देशिका तथा प्रशिक्षण सामग्री, प्राविधिक शिक्षा तथा व्यावसायिक तालीम परिषद्  
२०६९

ख) प्रशिक्षार्थीहरूका लागि निर्मित पाठ्यसामग्री तथा कार्यपुस्तिका, प्राविधिक शिक्षा तथा व्यावसायिक तालीम परिषद्  
(अप्रकाशित), २०६९

**Reference book:**

Entrepreneur's Handbook, Technonet Asia, 1981.

## On the Job Training (OJT)

**Full Marks: 500**

**Practical: 24 weeks/960Hrs**

**Description:**

On the Job Training (OJT) is a 6 months (24 weeks/144 working days) program that aims to provide trainees an opportunity for meaningful career related experiences by working fulltime in real organizational settings where they can practice and expand their classroom based knowledge and skills before graduating. It will also help trainees gain a clearer sense of what they still need to learn and provides an opportunity to build professional networks. The trainee will be eligible for OJT only after attending the final exam. The institute will make arrangement for OJT. The institute will inform the CTEVT at least one month prior to the OJT placement date along with plan, schedule, the name of the students and their corresponding OJT site.

**Objectives:**

The overall objective of the On the Job Training (OJT) is to make trainees familiar with firsthand experience of the real work of world as well as to provide them an opportunity to enhance skills. The specific objectives of On the Job Training (OJT) are to;

- apply knowledge and skills learnt in the classroom to actual work settings or conditions and develop practical experience before graduation
- familiarize with working environment in which the work is done
- work effectively with professional colleagues and share experiences of their activities and functions
- strengthen portfolio or resume with practical experience and projects
- develop professional/work culture
- broaden professional contacts and network
- develop entrepreneurship skills on related occupation

**Activities:**

In this program the trainees will be placed in the real world of work under the direct supervision of related organization's supervisors. The trainees will perform occupation related daily routine work as per the rules and regulations of the organization as follows;

- Electrical installation
- Motor installation and control
- Power transmission and distribution
- Basic electronics
- Repair and maintenance,
- Electro-technology,
- Engineering drawing,

**Potential OJT Placement site:**

The nature of work in OJT is practical and potential OJT placement site should be as follows;

- National Planning Commission (National Volunteer Development Voluntary Service)
- Hydropower
- Nepal Electric Authority
- District Development Committee
- Municipality
- Industries:
  - Manufacturing
  - Product
  - Process

**Requirements for Successful Completion of On the Job Training:**

For the successful completion of the OJT, the trainees should;

- Submit daily attendance record approved by the concerned supervisor and minimum 144 working days attendance is required
- Maintain daily diary with detail activities performed in OJT and submit it with supervisor's signature
- Prepare and submit comprehensive final OJT completion report with attendance record and diary
- Secure minimum 60% marks in each evaluation

**Complete OJT Plan:**

SN	Activities	Duration	Remarks
1	Orientation	2 days	Before OJT placement
2	Communicate to the OJT site	1 day	Before OJT placement
3	Actual work at the OJT site	24 weeks/144 days	During OJT period
4	First-term evaluation	one week (for all sites)	After 6 to 7 weeks of OJT start date
5	Mid-term evaluation	one week (for all sites)	After 15 to 16 weeks of OJT start date
6	Report to the parental organization	1 day	After OJT placement
7	Final report preparation	5 days	After OJT completion

- First and mid-term evaluation should be conducted by the institute.
- After completion of 6 months OJT period, trainees will be provided with one week period to review all the works and prepare a comprehensive final report.
- Evaluation will be made according to the marks at the following evaluation scheme but first and mid-term evaluation record will also be considered.

**Evaluation Scheme:**

Evaluation and marks distribution are as follows:

S.N	Activities	Who/Responsibility	Marks
1	OJT Evaluation (should be three evaluation in six months –one evaluation in every two months)	Supervisor of OJT provider	300
2	First and mid- term evaluation	The Training Institute	200
	<b>Total</b>		500

**Note:**

- Trainees must secure 60 percent marks in each evaluation to pass the course.
- If OJT placement is done in more than one institution, separate evaluation is required from all institutions.

**OJT Evaluation Criteria and Marks Distribution:**

- OJT implementation guideline will be prepared by the CTEVT. The detail OJT evaluation criteria and marks distribution will be incorporated in the guidelines.
- Representative of CTEVT, Regional offices and CTEVT constituted technical schools will conduct the monitoring & evaluation of OJT at any time during the OJT period.