

CURRICULUM GUIDE

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TSLC in Electrical Engineering (Post SLC)



Council for Technical Education and Vocational Training

CURRICULUM DEVELOPMENT DIVISION

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Background

Energy is the basic necessity for the economic development of a country. Many functions necessary to present day living come to halt when the supply of energy stops. As a matter of fact, there is a close relationship between the energy used per person and his standard of living. Energy exists in different forms in nature but the most important form is the electrical energy.

The world is using many electrical appliances and equipment. We cannot imagine the world without Electrical devices. Eventhough 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. By doing so, Institute of Engineering can concentrate in preparing higher-level skilled workforce needed for the country. Thus, with the joint effort of CTEVT and Institute of Engineering, TU, and engineering faculties of all universities of the country together walk to materialize the concept of skill for all. In this new concept it will become more necessary or produce a huge number of TSLC graduates in electrical engineering to meet the target of the country without compromising quality of the training. To do so, CTEVT and private training institutions affiliated to CTEVT are starting to work for this great challenging task. In this context a well-developed curriculum is a fundamental pre-requisite for the training program. The foundation of the curriculum is the results of the DACUM workshop for TSLC in Electrical Engineering workforce, conducted in April 2010. The DACUM workshop produced an up-to date list of tasks performed by workers in Electrical Engineering sub-overseer occupation and therefore provided a valuable insight into what actually is required for such electrical workforces in this occupation. The next phase of developing this guide consisted of validating the task lists with a larger sample of electrical workforce and their users.

Having with the feedbacks after the successful implementation of this curriculum, CTEVT Curriculum Development Division organized a seminar of subject experts of long experience in the field. The experts rigorously worked for consecutive 10 days and the curriculum now is in this shape. It is believed that this revised curriculum of TSLC in Electrical Engineering will correct almost all the observed shortcomings.

Mostly the trained candidates are employed in the work of world, national and international organizations working as a basic level electrical workforce and rest are employed in NGOs and INGOs, which are working for the development of community of Nepal as well as in the international market and some of them are working as entrepreneurs placing emphasis on the preventive care and repair and maintenance of electrical devices.

Hence this curriculum is designed to be implemented in the technical schools under the CTEVT to produce workforce in the electrical fields. These graduates are awarded TSLC in Electrical Engineering and expected to the key workforces to install, operate, repair and maintenance of electrical system, machine and domestics devices.

Introduction

The Council for Technical Education and Vocational Training (CTEVT) has been running its post SLC intake Junior Electrical Technician (Electrical Sub-Overseer) program since 1997. Till date, this program had not been revised to incorporate new skills and technologies. During this first revision, the structure of the curriculum has been changed from the previous curriculum. Although it follows the same contents of older version new subjects and tasks are added according to the demand and new innovation in this field. The name of this program was Junior Electrical Technician (Electrical Sub-Overseer), but as per new provision the course given to the SLC passed people and 15 months program is given TSLC in the related field. So the name of the program is given TSLC in Electrical Engineering.

The competency based and market oriented curriculum for TSLC in Electrical Engineering is designed to produce competent skillful work force in electrical engineering equipped with knowledge, skills and attitudes. This curriculum focuses on the basic electrical works so as to contribute in the national streamline of the use of electrical engineering equipment and repair and maintenance of electrical devices used in the country. At the same time, this curriculum aims to offering ample of opportunity for employment in the related sector, mainly entrepreneurship development of the graduates as well as the employment in national and international employment market.

Aims

- To produce competent work force in electrical engineering able to provide services in different community.
- To produce such human resources through institutional training program followed by "On the job training (OJT)", providing sufficient skill needed in "The World of Work". The trainees will get maximum experience & exposure in related subject.
- This program will aim at producing capable electrical work force, who will be able to be an entrepreneur, or employed in Assistant Electrical Sub-engineer or Electrical overseer or equivalent post in national and international market of electrical field.

Objectives

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

- Familiarize with basic electrical engineering
- Install basic electricity
- 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/Course 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 12 months /52 weeks /1560 hours. In addition, trainees will be assigned 3-months/ 480 hours on-the-job training after completion of the course.

Target group

The target group for this training will be all the interested individuals of the country with academic qualification of SLC pass. Preference will be given to the individuals poor, female, Dalit, Janjati, Disadvantaged Groups (DAGs), conflict affected and differently able people as the rule of CTEVT.

Group size

The group size of this training program will be not more than 40.

Maximum 40 trainees in theory class and maximum 15 trainees will be in a group for practical.

Entry Requirements

Individuals who meet the following criteria will be eligible for this program:

- SLC pass
- Candidates will be selected on the basis of entrance examination or as per the CTEVT rule.
- Reservation quota for different category of students will be provided as the enrollment policy of CTEVT

Medium of instruction

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

Patterns of Attendance

40 hrs. per week for 39 weeks per year the students should have 90% attendance to be eligible for internal assessments and final examinations.

Teacher and Student Ratio

- Overall ratio of teacher and student must be 1:10 at the institution level.
- Teacher and student ratio for practical demonstration 1:12
- Teacher and student ratio for bench work 1:6
- Minimum of 75% of the teachers must be fulltime.

Instructional Media and Materials

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

- Printed Media Materials (assignment sheets, case studies, handouts, information sheets, Individual training packets, procedure sheets, performance check lists, textbooks etc.)
- Non-projected Media Materials (display, models, photographs, flip chart, poster, writing board etc.)
- Projected Media Materials (multi media, overhead transparencies, slides etc.)
- Audio-Visual Materials (Audio, films, slide-tape programs, videodiscs, videotapes etc.)
- Computer-Based Instructional Materials (computer-based training, interactive video etc.)

Teaching Learning Methodology

The methods of teachings for this curricular program will be a combination of several approaches. Such as illustrated talk, group discussion, demonstration, simulation, guided practice, practical experiences, fieldwork, report writing & presentation, role-playing, and other independent learning.

- **Theory:** Lecture, ediscussion, assignment, group work.
- **Practical:** Demonstration, observation, guided practice and individual practice.

Evaluation Details

Theory and Practical Evaluation

- 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.
- Related technical knowledge learnt by students will be evaluated through written tests.
- Students must score a minimum mark of 40% in written test and 60% in practical test in each subject separately.
- There will be three internal assessments and one final examination in each subject. Moreover, the mode of assessment/examination includes both written and practical test as per the nature of course.
- The ratio between the written and practical test will be 20:80 in case of a practical nature subject.
- 50% weightage is allotted for the internal assessments and the remaining is allotted for the final examination

- Candidate who fails in the final exam can appear in the re-test scheduled by CTEVT.

On the Job Training (OJT)

After completion of the final examination trainees will be sent for on the job training (OJT). Each school should plan for the OJT through discussion with representatives from user agencies and agree to a detailed plan for evaluating each trainee on the basis of the CTEVT guidelines.

The objective of the OJT

1. To make the trainees more practicable in the particular technical area.
2. To match the technical skills learn in the school with the needs of the employer.
3. To increase self-confidence in the student so that he/she can face the real world of work.
4. To make the employers feel the trainees to be their own employees and thus supervise the trainees activities in his duty so that employer is made to pay the trainees.
5. To ensure the standard of the training to keep pace with the requirement of the employer.

OJT Evaluation

1. 100 to be awarded by the supervisor of the trainee in the user agency.
2. 100 to be awarded by the relevant subject specialist from the school concerned.
3. 100 to be awarded by an expert appointed by the CTEVT.

Grading System

The grading system will be as follows:

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

Certificate Requirements

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

Career Path

The graduates will be eligible to work in the position of electrical sub-overseer in the government related organizations as prescribed by the Public Service Commission or the concerned authorities of the Republic of Nepal

Course Structure

Technical School Leaving Certificate (TSLC) in Electrical Engineering (Post SLC)

Time & marks allotment			Time allotment					Marks allotment					
S N	Subject Title	Nature	Hours/ week	Total class or hrs.				Th. (20%)		Pr. (80%)		Total	
				Th.	Pr.	Total	Int.	Ext.	Total	Int.	Ext.	Total	FM
1	Applied math	T	2	78	0	78	25	25	50	00	00	00	50
2	Bench Work	T+P	4	30	126	156	10	10	20	40	40	80	100
3	Electrical Installation (Domestic, Industrial & Commercial)	T+P	10	76	314	390	25	25	50	100	100	200	250
4	Repair & Maintenance	T+P	4	30	126	156	10	10	20	40	40	80	100
5	Engineering Drawing and Computer Application	T+P	6	44	190	234	15	15	30	60	60	120	150
6	Electro Technology	T	4	156	00	156	50	50	100	00	00	00	100
7	Motor Installation & Control System	T+P	4	30	126	156	10	10	20	40	40	80	100
8	Power Distribution System	T+P	2	16	62	78	5	5	10	20	20	40	50
9	Basic Electronics	T+P	3	22	95	117	7.5	7.5	15	30	30	60	75
10	Entrepreneurship Development	T	1	39	00	39	12.5	12.5	25	00	00	00	25
Total:			40	521	1039	1560	170	170	340	330	330	660	1000

On the job training	P	3 Months	480	300
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Practical areas

- a) Class and workshop 1560 hrs (12 Months)
- b) OJT - 480 hrs (3 Months)

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.

Subject 1: Applied Math	
Description:	This course provides skill and knowledge to solve the numerical problem related to the TSLC in Electrical Engineering course.
Objectives:	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> ▪ calculate and convert units. ▪ interpret graphical representation. ▪ calculate electrical parameters. ▪ apply and calculate different laws related to electrical fields. ▪ apply fundamental of AC circuits calculation. ▪ apply the different types of electrical machines' related calculation.

S.N.	Tasks/Topics	Related Technial Knowledge	Time Hours
1.	Workshop calculation <ul style="list-style-type: none"> • Length • Area • Volume • Trigonometry • Converion units 	Units and measurement <ul style="list-style-type: none"> • Introduction • SI units • Pythagorus theorem • Temperature • Formulae 	5
2.	Work, power and energy <ul style="list-style-type: none"> • Calculate work, power and energy • Calculate cost per unit. 	Work, power and energy <ul style="list-style-type: none"> • Introduction • Joule's law of electric heating • SI units • Unitary method • Formulae 	3
3.	Graphs and charts Interpret and present <ul style="list-style-type: none"> • Graph • Bar • Pie • Map 	Graphical representation <ul style="list-style-type: none"> • Introduction • Types • Process • Percentage 	2
4.	Linear equation <ul style="list-style-type: none"> • Calculate simple linear equation 	Linear equation <ul style="list-style-type: none"> • Introduction • Method 	2
5.	scalar and vector <ul style="list-style-type: none"> • Calculate scalar and vector quantity 	Scalar and vector quantity <ul style="list-style-type: none"> • Introduction • Speed • Velocity • Acceleration • Formulae 	2
6.	Fundamental of Electricity Calculate :	Fundamental of Electricity <ul style="list-style-type: none"> • Law of resistance • Ohm's law 	5

	<ul style="list-style-type: none"> • Resistance • Voltage • Current • Power 	<ul style="list-style-type: none"> • Kirchoff's law • Resistivity • Resistance in series and parallel circuit • Formulae 	
7.	Electromagnetic induction Calculate : <ul style="list-style-type: none"> • Self induction • Mutual induction • Coefficient of coupling • Induced e.m.f. • Inductance 	Electromagnetic induction <ul style="list-style-type: none"> • Introduction • Faraday's law • Lenz's law • series/parallel inductive circuit • Formulae 	6
8.	Capacitor Calculate : <ul style="list-style-type: none"> • Capacitance • Charge and potential difference • Energy store 	Capacitance <ul style="list-style-type: none"> • Coulomb's law • Charging and discharging • series/parallel capacitive circuit • Formulae 	4
9.	A.C Fundamental Calculate: <ul style="list-style-type: none"> • Cycle • Time period • Frequency • Average value • Effective value/RMS 	A.C Fundamental <ul style="list-style-type: none"> • Introduction • Formulae 	6
10	A.C. circuit Calculate: <ul style="list-style-type: none"> • resistance/capacitance/ inductance • R-L, R-C and R-L-C circuit • Impedance • Power factor • Phase angle • Active/reactive and apparent power • Resonance frequency 	A.C. circuit <ul style="list-style-type: none"> • Introduction • Pure resistive/capacitive/inductive circuit • Effect of power factor (low/high) • Series and parallel circuit • Formulae 	7
11	Poly-phase circuit Calculate : <ul style="list-style-type: none"> • Power • Current • Voltage 	Poly-phase circuit <ul style="list-style-type: none"> • Introduction • Work, power, energy in delta/star connection • Two watt meter method 	5
12	Illumination Calculate: <ul style="list-style-type: none"> • Illumination • Luminous flux • Intensity • Number of lamps 	Illumination <ul style="list-style-type: none"> • Introduction • Units • Law of Illumination • Formulae 	4

	<ul style="list-style-type: none"> Elaborated standard IS 		
13	Transformer Calculate: <ul style="list-style-type: none"> Input/output voltage No. of turns in primary/secondary Transmission ratio Losses and efficiency E.m.f. calculation Voltage regulation 	Transformer <ul style="list-style-type: none"> Introduction E.m.f. equation Transmission ratio Formulae 	7
	DC generator Calculate: <ul style="list-style-type: none"> Generator emf and terminal voltage Armature current and field current Losses (copper) Electrical, mechanical and commercial efficiency 	DC generator <ul style="list-style-type: none"> Introduction E.m.f. equation Formulae 	4
	Synchronous generator Calculate: <ul style="list-style-type: none"> Phase and line voltage Voltage regulation. Efficiency 	Synchronous generator <ul style="list-style-type: none"> Introduction Formulae 	4
	Synchronous motor Calculate: <ul style="list-style-type: none"> Synchronous speed. Back e.m.f. Mechanical power 	Synchronous motor <ul style="list-style-type: none"> Introduction Formulae 	4
	Induction motor Calculate: <ul style="list-style-type: none"> Synchronous speed Back e.m.f. Slip, Normal speed 	Induction motor <ul style="list-style-type: none"> Introduction Working principle Formulae 	4
	Calculate tariff <ul style="list-style-type: none"> Domestic Commercial 	Tariff <ul style="list-style-type: none"> Introduction Ratio and proportion Percentage Formulae 	4
		Total	78

Reference Books:

- Electrical Technology - B.L. Thereja
- Basic Electrical Engineering – M. L. Anwani

Bench Work

Course Nature: Practical

Class per Week: 4 hrs.

Full marks: 100

Total Class: 156 hrs.

Subject 2: Bench Work	
Description:	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.
Objectives:	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> ▪ Know hazards and observe safety rules. ▪ Identify, use and care of mechanical tools, instrument and machines. ▪ Perform basic operation related to mechanical work, such as: measure, mark, cut, bend, file, drill, rivet according to the specification . ▪ Perform sheet metal works. ▪ Perform gas welding.

S.N.	Task/Skill	Related Technical Knowledge	Time Hours		
			Th.	Pr.	Total
1.	Perform filling	Filling <ul style="list-style-type: none"> • Introduction • Types • tools/materials • Importance & Applications • Process • Safety precautions 	4	17	21
2.	Perform measuring and marking	Measuring & marking <ul style="list-style-type: none"> • Introduction • Types • Tools/materials • Importance & Applications • Process • Safety precautions 	1	6	7
3.	Perform the punching	Letter/number/centre punch <ul style="list-style-type: none"> • Introduction • Types & size • Tools/materials • Importance & Applications • Process • Safety precautions 	2	12	14
4.	Perform the sawing	Sawing <ul style="list-style-type: none"> • Introduction • Types • Tools/materials • Importance & Applications • Process • Safety precautions 	1.5	5.5	7

5.	Perform the drilling	Drilling <ul style="list-style-type: none"> • Introduction • Types & Parts • Tools/materials • Importance & Applications • Process • Method of selection RPM and drill bit size • Safety precautions 	2	12	14
6.	Perform Tapping/die.	Thread cutting (Tapping/Die) <ul style="list-style-type: none"> • Introduction • Types • Importance and uses • Procedure of tapping and die • Applications • Safety precautions 	1.5	5.5	7
7.	Perform Sheet metal work (figure cutting)	sheet metal <ul style="list-style-type: none"> • Introduction • tools and materials • Application • Safety precautions 	2	5	7
		Folding <ul style="list-style-type: none"> • Introduction • Types • Importance and uses • Methods • Safety precautions 	3	11	14
		Riveting <ul style="list-style-type: none"> • Introduction • Importance and application • Types • Uses • Methods 	2	9	11
8.	Perform the bending (PVC & Metal Conduit)	Bending (PVC & Metal Conduit) <ul style="list-style-type: none"> • Introduction • Importance and application • Types • Methods • Safety precautions 	3	11	14
9.	Perform joint work (Gas welding)	Gas welding <ul style="list-style-type: none"> • Introduction • Types • Methods & Applications • tools/equipment • Safety precautions 	8	32	40
		Total	30	126	156

Reference Book:

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

Required Tool and Equipment

• 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	• Varnier caliper
• Letter punch	• V-block
• Mallet	• Welding Machine
• Marking scriber	• 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 sas	

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: 250

Class per week: 10 hrs.
Total Class: 390

Subject 3: Electrical Installation	
Description:	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.
Objectives:	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> ▪ select electrical tools, equipment, materials, accessories, fitting and safety device as per drawing. ▪ install panel board, capacitor bank, cable tray, lightning arrester, PABX, telephone distribution board. ▪ interpret lay out and wiring diagram, ▪ perform board wiring and brick wall wiring. ▪ instal supporting assocoessories (PVC conduit, metal box, distribution box, L.T. cable etc.) ▪ perform wiring system and electrical safety test, ▪ connect and control single & three phase motor system

S.N.	Task/Skill	Related Technical Knowledge	Time Hours		
			T	Pr.	Total
1.	Handle electrical tools and equipment.	Tools and equipment for Electrical installation <ul style="list-style-type: none"> • Introduction • Types • Importance & use • safety 	5	20	25
2.	Select the electrical materials	Electrical materials <ul style="list-style-type: none"> • Introduction • Types • Importance and use 	5	20	25
3.	Select electrical accessories	Electrical accessories <ul style="list-style-type: none"> • Introduction • Types • Importance & use 	5	20	25
4.	Select protective device.	Protective device <ul style="list-style-type: none"> • Introduction • Types • Importance & use 	4	16	20
5.	Provide first aid services Perform simulation first aid to simulated electrocuted person	First aid <ul style="list-style-type: none"> • Introduction • Importance and application • Process 	1	3	4
6.	Install electrical fitting	Electrical fitting <ul style="list-style-type: none"> • Introduction • Types 	5	20	25

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

14	<p>Install panel board (LT)</p> <ul style="list-style-type: none"> • Isolating switch (single and three phase) • Energy meter (single and three phase) • Bus Bar three phases four wire. • Ammeter and voltmeter with selector switch. • Frequency meter. • CT, PT <ul style="list-style-type: none"> ▪ Bank of capacitor ▪ Cable glanding and termination 	<p>Panel board and components</p> <ul style="list-style-type: none"> • Introduction • Types • Controlling and protective devices • Importance and application • Process • safety 	6	27	33
15	<p>Perform earthing and install lightning arrester.</p>	<p>Earthing and lightning arrester</p> <ul style="list-style-type: none"> • Introduction • Importance and application • Types • Process of earthing 	3	12	15
16	<p>Install PABX, telephone distribution board and tag.</p>	<p>PABX telephone distribution board and tag.</p> <ul style="list-style-type: none"> • Introduction • Types • Importance and application • color code and tag termination method. • Process • safety 	2	20	22
17	<p>Perform three phase motor wiring and install change over switch.</p>	<p>Motor connection</p> <ul style="list-style-type: none"> • Introduction • Types • Controlling and protective devices • Importance and application • safety 	4	16	20
18	<p>Connect single and three phase supply.</p>	<p>Supply connection (single & three phase)</p> <ul style="list-style-type: none"> • Introduction • Types • Importance and application • Process • safety 	2	8	10
19	<p>Test electrical safety.</p> <ul style="list-style-type: none"> • Insulation test. • Earth test • Continuity test 	<p>Electrical safety test</p> <ul style="list-style-type: none"> • Introduction • Types • Importance and application • Process • safety 	2	8	10
20	<p>Operate isolating switch</p>	<p>Isolating switches</p>	2	8	10

	<ul style="list-style-type: none"> • MCB • MCCB • ACB • OCB 	<ul style="list-style-type: none"> • Introduction • Types • Importance and application • Process • safety 			
21	Perform circuit test. <ul style="list-style-type: none"> • Open • Close • Short 	Circuit test <ul style="list-style-type: none"> • Introduction • Types • Importance and application • Process • safety 	2	8	10
22	Identify energy conservation and perform solar home system installation	Solar home system <ul style="list-style-type: none"> • Introduction • Importance and application • Components • Process • Safety 	3	7	10
Total			76	314	390

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: 100

Class per Week: 4 hrs.
Total hours: 156 hrs.

Subject: 4: Repair & Maintenance	
Description:	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.
Objectives:	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> ▪ repair and maintenance of domestic appliances. ▪ repair and maintenance of Industrial machine and tools. ▪ develop simple lay out and wiring diagram of different types of electric machine/equipment and appliances. ▪ disassemble and assemble various types of electrical machine and equipment. ▪ perform basic maintenance of transformer ▪ perform single phase and three phase motor rewinding. ▪ apply safety precautions for electrical repair and maintenance work.

S.N.	Task/Skill	Related Technical Knowledge	Time hrs		
			Th	Pr.	Total
1.	Repair/maintenance electrical appliances and accessories (Immersion heater/rod, Iron, kettle, hot plate and switches)	<p>Concept of preventive and corrective maintenance</p> <p>Immersion heater, rod heater, Iron, Kettle, Hotplate, heating element</p> <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	1	3	4
2.	Repair/maintenance electrical, Cooker, oven, geyser.	<p>Electrical Cooker, oven, Geyser, heating element</p> <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	0.5	3.5	4
3.	Repair and maintain electrical toaster.	<p>Electrical toaster</p> <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process 	0.5	1.5	2

		<ul style="list-style-type: none"> • connection diagram • Log book/ work report 			
4.	Repair and maintain emergency light.	Emergency light <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	0.5	1.5	2
5.	Repair and maintain fan heater/electrical hair dryer	Fan heater, Hair dryer, Motor <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	0.5	3.5	4
6.	Repair and maintain vacuum cleaner.	Vacuum cleaner, Universal Motor <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	0.5	2.5	3
7.	Repair and maintain mixture/grinder.	Mixture/grinder <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	0.5	2.5	3
8.	Repair and maintain portable drill machine.	Drill machine, switch <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	1	5	6
9.	Repair and maintain welding machine.	Welding machine <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	1	3	4
10.	Repair and maintain table fan, ceiling fan/exhaust fan.	Fan <ul style="list-style-type: none"> • Introduction • Types • Importance and use • Working principle and function 	1	3	4

		<ul style="list-style-type: none"> • Process • connection diagram • Log book/ work report 			
11.	Repair & maintenance of Domestic/commercial/industrial installation	Electrical Installation <ul style="list-style-type: none"> • Introduction • Importance and use • Process • connection diagram • Fault finding & remedies • Log book/ work report 	2	4	6
12.	Repair and maintain washing machine.	Washing machine <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	1	3	4
13.	Repair and maintain AC single phase motor.	AC single phase motor <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process of repair and maintenance • Process of dismental and assemble • Size/types • connection diagram • calculation of turns and size • Rewinding and installing process of coil • Log book/ work report 	4	22	26
14.	Repair and maintain AC three phase motor (Balance)	AC three phase motor, coil <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process of repair and maintenance • Process of dismental and assemble • Size • connection diagram • calculation of turns and size • Rewinding and installing process of coil • Log book/ work report 	4	22	26
15.	Repair and maintain AC three phase motor (Unbalance)	AC three phase motor <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function 	3	22	25

		<ul style="list-style-type: none"> • Process of repair and maintenance • Process of dismantling and assembling • Size • connection diagram • calculation of turns and size • Rewinding and installing process of coil • Log book/ work report 			
16.	Repair and maintain DC shunt motor.	DC shunt motor <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process of repair and maintenance • Dismantling and assembling process • Size • connection diagram • calculation of turns and size • Rewinding and installing process of coil • Log book/ work report 	3	4	7
17.	Repair and maintain DC series motor.	DC series motor <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process of repair and maintenance • Size • connection diagram • calculation of turns and size • Rewinding and installing process of coil • Log book/ work report 	2	4	6
18.	Maintain Generator Set	Generator <ul style="list-style-type: none"> • Introduction • Importance and use • Types of generator • Working principle and function • Process of maintenance • Trouble shooting 	2	6	8
19.	Repair and maintain single phase low voltage transformer.	Single phase low voltage transformer <ul style="list-style-type: none"> • Introduction • Parts/components • Importance and use • Working principle and function 	2	4	6

		<ul style="list-style-type: none"> • Process • connection diagram • calculation of turns and size • Binding and installing process • Log book/ work report 			
20.	Repair and maintain Invertors, converters, solar panel, D.C. battery.	Invertors, converters, solar penal <ul style="list-style-type: none"> • Introduction • Importance and use • Working principle and function • Process • connection diagram • Log book/ work report 	2	4	6
		Total	32	124	156

Reference Books:

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

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 & Computer Application

Course nature: Practical
Full Marks: 150

Class per Week: 4+2
Total hours: 234

Subject 5: Engineering Drawing & Computer Application	
Description:	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.
Objectives:	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> ▪ know, describe and use of the engineering drawing. ▪ draw line, curve and plan of geometrical solids. ▪ sketch freehand and three dimensional objects. ▪ read, interpret Electrical symbols to use in different circuit diagram. ▪ Read, interpret and draw electrical connection diagram in transmission & distribution system. ▪ draw the development diagram of single phase & three phase motors' component, equipment, & machines.

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

5.	Draw different types of lines.	Lines <ul style="list-style-type: none"> • Introduction • Types • Importance and use 	1	3	4
6.	Write lettering <ul style="list-style-type: none"> • English/Nepali. 	Lettering <ul style="list-style-type: none"> • introduction • Importance and use • Types and size • process. 	1	3	4
7.	Construct regular geometrical figure: <ul style="list-style-type: none"> • Rectangle • Square • Triangle • circle 	Geometrical figures <ul style="list-style-type: none"> • Introduction • Drawing process 	1	3	4
8.	Construct regular polygons. <ul style="list-style-type: none"> • Pentagon • Hexagon • Octagon 	Regular polygon <ul style="list-style-type: none"> • Introduction • Process 	1	7	8
9.	Draw an ellipse/parabola.	Ellipse/parabola <ul style="list-style-type: none"> • Introduction • Process • Method 	1	7	8
10.	Dimension the drawing objects.	Dimensioning <ul style="list-style-type: none"> • Introduction • Types • Importance and use • Process 	1	3	4
11.	Draw orthographic projection. <ul style="list-style-type: none"> • First angle • Third angle 	Projection <ul style="list-style-type: none"> • Introduction • Types of projection • Importance • Difference between first and third angle projection • Introduction, uses and types of sectional drawing • Process 	3	13	16
12.	Draw isometric views.	▪ Isometric projection <ul style="list-style-type: none"> • Introduction • Importance • Process 	2	6	8
Electrical Engineering Drawing					
13.	Draw electrical symbols	Electrical Symbols <ul style="list-style-type: none"> • Introduction • Importance and use • Process 	1	3	4
14.	Draw the electrical diagram <ul style="list-style-type: none"> • Lay out • Wiring 	Electrical diagram <ul style="list-style-type: none"> • Introduction • Importance and use 	1	3	4

	<ul style="list-style-type: none"> • Connection 	<ul style="list-style-type: none"> • Process 			
15.	Draw complete diagram of domestic, commercial building system with architectural building plan and cost calculation.	Building drawing <ul style="list-style-type: none"> • Introduction • Importance • Material estimating and costing • Process 	3	25	28
16.	Draw Motor control system diagram <ul style="list-style-type: none"> • DOL • Star/Delta • Forward/reverse • Two place 	Motor control and power diagram. <ul style="list-style-type: none"> • Introduction • Importance and use • Process 	2	22	24
17.	Draw winding diagram of different types motor	winding diagram of motors <ul style="list-style-type: none"> • Introduction • Types of motors • Types of winding • Types of layer • Importance and use • Name plate • Parts of motor 	2	10	12
18.	Draw armature winding of a simple motor.	Armature winding <ul style="list-style-type: none"> • Introduction • Types • Importance and use 	1	3	4
19.	Draw single line diagram of generation, transmission and distribution system.	<ul style="list-style-type: none"> • Single line diagram of power supply system • Introduction • Types • Importance and use • Nepal Electrical authority (NEA) rule, regulation and standard. 	2	6	8
Computer application and auto CAD					
20.	Familiarize with computer application <ul style="list-style-type: none"> • MS Word • MS Excel • E-mail, internet 	Computer application <ul style="list-style-type: none"> • Introduction • Importance and application • Process 	6	22	28
21.	Draw electrical drawing using Auto CAD	Auto CAD <ul style="list-style-type: none"> • Introduction • Importance and application • Process • Electrical line/symbol • Civil/Architectural/electrical plan 	10	40	50
		Total	44	190	234

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

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

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

S.N.	Tasks/Topics	Related Technical Knowledge	Time hrs.
1.	Safety Apply safety rules for electrical works	Safety <ul style="list-style-type: none"> • Introduction • Importance • electric shock resistance of human body and withstanding voltage and current in wet and dry condition • symbols and signs • safety rules and regulations 	3
2.	First aid Give first aid to a electrocuted person	First aid <ul style="list-style-type: none"> • Introduction • symptoms of person having electric shock • precautions for providing first aid. 	2
3.	Tools/equipment, machine and materials List tools /equipment /machine and materials	Tools/equipment/machine and materials <ul style="list-style-type: none"> • Introduction • Types • Importance and use 	4
4.	Electricity rules and regulation Apply electricity rules	<ul style="list-style-type: none"> • Concept of electrical energy development in Nepal • Rules for – consumer, standard 	2

	and regulations	voltage for distribution <ul style="list-style-type: none"> • Concept of NEA code of practice 	
5.	Constitution of matter Explain: <ul style="list-style-type: none"> • Modern theory of electron • Structure of Atom 	<ul style="list-style-type: none"> • Concept of modern electron theory: Matter, Molecule, Atom, Protons, Neutrons, Electrons • Structure of Atom 	3
6.	Fundamental SI definitions Explain advantages and application of A.C. and D.C.	<ul style="list-style-type: none"> • Introduction • Importance and Application • Advantages and disadvantages 	6
	Define : <ul style="list-style-type: none"> • EMF and P.D. • Current, voltage, resistance and power • Cells and battery 	<ul style="list-style-type: none"> • Current, Voltage and Resistance and their measuring units • Cells and batteries • EMF and potential difference 	
7.	Laws of electricity Explain : <ul style="list-style-type: none"> • Law of conservation of energy • Ohm's law • Kirchhoff's law and their application • Laws of resistance • Specific resistance • Effect of temperature on resistance • Connection of cells and battery 	<ul style="list-style-type: none"> • Law of conservation of energy • Ohm's law • Kirchhoff's laws • Laws of resistance • Specific resistance • Effect of temperature on resistance, temperature co-efficient of resistance • Connection of cells and battery • Effects of electric current 	20
8.	Engineering materials Explain <ul style="list-style-type: none"> • Conductor and insulator • Metal and non-metal • Ferrous/non ferrous metal 	Engineering materials <ul style="list-style-type: none"> • Introduction • Types • Importance and use • Properties 	8
9.	Series and parallel circuits Explain and compare : <ul style="list-style-type: none"> • Resistances in series and parallel • Relation of voltage, current, resistance, and power in series and parallel circuits 	Electrical circuits <ul style="list-style-type: none"> • Introduction • Types • Importance and use • Comparison • Relation of voltage, current, resistance, and power in series and parallel circuits 	12
10.	Work, power and Energy Explain work, energy and power in electric	<ul style="list-style-type: none"> • Introduction • Types • Importance and use • Measuring units in M.K.S. and F.P.S. 	4

	circuit and their measuring units	system	
11.	Magnetism Electromagnetism <ul style="list-style-type: none"> Explain the importance of magnetism in electricity Define magnetic terms and their measuring units 	<ul style="list-style-type: none"> Importance of magnetism in electricity 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 Properties of lines of force Dimagnetic, Paramagnetic, Ferromagnetic materials 	16
	<ul style="list-style-type: none"> Explain electromagnetism and its laws Explain magnetic losses 	<ul style="list-style-type: none"> Advantages of electro-magnetism Laws of electromagnetism Faraday's law of electromagnetic induction Comparison between electric circuit and magnetic circuit Self and mutual inductance Eddy current and Hysteresis loss 	
12.	AC definition and circuit Define: <ul style="list-style-type: none"> Period, Cycle or frequency Amplitude, Peak Instantaneous and R.M.S. values Form factor, in phase, out of phase Inductance and inductive reactance Capacitance and capacitive reactance 	AC circuit Comparison between A.C. and D.C. <ul style="list-style-type: none"> Definition of : <ul style="list-style-type: none"> Period Cycle or frequency Amplitude Peak Instantaneous and R.M.S. values, Form factor, peak factor in phase, out of phase Inductance and inductive reactance Capacitance and capacitive reactance, 	20
	Explain and solve A.C. circuits <ul style="list-style-type: none"> Poly phase A.C. 	<ul style="list-style-type: none"> Condensers in series and parallel Impedance Addition of vectors Pure resistive, inductive and capacitive circuit in A.C RLC in series and parallel circuit in A.C. Resonance Impedance triangle and power factor Cause of low power factor in industrial areas and its improvement Single and three phase circuits 	

13.	Generation, transmission, distribution and Utilization of Electrical power Explain the basic concept of energy sources and power generation in Nepal	<ul style="list-style-type: none"> Sources of electrical Energy in Nepal: Production of power sources: <ul style="list-style-type: none"> Solar and wind power station Hydroelectric power station Diesel and thermal power station etc. Power development of Nepal Total Power Generation of Nepal 	20
	Describe sub-station and sub-station equipment	Concept of sub-station: <ul style="list-style-type: none"> Sub-station equipment Circuit breakers Isolators Bus-bars Lightning arrestors Types of sub-station Pole type sub station Out door sub station Indoor sub station Switchgear, control and protection devices 	
	Explain transmission system	<ul style="list-style-type: none"> Importance of transmission system Concept of tower, pole, hardware and Insulators Advantages of H.V. Transmission 	
	Describe distribution system and service connection	<ul style="list-style-type: none"> Methods of power distribution Comparison between overhead line and Underground cable Domestic service connection and its components Poles, hardware and stay Voltage ranges Conductor spacing and sag 	
	Explain utilization of electric power Explain illumination and its units Control and protection	<ul style="list-style-type: none"> Utilization of electrical energy Agricultural sector Industrial sector Domestic sector Commercial sector Transportation sector Concept of illumination Luminous flux, intensity Candle power and solid angle Concept of energy efficiency Relays Lighting arrestor System earthing Equipment earthing 	
19.	Electrical Machines Define and explain the	Definition, construction, working principles and types of :	20

	construction and working of electrical machines	<ul style="list-style-type: none"> • D.C. generator and its types • Alternator • Transformer • EMF equation of transformer • Transformer ratio • Transformer tests and losses • Parallel operation of alternator and transformer <p>D.C and A.C. Motors (Definition, construction, working principles)</p> <ul style="list-style-type: none"> • Single phase • Three phase motors • Split phase motor • Synchronous motors • Capacitor start induction motor • Capacitor start capacitor run motors • Universal and sheded pole motors • Permanent capacitor motors • Principle of induction motor • Torque formula • Motor speed and sleep 	
20.	<p>Electrical measuring instruments Explain and apply electrical measuring instrument and measurement</p>	<ul style="list-style-type: none"> • Concept of measuring units of electrical quantities • Types of measuring Instrument <p>Construction of measuring instruments on the basis of:</p> <ul style="list-style-type: none"> • Working principles • Construction • Measurement • Concept of different torques <p>Construction and working principles of:</p> <ul style="list-style-type: none"> • Megger • Earth tester • Single and Three phase Energy meter • Watt meters • Power factor meter • Frequency meter • Synchroscope • Lux meter <p>Increasing range of measuring instruments</p> <ul style="list-style-type: none"> • Concept and use of C.T. and P.T. • Measurement of specific gravity of electrolyte in battery 	16
		Total	156

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: 100

Class per Week: 4 hrs.
Total Class: 156 hrs.

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

S.N.	Task/Skill	Related Technical Knowledge	Time Hours		
			Th.	Pr.	Total
1.	Install DOL starter to control induction motor.	3-Phase starter/single phase (Relay,contractor,switch,multi-meter and MCB) <ul style="list-style-type: none"> •Introduction •Types •Importance and uses •Function • Advantages and limitations • Procedure • Control and power circuit diagram • Log Book/work report 	3	11	14
2.	Install forward/reverse starter to control 3 phase induction motor (two direction motor from two places)	3-Phase starter (forward/reverse) <ul style="list-style-type: none"> • Introduction •Types •Importance and uses •Function • Advantages and limitations • Procedure • Control and power circuit diagram • Log Book/work report 	4	17	21
3.	Install star/delta starter (manual) to control 3 phase induction motor.	3-Phase starter (star/delta) <ul style="list-style-type: none"> • Introduction •Types •Importance and uses •Function • Advantages and limitations •Procedure • Control and power circuit diagram • Log Book/work report 	4	17	21
4.	Install star/delta starter (semi-auto)	Star/delta semi- automatic <ul style="list-style-type: none"> • Introduction 	4	17	21

	to control 3 phase induction motor.	<ul style="list-style-type: none"> ●Types ●Importance and uses ●Function <ul style="list-style-type: none"> • Advantages and limitations ● Procedure <ul style="list-style-type: none"> • Control and power circuit diagram ● Log Book/work report 			
5.	Install star/delta starter (automatic to control 3 phase induction motor.	Star/delta automatic <ul style="list-style-type: none"> ● Introduction ●Types ●Importance and uses ●Function <ul style="list-style-type: none"> • Advantages ●Procedure <ul style="list-style-type: none"> • Control and power circuit diagram ● Log book/work report 	4	17	21
6.	Install slip ring starter to control slip ring motor.	3-Phase starter slip ring motor <ul style="list-style-type: none"> ● Introduction ●Types ●Importance and uses ●Function <ul style="list-style-type: none"> • Advantages and limitations ●● Procedure <ul style="list-style-type: none"> • Control and power circuit diagram ● Log book/work report 	3	13	16
7.	Install DC shunt motor controller (Armature and Field control).	Shunt motor starter (Controller, switch) <ul style="list-style-type: none"> ● Introduction ●Types ●Importance and uses ●Function <ul style="list-style-type: none"> • Advantages and limitations ●Procedure <ul style="list-style-type: none"> • Control and power circuit diagram ● Log book/work report 	4	17	21
8.	Install PLC starter for 3 phase induction motor control (DOL starter)	3 phase starter (PLC, Relay, Contractor, switch) <ul style="list-style-type: none"> ● Introduction ●Types ●Importance and uses ●Function <ul style="list-style-type: none"> • Advantages and limitations ● Procedure <ul style="list-style-type: none"> • Control and power circuit diagram ● Log book/work report 	4	17	21
		Total	30	126	156

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.

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

S.N.	Task/Skill	Related Technical Knowledge	Time hrs.		
			Th.	Pr.	Total
Overhead Line Construction					
1.	Interpret occupational documentation.	<ul style="list-style-type: none"> • Electrical drawing symbols and legends • Drawings, specifications and standards • NEA distribution rules & regulations and 11 KV and 400/230 V overhead line construction standards. 	0.5	1.5	2
2.	Draw the single line diagram of distribution lines.	<ul style="list-style-type: none"> • Electrical drawing standards • Symbols and legends • Process • Single line diagram of 11 KV feeders & 400/230 distribution lines • NEA distribution rules & regulations • NEA 11 KV and 400/230V overhead line construction 	0.5	1.5	2

		standards.			
3.	Perform route cleared.	Route clearance <ul style="list-style-type: none"> • Importance • Tool & equipment for clearing routes • Process • Safety 	0.5	1.5	2
4.	Pole erection (Select, Raise and set the poles)	Pole erection <ul style="list-style-type: none"> • Introduction • Types and size of poles • Pole used on 11 KV and 400/230 V distribution lines • Process • Safety 	1	5	6
5.	Install Guy wire on 11 KV pole	Guy wire installation <ul style="list-style-type: none"> • Introduction • Types and size of guy wire • Use of guy wire on 11 KV • Fitting accessories • Tools used • Process • Safety 	1	4	5
6.	Install cross arm and bracing on the poles	Cross arm and bracing fitting <ul style="list-style-type: none"> • Introduction • Types and size of cross arm and bracing • Use of cross arm and bracing • Fitting accessories • Tools used • Process • Pin ,disc insulators • Safety 	1	5	6
7.	String the Aluminum conductors steel Reinforced (ACSR) 11 KV	ACSR conductors <ul style="list-style-type: none"> • Introduction • Types and size • Current carrying capacity • Commercial names • Advantages and disadvantages • Fitting accessories • Tools used • Process • Safety 	1.5	3.5	5
8.	String the Aerial Bundle Conductors (ABC) cable (11 KV)	Aerial Bundle Conductors (ABC) cable <ul style="list-style-type: none"> • Introduction • Size • Importance and use • Single and double suspension clamp of proper sizes 	1	5	6

		<ul style="list-style-type: none"> Anchor clamp Fitting accessories Tools used Process Safety 			
9.	Install pole mounted distribution transformer	Transformer connection <ul style="list-style-type: none"> Introduction Size and capacity Use Process Protective devices (D.O. fuse) Lighting arrester Channels of proper sizes MCCB of proper capacity on the LT line of the transformer Four core cable of proper for connection from LT side of the transformer to the MCCB Safety 	1	5	6
10	Install earthing on the pole mounted transformer	Earthing <ul style="list-style-type: none"> Introduction Type Importance and use Earthing materials Measurement of earth Process resistance 	1	3	4
Overhead Line Construction 400/230V					
11.	Pole erection (Select, Raise and set the poles)	Pole erection <ul style="list-style-type: none"> Introduction Size and types Use Tools used Process Safety 	1	5	6
12.	Install D-iron and Shackle insulators on poles	D-iron and shackle insulators <ul style="list-style-type: none"> Introduction Types Use Fitting accessories Tools used Process Safety 	0.5	2.5	3
13.	Install Guy wire on 400/230V pole	Guy wire installation <ul style="list-style-type: none"> Introduction Types Use Fitting accessories Tools used 	0.5	2.5	3

		<ul style="list-style-type: none"> • Process • Safety 			
14	String the Aluminum conductors steel reinforced ACSR) conductors 400/230 V	String ACSR conductors <ul style="list-style-type: none"> • Introduction • Types and size • Use • Fitting accessories • Tools used • Process • Safety 	2	4	6
15	String the Aerial Bundle Conductors (ABC) cable 400/230 V	Aerial Bundle Conductors (ABC) cable <ul style="list-style-type: none"> • Introduction • Size • Use • Single and double suspension clamps of proper sizes • Anchor clamp • Fitting accessories • Tools used • Process • Safety 	1	5	6
	Underground cables				
16	<ul style="list-style-type: none"> • Perform cable joint • Lay under ground cable 	Cable joint <ul style="list-style-type: none"> • Introduction • Types • Importance and use • Components of cable joints • Cable joint material for overhead cable joint (Reychem) • Cable jointing materials for under ground (straight through joint) • Process • Application • Use of trench • Process of trench 	1	3	4
	Consumers' Service Line Construction 400/230Volts.				

17.	Install & connect single phase and three phase consumers' service lines as per NEA's distribution rules and standards	<ul style="list-style-type: none"> • Consumer service lines • Concentric cables • Introduction • Types, sizes • Importance and use • Process • Wall bracket • Shackle insulator • Safety • NEA distribution rules & regulations • Insulated connector for connection of concentric cable on ABC cable 	1	5	6
		Total	16	62	78

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 ladder	• Insulated 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: 75

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

Subject 9 : Basic Electronics	
Description:	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.
Objectives:	At the end of the course the participants will be able to: <ul style="list-style-type: none"> ▪ Identify, describe various electronics components. ▪ Interpret their characteristics and applications. ▪ Calculate the value of electronics components. ▪ Test electronics components. ▪ Design electronic circuits using diodes. ▪ Construct voltage regulator with transistor and zener diode. ▪ Construct NOT, AND, OR, NAND, NOR Logic gate in IC. ▪ Apply safety precaution during electronics works.

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

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

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

Reference Books:

- Principle of Electronics- V.K. Methata
- 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

Course Nature: Theory

Class per Week: 1 hrs.

Full Marks: 25

Total Class: 39 hrs.

Subject 10 : Entrepreneurship Development	
Description:	This course provides theoretical knowledge related to Entrepreneurship which consists of concept of entrepreneurship, its importance and challenges, selection of appropriate occupation, surveying market, how to prepare work plan, calculation of capital cost and operating cost, promotion of business and preparation of a complete scheme to start own business.
Objectives:	At the end of the course the participants will be able to: <ul style="list-style-type: none"> • familiarize the students about entrepreneur and entrepreneurship. • provide overview of starting, operating and promotion of business effectively and efficiently.

S.N.	Task/Skill/Topics	Related Technical Knowledge	Time hrs.
1.	Introduction of Entrepreneurship	Entrepreneurship <ul style="list-style-type: none"> • definition, Importance • Challenges of entrepreneurship and being an entrepreneur • stages of entrepreneurship 	2
2.	The Individual Entrepreneur	Entrepreneur <ul style="list-style-type: none"> • Introduction • background and characteristics • Role and leadership • SWOT analysis and J-window • Types of different occupations • Pros and cons of different occupations • Group the occupations • Prioritization the occupations • Selection of occupation 	6
3.	Marketing for Entrepreneur	Marketing <ul style="list-style-type: none"> • Definition, concept of marketing • demand and supply • Relationship between demand and supply • Porter's five forces model • Identification of possible market • Decision for the location of an enterprise • Selection of location for enterprise • Analysis of facilities (transportation, raw material availability, overhead facilities) • Identification of possible market extension 	7

		<ul style="list-style-type: none"> • marketing challenges 	
4.	Business Plan	Business plan <ul style="list-style-type: none"> • definition, concept • components of business plan • Remember things about developing business plan • Analysis of critical information • Identification and selection of machines, equipment, materials, labors • Preparation of job and responsibilities of employees 	6
5.	Entrepreneurial Finance	Finance and Accounting <ul style="list-style-type: none"> • sources of funds • critical issues in entrepreneurial finance • capital cost, operating cost, overhead cost • method of financing • financing and equity • account keeping process • Calculation of profit and loss 	4
6.	Selling of products	Societal marketing <ul style="list-style-type: none"> • concept • social enterprise spectrum • Types of different advertising medias • distribution channels • social value, norms and ethics 	3
7.	Communication	Communication <ul style="list-style-type: none"> • concept • writing skills • report writing • proposal writing • letter writing • meeting and minuting 	5
8.	Scheme/project	<ul style="list-style-type: none"> • Preparation of scheme • Presentation of scheme 	6
		Total	39

Reference Books :

- उद्यमशिलता विकास - प्राविधिक शिक्षा तथा व्यावसायिक तालिम परिषद्



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