

Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister's Hunarmand Pakistan Program

"Skills for All"



Course Contents / Lesson Plan

Course Title: Industrial Electrician

Duration: 3 Months

Revised Edition

Trainer Name	Prof. Dr. Sheeraz Ahmed
Course Title	Industrial Electrician
Objectives and Expectations	<p>Employable skills and hands-on practice in Industrial Electrician</p> <p>This is a special course designed to address unemployment in the youth. The course aims to achieve the above objective through hands on practical training delivery by a team of dedicated professionals having rich market/work experience. This course is therefore not just for developing a theoretical understanding/back ground of the trainees.</p> <p>Contrary to that it is primarily aimed at equipping the trainees to perform commercially in a market space in independent capacity or as a member of a team. The course therefore is designed to impart not only technical skills but also soft skills (i.e. interpersonal/communication skills; personal grooming of the trainees etc.) as well as entrepreneurial skills (i.e. marketing skills; free lancing etc.). The course also seeks to inculcate work ethics to foster better citizenship in general and improve the image of Pakistani work force in particular.</p> <p><u>Main Expectations:</u></p> <p>In short, the course under reference should be delivered by professional instructors in such a robust hands-on manner that the trainees are comfortably able to employ their skills for earning money (through wage/self-employment) at its conclusion.</p> <p>This course thus clearly goes beyond the domain of the traditional training practices in vogue and underscores an expectation that a market-centric approach will be adopted as the main driving force while delivering it. The instructors should therefore be experienced enough to be able to identify the training needs for the possible market roles available out there. Moreover, they should also know the strengths and weaknesses of each trainee to prepare them for such market roles during/after the training.</p> <ol style="list-style-type: none"> <li data-bbox="365 1354 1572 1606">i. Specially designed practical tasks to be performed by the trainees have been included in the Annexure-I to this document. The record of all tasks performed individually or in groups must be preserved by the management of the training Institute clearly labeling name, trade, session, etc. so that these are ready to be physically inspected/verified through monitoring visits from time to time. The weekly distribution of tasks has also been indicated in the weekly lesson plan given in this document. <li data-bbox="365 1606 1572 1963">ii. To materialize the main expectations, a special module on <u>Job Search & Entrepreneurial Skills</u> has been included in the latter part of this course through which, the trainees will be made aware of the Job search techniques in the local as well as international job markets (Gulf countries). Awareness around the visa process and immigration laws of the most favored labor destination countries also form a part of this module. Moreover, the trainees would also be encouraged to venture into self-employment and exposed to the main requirements in this regard. It is also expected that a sense of civic duties/roles and responsibilities will also be inculcated in the trainees to make them responsible citizens of the country.

iii. A module on **Work Place Ethics** has also been included to highlight the importance of good and positive behavior in the workplace in the line with the best practices elsewhere in the world. An outline of such qualities has been given in the Appendix to this document. Its importance should be conveyed in a format that is attractive and interesting for the trainees such as through PPT slides +short video documentaries. Needless to say that if the training provider puts his heart and soul into these otherwise non-technical components, the image of the Pakistani workforce would undergo a positive transformation in the local as well as international job markets.

To maintain interest and motivation of the trainees throughout the course, modern techniques such as:

- Motivational Lectures
- Success Stories
- Case Studies

These techniques would be employed as an additional training tool wherever possible (these are explained in the subsequent section on Training Methodology).

Lastly, evaluation of the competencies acquired by the trainees will be done objectively at various stages of the training and a proper record of the same will be maintained. Suffice to say that for such evaluations, practical tasks would be designed by the training providers to gauge the problem-solving abilities of the trainees.

(i) Motivational Lectures

The proposed methodology for the training under reference employs motivation as a tool. Hence besides the purely technical content, a trainer is required to include elements of motivation in his/her lecture. To inspire the trainees to utilize the training opportunity to the full and strive towards professional excellence. Motivational lectures may also include general topics such as the importance of moral values and civic role & responsibilities as a Pakistani. A motivational lecture should be delivered with enough zeal to produce a deep impact on the trainees. It may comprise of the following:

- Clear Purpose to convey the message to trainees effectively.
- Personal Story to quote as an example to follow.
- Trainees Fit so that the situation is actionable by trainees and not represent a just idealism.
- Ending Points to persuade the trainees on changing themselves.

A good motivational lecture should help drive creativity, curiosity, and spark the desire needed for trainees to want to learn more.

The impact of a successful motivational strategy is amongst others commonly visible in increased class participation ratios. It increases the trainees' willingness to be engaged on the practical tasks for a longer time without boredom and loss of interest because they can see in their mind's eye where their hard work would take them in short (1-3 years); medium (3 -10 years) and long term (more than 10 years).

As this tool is expected that the training providers would make arrangements for regular well planned motivational lectures as part of a coordinated strategy interspersed throughout the training period as suggested in the weekly lesson plans in this document.

Course-related motivational lectures online link is available in **Annexure-II**.

(ii) Success Stories

Another effective way of motivating the trainees is using Success Stories. Its inclusion in the weekly lesson plan at regular intervals has been recommended till the end of the training.

A success story may be disseminated orally, through a presentation, or using a video/documentary of someone that has risen to fortune, acclaim, or brilliant achievement. A success story shows how a person achieved his goal through hard work, dedication, and devotion. An inspiring success story contains compelling and significant facts articulated clearly and easily comprehensible words. Moreover, it is helpful if it is assumed that the reader/listener knows nothing of what is being revealed. The optimum impact is created when the story is revealed in the form of:-

- Directly in person (At least 2-3 cases must be arranged by the training institute)
- Through an audio/ videotaped message (2-3 high-quality videos must be arranged by the training institute)

It is expected that the training provider would collect relevant high-quality success stories for inclusion in the training as suggested in the weekly lesson plan given in this document.

The suggestive structure and sequence of a sample success story and its various shapes can be seen in **Annexure III**.

(iii) Case Studies

Where a situation allows, case studies can also be presented to the trainees to widen their understanding of the real-life specific problem/situation and to explore the solutions.

In simple terms, the case study method of teaching uses a real-life case example/a typical case to demonstrate a phenomenon in action and explain theoretical as well as practical aspects of the knowledge related to the same. It is an effective way to help the trainees comprehend in depth both the theoretical and practical aspects of the complex phenomenon in depth with ease. Case teaching can also stimulate the trainees to participate in discussions and thereby boost their confidence. It also makes the classroom atmosphere interesting thus maintaining the trainee interest in training till the end of the course.

Depending on suitability to the trade, the weekly lesson plan in this document may suggest case studies be presented to the trainees. The trainer may adopt a PowerPoint presentation or video format for such case studies whichever is deemed suitable but only those cases must be selected that are relevant and of a learning value.

The Trainees should be required and supervised to carefully analyze the cases.

For this purpose, they must be encouraged to inquire and collect specific information/data, actively participate in the discussions, and intended solutions to the problem/situation.

Case studies can be implemented in the following ways: -

- i. A good quality trade-specific documentary (At least 2-3 documentaries must be arranged by the training institute)
- ii. Health & Safety case studies (2 cases regarding safety and industrial accidents must be arranged by the training institute)
- iii. Field visits(At least one visit to a trade-specific major industry/ site must be arranged by the training institute)

Entry-level of trainees	<p>For an Industrial Electrician course, proposed entry level is minimum matric in science subjects, so expectations from the trainees are:</p> <ul style="list-style-type: none"> • Have knowledge of Physics Concepts • Have concept of Basic Mathematics • Having a knowledge of basic electronics
Learning Outcomes of the course	<p>By the end of this course, students will be able to:</p> <ul style="list-style-type: none"> • Practice safe working methods on electrical systems. • Understand the relevant regulative requirements. • Demonstrate an understanding of electrical principles and units. • Identify a wide range of electrical equipment & devices and understand their principles of operation / connections. • Demonstrate an understanding of electrical systems, switchgear and circuit types. • diagnose basic faults and recognize their associated symptoms • Work with a range of cable types and carry out correct terminations and connections. • Recognition practically about Armed Cables, Hard cables, Flexible cable, VIR cable. • Recognize the most common industrial motor types and understand their operation, connections and maintenance requirements. • Demonstrate an understanding of Automatic star delta starter. • Use electrical test equipment effectively and carry out testing of a range of motors, solenoids, cables, etc. (using insulation, continuity, tong testers, etc.) • Identify motor and power circuit faults. • Use circuit diagrams as an aid to maintenance. • Read out and practically known the electrical drawing and symbols. • Access electrical enclosures and replace fuses, reset overloads etc. • Perform electrical isolation, testing for dead, etc. on a wide range of devices and circuits safely. • Understand the principles of earthing / protection and associated protective devices.
Course Execution Plan	<p>The total duration of the course: 3 months (12 Weeks) Class hours: 4 hours per day Theory: 20% Practical: 80% Weekly hours: 20 hours per week Total contact hours: 240 hours</p>

Companies offering jobs in the respective trade	<ul style="list-style-type: none"> • Public/Private industries including: • Pakistan Atomic energy commission (PAEC), Pakistan Ordnance factories (POFs), WAPDA, OGDCL, Construction companies, Oil mills, • flour mills, Petrol & CNG stations etc. • Solar panels installation
Job Opportunities	<ul style="list-style-type: none"> • Technician / Electrician in industry (Textile, Leather, Pharmaceuticals, Food Processing, Automotive, Cement etc.) • Self-employment.
No of Students	25
Learning Place	Classroom / Lab / Workshop / Industry
Instructional Resources	<ol style="list-style-type: none"> 1. Industrial electrical panel wiring training with all details: https://youtu.be/0eF0iZ2YWj4?si=lZNkzdiq-owjOyB_ If you want to become a electrician, watch this video until the end. In this video, we are wiring an industrial switchboard. 2. Easy work being an industrial electrician!: https://youtu.be/bSsg1yBmb4A?si=3_QJ0QWzNAIZKAR4 This video provides a crash course in easy work being an industrial electrician!. 3. How to Read Electrical Diagrams Wiring Diagrams Explained Control Panel Wiring Diagram: https://youtu.be/s04vep-IqbI?si=xIUHWOh9FO_AYTK8 How to Read Electrical Diagrams Wiring Diagrams Explained Control Panel Wiring Diagram? How to read electrical wiring diagram ?. 4. How to Read Electrical Schematics (Crash Course) TPC Training: https://youtu.be/Et-gHKTdziU?si=A83bL8VyJgcV_cER Reading and understanding electrical schematics is an important skill for electrical workers looking to troubleshoot their electrical systems. Understanding symbols and logic in an electrical diagram can save valuable time and man-hours on the job.

MODULES

Schedul ed Weeks	Module Title	Days	Hours	Learning Units	Home Assignment
Week 1	Introduction and Basic Numeracy	Day 1	Hour 1	Course Introduction and Expectations	<p>Task-1 (Details maybe seen at Annexure-I)</p> <p>Home Assignment -1 (Details may be seen at Annexure-IV)</p>
			Hour 2	Applications of the course	
			Hour 3	Job Market Overview	
			Hour 4	Work Ethics in Institute	
		Day 2	Hour 1	Motivational Lecture	
			Hour 2	Health & Safety	
			Hour 3	Recognize basic arithmetic symbols	
			Hour 4	State the correct sequence for arithmetical operations and solve equations	
		Day 3	Hour 1	Common Weights and Measures	
			Hour 2	Units of Measurements & their interconversion	
			Hour 3	Identify two- and three dimensional shapes which may include: Rectangle, Triangle, Sphere, Cube, Cylinder	
			Hour 4	Identify two- and three dimensional shapes which may include: Pyramid,	

				Square, Polygons, Circle, Cuboids	
		Day 4	Hour 1	Calculate area and volume of regular shapes and objects	
			Hour 2	Demonstrate knowledge of graphs and tables	
			Hour 3	Demonstrate use of simple formulae & algebraic expressions may relate to: Area, Perimeter,	
			Hour 4	Dimensions of regular and irregular shapes	
		Day 5	Hour 1	Prepare safety charts	
			Hour 2	Prepare safety charts	
			Hour 3	Showing General & Trade specific safety measure (text/pictorial). Each trainee will prepare different chart.	
			Hour 4	Showing General & Trade specific safety measure (text/pictorial). Each trainee will prepare different chart.	
Week 2	Basic Electrical Theory	Day 1	Hour 1	Motivational Lecture	•Task 2 <i><u>Details may be seen at Annexure-I</u></i>
			Hour 2	Matter & different states of matter with examples	
			Hour 3	Atom & Atomic Structure	
			Hour 4	Description of proton, electron and neutron	

		Day 2	Hour 1	Definition of valence and free electrons
			Hour 2	Properties of positive and negative charge
			Hour 3	Definition of electricity, Conventional current and electron flow theory
			Hour 4	Static and dynamic charges
		Day 3	Hour 1	Insulators, Conductors & Semi-Conductor (Properties & examples)
			Hour 2	Insulators, Conductors & Semi-Conductor (Properties & examples)
			Hour 3	Generation of Electricity
			Hour 4	Describe Voltage, Voltage Drop, Current, Resistance, Electric Charge, Conductance, Load and their units
		Day 4	Hour 1	Relation between current (I), voltage (V) and resistance (R)
			Hour 2	Ohm's Law and numerical applications
			Hour 3	Laws of resistance Definition of resistivity
			Hour 4	Factors affecting resistance of conductors

		Day 5	Hour 1	Tools & Equipment used by an Electrician	
			Hour 2	Tools & Equipment used by an Electrician	
			Hour 3	Hands-on Practice	
			Hour 4	Hands-on Practice	
Week 3	Basic Electrical Theory - continued	Day 1	Hour 1	Factors affecting resistance of conductors- revision	<p>• Task 3</p> <p><i>Details may be seen at Annexure-I</i></p> <p>Home Assignment -2 (Details may be seen at Annexure-IV)</p>
			Hour 2	Calculating resistance of a conductor with regard to cross sectional area, length, resistivity and operating temperature	
			Hour 3	Numerical problems on resistivity	
			Hour 4	Basic Symbols of Electricity	
		Day 2	Hour 1	Motivational Lecture	
			Hour 2	Case Study (Health & Safety) (For further detail please see Page No: 5-6)	
			Hour 3	Case Study (Health & Safety) (For further detail please see Page No: 5-6)	

			Hour 4	Hands-on Practice with Safety tools
	Day 3	Hour 1	Sources of electricity generation ; Static electricity	
		Hour 2	Electromagnetic induction	
		Hour 3	Electrochemistry Photovoltaic effect	
		Hour 4	Thermoelectric effect Piezoelectric effect	
	Day 4	Hour 1	Alternating & Direct Current (AC & DC)	
		Hour 2	Importance of polarity in DC circuits	
		Hour 3	Electric Circuit & its types Series Circuit Parallel Circuits	
		Hour 4	Series-Parallel Circuit Open Circuit Closed Circuit Short Circuit	
	Day 5	Hour 1	Calculate electrical quantities (Voltage, Current, Resistance and Power etc.) in circuits	
		Hour 2	Calculate electrical quantities (Voltage, Current, Resistance and Power etc.) in circuits-continued	
		Hour 3	Briefly Describe Transmission Line, Feeder, Distributer and Service Mains	
		Hour 4	Briefly Describe Transmission Line, Feeder, Distributer and Service Mains - continued	

Week 4	Describe basic magnetism and electromagnetism	Day 1	Hour 1	Institute/Work ethics (For further detail please see Annexure-II at the end)	<p>•Task 4</p> <p><u>Details may be seen at Annexure-I</u></p>
			Hour 2	Magnet & its types	
			Hour 3	Describe magnetic lines of force and list their characteristics/properties	
			Hour 4	Describe Magnet rules of action	
		Day 2	Hour 1	Define Flux, Flux Density, MMF, Magnetic Field, Magnetizing Force & their units.	
			Hour 2	Introduction to Magnetic Materials	
			Hour 3	Describe Magnetic field of a straight current carrying conductor and coil	
			Hour 4	Briefly describe effect of iron core in a coil.	
		Day 3	Hour 1	Briefly explain mechanical force on a current carrying conductor in a magnetic field	
			Hour 2	Apply the fundamental laws of magnetism	
			Hour 3	Fleming's Right hand & Left hand rules	
			Hour 4	Case Study (Health & Safety) (For further detail please see Page No: 5-6)	
		Day 4	Hour 1	Electromagnetic Induction	
			Hour 2	Faraday's Laws of Electromagnetic Induction & its	

				applications	
			Hour 3	Describe dynamically & statically induced e.m.f	
			Hour 4	Describe self & Mutual Inductances	
		Day 5	Hour 1	Motivational Lecture (For further detail please see Page No: 3-4)	
			Hour 2	Describe self & Mutual Inductances - revision	
			Hour 3	Briefly describe Hysteresis & Eddy Current Losses	
			Hour 4	Hands-on Practice in lab	
Week 5	Describe AC SinglePhase Electrical Supply/Circuits , Power factor, Three Phase Electrical Supply/Circuits	Day 1	Hour 1	Motivation Lecture	•Task 5 <i>Details may be seen at <u>Annexure-I</u></i>
			Hour 2	Introduction to AC Single Phase (1-Ø) Supply	
			Hour 3	Define alternating current & voltage	
			Hour 4	Describe working principle of A.C. Generator	
		Day 2	Hour 1	Define terms cycle, frequency, phase difference, Impedance, phase angle, & power factor	
			Hour 2	Describe resistive, inductive andcapacitive loads	
			Hour 3	Measure power factor of grid electricity	

			Hour 4	State the advantages and disadvantages of low power factor and high power factor	
		Day 3	Hour 1	Explain the causes of low power factor and techniques to improve it	
			Hour 2	Case Study (For further detail please see Page No: 5-6)	
			Hour 3	Case Study (For further detail please see Page No: 5-6)	
			Hour 4	Case Study (For further detail please see Page No: 5-6)	
		Day 4	Hour 1	Introduction to AC Three Phase (3- \emptyset) Supply	
			Hour 2	Describe generation of two-phase & 3- phase e.m.f	
			Hour 3	Draw & explain star & delta connections	
			Hour 4	Draw & explain star & delta connections- continued	
		Day 5	Hour 1	Verification of the line and phase relationship in star and delta connections	
			Hour 2	Verification of the line and phase relationship in star and delta connections	
			Hour 3	Practical applications of connections	
			Hour 4	Hands-on practice in lab	
Week 6	Demonstrate knowledge of electric power&	Day 1	Hour 1	Motivational Lecture	• Task 6

	energy, Calculations, measuring instruments		Hour 2	Describe 3-Phase, 4-wire distribution network	<i><u>Details may be seen at Annexure-I</u></i>
			Hour 3	Compare Star (Y) & Delta (Δ) Connections with their uses	
			Hour 4	Application of phase sequence meter	
		Day 2	Hour 1	Describe advantages of 3-phase supply over single phase supply	
			Hour 2	Describe active & reactive component, actual power, apparent power & reactive power with relationships	
			Hour 3	Define the terms KVA, KVAR and KW	
			Hour 4	Describe electrical relationships of power and energy	
		Day 3	Hour 1	Power equation in single phase & three phase systems	
			Hour 2	Calculate Power & Energy billing of single phase & three phase installation	
			Hour 3	Describe Measurement of power in single phase & three phase system	
			Hour 4	Describe Measurement of power in single phase & three phase system - continued	
		Day 4	Hour 1	Electrical Measuring Instruments & its Applications (Voltmeter, Ampere Meter	

			Hour 2	Ohmmeter, Watt Meter, Energy Meter, Multimeter, Clamp meter/Tong Tester, Frequency Meter, Power Factor Meter	
			Hour 3	Tachometer, Megger, Earth Tester, Potentiometer, Pyrometer, Temperature Gun, etc.)	
			Hour 4	Methods to connect the above electrical measuring instruments in circuit	
		Day 5	Hour 1	Demonstrate procedures or inspecting wiring and distribution board	
			Hour 2	Conduct operational and functional tests	
			Hour 3	Demonstrate log out/tag out & labeling procedures	
			Hour 4	Hands On practice	
Week 7	Describe Electrical Wires, Cables and Jointing; installation of wiring	Day 1	Hour 1	Overview of the previous weeks	<ul style="list-style-type: none"> • Task 7 <i>Details may be seen at Annexure-I</i>
			Hour 2	Overview of the previous weeks	
			Hour 3	Overview of the previous weeks	
			Hour 4	Overview of the previous weeks	
		Day 2	Hour 1	Mid Term Examination	

			Hour 2	Mid Term Examination
			Hour 3	Mid Term Examination
			Hour 4	Mid Term Examination
		Day 3	Hour 1	Difference between Wires, Cable
			Hour 2	Construction, Types and sizes of electrical Wires & Cables according to voltage grade, core and strands, Insulation & current carrying capacity
			Hour 3	continued
			Hour 4	Calculate size of cable for a given load
		Day 4	Hour 1	Electrical Joints & Soldering
			Hour 2	Electrical power cable joints
			Hour 3	Special purpose cables
			Hour 4	Copper, Silver, Aluminum and its identification
		Day 5	Hour 1	Overhead conductor and its types
			Hour 2	The basic domestic/commercial electrical system
			Hour 3	Prepare installation of cables

			Hour 4	Demonstrate procedures for installing conduits and/or ducts	
Week 8	Describe Three Phase Electrical Supply/Circuits	Day 1	Hour 1	Motivational Lecture	<p>•Task 8</p> <p><i>Details may be seen at Annexure-I</i></p>
			Hour 2	Methods of Electrical Wiring Systems w.r.t Taking Connection.	
			Hour 3	Joint box system or Tee system Loop – in system	
			Hour 4	continued	
		Day 2	Hour 1	Types of Electrical Wiring Systems	
			Hour 2	Comparison between Different Wiring Systems	
			Hour 3	Confirm wiring specifications	
			Hour 4	Prepare installation of cables	
		Day 3	Hour 1	Demonstrate procedures for installing conduits and/or ducts	
			Hour 2	Demonstrate procedures for connecting fixture	
			Hour 3	Perform final testing	
			Hour 4	Demonstrate procedures for final quality inspection	
		Day 4	Hour 1	Mechanical Switches: →Single Pole Single Throw (SPST) →Single Pole Double Throw	

				(SPDT)	
			Hour 2	→Double Pole Single Throw (DPST) →Double Pole Double Throw (DPDT)	
			Hour 3	→2 poles 6 throw →Intermediate switch	
			Hour 4	Plugs, sockets and combination units	
		Day 5	Hour 1	Case Study (For further detail please see Page No: 5-6)	
			Hour 2	Case Study (For further detail please see Page No: 5-6)	
			Hour 3	Case Study (For further detail please see Page No: 5-6)	
			Hour 4	Case Study (For further detail please see Page No: 5-6)	
Week 9	Electrical / Electronic Switches (Transistor, MOSFETS, Relay); Motors and Generators; Relays	Day 1	Hour 1	Brief Introduction of Electrical / Electronic Switches (Transistor, MOSFETS, Relay)	• Task 9,10 <i>Details may be seen at <u>Annexure-I</u></i>
			Hour 2	Push Buttons Selector Switches	
			Hour 3	Limit Switches	
			Hour 4	Emergency Switches	
		Day 2	Hour 1	Briefly describe DC Generators, Motors & their types	
			Hour 2	Briefly describe DC Generators, Motors & their types	

			Hour 3	Practical Session
			Hour 4	Discussion session
		Day 3	Hour 1	Briefly describe AC Generators & Motors & their types
			Hour 2	Briefly describe AC Generators & Motors & their types
			Hour 3	Briefly describe Transformer and its types
			Hour 4	Briefly describe Transformer and its types
		Day 4	Hour 1	Electromechanical Relay (EMR) Solid State Relay (SSR)
			Hour 2	Hybrid Relay Reed Relay
			Hour 3	Thermal Relay (Overload Relay) Polarized & Non-polarized Relay
			Hour 4	Time Delay Relays Protective Relays Buchholz relay
		Day 5	Hour 1	Job market & job search Job related skills.
			Hour 2	Interpersonal skills

			Hour 3	Job market & job search Job related skills. Interpersonal skills	
			Hour 4	Communication skills	
Week 10	Contactors, and timers, their Application/Uses	Day 1	Hour 1	Motivational Lecture	•Task 11,12 <i>Details may be seen at Annexure-I</i>
			Hour 2	Contactors: Construction, Operation/working Principal, Types & Applications	
			Hour 3	Types & Applications	
			Hour 4	Difference between Relay & Contactor	
		Day 2	Hour 1	Timer: Construction, Operation/working Principal,	
			Hour 2	Types & Applications	
			Hour 3	Local & international brands of all of the above	
			Hour 4	Local & international brands of all of the above	
		Day 3	Hour 1	Fuses: Construction, Operation/working Principal, Types & Applications	
			Hour 2	Installation of fuses	
			Hour 3	Circuit Breakers: Construction, Operation/working Principal,	

				Types & Applications	
			Hour 4	Installation of circuit breakers	
		Day 4	Hour 1	Lightning arrestors: Construction, Operation/working	
			Hour 2	Principal, Types & Applications	
			Hour 3	Installation of lightning arrestors	
			Hour 4	continued	
		Day 5	Hour 1	Session on Self-Employment	
			Hour 2	How to start a Business	
			Hour 3	Requirements (Capital, Physical and Human requirements etc)	
			Hour 4	Benefits/Advantages of self- employment	
Week 11	Install wiring	Day 1	Hour 1	Describe earthing system & its types	<p>•Task 13, 14 <i>Details may be seen at Annexure-I</i></p>
			Hour 2	Importance of earthing system	
			Hour 3	Components/parts of earthing system	

			Hour 4	Earthing system installation
		Day 2	Hour 1	Measurement of earthing resistance
			Hour 2	Industrial earthing system
			Hour 3	Case Study (For further detail please see Page No: 5-6)
			Hour 4	Case Study (For further detail please see Page No: 5-6)
		Day 3	Hour 1	Describe insulators and its types
			Hour 2	Application of different types of insulators
			Hour 3	Inspection requirements
			Hour 4	Explain the purpose of visual inspection
	Day 4	Hour 1	Interpretation of drawings and circuit diagrams	
		Hour 2	Troubleshooting requirements	
		Hour 3	Implement troubleshooting procedures and identify fault	
		Hour 4	Implement troubleshooting procedures and identify fault	
	Day 5	Hour 1	Session on General Overseas Employment opportunities	

			Hour 2	Job search Avenues	
			Hour 3	Visa Processes and other necessary requirements	
			Hour 4	Immigration Information (Legal age requirements, Health Certificate, Police Clearance & Travel Insurance)	
Week 12	Industrial switches & sockets, their symbols and application/Uses	Day 1	Hour 1	Maintenance of electrical instruments and equipment;	<p>•Task 15</p> <p><i>Details may be seen at Annexure-I</i></p> <p>Final Project</p>
			Hour 2	Types of common faults of wiring; Load balance; Safety precautions	
			Hour 3	Troubleshooting Fault	
			Hour 4	Loads Schedule inspection	
		Day 2	Hour 1	Apply the diagnostic procedures for troubleshooting	
			Hour 2	Identify faulty parts and / or equipment	
			Hour 3	List the tools for required troubleshooting	
			Hour 4	Explain the procedures for monitoring load	
		Day 3	Hour 1	Describe procedures to monitor electrical power/energy consumption	

			Hour 2	Identify the repair or replace component parts	
			Hour 3	<ul style="list-style-type: none">• Carry out operational testing	
			Hour 4	<ul style="list-style-type: none">• Carry out operational testing	
		Day 4	Hour 1	Final Assessment	
		Day 5	Hour 1	Final Assessment	

Note: The following tasks are required to be performed multiple times by each trainee/group until sufficient proficiency level is acquired. The trainer is required to determine the number of times, each task needs to be repeated by a trainee as per his/her low/medium/high level of skill and proficiency during any stage of the course.

TASKS FOR INDUSTRIAL ELECTRICIAN

Task No.	Task	Description
1	Prepare safety charts.	Showing General & Trade specific safety measure (text/pictorial). Each trainee will prepare different chart.
2	Draw different Tools, Equipment, Measuring Instruments & their symbols.	Each trainee to draw sketches of different Tools & Equipment (at least 10) on drawing sheet.
3	Draw and label the line diagram of electrical power system.	Each trainee to draw neat & clean detailed line diagram of electrical power system (from the generating station to consumer end) on drawing sheet.
4	Make an electromagnet	Each trainee to make an electromagnet, trace the lines of force on drawing sheet and identify its magnetic poles. Further, clearly label the magnet, poles, lines of force, magnetic field etc.
5	Make a staircase circuit and draw its circuit diagram using standard symbols.	Staircase circuit is a common switching connection used to operate a lamp from two different places (i.e. above or below the stairs). We can use this circuit at other places also like Store / Bathroom etc.
6	Make Direct On Line (DOL) Starter, also draw its Power and Control circuits using standard symbols.	This is a simple kind of motor starter used to operate single phase or three phase motors. A DOL applies the full line voltage to the motor's input.
7	Make Forward-Reverse Circuit (with limit switches) for a 3-Phase Motor, also draw its power & control circuits.	This circuit is used to change the direction of rotation of a 3-Phase induction motor (i.e. forward & backward or upward & downward). Forward-Reverse movement of a 3-Phase motor can be obtained by changing its phase sequence.

8	Make Automatic Star-Delta Starter, also draw its power & control circuits.	3-phase induction motors (squirrel cage) are needed some suitable starting mechanism/arrangement because at the time of starting it draw a huge amount of current and when such large machines are started directly, it ultimately can cause damage to the machine or attached equipment.
9	Make different types of Electrical Joints.	Make and draw neat sketches the following types of electrical joints. Britannia Joint. Straight Joint. Tee Joint. Western Union Joint. Married Joint.
10	Make Godown or Tunnel wiring circuit and draw its circuit diagram using standard symbols.	This circuit is used to operate No. of lamps in a sequential manner by operating only one lamp at a time. It is commonly used in godowns, tunnels, long passages/tracks etc.
11	Make Star/Delta (Y-Δ) - Reverse/Forward circuit for 3-phase motor, also draw circuit diagram using standard symbols.	This can be used in conveyor belts, Escalator, Lifts, etc
12	Perform insulation resistance test with the help of megger.	An electrical system degrades its quality of insulation resistance with time and various environmental conditions including temperature, moisture, dust particles & humidity. Megger is a measuring instrument used for the measurement of insulation resistance of an electrical system.
13	Make an ATS Circuit, also draw circuit diagram using standard symbols.	This circuit is widely used in industries. The trainees have to make such circuit with the following options.\ <ol style="list-style-type: none"> 1. When the main supply goes down, The Generator Will Turn ON automatically after 5 Min. 2. When the Generator Turned ON, the load shifts to Generator after 3 min. automatically. 3. When the main supply becomes available, shift load immediately on main while the Generator will then run without load for 3 min. and then turn OFF automatically.
14	Carry out Earth Continuity Test and find the resistance of an existing earth pit with the help of earth tester.	All the equipment of the power system is connected to the earth system. The resistance of the earth is kept very low, so the fault current passes to the earth through the earth electrode.

15	What are the techniques to detect a Fault in an Electrical System? Troubleshoot an electrical fault by using any of the stated technique.	Troubleshooting is the process of analyzing the behavior or operation of a faulty circuit to determine what is wrong with the circuit. It then involves identifying the defective component(s) and repairing the circuit. Depending on the type of equipment.
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Suggestive Format And Sequence Order Of Success Story

S. No	Key Information	Detail/Description
1.	Self & Family background	<ul style="list-style-type: none"> • Self-introduction • Family background and socio economic status, • Education level and activities involved in • Financial hardships etc
2.	How he came on board NAVTTC Training/ or got trained through any other source	<ul style="list-style-type: none"> • Information about course, apply and selection • Course duration, trade selection • Attendance, active participation, monthly tests, interest in lab work
3.	Post training activities	<ul style="list-style-type: none"> • How job / business (self-employment) was set up • How capital was managed (loan (if any) etc). • Detail of work to share i.e. where is job or business being done; how many people employed (in case of self-employment/ business) • Monthly income or earnings and support to family • Earning a happy life than before
4.	Message to others (under training)	<ul style="list-style-type: none"> • Take the training opportunity seriously • Impose self-discipline and ensure regularity • Make Hard work pays in the end so be always ready for the same.

Note: Success story is a source of motivation for the trainees and can be presented in a number of ways/forms in a NAVTTC skill development course as under: -

1. To call a passed out successful person of institute. He/she will narrate his/her success story to the trainees in his/her own words and meet trainees as well.
2. To see and listen to a recorded video/clip (5 to 7 minutes) showing a successful person Audiovideo recording that has to cover the above mentioned points.
3. The teacher displays the picture of a successful trainee (name, trade, institute, organization, job, earning per month etc) and narrates his/her story in teacher's own motivational words.

Annexure-IV

HOME ASSIGNMENTS FOR INDUSTRIAL ELECTRICIAN

Assign. No.	Assignment
1	<p>i. Find area of a circle having radius = 6cm, also convert the result into inches.</p> <p>ii. Find area of a square having each side = 3 inches, also convert the result into mm.</p> <p>iii. Find area of a triangle having height = 8.6 cm & base = 0.05m, also convert the result into inches.</p> <p>iv. Cylinder having height = 2.25ft & radius = 255mm, also convert the result into meters.</p> <p>(Note: Draw neat and clean sketches of all of the above on drawing sheet)</p>
2	Draw & explain ohm's law triangle
3	Compare permanent magnet & electromagnet, also how could you prove that when electric current passes through a wire it produces a magnetic field?
4	Study of self-induction of a coil and effect of introducing iron core in it.
5	Explain the purpose of star/delta starter in detail.
6	<p>Draw the wiring/circuit diagram of any of the lab/workshop of your institute.</p> <p>“From Main Board to final circuit using standard symbols. (should be made on drawing sheet) For wiring/circuit diagram each trainee will select different lab/workshop. In case less number of labs/workshops, the trainees can select two offices of admin block/two class rooms etc.”</p>

Workplace/Institute Ethics Guide

Work ethic is a standard of conduct and values for job performance. The modern definition of what constitutes good work ethics often varies. Different businesses have different expectations. Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue, or value to strengthen character and individual abilities. It is a set of values-centered on the importance of work and manifested by determination or desire to work hard.

The following ten work ethics are defined as essential for student success:

1. Attendance:

Be at work every day possible, plan your absences don't abuse leave time. Be punctual every day.

2. Character:

Honesty is the single most important factor having a direct bearing on the final success of an individual, corporation, or product. Complete assigned tasks correctly and promptly. Look to improve your skills.

3. Team Work:

The ability to get along with others including those you don't necessarily like. The ability to carry your weight and help others who are struggling. Recognize when to speak up with an idea and when to compromise by blend ideas together.

4. Appearance:

Dress for success set your best foot forward, personal hygiene, good manner, remember that the first impression of who you are can last a lifetime

5. Attitude:

Listen to suggestions and be positive, accept responsibility. If you make a mistake, admit it. Values workplace safety rules and precautions for personal and co-worker safety. Avoids unnecessary risks. Willing to learn new processes, systems, and procedures in light of changing responsibilities.

6. Productivity:

Do the work correctly, quality and timelines are prized. Get along with fellows, cooperation is the key to productivity. Help out whenever asked, do extra without being asked. Take

pride in your work, do things the best you know-how. Eagerly focuses energy on accomplishing tasks, also referred to as demonstrating ownership. Takes pride in work.

7. Organizational Skills:

Make an effort to improve, learn ways to better yourself. Time management; utilize time and resources to get the most out of both. Take an appropriate approach to social interactions at work. Maintains focus on work responsibilities.

8. Communication:

Written communication, being able to correctly write reports and memos. Verbal communications, being able to communicate one on one or to a group.

9. Cooperation:

Follow institute rules and regulations, learn and follow expectations. Get along with fellows, cooperation is the key to productivity. Able to welcome and adapt to changing work situations and the application of new or different skills.

10. Respect:

Work hard, work to the best of your ability. Carry out orders, do what's asked the first time. Show respect, accept, and acknowledge an individual's talents and knowledge. Respects diversity in the workplace, including showing due respect for different perspectives, opinions, and suggestions.