GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

**COMPETENCY BASED CURRICULUM**

# WIND PLANT TECHNICIAN

**(Duration: Two Years)**

## CRAFTSMEN TRAINING SCHEME (CTS)

### NSQF LEVEL – 4

## SECTOR – POWER

Directorate General of Training

# WIND PLANT TECHNICIAN

**(Engineering Trade)**

**(Designed in March 2023)**

**Version: 1.0**

## CRAFTSMEN TRAINING SCHEME (CTS)

## NSQF LEVEL- 4

Developed By

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Directorate General of Training
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# 1. COURSE INFORMATION

During the two years duration of Electrician-Power Distribution trade a candidate is trained on professional skills & knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered during the course are given below:

**FIRST YEAR:** The trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He/she gets the idea of trade tools & its standardization, identifies different types of conductors, cables & their skinning & joint making. Basic electrical laws like Kirchhoff's law, ohm's law, laws of resistances and their application in different combinations of electrical circuit are practiced along with laws of magnetism. The trainee practices on electric circuit for single/poly-phase circuits for 3 wire/4 wire balanced& unbalanced loads. Skilling practice on different types of operation and maintenance. Wiring practice with installation of different accessories like Iron Clad Double Pole (ICDP) switch, distribution fuse box and mounting energy meters and its fault detection are done by trainee. The trainee will practice for pipe & plate earthing. The trainee will practice on different types of measuring instruments like multimeter, wattmeter, energy meter, phase sequences meter, frequency meter, for measurement of electrical parameters in single & three phase circuits. He/she will gain skill on range extension, calibration and testing of meters. Practice for dismantling, assembling and testing of different electrical equipment and machines will be done by trainee. Skill will be gained on transformer for operation, efficiency, series parallel operation, replacement of transformer oil and combination of single-phase transformers for 3 phase operation. The trainee will practice on electrical rotating machines, induction motors, synchronous motors and alternators. The trainee will practice and understand the basic concept of Electronics diodes for bridge rectifier, switching devices & amplifiers by electronic components, testing by CRO, computer hardware, basic structure of programmable logic controller, Embedded Systems and basic functions of SCADA. The trainee will understand the basic concept of control system and communication electronics open loop and closed loop controller, Microprocessor, 8051 Microcontroller and difference between Inverters and UPS. The trainee will practice on distribution system, domestic service line and accessories & their protection by practicing on relay and circuit breaker for operation and maintenance. The trainee will get basics understanding of gear and gearbox, brakes, dynamometers, clutches, bearings, couplings, lubrication, hydraulics. The trainee will learn the basic knowledge on Non-renewable and broadly on renewable energy systems. The trainees will also learn about the components of Wind Turbines and will acquire technical details of Wind power plant working.

**SECOND YEAR:** In this year the trainee will understand the details of wind turbine components and their electrical control circuits. The trainee will assemble parts of generator, gears, rings, hydraulics system and aerodynamics aspect of rotor blade. The trainee will work on Protection devices, sensors and transducers. The trainee will practice on electric motor maintenance. The trainee will study Power collection network and carry out wind resource assessment. The trainee will practice on Met- Mast, its erection, assembling and commissioning of sensor etc. The trainee will work on wind instrument system, collect wind data, and practice on their processing, validation, analysis and reporting. The trainee will practice on cranes, different slings and lifting jigs as well as signals for crane operators. The trainee will understand the concept of electrical and mechanical components in wind turbine. The trainee will learn about the installation and commissioning of wind turbines and understanding the operation and maintenance aspects of Wind Farms. The trainee will undergo practical orientation for 4-8 weeks in a working wind farm. The trainee will learn about environment and safety aspects of wind farms. The trainee will carry out maintenance, repair or replacement of faulty mechanical components and equipment's of WTG, transformer, switchgear etc. The trainee will understand the challenges and safety measures for transporting wind turbine components and working on heights with safety measures. The trainee will have Hands on training by building the small wind turbines wooden blades on their own.

# 2. TRAINING SYSTEM

## 2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

'Wind Plant Technician' trade under CTS is one of the newly designed courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Workshop Calculation and science, Engineering Drawing and Employability Skills) imparts requisite core skill, knowledge and life skills. After passing out of the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

### Trainee broadly needs to demonstrate that they are able to:

- Read and interpret technical parameters/ documents, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge & employability skills while performing jobs.
- Check the job/ assembly as per drawing for functioning identify and rectify errors in job/ assembly.
- Document the technical parameters related to the task undertaken.

## 2.2 PROGRESSION PATHWAYS

- Can join in wind industry as technician and will progress further as senior technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in the diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programs in different types of industries leading to a National Apprenticeship Certificate (NAC)
- Can join Instructor Training Program and become an instructor in ITIs.

## 2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

| S No. | Course Element | Notional Training Hours | |
|---|---|---|---|
| | | 1st Year | 2nd Year |
| 1 | Professional Skill (Trade Practical) | 840 | 840 |
| 2 | Professional Knowledge (Trade Theory) | 240 | 300 |
| 3 | Employability Skills | 120 | 60 |
| | **Total** | **1200** | **1200** |

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

| | | |
|---|---|---|
| On the Job Training (OJT)/ Group Project | 150 | 150 |
| Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses) | 240 | 240 |

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

## 2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training program through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal)during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines.

The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

## 2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

## 2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

| Performance Level | Evidence |
|---|---|

| (a) Marks in the range of 60 -75% to be allotted during assessment | |
|---|---|
| For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship. | ● Demonstration of good skill in the use of hand tools, machine tools and workshop equipment<br>● 60-70% accuracy achieved while undertaking different work with those demanded by the component/job.<br>● A fairly good level of neatness and consistency in the finish<br>● Occasional support in completing the project/job. |
| (b) Marks in the range of above75% - 90% to be allotted during assessment | |
| For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship. | ● Good skill levels in the use of hand tools, machine tools and workshop equipment<br>● 70-80% accuracy achieved while undertaking different work with those demanded by the component/job.<br>● A good level of neatness and consistency in the finish<br>● Little support in completing the project/job |
| (c) Marks in the range of above 90% to be allotted during assessment | |
| For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship. | ● High skill levels in the use of hand tools, machine tools and workshop equipment<br>● Above 80% accuracy achieved while undertaking different work with those demanded by the component/job.<br>● A high level of neatness and consistency in the finish.<br>● Minimal or no support in completing the project. |

# 3. JOB ROLE

Equipment Manufacture, assembling and O&M forms the major industry in **wind sector**

**Wind power plant installation Technician (Electrical):** The wind power plant Installation Technician is responsible for installing electrical components of wind power plant.

**Wind Power Plant Maintenance Technician (Electrical):** He is responsible for maintenance and effective functioning of the installed wind power plant. The individual has to carry out the testing of transformers, switch Gear and protection devices.

**Manufacturing technician** associates manufacturing wind turbine components in industries, control equipment making, testing, quality checking, finishing, storing etc. also involves in making of support structures, sensors, SCADA systems, servomotors, blades, anemometers, control systems, instrumentation etc.

**Service technician** associates in operation and maintenance of wind farms, troubleshoots electrical and mechanical components in wind turbines; replaces defective components, reconditions wear out parts or structures, counsels better maintenance aspects to project owners.

**Project developer/assistant** associates in developing, erection, installing and commissioning wind turbine projects, coordinates logistics, data analysts, electrical, computer, mechanical and construction works, equipment transporters, monitors project completion etc.

**Electrical and Electronic Equipment Mechanics and Fitters and Related Workers, Other**; include all other workers engaged in fitting, assembling, repairing and maintaining electronic and electrical equipment, machinery, appliances, etc., not elsewhere classified.

**Reference NCO-2015:**

(i) 7419.9900 - Electrical and Electronic Equipment Mechanics and Fitters and Related Workers, Other

**Reference NOS:**

| | | | | | |
|---|---|---|---|---|---|
| I. | CSC/N0304 | XI. | PSS/N1707 | XXI. | PSS/N9405 |
| II. | PSS/N0108 | XII. | CSC/N0901 | XXII. | SGJ/N9401 |
| III. | PSS/N6001 | XIII. | ELE/N9432 | XXIII. | SGJ/N9409 |
| IV. | SGJ/N6001 | XIV. | ELE/N5804 | XXIV. | ISC/N9439 |
| V. | SGJ/N0104 | XV. | ELE/N9443 | XXV. | SGJ/N9411 |
| VI. | PSS/N6002 | XVI. | SGJ/N9404 | XXVI. | SGJ/N9410 |
| VII. | PSS/N7001 | XVII. | SGJ/N9405 | XXVII. | PSS/N9401 |
| VIII. | PSS/N2407 | XVIII. | SGJ/N9406 | XXVIII. | PSS/N9402 |
| IX. | PSS/N1709 | XIX. | SGJ/N9407 | | |
| X. | PSS/N0106 | XX. | SGJ/N9408 | | |

## 4. GENERAL INFORMATION

| | |
|---|---|
| **Name of the Trade** | **WIND PLANT TECHNICIAN** |
| **Trade Code** | DGT/2020 |
| **NCO - 2015** | 7419.9900 |
| **NOS Covered** | CSC/N0304, PSS/N0108, PSS/N6001, SGJ/ N6001, SGJ/N0104, PSS/N6002, PSS/N7001, ELE/4402, PSS/N2407, PSS/N1709, PSS/N9405, PSS/N0106, PSS/N1707, CSC/N0901, ELE/N9432, ELE/N5804, ELE/N9443, SGJ/N9405, SGJ/N9406, SGJ/N9407, SGJ/N9408, SGJ/N9404, SGJ/N9401, SGJ/N9409, ISC/N9439, SGJ/N9411, SGJ/N9410, PSS/N9401, PSS/N9402 |
| **NSQF Level** | Level-4 |
| **Duration of Craftsmen Training** | Two Years (2400 hours + 300 hours OJT/Group Project) |
| **Entry Qualification** | Passed 10$^{th}$ class examination with Science and Mathematics or its equivalent. |
| **Minimum Age** | 14 years as on first day of academic session. |
| **Eligibility for PwD** | This is the specialized course and requires technicians to work at heights and hence it is not desirable for PwD |
| **Unit Strength (No. Of Student)** | 20 (There is no separate provision of supernumerary seats) |
| **Space Norms** | 100 Sq. m |
| **Power Norms** | 5 KW |
| **Instructors Qualification for** | |
| **(i) Wind Plant Technician Trade** | B.Voc/Degree in Mechanical/ Electrical/ Electronics and Instrumentation Engineering from recognized Engineering College/university with one year experience in the relevant field.<br>**OR**<br>Diploma in Electrical/ Mechanical/ Electronics and Instrumentation Engineering from recognized board of technical education with two years' experience in the relevant field.<br>**OR**<br>NTC/NAC passed in the Trade of "Wind Plant Technician" With three years' experience in the relevant field.<br>**Essential Qualification:** |

| | |
|---|---|
| | Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT.<br><br>***Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.*** **However, both of them must possess NCIC in any of its variants.** |
| **(ii) Workshop Calculation & Science** | B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.<br>**OR**<br>03 years Diploma in Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.<br>**OR**<br>NTC/ NAC in any one of the engineering trades with three years experience.<br>**Essential Qualification:**<br>National Craft Instructor Certificate (NCIC) in relevant trade<br>**OR**<br>NCIC in RoDA or any of its variants under DGT |
| **(iii) Engineering Drawing** | B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.<br>**OR**<br>03 years Diploma in Engineering from AICTE /UGC recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.<br>**OR**<br>NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience.<br><br>**Essential Qualification:**<br>Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade |

| | |
|---|---|
| | OR<br>Regular/RPL variants NCIC in RoDA or any of its variants under DGT |
| **(iv) Employability Skill** | MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills.<br>(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)<br>**OR**<br>Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills. |
| **(v) Minimum age for Instructor** | 21 years |
| **List of Tools & Equipment** | As per Annexure-I |
| | |

# 5. LEARNING OUTCOME

***Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.***

## 5.1 LEARNING OUTCOMES

**FIRST YEAR**

1. Plan and organize the work to make job as per specification applying different types of basic fitting operations and check for dimensional accuracy following safety precautions. [Basic fitting operations – Marking, Hack-sawing, Chiselling, Filing, Drilling, Threading etc. Accuracy: ± 0.25mm] (NOS: CSC/N0304)
2. Perform joining of electrical wires as per specification applying different types of operations like soldering, crimping and measuring of insulation resistance. (NOS: PSS/N0108)
3. Construct and verify characteristics of electrical and magnetic circuits. (NOS: SGJ/N6001, PSS/N6001, SGJ/N0104)
4. Assemble Electrical accessories and test charging and discharging of batteries. (NOS: PSS/N6002)
5. Assemble, install and test Wiring and Earthing system, check faults and carry out repairing of circuit breakers. (NOS: PSS/N7001, PSS/N6001, PSS/N6002)
6. Plan, execute commissioning, testing of AC & DC motors and carry out maintenance of transformer. (NOS: PSS/N2407, PSS/N1709)
7. Plan, connect, test, evaluate performance and carry out maintenance of synchronous motors, induction motors and alternator. (NOS: PSS/N9405)
8. Erect overhead distribution line and outline various power plant layout. (NOS: PSS/N0106)
9. Measure electrical parameters by using analog/digital measuring instruments. (NOS: PSS/N1707)
10. Perform installation and check functionality of gear box, brakes, dynamometers, clutches & bearings, couplings and maintain lubrication system. (NOS: CSC/N0901)
11. Apply the basic parameters of hydraulics. (NOS: ELE/N9432)
12. Select the appropriate electronic components and check their performance. (NOS: ELE/N5804)
13. Construct and test circuits and communication components using microcontroller 8051. (NOS: ELE/N9443)
14. Prepare a report on renewable and Non- renewable energy technology and test a model wind turbine component and record the observations. (NOS: SGJ/N9404)
15. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)

16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

**SECOND YEAR**

17. Assemble parts of generator and gears used in Wind Turbine and test the performance. (NOS: SGJ/N9405)
18. Operate, troubleshoot and control the Hydraulic equipment used in Wind Energy Sector. (NOS: SGJ/N9406)
19. Demonstrate the working principle of Aerodynamics aspect of Rotor Blade. (NOS: SGJ/N9407)
20. Examine various types of wind energy generators and evaluate their performance. (NOS: SGJ/N9408)
21. Install, test, repair and maintenance of Generator and Electric Motor. (NOS: PSS/N9405)
22. Check the availability of wind in a place & prepare a feasibility report on site suitability for a project. (NOS: SGJ/N9404)
23. Measure Wind energy by using Sensors and install, operate and maintain Wind Sensor Instrument. (NOS: SGJ/N9401)
24. Perform Collection, Processing, Validation, Analysis and Reporting of Wind Data. (NOS: SGJ/N9409)
25. Demonstrate operating of Cranes, different slings, lifting jigs and Signals for crane operators. (NOS: ISC/N9439)
26. Perform installation, commissioning, operation and maintenance of wind turbine in a working wind farm. (NOS: SGJ/N9411)
27. Perform repair and replacement activities of electrical control parts and mechanical components of Wind Turbine Generator. (NOS: SGJ/N9410)
28. Evaluate the Challenges for transportation and setting-up of Wind turbine components at heights and under hazardous conditions. (NOS: SGJ/N9411)
29. Adhere to Environmental and Safety guidelines followed in wind power plant. (NOS: SGJ/N9411)
30. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
31. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

# 6. ASSESSMENT CRITERIA

| LEARNING OUTCOMES | ASSESSMENT CRITERIA |
|---|---|
| **FIRST YEAR** | |
| 1. Plan and organize the work to make job as per specification applying different types of basic fitting operations and check for dimensional accuracy following safety precautions. *[Basic fitting operations – Marking, Hack-sawing, Chiselling, Filing, Drilling, Threading etc. Accuracy: ± 0.25mm]*. (NOS: CSC/N0304) | Identify the trade tools; practice their uses with safety, care & maintenance. |
| | Identification of danger, warning, caution & safety signs. |
| | Preventive measures for electrical accidents and use of fire extinguishers. |
| | Perform fitting jobs and Safety precautions. |
| | Identify and practice use of fitter tools and accessories. |
| | Perform filing true to line. |
| | Demonstrate Sawing and planning and use carpenter's common hand tools. |
| | Demonstrate and use types of drills, power drilling machines, care and maintenance. |
| | Perform on use of snips, marking & cutting of straight & curved pieces in sheet metals. |
| | Perform riveting practice in sheet metal. |
| | Perform in making different joints in sheet metal and soldering the joints. |
| | Demonstrate dismantling and assembling in D.C. Machine. |
| | Connect shunt generators and measure of voltage. demonstrate field excitation. |
| | Explain No load & load characteristics of series, shunt & compound generator - cumulative and differential. |
| | Perform controlling and protecting DC generator. |
| | Explain 3 point & 4-point starters, Connect, start, run, and control speed of DC motors. |
| | |
| 2. Perform joining of electrical wires as per specification applying different types of operations like soldering, crimping and measuring | Demonstrate skinning, twisting and crimping. |
| | Identify various types of cables and measure conductor size using SWG and micrometer. |
| | Make joints on single strand conductors. |
| | Perform crimping and soldering of joints/lugs. |

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| of insulation resistance. (NOS: PSS/N0108) | |
| | |
| 3. Construct and verify characteristics of electrical and magnetic circuits. (NOS: SGJ/N6001, PSS/N6001, SGJ/N0104) | Measure parameters in combinational DC circuits by applying Ohm's Law for different resistor values and voltage sources. |
| | Measure current and voltage in DC circuits to verify Kirchhoff's Law. |
| | Verify laws of series and parallel circuits with voltage source in different combinations. |
| | Measure current and voltage and analyze the effects of shorts and opens in series and parallel circuits. |
| | Measure power, energy for lagging and leading power factors in single phase circuits. |
| | Determine the relationship between Line and Phase values for star and delta connections. |
| | Measure the Power of three phase circuit for balanced and unbalanced loads. |
| | |
| 4. Assemble Electrical accessories and test charging and discharging of batteries. (NOS: PSS/N6002) | Perform Battery Charging by different methods and test charging. |
| | Check discharged and fully charged battery and prepare report. |
| | Perform routine care, maintenance of Batteries, filling of electrolytes. |
| | |
| 5. Assemble, install and test Wiring and Earthing system, check faults and carry out repairing of circuit breakers. (NOS: PSS/N7001, PSS/N6001, PSS/N6002) | Perform installation of earthing system and testing of earthing system. |
| | Perform utility of an earth leakage relay. |
| | |
| 6. Plan, execute commissioning, testing of AC & DC motors and carry out maintenance of transformer. (NOS: ELE/4402, | Explain the difference between AC and DC Motors. |
| | Identify types of transformers. |
| | Demonstrate use of C.T. & P.T. |
| | Conduct No-load and short circuit tests. |
| | Test single phase and three phase transformers. |
| | Demonstrate changing of oil in transformer. |

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| PSS/N2407, PSS/N1709) | Test for faults in transformer. |
| | |
| 7. Plan, connect, test, evaluate performance and carry out maintenance of synchronous motors, induction motors and alternator. (NOS: PSS/N9405) | Demonstrate Power factor correction of Industrial load. |
| | Explain the effect of changing the field excitation. |
| | Perform connection of D.O.L Starter. |
| | Perform connection of Star /Delta starter. |
| | Perform connection of autotransformer starter. |
| | Make connections of single-phase motor, testing, running, and reversing. |
| | Demonstrate voltage Building, load characters & regulation on alternators. |
| | Perform installation, running and maintenance of Alternators. |
| | |
| 8. Erect overhead distribution line and outline various power plant layout. (NOS: PSS/N0106) | Explain the behaviour of R, $X_L$ & $X_C$ in A.C. circuits both in series and in parallel. |
| | Demonstrate use of single phase preventer. |
| | Demonstrate use of phase sequence meter. |
| | Explain erection of overhead distribution lines. |
| | |
| 9. Measure electrical parameters by using analog/ digital measuring instruments. (NOS: PSS/N1707) | Perform tests on Multimeter, Wattmeter, P F meter, Energy meter, Frequency mete, functional check of measuring instruments. |
| | Demonstrate operation of C.R.O. |
| | Demonstrate maximum demand meter. |
| | Demonstrate use of phase sequence indicator and digital Instruments. |
| | |
| 10. Perform installation and check functionality of gear box, brakes, dynamometers, clutches & bearings, couplings and maintain lubrication system. (NOS: CSC/N0901) | Demonstrate connection of gear generating. |
| | Explain the working principle of gear box in WT |
| | Functions of gear measurement and testing. |
| | Functions of Brakes, Dynamometers, Clutches & Bearings. |
| | Identifying the materials used in brake components. |
| | Identifying the structure and function of various brake systems. |
| | Identifying the areas of use for brake systems. |
| | Explain how brake systems are monitored using sensors. |
| | Recognize the dangers of working on brake systems. |
| | Demonstrate Installation and removal of brake system. |
| | Explain functions and working principle of coupling. |

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| | Explain commissioning of couplings. |
| | Identifying the damages of couplings. |
| | Explain functions and working principle of lubrication. |
| | Identification of characteristics and functions of oils and greases. |
| | |
| 11. Apply the basic parameters of hydraulics. (NOS: ELE/N9432) | Functions and working principle of hydraulics and types of flow. |
| | Identification of parameters associated with fluid flow and hydrostatic pressure. |
| | Explain physical principles of hydraulics. |
| | |
| 12. Select the appropriate electronic components and check their performance. (NOS: ELE/N5804) | Test diodes and study characteristics of diodes using multi-meter. |
| | Perform working of bridge wave rectifier circuit. |
| | Test and demonstrate characteristics of transistors. |
| | Assemble and test a single stage amplifier and check on C.R.O. |
| | Test power amplifier. |
| | Draw Power control circuits using S.C.R. & Diac, Triac, I.G.B.T. |
| | Basic structure of programmable logic controller (PLC). |
| | Basic structure of embedded system. |
| | Basic functions of SCADA features. |
| | |
| 13. Construct and test circuits and communication components using microcontroller 8051. (NOS: ELE/N9443) | 8051 Microcontroller, architecture, pin details & the bus system. |
| | Construct and test control circuits using Protection devices, Sensors and Transducers. |
| | Construct circuits with popular ICs used in controlling wind turbine equipment's. |
| | Test servo stabilizer and measure input and output voltages. |
| | Working with UPS. |
| | |
| 14. Prepare a report on renewable and Non-renewable energy technology and test a model wind turbine components and record the observations. (NOS: PSS/N9401) | Renewable & Non-renewable energy sources and applications. |
| | Working of wind energy plant. |
| | Advantages and growth of wind energy applications. |
| | Evaluate Major components of horizontal & vertical axis WT. |
| | Evaluate small wind turbine components. |
| | |

| | |
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| 15. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401) | Read & interpret the information on drawings and apply in executing practical work. |
| | Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. |
| | Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work. |
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| 16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402) | Solve different mathematical problems |
| | Explain concept of basic science related to the field of study |
| **SECOND YEAR** | |
| 17. Assemble parts of generator and gears used in Wind Turbine and test the performance. (NOS: SGJ/N9405) | Demonstration on wind turbine models. |
| | Assemble parts of wind turbine blades and demonstrate its working. |
| | Assemble Generator, Gears and rings to the turbine blades and verify the function. |
| | Effect of Blade angles on the performance of wind turbine. |
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| 18. Operate, troubleshoot and control the Hydraulic equipment used in Wind Energy Sector. (NOS: SGJ/N9406) | Oil hydraulics, Hydraulic drive train, Hydraulic system used in blade mechanism, Hydraulic pitch control, Hydraulic battery, hydraulic switches and Electro-hydraulic component. |
| | Functions of hydraulic energy transmission and hydraulic circuit arrangements |
| | Describe external gear pumps and hydraulic cylinders. |
| | Assemble simple basic hydraulic circuits. |
| | Assemble, dismantle and perform maintenance of control blocks variable displacement pumps and pressure storage units. |
| | Interpret complex hydraulic diagrams for wind turbines. |
| | Describe the structure and function of variable displacement pumps with control devices. |

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| | Describe the structure and function of hydrostatic gears for wind turbines. |
| | Explain the structure and function of hydraulic storage units. |
| | Name opportunities for energy saving based on the choice of components and circuit types. |
| | Explain connecting systems for valves and control blocks. |
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| 19. Demonstrate the working principle of Aerodynamics aspect of Rotor Blade. (NOS: SGJ/N9407) | Wind turbine blades and moulds with available materials. |
| | Characteristics of design features of rotors and rotor blades. |
| | Factors affecting on performance of rotor. |
| | Importance of good blade condition. |
| | Aerodynamics of a wind turbine. |
| | Procedures for working on and in rotor blades. |
| | Construction of rotor blades and the materials used. |
| | Blade access techniques. |
| | Types of damages to rotor blades. |
| | Identify the tools and devices needed for the inspection of rotor blades. |
| | Possible hazards encountered in working on rotor blades. |
| | Techniques of rotor assembling. |
| | Benefits pitch actuator. |
| | Analyzing the fault of pitch sensor. |
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| 20. Examine various types of wind energy generators and evaluate their performance. (NOS: SGJ/N9408) | Performance evaluation of horizontal axis wind turbine and record observation. |
| | Performance evaluation of vertical axis wind turbine and record observation. |
| | Grid connected WEG system – Fixed speed, variable speed and doubly fed system and record observation. |
| | Synchronization of wind electric generators and record observation. |
| | Noise level of wind turbine system and record observation. |
| | Working principles of different components of power collection network. |
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| 21. Install, test, repair and maintenance of Generator and Electric | Electrical and mechanical control circuits used in wind energy plant. |
| | Generation of AC and three-phase voltage. |
| | How rotating field and torque is produced |

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| Motor.<br>(NOS: PSS/N9405) | How a commutator motor works. |
| | Maintenance and test procedures for electrical machines in wind turbines. |
| | Protection devices for three-phase machines. |
| | Design, functions and controls of various inverter systems. |
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| 22. Check the availability of wind in a place & prepare a feasibility report on site suitability for a project.<br>(NOS: SGJ/N9404) | Wind resource assessment techniques. |
| | Estimate and evaluate wind resource for prospective site. |
| | Identifying the site and its characteristics. |
| | Feasibility of a site/project. |
| | Identification of good wind resource potential site. |
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| 23. Measure Wind energy by using Sensors and install, operate and maintain Wind Sensor Instrument.<br>(NOS: SGJ/N9401) | Identifying various sensors used in wind turbines. |
| | Identifying possible causes of faults in sensors. |
| | Install and adjust sensors in accordance with manufacturer data. |
| | Installation and erection of Met- Mast. |
| | Assemble techniques of sensors in order. |
| | Testing and trouble-shooting on wind turbine sensors. |
| | Visual inspection and maintenance of lightning protection systems. |
| | Identify and replace damaged components of sensor instruments. |
| | Test the assembled sensors and verify results. |
| | Test the data logger and verify the measurements. |
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| 24. Perform Collection, Processing, Validation, Analysis and Reporting of Wind Data.<br>(NOS: SGJ/N9409) | Demonstrate data collection techniques. |
| | Raw data measuring techniques. |
| | Wind speed calculation and wind rose diagram. |
| | Analyze sources of error and possibilities. |
| | Verify basic measuring parameters. |
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| 25. Demonstrate operating of Cranes, different slings and lift jigs following the Signals for crane operators.<br>(NOS: ISC/N9439) | Demonstrate operation of cranes. |
| | Demonstrate Signals for crane operators. |
| | Test properties of oils and lubricants. |
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| 26. Perform installation, commissioning, operation and maintenance of wind turbine in a working wind farm. (NOS: SGJ/N9411) | Perform foundation for wind turbine tower. |
| | Perform tower assembly. |
| | Brief of Balance of Plant (BoP) for wind project. |
| | Demonstrate operation of wind turbine generator. |
| | Preventive maintenance of wind turbine generator. |
| | Carry out inspections of WTG, blade and associated mechanical components. |
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| 27. Perform repair and replacement activities of electrical control parts and mechanical components of Wind Turbine Generator. (NOS: SGJ/N9410) | Tools to carry out online testing of WTG and components. |
| | Measure and record performance parameters like voltage, current, frequency parameters, WTG temperature, etc. |
| | Measure and record for performance parameters of transformer like input voltage/ output voltage, frequency, phase sequence, etc. |
| | Identify the operation manuals of all mechanical components for inspection. |
| | Measure and record real time parameters of WTG and associated components like vibration, torqueing, temperature of bearings, grease level, alignment etc. |
| | Measure and record real time parameters of wind turbine blades and associated components like temperature, vibration, alignment, etc. |
| | Carry out maintenance activities for mechanical components of WTG as per standard operating procedures. |
| | Measure and record parameters post maintenance activities. |
| | Carry out repair or replacement of faulty mechanical components and equipment's of WTG. |
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| 28. Evaluate the Challenges for transportation and setting-up of Wind turbine components at heights and under hazardous conditions. (NOS: SGJ/N9411) | Rules on permitting process involves road bonding. |
| | Wind component dimensions and weight lack uniformity. |
| | Factors Influencing Route Choice and Transportation Costs. |
| | Concept of Transportation Breakpoints. |
| | Select the appropriate PPE (Personal Protective Equipment) to carry out the specific activity. |
| | Assess weather and environmental conditions for working at heights. |
| | Hazards, risks and basic rescue techniques at heights. |
| | Correct use of PPE, such as safety harnesses, lanyards, fall arresters and work positioning equipment. |

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| 29. Adhere to Environmental and Safety guidelines followed in wind power plant. (NOS: SGJ/N9411) | Select and use of standard items of personal protective equipment. |
| | Assess risk situations in general work activities. |
| | Take general accident prevention measures. |
| | Identify the location of the conduit, cables, pipes & other undergoing devices prior to performing maintenance work. |
| | Perform visual inspection of the electrical and mechanical systems of wind power plant and record any defects. |
| | Identify and follow warning signs on site. |
| | Ensure safe working practices when working at heights, confined areas and trenches. |
| | Identify methods of accident prevention in the work environment. |
| | Use of various appropriate fire extinguishers on different types of fires correctly. |
| | Administer appropriate first aid to victims as required. |
| | Emergency procedures: raising alarm, safe/efficient, evacuation, correct means of escape, correct assembly point, roll call, correct return to work. |
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| 30. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401) | Read & interpret the information on drawings and apply in executing practical work. |
| | Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. |
| | Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work. |
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| 31. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402) | Solve different mathematical problems |
| | Explain concept of basic science related to the field of study |
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## 7. TRADE SYLLABUS

| SYLLABUS FOR WIND PLANT TECHNICIAN TRADE | | | |
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| **FIRST YEAR** | | | |
| **Duration** | **Reference Learning outcome** | **Professional Skills (Trade Practical)** | **Professional Knowledge (Trade Theory)** |
| Professional Skills<br>60 Hrs<br><br>Professional Knowledge<br>12 hrs | Plan and organize the work to make job as per specification applying different types of basic fitting operations and check for dimensional accuracy following safety precautions. *[Basic fitting operations – Marking, Hack-sawing, Chiselling, Filing, Drilling, Threading etc. Accuracy: ± 0.25mm]* | 1. Perform various safety measures in the shop floor with first aid tools.<br>2. Visit different sections of the Institute.<br>3. Demonstrate on elementary first aid and artificial Respiration.<br>4. Demonstrate using Trade hand tools.<br>5. Identify simple types of screws, nuts & bolts, chassis, clamps, rivets etc.<br>6. Practice use, care & maintenance of various hand tools. | Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard<br><br>Identification of Trade-Hand Tools- Specifications |
| | | 7. Practice fitting jobs and Safety precautions.<br>8. Identify and practice use of fitter tools and accessories.<br>9. Practice on marking tools usage, use of chisels.<br>10. Practice hacksaw on flats.<br>11. Practice sheet metal filing.<br>12. Practice filing true to line.<br>13. Practice use of firmer chisel and preparing simple half lap joint.<br>14. Demonstrate Sawing and | **ALLIED TRADES:**<br>Introduction of fitting trade. Safety precautions to be observed Description of files, hammers, chisels, hacksaw frames & blades- their specification & grades. Care & maintenance of steel rule try square and files.<br><br>Marking tools description & use. Description of carpenter's common hand tools such as saws planes, chisels mallet claw hammer, |

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| | | planning and use carpenter's common hand tools.<br>15. Demonstrate and use types of drills, power drilling machines, care and maintenance.<br>16. Practice grinding of drill bits.<br>17. Practice on use of taps &dies, threading hexagonal & square nuts etc. to cut external threads on stud and on pipes.<br>18. Practice on use of snips, marking & cutting of straight & curved pieces in sheet metals.<br>19. Practice bending the edges of sheets metals.<br>20. Practice riveting practice in sheet metal.<br>21. Practice in making different joints in sheet metal and soldering the joints. | marking, dividing & holding tools- their care and maintenance.<br><br>Types of drills description & drilling machines, proper use, care and maintenance.<br><br>Description of taps &dies, types in rivets & riveted joints. Use of thread gauge.<br><br>Description of marking &cutting tools such as snubs shears punches & other tools like hammers, mallets etc. used by sheet metal workers. Types of soldering irons- their proper uses.<br><br>Use of different bench tools used by sheet metal worker. Soldering materials, fluxes and process. |
| Professional Skills<br>60 Hrs<br><br>Professional Knowledge<br>12 hrs | Perform joining of electrical wires as per specification applying different types of operations like soldering, crimping and measuring of insulation resistance. | 22. Practice using cutting pliers, screw drivers etc.<br>23. Practice skinning the cables, and single strand joint.<br>24. Demonstrate& Practice bare conductors joints– such as Britannia, straight, Tee, Western union Joints.<br>25. Practice soldering of different components.<br>26. Measure Resistance and | Fundamental of electricity. Electron theory- free electron. Fundamental terms, definitions, units & effects of electric current.<br><br>Solders, flux and soldering technique. Resistors - types of resistors & properties of resistors.<br><br>Explanation, Definition and properties of conductors, insulators and semi-conductors. |

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| | | specific Resistance.<br>27. Demonstrate and identify types of cables.<br>28. Demonstrate & practice use of standard wire gauge.<br>29. Practice use of crimping thimbles, Lugs.<br>30. Examine and check cables and conductors.<br>31. Verify materials according to the span. | Voltage grading of different types of Insulators, Temp. Rise permissible Types of wires & cables standard wire gauge Specification of wires &Cables insulation & voltage grades –Low, medium & high voltage Precautions in using various types of cables. |
| Professional Skills<br>60 Hrs<br><br>Professional Knowledge<br>12 hrs | Construct and verify characteristics of electrical and magnetic circuits. | 32. Measure resistance by voltage drop method.<br>33. Verify Series & shunt circuits.<br>34. Use of Multi-meter in circuits.<br>35. Verify Ohm's Law.<br>36. Verify series and parallel circuits.<br>37. Practice assembly / winding of a simple electro magnet.<br>38. Identify different types of Capacitors.<br>39. Practice charging & discharging of capacitor.<br>40. Test Capacitors using DC voltage and lamp. | **Resistance** Different Types of resistors used in electrical circuits. Specification of resistance and tolerance. Effect of variation of temperature on resistance.<br>**Measurement of resistance by different methods**<br>a) Using Wheatstone Bridge<br>b) By voltage drop method.<br>**Ohm's Law –** Simple electrical circuits and problems.<br>**Resistors** –Law of Resistance. Series and parallel circuits.<br>**Kirchoff's Laws** & applications<br>**Magnetism –** classification of magnets, methods of magnetizing, magnetic materials. Properties, care & maintenance, methods of magnetizing magnetic materials. Para & Diamagnetism and Ferro magnetic materials. Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left- & right-hand rules, Magnetic field of current carrying conductors, loop & solenoid. |

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| | | | **MMF**, Flux density, reluctance. **B.H.** curve, Hysteresis, Eddy current. Principle of electromagnetic Induction, Faraday's Law, Lenz's Law. **Electrostatics** – Capacitor Different types, functions & uses. |
| Professional Skills<br>60 Hrs<br><br>Professional Knowledge<br>12 hrs | Assemble Electrical accessories and test charging and discharging of batteries. | 41. Fix switches, holder plugs etc. in T.W. boards.<br>42. Identify and practice use of wiring accessories.<br>43. Practice Battery Charging and discharging by different methods and test charging.<br>44. Test cells, check discharged and fully charged battery.<br>45. Practice installation of batteries.<br>46. Practice routine care, maintenance of Batteries, filling of electrolytes. | Common Electrical Accessories, their specifications. Explanation of switches lamp holders, plugs and sockets.<br>Developments of domestic circuits, Alarm & switches, lamp, fan with individual switches, Two-way switch.<br><br>**Chemical** effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis. Basic principles of Electro-plating and Electro chemical equivalents. Explanation of Anodes and cathodes. Lead acid cell-description, methods of charging-Precautions to be taken. |
| Professional Skills<br>55 Hrs<br><br>Professional Knowledge<br>10 hrs | Assemble, install and test Wiring and Earthing system, check faults and carry out repairing of circuit breakers. | 47. Practice in casing, Capping. Conduit wiring with minimum to a greater number of points.<br>48. Practice use of two-way switches.<br>49. Test insulation by two lamp method & megger.<br>50. Identify & demonstrate conduits and accessories & their uses. Practice cutting, threading & laying.<br>51. Practice installation of earthing system and | **Electric wirings**, importance, I.E rules. Types of wirings both domestic & industrial – Specifications for wiring – Grading of cables and current ratings. Principle of laying out in domestic wiring-testing by megger<br><br>**Wiring system** – Using casing capping, P.V.C., concealed system. –Maintenance & Repairing data sheet preparation. Specifications, standards for conduits & accessories |

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| | | testing.<br>52. Practice utility of an Earth Leakage Relay. | **Earthing** – Principle of different methods of earthing. Importance of Earthing. –Earth Leakage Relay. |
| Professional Skills<br>45 Hrs<br><br>Professional Knowledge<br>08 hrs | Plan, execute commissioning, testing of AC & DC motors and carry out maintenance of transformer. | 53. Identify types of transformers.<br>54. Practice connection of transformers and study their efficiencies.<br>55. Test transformer and conduct No-load and short circuit tests.<br>56. Demonstrate use of Instrument transformer (C.T. & P.T).<br>57. Test single phase and Three Phase Transformers.<br>58. Demonstrate Cleaning and maintenance of Transformers.<br>59. Demonstrate Changing of oil in transformer.<br>60. Test for faults in transformer. | Introduction of **AC and DC Motors** Demonstrate the difference between AC and DC Motors **TRANSFORMERS** Working principle of Transformer, classification instrument transformer - C.T., P.T. Instrument and Auto Transformer/Variac Construction of Single phase and Poly phase transformers. E.M.F. equation, parallel operation of transformer, their connections. Regulation and efficiency, Cooling of transformer, protective devices. Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency. Special transformers. Transformer – construction core type, shell type, winding shielding, auxiliary parts breather, conservator Buchholz Relay, other protective devices, cooling of transformer, Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination. |
| Professional Skills<br>80 Hrs<br><br>Professional Knowledge<br>20 hrs | Plan, connect, test, evaluate performance and carry out maintenance of synchronous motors, induction motors and alternator. | 61. Practice on starting, running, connection to bus bar.<br>62. Study effect of changing the field excitation.<br>63. Demonstrate Power factor correction of Industrial | **SYNCHRONOUS MOTOR** – Working principle, effect of change of excitation and load. Application in industry in power factor improvement.<br><br>**Converter**-inverter, M.G. Set |

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| | | load.<br>64. Practice on connection of D.O.L Starter.<br>65. Practice on connection of Star /Delta starter.<br>66. Practice on connection of Autotransformer starter.<br>67. Practice on starting, running & speed control.<br>68. Practice connection of single-phase motor, identification, testing, running, and reversing.<br>69. Demonstrate voltage Building, load characteristics & regulation on alternators.<br>70. Practice installation, running and maintenance of Alternators. | description-Characteristics, specifications-running and maintenance.<br><br>**Induction motor** – Working principle, Squirrel Cage Induction motor, Slip-ring induction motor Construction and characteristics, starting and speed control.<br><br>D.O.L Starter, Star/Delta starter, Autotransformer starter.<br><br>**Single phase induction** motor Working principle, different method of starting and running (capacitor start/capacitor run, shaded pole technique). FHP motors.<br>**ALTERNATOR** – Explanation of alternator, prime mover, types, regulations, phase sequence, specification of alternators and brushless alternator. Automatic Voltage Regulator. |
| Professional Skills<br>45 Hrs<br><br>Professional Knowledge<br>08 hrs | Erect overhead distribution line and outline various power plant layout. | 71. Study of the behaviour of R, $X_L$ & $X_C$ in A.C. circuits both in series and in parallel.<br>72. Practice on use of single-phase preventer.<br>73. Practice use of phase sequence meter.<br>74. Practice erection of overhead distribution lines. | **Alternating Current** – Comparison D.C & A.C., Advantages of A.C. Alternating current & related terms frequency, Instantaneous value, R.M.S. value, Average value, Peak factor, form factor. Generation of sine wave, phase and phase difference. Inductive & Capacitive reactance $X_L$ & $X_c$, Impedance (Z), power factor; Vector diagram. Active and Reactive power, Simple problems on A.C. circuits, single phase & three phase system etc. |

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| | | | Problems on A.C. circuits. Both series & parallel power consumption P.F. etc.<br>Concept three-phase Star & Delta connection Line voltage & phase voltage, current & power in a 3 phase circuit, with balanced and unbalanced load.<br>Layout of power plant, sub-stations and wind farms. |
| Professional Skills<br>45Hrs<br><br>Professional Knowledge<br>12 hrs | Measure electrical parameters by using analog/ digital measuring instruments. | 75. Perform tests on Multimeter, Wattmeter, P F meter, Energy meter, Frequency meter, Functional Check of measuring instruments.<br>76. Practice operation of C.R.O.<br>77. Demonstrate Maximum Demand meter.<br>78. Practice use of Phase sequence indicator.<br>79. Practice use of Digital Instruments. | **Electrical measuring Instruments** – Types, Deflecting torque, Controlling torque & Damping torque, -Moving coil permanent magnet –Moving iron –Range extension –Multimeter – Wattmeter – P.F. meter – Intergrading type, Digital Energy meter – megger. –Energy meter – Frequency meter – Tri vector meter –Max Demand meter –Phase Sequence indicator –Multimeter – Analog and Digital – C.R.O |
| Professional Skills<br>90 Hrs<br><br>Professional Knowledge<br>20 hrs | Perform installation and check functionality of gear box, brakes, dynamometers, clutches & bearings, couplings and maintain lubrication system. | 80. Practice on connection of gear generating.<br>81. Understanding the working principle of Gear box in WT.<br>82. Functions of Gear Measurement and Testing.<br>83. Identifying the materials used in brake components.<br>84. Identifying the structure and function of various brake systems.<br>85. Identifying the areas of use | **Gear Making:** Manufacture of gears – by Casting, Moulding, Stamping, Coining Extruding, Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes; Gear materials and specification; Heat treatment processes applied to gears.<br>**Gear Measurement and Testing** |

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| | | for brake systems.<br>86. Practice on how brake systems are monitored using sensors.<br>87. Recognize the dangers of working on brake systems.<br>88. Practice on Install and remove brake system.<br>89. Identify and rectify damage to Couplings.<br>90. Identification of characteristics and functions of oils and greases.<br>91. Perform selecting, maintaining and replacing filters.<br>92. Perform working on oil change.<br>93. Perform choosing of fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products.<br>94. Identification of risks in working with oils and greases. | **aspects:** Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth Vernier; Errors in gears such as backlash, runout, composite.<br>**Brakes, Dynamometers, Clutches & Bearings:** Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers;<br>Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; Construction and working of i) Rope Brake Dynamometer, ii) Hydraulic Dynamometer, iii) Eddy current Dynamometers; Clutches-Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numerical on single and Multiplate clutch); Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. Torque & power lost in friction (no derivation). Simple numericals.<br>**Design of Couplings** – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible |

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| | | | coupling; Spur gear design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.<br>Demonstrate the Commission of Couplings.<br>**Couplings**: Couplings, necessity of coupling, classification of couplings. Uses and proportion of different types of couplings, Materials used for couplings.<br>**Lubrication** – function and characteristic properties of good lubricant, classification with examples, lubrication mechanism – hydrodynamic and boundary lubrication, physical properties (viscosity and viscosity index, oiliness, flash and fire point, could and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.<br>Explain the importance of cutting fluids & lubricants in machining. |
| Professional Skills<br>45 Hrs<br><br>Professional Knowledge<br>08 hrs | Apply the basic parameters of hydraulics. | 95. Video demonstration of safety procedures in hydraulic systems.<br>96. Identification of parameters associated with fluid flow and hydrostatic pressure. | Study on physical principles of hydraulics.<br>Technical terms used in **Hydraulics** – fluid, fluid mechanics, hydraulics, hydrostatics and hydrodynamics - ideal and real fluid, application of hydraulics.<br>**Types of flow** – Gravity and pressure flow, Laminar, Turbulent, Uniform, Non-uniform, Steady, Unsteady flow. Reynolds number. |

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| Professional Skills<br>70 Hrs<br><br>Professional Knowledge<br>12 hrs | Select the appropriate electronic components and check their performance. | 97. Identification of semiconductor devices: Diodes – symbol.<br>98. Test Diodes and Study Characteristics of Diodes using multi-meter.<br>99. Perform working on Half wave rectifier circuit.<br>100. Perform working of Full wave rectifier circuit.<br>101. Perform working of Bridge rectifier circuit.<br>102. Study functions of Filter circuits.<br>103. Demonstrate operations of Oscilloscope.<br>104. Identify transistors and study their construction and terminals.<br>105. Test Transistors.<br>106. Study the characteristics of transistors.<br>107. Test Cascade Amplifier.<br>108. Test power amplifier.<br>109. Study simple circuits using U.J.T. for triggering.<br>110. Study an amplifier using FET.<br>111. Study Power control circuits using S.C.R. & Diac, Triac, I.G.B.T.<br>112. Practice on Computer Hardware, OS, MS office Networking and Different Hardware.<br>113. PLC Operating Cycle - Basic Programming | Introduction to **Basic electronics** Semiconductor energy level atomic structure. 'P' & 'N' type of materials – P-N-junction. Diode-classification of Diodes – Revered Bias and Forward Bias, Heat sink. Specification of Diode – PIV rating Explanation and importance of **D.C. Rectifier** circuit. Half wave, Full wave and Bridge circuit. L.E.D. and Solar cells. Filter circuits-passive filter. Working principle and uses of an oscilloscope.<br><br>Types of **transistors** Characteristics of a transistors Biasing of transistors. Mode of use of transistor. Specification and rating of transistors<br>Explanation of transistor **Amplifiers**, Amplifiers. – class A, B & C Power amplifier.<br>Explanation of oscillator-working principle Explanation of stages and types. Multivibrator – applications. Explanation. And working principle and practical applications of U.J.T., F.E.T., S.C.R. Diac, Triac, power MOSFET, G.T.O & I.G.B.T.<br><br>Computer Hardware, OS, MS office Networking and Different Hardware. |

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| | | Instructions.<br>114. Embedded Systems – I/O Programming – Assembly Language. | |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>12 hrs | Construct and test circuits and communication components using microcontroller 8051. | 115. Practice 8051 Microcontroller, architecture, pin details & the bus system.<br>116. Construct and test control circuits using Protection devices, Sensors and Transducers.<br>117. Construct circuits with popular ICs used in controlling wind turbine equipment's.<br>118. Test servo stabilizer and measure input and output voltages.<br>119. Practice working with UPS. | Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.<br><br>Brief on **8051 Microcontroller**, architecture, pin details & the bus system Protection devices, Sensors, Transducers and Applications.<br><br>Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment, voltage cut-off systems, study of different types of relays used in stabilizer.<br>Concept of UPS, Difference between Inverters and UPS. |
| Professional Skills<br>60 hrs<br><br>Professional Knowledge<br>12 hrs | Prepare a report on renewable and Non-renewable energy technology and test a model wind turbine component and record the observations. | 120. Prepare reports on advantages and growth of wind energy applications.<br>121. Test major components of horizontal axis WT.<br>122. Test major components of vertical axis WT.<br>123. Test small wind turbine components. | **Introduction about Energy** – Non-renewable energy (thermal and nuclear) with applications<br><br>**Renewable Energy Technology** (Wind, Solar, Ocean, Hydro, Biomass, waste to energy) with Applications<br><br>**Introduction of Wind Energy** - wind energy applications, advantages and its development, wind energy production and its status, wind energy potential and |

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| | | | installation in India and wind and renewable energy scenario Explain the Non-renewable energy sources and applications.<br>Explain the renewable energy sources and applications.<br>Explain wind energy plant working.<br>Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Wind resource assessment, Weibull distribution; Betz limit, Wind energy conversion systems: classification, applications, power, torque and speed characteristics<br><br>Aerodynamic design principles; Aerodynamic theories: Axial momentum, Blade element and combine theory, Rotor and Generator characteristics, Maximum power coefficient, Tip loss correction, Wind turbine design considerations: methodology, theoretical simulation of wind turbine characteristics. |
| **ENGINEERING DRAWING: 40 Hrs.** | | | |
| Professional Knowledge<br>ED- 40 Hrs. | Read and apply engineering drawing for different application in the field of work. | Introduction to Engineering Drawing and Drawing Instruments-<br>● Conventions<br>● Sizes and layout of drawing sheets<br>● Title Block, its position and content<br>● Drawing Instrument<br>Free hand drawing of –<br>● Geometrical figures and blocks with dimension<br>● Transferring measurement from the given object to the free hand sketches.<br>● Free hand drawing of hand tools. | |

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| | | Drawing of Geometrical figures:<br>● Angle, Triangle, Circle, Rectangle, Square, Parallelogram.<br>● Lettering & Numbering – Single Stroke<br>Dimensioning Practice<br>● Types of arrowhead<br>Symbolic representation<br>● Different electrical symbols used in the related trades<br>Reading of Electrical Circuit Diagram<br>Reading of Electrical Layout drawing |
| **WORKSHOP CALCULATION & SCIENCE: 30 Hrs.** | | |
| Professional Knowledge WCS- 30 Hrs. | Demonstrate basic mathematical concept and principles to perform practical operations.<br>Understand and explain basic science in the field of study. | **Unit, Fractions**<br>Classification of unit system<br>Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units<br>Measurement units and conversion<br>Factors, HCF, LCM and problems<br>Fractions - Addition, substraction, multiplication & division<br>Decimal fractions - Addition, subtraction, multiplication & division<br>Solving problems by using calculator<br>**Square root, Ratio and Proportions, Percentage**<br>Square and square root<br>Simple problems using calculator<br>Applications of Pythagoras theorem and related problems<br>Ratio and proportion<br>Ratio and proportion - Direct and indirect proportions<br>Percentage<br>Percentage - Changing percentage to decimal and fraction<br>**Material Science**<br>Types metals, types of ferrous and non-ferrous metals<br>Introduction of iron and cast iron<br>**Mass, Weight, Volume and Density**<br>Mass, volume, density, weight<br>Related problems for mass, volume, density, weight<br>Work, power, energy, HP, IHP, BHP and efficiency<br>Potential energy, kinetic energy and related problems with assignment<br>**Heat & Temperature and Pressure**<br>Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals<br>Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature<br>Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, |

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| | | convection and radiation.<br>**Mensuration**<br>Area and perimeter of square, rectangle and parallelogram<br>Area and perimeter of Triangles<br>Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse<br>Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder<br>**Trigonometry**<br>Measurement of angles<br>Trigonometrical ratios<br>Trigonometrical tables |
| **In-plant training/ Project work** | | |
| **Examination** | | |

| SYLLABUS FOR WIND PLANT TECHNICIAN TRADE | | | |
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| **SECOND YEAR** | | | |
| **Duration** | **Reference Learning Outcome** | **Professional Skills (Trade Practical) With Indicative Hours** | **Professional Knowledge (Trade Theory)** |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>16 hrs | Assemble parts of generator and gears used in Wind Turbine and test the performance. | 124. Perform practice on wind turbine models.<br>125. Study the characteristics of wind turbine.<br>126. Assemble parts of wind turbine blades and demonstrate its working.<br>127. Assemble Generator, Gears and rings to the turbine blades and verify the function.<br>128. Study Effect of Blade angles on the performance of wind turbine. | **Wind Turbine Laboratory**<br>Wind Turbine Components - Types of Wind turbine, Characteristics and performance of Wind turbine Components, Design aspects of Wind turbine<br>Wind Turbine Tower - Rotor Blades - Nacelle - Low and High - Speed shaft<br><br>Wind Turbine Components Gearbox – Generator – Controller - Yaw Controlling Mechanism. |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>17 hrs | Operate, troubleshoot and control the Hydraulic equipment used in Wind Energy Sector. | 129. Describe external gear pumps and hydraulic cylinders.<br>130. Assemble simple basic hydraulic circuits.<br>131. Assemble, dismantle and perform maintenance of control blocks variable displacement pumps and pressure storage units.<br>132. Interpret complex hydraulic diagrams for wind turbines.<br>133. Describe the structure and function of variable | Study functions of hydraulic energy transmission.<br>Study functions of basic hydraulic circuit arrangements.<br>Oil hydraulics<br>Hydraulic drive train<br>Hydraulic system used in blade mechanism<br>Hydraulic pitch control<br>Hydraulic battery<br>hydraulic switches<br>Electro-hydraulic components. |

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| | | displacement pumps with control devices.<br>134. Describe the structure and function of hydrostatic gears for wind turbines.<br>135. Explain the structure and function of hydraulic storage units.<br>136. Name opportunities for energy saving based on the choice of components and circuit types.<br>137. Explain connecting systems for valves and control blocks. | |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>17 hrs | Demonstrate the working principle of Aerodynamics aspect of Rotor Blade. | 138. Practice on wind turbine blades and moulds with available materials (like wood, glass fibre, etc.,) and make blade profile with length up to 1 meter.<br>139. Identifying and name the tools and devices needed for the inspection of rotor blades.<br>140. Inspect cable loops and twisted pair cables.<br>141. Identify and document damage to yaw systems.<br>142. Clear faults and perform maintenance of yaw systems including documentation of maintenance work.<br>143. To understand the Aerofoil Lift and Drag force.<br>144. Study simple calculation of | Principle of Rotation – Forces on Rotor Blade – Aerodynamic power regulation<br>Different types of Yaw system Yaw bearing, Yaw drives, Yaw brake and Yaw vane (Active and Passive)<br>Working principle of Pitch controller – Pitch Action, pitch power curve, pitch mechanism, features of pitch controlled.<br>Factors affecting on performance of rotor.<br>Design features of rotors and rotor blades. Importance of good blade condition. Aerodynamics of a wind turbine. Construction of rotor blades and the materials used. Blade access techniques.<br>Demonstrate the types of damages to rotor blades. Procedures for working on and in rotor blades. Explain the possible hazard encountered in working on and in |

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| | | Pitch Angle and Pitch Coefficient.<br>145. Understanding the benefits Pitch Actuator.<br>146. Analyzing the Fault of Pitch Sensor. | rotor blades.<br>Demonstrate the techniques of rotor assembling.<br>Explain the Commission of yaw systems. |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>17 hrs | Examine various types of Wind energy generators and evaluate their performance. | 147. Performance evaluation of horizontal axis wind turbine.<br>148. Performance evaluation of vertical axis wind turbine.<br>149. Performance evaluation of wind water pumping system.<br>150. Evaluate the Tip Speed Ratio (TRS) at different wind speed.<br>151. Evaluate the Wind Turbine Power Coefficient (cp).<br>152. Check power electronics system on grid interaction.<br>153. Study Standalone WEG.<br>154. Check Grid connected WEG system – Fixed speed, variable speed and doubly fed system.<br>155. Synchronization of wind electric generators.<br>156. Thermo gram of wind rotor system and gear box.<br>157. Noise level of wind turbine system.<br>158. Develop tower design.<br>159. Perform working principles of Different components of power | Wind Turbine Components Aerodynamic Breaking System of Wind Power Turbine<br>Discussion on the identified projects with respect to data of the concerned ICs, components used in the project<br><br>Wind Turbine Components Constant / Variable Speed Wind turbines, Transformers, Power Electronics, Power Converters, Tower Foundation of Wind Turbine<br><br>Power collection network. |

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| | | collection network. | |
| Professional Skills<br>60 hrs<br><br>Professional Knowledge<br>17 hrs | Install, test, repair and maintenance of Generator and Electric Motor. | 160. Examine Principle components and applications in electrical power generation.<br>161. Practice on electrical and Mechanical control circuits used in wind energy plant.<br>162. Practice on generation of AC and three-phase voltage.<br>163. Practice on how to rotating field and torque is produced.<br>164. Practice on how a commutator motor works.<br>165. Practice on how a rotating field motor works.<br>166. Identifying and maintenance and test procedures for electrical machines in WT.<br>167. Practice on Protection devices for three-phase machines.<br>168. Practice on design, functions and controls of various inverter systems.<br>169. Practice on Installation of inverter systems in WT. | Overview of the structure and function of DC, AC and three-phase machines installed in wind turbines. |
| Professional Skills<br>60 hrs | Check the availability of wind in a place & prepare a feasibility report on site | 170. Estimate and evaluate wind resource for prospective site. (30Hrs)<br>171. Prepare feasibility study | Wind Resource Assessment<br><br>● Introduction and basics of Wind Resource Assessment |

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| Professional Knowledge<br>17 hrs | suitability for a project. | of a site /project. | Techniques - Types and Nature of Wind<br>● Techniques for Estimating Wind Resource - Wind Data for Prospective Site<br>● Identifying the Site and its Characterize in the Wind Resource - Evaluation of Sites<br>● Identification of Good Wind Resource Potential Site<br>● Feasibility Study of a Site / Project. |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>17 hrs | Measure Wind energy by using Sensors and install, operate and maintain Wind Sensor Instrument. | 172. Identifying and Practice on structure and function of various sensors used in wind turbines.<br>173. Identifying possible causes of faults in sensors.<br>174. Test the assembled sensors and verify results.<br>175. Test the data logger and verify the measurements. | Different types of Sensors: Anemometer, wind vane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gearbox and generator; cable untwisting and vibration sensors.<br><br>Operation & Maintenance of Wind Sensors Instrument and its trouble-shooting<br>● Meteorological Mast<br>● Data Logger<br>● Wind Vane<br>● Anemometer<br>● Temperature Sensor<br>● Barometer Pressure Sensor<br>● Relative Humidity Sensor<br>● Measurement Duration and Data Recovery Techniques<br>● Grounding and Lightning Protection Maintenance. |
| Professional Skills | Perform Collection, Processing, Validation, | 176. Demonstrate data collection techniques. | How to collect Wind Data, Processing, Validation, Analysis and |

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| 60 hrs<br><br>Professional Knowledge<br>17 hrs | Analysis and Reporting of Wind Data. | 177. Practice Raw Data Measuring Techniques.<br>178. Practice on wind speed calculation and wind rose diagram.<br>179. Analyze sources of error and possibilities.<br>180. Verify basic measuring parameters. | Reporting<br><br>● Detailed Data Collection Techniques<br>● Raw Data Measuring Techniques<br>● Source of Error and Possibilities<br>● Basic Measuring Parameters |
| Professional Skills<br>60 hrs<br><br>Professional Knowledge<br>17 hrs | Demonstrate operating of Cranes, different slings lifting jigs and Signals for crane operators. | 181. Demonstrate operation of Cranes.<br>182. Practice on different slings and lifting jigs.<br>183. Demonstrate Signals for crane operators.<br>184. Test properties of Oils and Lubricants. | Principles of lifting structures, Cranes.<br><br>Different types of oils and lubricants and principles of lubrication. |
| Professional Skills<br>80 hrs<br><br>Professional Knowledge<br>28 hrs | Perform installation, commissioning, operation and maintenance of wind turbine in a working wind farm. | 185. Visit an Industry manufacturing wind turbine components.<br>186. Perform Installation &Commissioning of Met-mast in a wind farm.<br>187. Perform foundation for wind turbine tower.<br>188. Perform tower assembly.<br>189. Perform assembly of Nacelle.<br>190. Perform assembly of other equipment in wind turbine tower.<br>191. Develop case study reports.<br>192. Demonstrate operation of wind turbine generator.<br>193. Demonstrate preventive maintenance of wind | Installation and Commissioning of Wind Turbine<br><br>● Installation Procedure<br>● Site Identification<br>● Micro siting<br>● Foundation<br>● Tower Assembling and Selection<br>● Step by step Nacelle Assembling<br>● Assembling Equipment Details<br><br>Brief of Balance of Plant (BOP) for wind project<br>Data Collection, BoP Cost Tool Development, BoP Carbon Tool Development, Site characteristics, BoP Carbon Tool Development, Electrical Balance of Plant (EBoP) |

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| | | turbine generator.<br>194. Perform troubleshooting for known errors in wind turbine.<br>195. Carry out scheduled & preventive inspections of electrical/mechanical components & equipment.<br>196. Carry out inspections of WTG, blade and associated mechanical components. | and Mechanical Balance of Plant (MBoP)<br><br>Operation and Maintenance aspects of Wind Farms<br><br>● Operation of Wind Turbine aspects<br>● Step by step process of Wind Turbine Maintenance<br>● Analysis of the O&M problem<br>● Component risk factors<br>● Base Case Failure Modes and Rates<br>● Quantitative analysis<br>● O&M Simulations of Wind Farm. |
| Professional Skills<br>70 hrs<br><br>Professional Knowledge<br>16 hrs | Perform repair and replacement activities of electrical control parts and mechanical components of Wind Turbine Generator. | 197. Arrange for tools to carry out online testing of WTG and components.<br>198. Check all the intersections & joints (termination) in the line and cable for faults like loose joint, short circuit, open circuit etc.<br>199. Measure and record performance parameters like voltage, current, frequency parameters, WTG temperature, etc.<br>200. Measure and record for performance parameters of transformer like input voltage/ output voltage, frequency, phase sequence, etc. | Introduction about Electrical control parts in Wind Turbines<br><br>Maintenance aspects and Objectives of:<br>• Reliability<br>• Lifetime<br>• Preventive maintenance<br>• Breakdown maintenance<br>• Manuals<br>• Spare parts<br>• Cause and effect diagrams<br>• Troubleshooting procedures<br>• Block diagrams<br>• Circuit diagrams<br>• Vendors list<br>• AMCs<br>• OEM<br>• Reconditioning |

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| | | 201. Maintain log of all systems condition parameters and performance parameters of switchgear measure and record all parameters of WTG and associated components like continuity, earthing resistance, etc.<br>202. Identify the operation manuals of all mechanical components for inspection.<br>203. Verify and record the operative parameters for all components as per design standard.<br>204. Monitor working efficiency of WTG and associated components.<br>205. Measure and record real time parameters of WTG and associated components like vibration, torqueing, temperature of bearings, grease level, alignment etc.<br>206. Measure and record real time parameters of wind turbine blades and associated components like temperature, vibration, alignment, etc.<br>207. Carry out maintenance activities for mechanical components of WTG as | |

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| | | per standard operating procedures.<br>208. Carry out testing of WTG components on Universal testing machine (UTM).<br>209. Compression testing machine (CTM).<br>210. Measure and record parameters post maintenance activities.<br>211. Arrange for tools and replacement equipment from the supervisor if required.<br>212. Carry out repair or replacement of faulty mechanical components and equipment's of WTG, transformer, switchgear etc. as per standard operating procedures.<br>213. Conduct readiness test on post replacement of equipment. | |
| Professional Skills<br>60 hrs<br><br>Professional Knowledge<br>16 hrs | Evaluate the Challenges for transportation and setting-up of Wind turbine components at heights and under hazardous conditions. | 214. Wind component dimensions and weight lack uniformity.<br>215. Identify the transportation difficultly by nature due to size barriers.<br>216. Select the appropriate PPE (Personal Protective Equipment) to carry out the specific activity.<br>217. Look after, store and maintain PPE correctly.<br>218. Assess weather and environmental conditions | Explain the rules on permitting process involves road bonding. Barriers are related to curvature and turning radiuses, road-weight limits, street overhangs, vertical and horizontal clearances of tunnels and bridges.<br><br>Factors Influencing Route Choice and Transportation Costs<br><br>Transportation Breakpoints<br>Burden of proof shifted to the wind industry. |

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| | | for working at heights.<br>219. Understand the hazards, risks and basic rescue techniques at heights.<br>220. Practice on correct use of PPE, such as safety harnesses, lanyards, fall arresters and work positioning rope and safety helmet.<br>221. Practice on Safe working at height. | Factors Influencing Route Choice and Transportation Costs.<br>concept of Transportation Breakpoints.<br><br>Introduction and understanding the Heights rescue measurements<br><br>Standards on Working at Height & Rescue measurements. |
| Professional Skills<br>65 hrs<br><br>Professional Knowledge<br>16 hrs | Adhere to Environmental and Safety guidelines followed in wind power plant. | 222. Practice on Select and put on standard items of personal protective equipment.<br>223. Assess risk situations in general work activities.<br>224. Take general accident prevention measures.<br>225. Identifying first aid measures in case of injuries and illnesses.<br>226. Identify the location of the conduit, cables, pipes & other undergoing devices prior to performing maintenance work.<br>227. Acquire required approvals and permit to work (PTW) from the concerned authority.<br>228. Select the relevant protective clothing/ equipment for specific tasks and work.<br>229. Ensure that system is shut | Introduction to Environment and Safety: General Principles, guidelines and acceptable limits.<br><br>Noise and Electro Magnetic Interference<br><br>Mechanical safety aspects related to wind turbines. |

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| | | down and power supply is isolated prior to carrying out work.<br>230. Perform visual inspection of the electrical and mechanical systems of wind power plant and record any defects.<br>231. State the name and location of relevant documents and people responsible for health and safety at the project site.<br>232. Identify possible causes of risk at project site and their mitigation measures.<br>233. Identify and follow warning signs on site.<br>234. Establish safe working procedures at project site.<br>235. Ensure safe working practices when working at heights, confined areas and trenches.<br>236. Identify methods of accident prevention in the work environment.<br>237. Follow safe operating procedures for lifting, carrying and transporting heavy objects & tools.<br>238. Inspect the at project site on a regular basis for any signs of spillage.<br>239. Ensure safe storage of flammable materials and machine lubricating oil.<br>240. Apply good housekeeping | |

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| | | practices at all times by removal/disposal of waste products.<br>241. Inform relevant authorities about any abnormal situation/ behavior of any equipment/system promptly. 3Hrs)<br>242. Exhibit the use of various appropriate fire extinguishers on different types of fires correctly.<br>243. Demonstrate rescue techniques applied during fire hazard.<br>244. Administer appropriate first aid to victims were required e.g. in case of bleeding, burns, choking, electric shock, poisoning etc.<br>245. Respond promptly and appropriately to an accident situation or medical emergency in real or simulated environments.<br>246. Participate in emergency procedures: raising alarm, safe/efficient, evacuation, correct means of escape, correct assembly point, roll call, correct return to work.<br>247. Report the accident to the relevant authority in the prescribed format. | |

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| **ENGINEERING DRAWING: 40 Hrs.** | | |
| Professional Knowledge ED- 40 Hrs. | Read and apply engineering drawing for different application in the field of work. | Reading of Electrical Sign and Symbols.<br>Sketches of Electrical components.<br>Reading of Electrical wiring diagram and Layout diagram. Reading of Electrical earthing diagram. Drawing the schematic diagram of plate and pipe earthing.<br>Drawing of Electrical circuit diagram.<br>Drawing of Block diagram of Instruments & equipment of trades. |
| **WORKSHOP CALCULATION & SCIENCE: 32 Hrs** | | |
| Professional Knowledge WCS- 32 Hrs. | Demonstrate basic mathematical concept and principles to perform practical operations.<br>Understand and explain basic science in the field of study. | **Friction**<br>Friction - Lubrication<br>**Algebra**<br>Algebra - Addition, subtraction, multiplication & division<br>Algebra - Theory of indices, algebraic formula, related problems<br>**Elasticity**<br>Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus<br>**Profit and Loss**<br>Profit and loss - Simple problems on profit & loss<br>Profit and loss - Simple and compound interest<br>**Estimation and Costing**<br>Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade.<br>Estimation and costing - Problems on estimation and costing |
| **In-plant training/ Project work** | | |
| **Examination** | | |

***NOTE:***

- *A group of 2 or 3 Students should develop a cost-effective small wind turbine gadget*
- *Evaluation is based on the product, report and viva voce.*
- *The project shall be a dissertation work individually carried out by the students under the supervision of faculty members/approved field engineers. The projects shall be carried out either in the university or in the wind industry or in R&D organizations.*
- *Trainees need to undergo field practice in Wind plant equipment manufacturing industries and Wind Plants. The institute should make suitable MoU with concerned Industries and plants for training the trainees' batch for 4 to 8 weeks. Only workshop equipment cannot cover all the scheduled skill sets in the syllabus under Professional Skill head.*

| SYLLABUS FOR CORE SKILLS |
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| 1. Employability Skills (Common for all CTS trades) (120 Hrs + 60 Hrs.) |

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in / www.dgt.gov.in.

**ANNEXURE-I**

| List of Tools & Equipment | | | |
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| **WIND PLANT TECHNICIAN (for Batch of 20 Candidates)** | | | |
| **Sl. No.** | **Name of the Tools and Equipment** | **Specification** | **Quantity** |
| **A. TRAINEES TOOL KIT** (For each additional unit trainees tool kit Sl. 1-12 is required additionally) | | | |
| 1. | Measuring Steel Tape | 5 meter | (20 +1) Nos. |
| 2. | Combination Plier Insulated | 200 mm | (20 +1) Nos. |
| 3. | Screwdriver Insulated | 4mm X 150 mm, Diamond Head | (20 +1) Nos. |
| 4. | Screwdriver Insulated | 6mm X 150 mm | (20 +1) Nos. |
| 5. | Electrician screwdriver thin stem insulated handle | 4mm X 100 mm | (20 +1) Nos. |
| 6. | Heavy Duty Screwdriver insulated | 5mm X 200 mm | (20 +1) Nos. |
| 7. | Electrician Screwdriver thin stem insulated handle | 4mm X 250 mm | (20 +1) Nos. |
| 8. | Punch Centre | 9mm X 150 mm | (20 +1) Nos. |
| 9. | Knife Double Bladed Electrician | 100 mm | (20 +1) Nos. |
| 10. | Neon Tester | 500 V | (20 +1) Nos. |
| 11. | Steel Rule Graduated both in Metric and English Unit | 300 mm with precision of 1/4th mm | (20 +1) Nos. |
| 12. | Hammer, cross peen with handle | 250 grams | (20 +1) Nos. |
| **B. SHOP TOOLS & EQUIPMENT** – For 2 (1+1) units no additional items are required | | | |
| **(i) List of Tools & Accessories** | | | |
| 13. | Hammer, ball peen with handle | 500 grams | 4 Nos. |
| 14. | Pincer | 150 mm | 4 Nos. |
| 15. | Spanner Adjustable drop forged, SS | 150 mm & 300mm | 2 Nos. each |
| 16. | Blow lamp brass | 0.5 ltr. | 1 No. |
| 17. | Chisel Cold | 25 mm X 200 mm | 2 Nos. |
| 18. | Chisel firmer with wooden Handle | 6 mm X 200 mm | 2 Nos. |
| 19. | Allen Key alloy steel | 1.5-10 mm (set of 9) | 1 Set |
| 20. | Grease Gun | 0.5 ltr. Capacity | 1 No |
| 21. | Bradawl | | 2 Nos. |
| 22. | Pulley Puller with 3 legs | 150 mm & 300mm | 1 each |
| 23. | Bearing Puller (inside and outside) | 200 mm | 1 No. each |
| 24. | Pipe vice Cast Iron with hardened jaw open type | 100 mm | 2 Nos. |

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| 25. | Scissors blade, SS | 200mm | 4 Nos. |
| 26. | Scissors blade, SS | 150 mm | 2 Nos. |
| 27. | Crimping Tool | 1.5 sq mm to 16 sq mm | 2 Nos. |
| | | 16 sq mm to 95 sq mm | 2 Nos. |
| 28. | Wire Cutter and Stripper | 150 mm | 4 Nos. |
| 29. | Hammer Extractor type | 250 grams | 4 Nos. |
| 30. | Hacksaw frame | Adjustable 300 mm / Fixed 150 mm | 2 Nos. each |
| 31. | Try Square | 150 mm blade | 4 Nos. |
| 32. | Outside Calliper | 150 mm spring type | 2 Nos. |
| 33. | Inside Calliper | 150 mm spring type | 2 Nos. |
| 34. | Divider | 150 mm spring type | 2 Nos. |
| 35. | Pliers long nose insulated | 150 mm | 4 Nos. |
| 36. | Pliers flat nose insulated | 200 mm | 4 Nos. |
| 37. | Pliers round nose insulated | 100 mm | 4 Nos. |
| 38. | Tweezers | 150 mm | 4 Nos. |
| 39. | Snip Straight and Bent heavy duty | 250 mm | 2 Nos. each |
| 40. | D.E. metric Spanner Double Ended | 6 - 32 mm | 2 Set |
| 41. | Drill hand brace | 0-100mm | 4 Nos. |
| 42. | Drill S.S. Twist block | 2 mm, 5 mm and 6 mm set of 3 | 4 Set |
| 43. | Plane cutters | 50 mm X 200mm | 2 Nos. |
| 44. | Smoothing cutters | 50 mm X 200mm | 2 Nos. |
| 45. | Gauge, wire imperial stainless steel marked in SWG & mm | Wire Gauge - Metric | 4 Nos. |
| 46. | File flat | 200 mm 2nd cut with handle | 8 Nos. |
| 47. | File half round | 200 mm 2nd cut with handle | 4 Nos. |
| 48. | File round | 200 mm 2nd cut with handle | 4 Nos. |
| 49. | File flat rough | 150 mm with handle | 4 Nos. |
| 50. | File flat bastard | 250 mm with handle | 4 Nos. |
| 51. | File flat smooth | 250 mm with handle | 4 Nos. |
| 52. | File Rasp, half round | 200 mm bastard with handle | 4 Nos. |
| 53. | Copper bit soldering iron. | 0.25 kg | 2 Nos. |
| 54. | De soldering Gun | Heat proof nozzle, PVC type, 250mm | 4 Nos. |
| 55. | Hand Vice | 50 mm jaw | 4 Nos. |
| 56. | Table Vice | 100 mm jaw | 8 Nos. |
| 57. | Oil Can | 250 ml | 2 Nos. |
| 58. | Contactor & auxiliary contacts | 3 phase, 415 Volt, 25 Amp with 2 NO and 2 NC | 2 Nos. each |

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| 59. | Contactor & auxiliary contacts. | 3 phase, 415 volt, 32 Amp with 2 NO<br>and 2 NC | 2 Nos. each |
| 60. | Limit Switch | Limit Switch, Liver operated 2A 500v,<br>2-contacts | 2 Nos. |
| 61. | Rotary Switch | 16 A/440v | 2 Nos. |
| 62. | **Relay**-<br>a. Cut out Relays<br>b. Reverse current<br>c. Over current<br>d. Under voltage<br>e. Earth Relay | <br>a. 16A,440V<br>b. 16A,440V<br>c. 16A,440V<br>d. 360V-440V<br>e. Up to 1 A | 2 No. each |
| 63. | Pin Type, shackle type, egg type & suspension type insulators including hardware fitting | | 2 Nos. each |
| 64. | Hydrometer | | 2 Nos. |
| 65. | Portable Electric Drill Machine | 0-12 mm capacity 750w, 240v with chuck and key | 1 No. |
| 66. | Load Bank ( Lamp / heater Type) | 6 KW, 3Ph | 1 No. |
| 67. | Brake Test arrangement with two spring balance rating | 0 to 25 kg | 1 No. |
| 68. | Out Side Micrometer | 0 - 25 mm least count 0.01mm | 2 Nos. |
| 69. | Series Test Lamp | 230V, 60W | 4 Nos. |
| 70. | Miniature Breaker | 16 amp | 2 Nos. |
| 71. | Earth Plate | 60cm X 60cm X 3.15mm Copper Plate<br>60cm X 60cm X 6mm GI Plate | 1 Each |
| 72. | Earth Electrode | Primary Electrode 2100x28x3.25mm Secondary Cu Strip 20x5mm | 1 No. |
| 73. | MCCB | 100Amps, Triple pole | 1 No. |
| 74. | ELCB and RCCB | 25Amps, double pole and 25Amps, double pole, IΔn 30 mA | 1 Each |
| 75. | Fuses | HRC – Glass - Rewire Type | 4 Each |
| 76. | Rheostat (Sliding type) | 0 - 25 Ohm, 2 Amp<br>0 - 300 Ohm, 2 Amp<br>0 -1 Ohm, 10Amp<br>0 -10 Ohm, 5 Amp | 1 No. each |

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| 77. | Capacitors | Electrolytic<br>Ceramic<br>Polyester film<br>Variable<br>Dualrun | 2 Each |
| 78. | Various Electronic components | Resistors, Diode, Transistor, UJT, FET, SCR, DIAC, TRAIC, IGBT, Small transformer etc. | As required |
| 79. | Plug socket Piano Switch Lamp Holder | 230 V, 5 A | 2 Each |
| 80. | **Cables**:<br>Twisted Pair<br>Non-Metallic Sheathed<br>Cable Underground Feeder<br>Cable Ribbon Cable<br>Metallic Sheathed<br>Cable Multi-<br>Conductor Cable<br>Coaxial Cable<br>Direct-Buried Cable | 1 mtr each | 1 Each |
| 81. | Bus bar with brackets | 1 mtr each | 3 Nos. |
| 82. | Rubber mat | 2’ x 4’ x 1” | 2 Nos. |
| 83. | Electrician Helmet | Yellow Color | 2 Nos. |
| 84. | Safety Belt | Standard quality | 2 Nos. |
| **(ii) List of Equipment** | | | |
| 85. | Ohm Meter; Series Type & Shunt Type, portable box type | 50/2000-ohm analog | 2 Nos. each |
| 86. | Digital Multi Meter | DC 200mv -1000v,0 – 10A & AC 200mv- 750v , 0-10A, resistance 0-20 MΩ and 3 1/2 digit | 12 Nos. |
| 87. | A.C. Voltmeter M.I. analog, portable box type housed in Bakelite case | Multi range 75 V - 150V - 300V - 600V | 3 Nos. |
| 88. | Milli Voltmeter centre zero analog, portable box type housed in Bakelite case | 100 – 0 – 100 mV | 2 Nos. |
| 89. | Ammeter MC analog, portable box type housed in Bakelite case | 0 - 500 mA, 0-5 A, 0-25 A | 2 Nos. each |
| 90. | AC Ammeter MI, analog, portable box type housed in Bakelite case | 0 - 1 A, 0-5 A, 0-25 A | 2 Nos. each |
| 91. | Kilo Wattmeter Analog | 0-1.5-3KW, pressure coil rating- 240v/440v, current rating-5A/10A Analogue, portable type Housed in | 2 Nos. |

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| | | Bakelite case | |
| 92. | Digital Wattmeter | 230 V, 1 KW, 50 Hz | 2 Nos. |
| 93. | A.C. Energy Meter | Single Phase, 10 A, 240 V induction type | 2 Nos. |
| 94. | A.C. Energy Meter | Three Phase, 15 A , 440 V induction type | 2 Nos. |
| 95. | Power Factor Meter Digital | 440 V, 20 A, Three Phase portable box type | 2 Nos. |
| 96. | Frequency Meter | 45 to 55 Hz | 2 Nos. |
| 97. | Magnetic Flux Meter | 0-500 tesla | 2 Nos. |
| 98. | Lux meter | lux meter LCD read out 0.05 to 7000 lumens with battery. | 2 Nos. |
| 99. | Tachometer | Analog Type - 10000 RPM | 1 No. |
| 100. | Tachometer | Digital Photo Sensor Type – 10000RPM | 1 No. |
| 101. | Tong Tester / Clamp Meter | 0 - 100 A (Digital Type) | 2 Nos. |
| 102. | Megger | Analog - 500 V | 2 Nos. |
| 103. | 3- point D.C. Starter | For 2.5 KW DC motor | 1 No. |
| 104. | 4- point D.C. Starter | For 2.5 KW DC motor | 1 No. |
| 105. | Wheat Stone Bridge with galvanometer and battery | | 2 Nos. |
| 106. | Single Phase Variable Auto Transformer | 0 - 270 V, 10Amp (Air cooled) | 2 Nos. |
| 107. | Phase Sequence Indicator | 3 Phase, 415 V | 2 Nos. |
| 108. | Growler | 230 V, 50 Hz, Single Phase, Adjustable jaws, Testing armature with ampere meter and testing probes. | 1 No. |
| 109. | **AC Starters: -**<br>a. Direct online Starter<br>b. Star Delta Starter – Semi automatic<br>c. Star Delta Starter – Fully automatic Star Delta Starter –Soft starter<br>d. Auto Transformer type | For A.C Motors of 2 to 5 H.P. | 1 No. each |
| 110. | Oscilloscope Dual Trace | 20 MHz | 1 No. |
| 111. | Function Generator | 2 to 200 KHz, Sine, Square, Triangular<br>220 V, 50 Hz, Single Phase | 1 No. |

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| 112. | Soldering Iron | 25-Watt, 65 Watt and 120-Watt, 230 Volt | 2 Nos. each |
| 113. | Temperature controlled Soldering Iron | 50-Watt, 230 Volt | 2 Nos. |
| 114. | Discrete Component Trainer | Discrete Component (for diode and transistor circuit) with regulated power supply +5,0- 5 V,+12 ,0-12V | 2 Nos. |
| 115. | Linear I.C. Trainer | Linear I.C. Trainer with regulated power supply 1.2V to 15V PIC socket 16pin and 20 pins with bread board | 1 No. |
| 116. | Digital I.C. Trainer | Digital I.C. Trainer 7 segment display and bread board | 1 No. |
| 117. | Oil Testing Kit | Oil Testing Kit 230 V, single phase 50 Hz 60 VA output 0-60 KV Variable | 1 No. |
| 118. | Inverter with Battery | 1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC | 1 No. |
| 119. | Voltage Stabilizer | AC Input - 150 - 250 V, 600 VA AC Output - 240 V, 10 A | 1 No. |
| 120. | DC Power Supply | 0 - 30 V, 5 A | 2 Nos. |
| 121. | Battery Charger | 0 - 6 - 9 - 12 - 24 - 48 V, 30amp | 1 No. |
| 122. | Current Transformer | 415 V, 50Hz, CT Ratio 25 / 5 A, 5VA | 2 Nos. |
| 123. | Potential Transformer | 415 V, 50Hz, PT Ratio, 440V/110V, 10VA | 2 Nos. |
| 124. | Pentium IV Computer or latest | 2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 19/21" Monitor, optical scroll mouse, multimedia keyboard, 32 bit LAN card with UPP port, necessary Drivers, etc. OR (Latest Version) | 2 Nos. |
| 125. | Ink jet/ laser printer | | 1 No. |
| **C. Shop Machinery** - For 4 (2+2) units no additional items are required | | | |
| 126. | AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse with Mechanical Load. | 5 HP, 3-Phase, 415 V, 50 Hz | 1 No. |

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| 127. | AC phase-wound slip ring Motor with starter switch | 5 HP, 440 V, 3 Phase, 50 Hz | 1 No. |
| 128. | Universal Motor with starter/switch | 240 V, 50 Hz, 1 HP | 1 No. |
| 129. | Synchronous motor with accessories like starter, excitation arrangements. | 3 Phase, 3 HP, 440V, 50Hz, 4 Pole | 1 No. |
| 130. | Thyristor /IGBT controlled D.C. motor drive with tacho-generator feedback arrangement | 1 HP | 1 No. |
| 131. | Thyristor/IGBT controlled A.C. motor drive with | VVVF control 3 Phase, 2 HP | 1 No. |
| 132. | Single phase Transformer, core type, air cooled | 1 KVA, 240/415 V, 50 Hz | 3 Nos. |
| 133. | Three phase transformer, shell type oil cooled with Delta/ Star | 3 KVA, 415/240 V, 50 Hz | 2 Nos. |
| 134. | Electrical Machine Trainer – | Suitable for demonstrating the construction and functioning of different types of DC machines and AC machines (single phase and three phase). Should be fitted with friction brake arrangement, dynamo meter, instrument panel and power supply unit | 1 for 8 (4+4) Units |
| 135. | Diesel Generator Set with changeover switch, over current breaker and water/ air-cooled with armature, star-delta connections AC 3 phase | 7.5 KVA, 415 volt or higher rating | 1 No. per institute |
| 136. | Used DC Generators-series, shunt and compound type for overhauling practice | | 1 No. Each |
| 137. | Pillar Electric Drill Machine Motorized | 12-20 mm Capacity, 1HP, 440V, 3 phase, Induction Motor with DOL starter, Bench Type | 1 No. |
| 138. | Motorized Bench Grinder | 1 HP. 3 phase, 440V with DOL starter, Double side with smooth and rough wheel with Tool Base | 1 No. |
| 139. | A.C. Series type Motor | 1 HP, 240 V, 50 Hz | 1 No. |
| 140. | Single Phase Capacitor Motor with starter switch | 1 HP, 240 V, 50 Hz | 1 No. |
| 141. | Manual Motor coil Winding Machine | With step arbor | 1 No. |

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| 142. | Primary current injection set | 220V, 50 Hz, 1-Φ, output current - 200 A (min) with timer | 1 No. |
| 143. | Stepper Motor with Digital Controller | | 1 No. |
| 144. | Shaded Pole Motor | Fractional HP, 240 V, 50 Hz | 1 No. |
| **D. Shop Floor Furniture and Materials** - For 2 (1+1) units no additional items are required | | | |
| 145. | Working Bench | 2.5 m x 1.20 m x 0.75 m | 4 Nos. |
| 146. | Wiring Board | 3-meter x1 meter with 0.5 meter projection on the top | 1 No. |
| 147. | Instructor's table | | 1 No. |
| 148. | Instructor's chair | | 2 Nos. |
| 149. | Metal Rack | 100cm x 150cm x 45cm | 4 Nos. |
| 150. | Lockers with drawers | 4 | 1 for Each Trainee |
| 151. | Almirah | 2.5 m x 1.20 m x 0.5 m | 1 No. |
| 152. | Black board/white board | (minimum 4X6 feet) | 1 No. |
| 153. | Fire Extinguisher CO2 | 2 KG | 2 Nos. |
| 154. | Fire Buckets | Standard size | 2 Nos. |
| **E. Wind Turbine Components*** | | | |
| 155. | Old model of Wind Turbine for demonstration | 55 KW to 1MW (Old Model) | 1 No. |
| 156. | Old Nacelle model to understand the Wind Turbine components assembling | | 1 No. |
| 157. | Old tower Re-assembling to teach working under the Height | | 1 No. |
| 158. | Old Blade model to understand the blade profile, design and technology and pitch mechanism | | 1 No. |
| 159. | Gear box assembly | | 1 set |
| 160. | Couplings | | 1 set |
| 161. | Old Met - mast with sensors and data loggers | | 1 set |

***Note: -***

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *Internet facility is desired to be provided in the classroom.*
3. *Trainees need to undergo field practice in Wind plant equipment manufacturing industries and Wind Plants. The institute should make suitable MoU with concerned Industries and plants for training the trainees' batch for 4 to 8 weeks. Only workshop equipment cannot cover all the scheduled skill sets in the syllabus under Professional Skill head.*

## ABBREVIATIONS

| | |
|---|---|
| CTS | Craftsmen Training Scheme |
| ATS | Apprenticeship Training Scheme |
| CITS | Craft Instructor Training Scheme |
| DGT | Directorate General of Training |
| MSDE | Ministry of Skill Development and Entrepreneurship |
| NTC | National Trade Certificate |
| NAC | National Apprenticeship Certificate |
| NCIC | National Craft Instructor Certificate |
| LD | Locomotor Disability |
| CP | Cerebral Palsy |
| MD | Multiple Disabilities |
| LV | Low Vision |
| HH | Hard of Hearing |
| ID | Intellectual Disabilities |
| LC | Leprosy Cured |
| SLD | Specific Learning Disabilities |
| DW | Dwarfism |
| MI | Mental Illness |
| AA | Acid Attack |
| PwD | Person with disabilities |


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