

MOTOR WINDING COURSE CONTENTS - 9TH CLASS

THEORY

Text	Scope
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Chapter No. 1

1. Electricity (02 periods)

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|----------------------------------|---|
| 1.1 Atom | • Explain the atomic structure |
| 1.2 Electricity | • Explain the types of electricity |
| 1.3 Current, Voltage, Resistance | • Explain current, voltage and resistance |
| 1.4 Alternating Current | • Explain alternating current (A.C) |
| 1.5 Ohm's Law | • Explain Ohm's law and its applications |
| 1.6 Circuits | • Explain series, parallel, short, close and open circuit |

Chapter No. 2

2. Magnetism (07 periods)

- | | |
|-------------------------|--|
| 2.1 Magnets | • Define and explain the types of magnet |
| 2.2 Magnetic properties | • Explain the magnetic properties & pole |
| 2.3 Power | • Explain the power & power law |
| 2.4 Frequency | • Define frequency. |
| 2.5 Inductor | • Explain the inductor and its types. |
| 2.6 Capacitor | • Explain the capacitor and its types. |

Chapter No. 3

3. Generation of Electricity (09 periods)

- | | |
|-------------------|---|
| 3.1 D.C machine | • Explain D.C. machine |
| | • Describe the field winding, field poles, carbon brush, holders, rocker and armature |
| 3.2 Armature | • Explain the armature winding and commutator |
| 3.3 Batteries | • Explain the type and charging of battery |
| 3.4 Rectification | • Describe half-way, full-way and bridge |

Text	Scope
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rectifiers

Chapter No. 4

4. Electrical Measurement

(04 periods)

4.1 Meters

- Explain ohm's meter, voltmeter and ammeter
- Explain multi-meter (analogue & digital), watt-meter and energy meter
- Frequency meter, tong tester & series test lamp

4.2 Megger

- Explain megger insulation, resistance tester and tachometer

Chapter No. 5

5. Electric Wires & Cables

(02 periods)

5.1 Wire insulation

- Explain the wire insulation

5.2 Conductors

- Explain the types of conductors

5.3 Current carrying in cables

- Describe the current carrying capacity of wire in single core & multi core cables

Chapter No. 6

6. Winding & Winding material

(05 periods)

6.1 Winding wire

- Explain winding wire, their insulation and insulating material, Lathride paper, sleeves, varnish and empire clothes

6.2 Wire size measurement

- Explain wire size and its measurement by micro-meter
 - Vernier caliper
 - S.W.G. & A.W.G.

Chapter No. 7

A.C. Induction Motor (06 periods)

7.1 Working principle of induction motor

- Describe the working principle of a squirrel Cage induction motor

Text	Scope
7.2 Types of single phase motor	<ul style="list-style-type: none"> • Explain various types of single phase AC motor
7.3 Capacitors	<ul style="list-style-type: none"> • Explain and use of capacitor, its types and connections
7.4 Centrifugal switch	<ul style="list-style-type: none"> • Describe centrifugal switch in running and starting winding
7.5 Motor Starter	<ul style="list-style-type: none"> • Explain the magnet contactor, circuit breaker and overload relays
7.6 Motor Protections	<ul style="list-style-type: none"> • Explain the motor protections with diagram

Chapter No. 8

8. Geometrical & Technical Drawing (05 periods)

8.1 Introduction of drawing	<ul style="list-style-type: none"> • Describe meaning, importance and uses of technical drawing
8.2 Drawing Instruments	<ul style="list-style-type: none"> • Describe drawing instruments, their construction, uses and cares.
8.3 Basic and alphabet of lines	<ul style="list-style-type: none"> • Describe the types of basic lines • Describe the types of alphabet of lines with their weight, shape and proper construction
8.4 Geometrical construction	<ul style="list-style-type: none"> • Describe angles, triangles, quadrilateral, polygons and circle elements
8.5 Free Hand sketching	<ul style="list-style-type: none"> • Describe the importance of sketching • Describe the procedure of sketching for shapes, geometric figures and models
8.6 Multi view Drawing	<ul style="list-style-type: none"> • Describe the concepts of orthographic drawing. • Describe the procedures to draw the Front, Side and Top Views
8.7 Pictorial Drawing	<ul style="list-style-type: none"> • Describe the procedure to draw the Isometric and Oblique drawing of simple shapes and models.
8.8 Symbols	<ul style="list-style-type: none"> • Describe various electrical and electronics symbols

MOTOR WINDING LIST OF PRACTICALS - 9TH CLASS

Practicals

1. Safety
 - 1.1 Introduction to workshop tool and safety precautions to be observed in electric shock and treatment against electric shock.

2. Basic Mechanical Processes
 - Drilling – counter sinking – counter boring – reaming
 - Drilling with power drilling machines/bench drilling machine
 - Drilling holes in solid material and sheet metal
 - Counter sinking
 - Counter boring
 - 2.1 Thread Counting
 - Internal thread cutting using of tap and tap handle.
 - External thread cutting using of die and die stock.
 - 2.2 Basic Hand Tools
 - Identifying and using of basic hand tools for armature winder.
 - Such as, side cutter, flat nose pliers and round nose pliers,
 - Screwdriver, file, hammers and mallets.
 - Identifying and use of measuring tools, such as steel rule, vernier caliper, S.W.G. and micrometer
 - 2.3 Cutting Tools
 - Identifying and use of hacksaw chisel and shear.
 - 2.4 Safety Rules
 - Safety precautions in winding shop
 - Elementary first aid in case of injuries.
 - 2.5 Bench Work
 - Making of terminal plate
 - Making of clamps
 - Making of wire joints
 - 2.6 Carpentry Tools
 - Identifying and use of wood saw, firmer chisel, rasp file, marking gauge and planing with planer
 - 2.7 Soldering Practice
 - Identifying and use of solder, Capacity and size of soldering
 - Soldering of wire joints and terminal iron
 - Soldering of lugs and soldering of P.C.B.

2.8 Measuring

- Steel rule and steel tapes
- Clippers (inside, out side)
- Vernier calliper
- Micro meter
- Feeler gauge

2.9 Off Hand Grinding

- Regrinding of centre punch, line scribe, flat chisel and twist drills on pedestal grinder

3. Electrical Measuring

- Identifying and using of wire gauge (S.W.G & A.W.G), volt meter, AVO meter, ammeter, energy meter, tong tester, megger, wattmeter

4. Basic Electrical Circuit

- Identifying and use of electrical symbols
- Identifying and use of electrical components circuit diagram
- Stripping of wires and cables
- Making of one lamp switch circuit
- Making of two lamp series circuit
- Making of two lamp parallel and socket circuit
- Making of testing board

5. A.C. Winding

5.1 Fan winding

- Identifying and using of none Capacitor fan.
- Identifying and using of Capacitor fan.
- Identifying and using of the parts of fan.
- Systematic detection of faults.
- Dismantling of fans, ceiling, bracket and pedestal.
- Removing old/burnt winding of fans.
- Identifying the gauge of wire, number of turns per coil, connection of coils and coil pitch, running/starting winding.
- Preparation of winding diagram.
- Preparation of slots insulation and placing in the slots.
- Rewinding of coils and placing in the slots, removing of enamel, connectioning, sleeveing and soldering the connection.
- Checking and testing the winding.
- Drying and varnishing and backing the winding.
- Assembling of Fan and testing on line changing of direction.
- Systematic detection of faults of fan regulator.
- Desoldering the connection.
- Dismantling of fan regulator.

- Counting the number of turns of coil, loop and oil, wire gauge.
- Preparing of bobbin, and former (pattern).
- Placing of insulation paper on the bobbin and each layer of winding.
- Rewinding of coils, testing, removing of enamel, soldering and sleeveing the all connection.
- Testing and checking as per requirement (speed/load).

5.2 Single-phase motor (Director on line starting)

- Identifying and using of single-phase motor.
- Identifying and using running and starting winding.
- Systematic detection of faults.
- Removing of old winding, noting gauge of wire, number of turns of coils, number of coils in a set, coil pitch and connections.
- Preparing winding diagram.
- Preparing of slot insulation and placing in the slots.
- Preparing of coils and placing in the slots, grouping of coils, connections as per drawn diagram.
- Testing, Drying, Varnishing and backing.
- Three-phase motor.
- Systematic detection of faults of three-phase motor.
- Dismantling of three-phase motor.
- Removing of old winding, noting gauge of wire, number of turns of the coil, number of coil in a set, number of sets per winding, connections.
- Preparing of winding diagram.
- Preparation of slots insulation and placing in the slots of motor.
- Preparing of coils and placing in the slots, grouping of coils jointing, soldering, sleeveing final connection and dressing the winding.
- Testing, drying, varnishing and baking, final test of motor.

6. Geometrical & Technical Drawing

- 6.1 Draw basic lines and alphabet of drawing lines.
- 6.2 Draw different types of angles, triangles, quadrilateral and polygons
- 6.3 Draw elements of circle
- 6.4 Sketch geometric shapes and models
- 6.5 Draw Front, Side and Top views of simple wooden model
- 6.6 Draw simple Isometric and Oblique Drawings of simple models
- 6.7 Draw the different symbols relating to electrical motor winding field.

MOTOR WINDING
LIST OF EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS

EQUIPMENT

1. Manual coil winding machine with 5 each counter
2. Electric coil winding machine with variable speed
3. Coil formers of different sizes
4. Growlers, Tong tester
5. Digital and analogue multi meter
6. Used/burnt fans
7. Motors
8. Fan regulators
9. D.C. small motor
10. Portable alternator (2KVA)
11. Batteries
12. Battery charger
13. Transformer (used) for winding practice

LIST OF TOOLS AND INSTRUMENTS

1. Checking and Measuring Tools
 - Steel rules of different sizes.
 - Steel measuring tapes – 6, 10 feet
 - Vernier Caliper – 12
 - Micro meters - 0 – 25 mm
 - Out side and inside calipers 6
2. Cutting Tools
 - Cold cheisels 8 x 1
 - Hand backsaw from hand wood saw tin cutter/snip,
 - Electrician's knife, Wire stripers
 - Wire cutter, Cable cutter of different type and sizes

3. Pliers
 - Compilation pliers, Flat nose pliers, Round nose, Circle pier external and internal thimble pliers (Grip) pliers
4. Files
 - Files of different type and size
5. Hammers
 - Hammers of different type and size
6. Mallets – Rubber & Wooden
7. Vices
 - Bench vices, Machine vices and Hand vices of different type and sizes
8. Punch set
 - Centre punches
9. Marking Tool
 - Line scribe, marking block and dividers of different types
10. Allen Keys
 - Allen keys set
11. Spanners/Wrenches
 - Open-ended spanners, Ring spanners, Reversible racket wrenches and adjustable wrenches of different type and size
12. Screw Drivers
 - Flat edged blade screwdrivers
 - Philips type screwdrivers of different type and size
13. Drill Machines
 - Hand ball machine, Counter sink drill, Stone drills – H.S.S. Drill Bits, Size selection of Drill
14. Soldering Irons
 - Non Electric Soldering irons
 - Electric Soldering irons
 - Electric sucker, blowlamps
15. Grinders
 - Pedestal Grinders Single Phase
 - Hand grinders, Motorized Grinders

16. Grease Guns
 - Oil Cans
17. Bearing and Pulley Puller
 - Bearing Pullers
18. Cleaning and Scraping Tools
 - Flat scraper, Wire burses
 - Simple Blower Pump, Electric blower
19. Tweezers
20. Speed Measuring Devices
 - Speedometers of various types
 - Speedometer digital type
21. Wire Gauges and other Gauges
 - S.W.G. wire and sheet gauge
 - A.W.G wire gauges
 - Feeler Gauges
22. Electrical Testing Devices
 - Electric test lamps
 - Phase tests, Growler, Megger
23. Drying and Baking Devices
 - Dryers, Electric oven
24. Circuit Breakers, Magnetic contactors, Over Load Relay, Timers, Earth Leakage Breaker
25. Measuring Devices
 - Ohm meter (A.V.O) meter, Megger, Volt meter, AC/DC
 - Ampere meter, 1 Phase – Energy (K.W.H) meter (Single Phase 3-Phase) Frequency meter

MOTOR WINDING

CONSUMABLE MATERIALS

ITEMS	QUANTITY
1. Winding Enamel wire – size 18 to 36 S.W.G	10 kg each Nos.
2. Leathroid paper No 7&10	20 kg
3. Insulating/ Varnish	20 lit
4. Sleeves (1mm to 10 mm)	100 each Nos.
5. Cotton tape $\frac{3}{4}$	100 Rolls
6. Cotton Thread	50 Rolls
7. Soldering Wire 40/60	50 Rolls $\frac{1}{2}$ kg
8. Soldering Paste	1 kg
9. Electric wire single core 3/029	10 coils
10. Electric wire single core 7/029	5 coils
11. Electric wire 3 core 7/064	2 coils
12. Electric wire 4 core 7/064	1 coil
13. Flexible wire 3 core 23/0076	2 coils
14. Flexible wire 4 core 40/076	2 coils
15. Electric accessories such as switches, socket, holders, circuit breaker single-phase – 3 phase	20 Nos. each

**MOTOR WINDING
REFERENCE BOOKS FOR TEACHERS**

- Tables for electric trade TTP (Development Cell for Skilled Labour Training, Lahore (GTZ))
- GTZ Electrical Power Engineering Proficiency Course
- A Textbook of Electrical Technology by B.L. Theraja.
- Electrical Installation and regulation by Michael Neidle 3rd Edition
- Electrical Installation by A.O. Akintanti and J.M. Hyde

GENERAL RECOMMENDATIONS

Text Book

1. The textbook should be fully illustrated based on approved national curriculum.
2. The language used should be Urdu/English. Script should be simple and easy. Examples should be chosen from every day life wherever possible.
3. There should be uniformity in terminology in textbooks. For this purpose a glossary of uniform terminology based upon S.I. Units should be prepared and provided.
4. The Technical Terms/Terminology should not be translated as such and these should be directly written in Urdu.
5. Objective type as well as descriptive test items should be provided at the end of each chapter, which should serve as guideline for students and teachers.
6. The experiments suggested in the curriculum should be dealt with in detail in a separate Practicals' Manual. The experiments should be prescribed in an open-ended manner.
7. Since curriculum development is a continuous process, a follow-up committee should be formed to check its proper implementation and evaluation.

Practical Manual

In order to maintain a uniform standard of practical activities throughout the country, Practical Manual should be prepared for the purpose. This manual should cover all the practicals in the trade indicating Title of practical, material, Tools & Instruments, Procedure, figure(s), Readings/ output data/result/conclusions and safety precautions etc. The final practical examination should be based on the activities prescribed in the curriculum.

Teacher's Guide

In order to provide direction in the planning of academic activities, the Trade teacher needs some resource material to bank upon. A teacher's guide giving essential background information, knowledge, lesson schemes, objectives, teaching methodologies, motivation, conducting practical, assessment procedures etc. be prepared for the purpose and provided to the Trade teachers.

Workshop

1. In order to facilitate the students to develop desired skills and competencies, it is recommended that practical activities should be carried out individually, where possible.
2. The workshop should be fully equipped as stipulated in the Curriculum. Provision should be made in school budget to purchase/replace latest tools and equipments to update the workshop.
3. Recommended consumables should be provided for practicals in reasonable quantity.

Evaluation of Curriculum

It is recommended that provincial curriculum evaluation committees should be formulated on permanent basis comprising curriculum experts, teacher trainers, working technical teachers, experts, subject specialists and educationists to evaluate the shortcomings and achievements of the curriculum. The committees will be expected to remain in contact with the teachers to obtain feedback for decision making.

Methodology of Instruction

Following methods of teaching may be used in technical education as considered appropriate by the teacher:

1. Project Method
2. Illustration Method
3. Investigation Method
4. Demonstration Method
5. Practice/Drill Method
6. Lecture Method
7. Assignment Method
8. Discussion (Questions & Answers) Method
9. Visit to industry
10. Tutorial

Characteristics of Technical Teachers

For effective instruction, the desirable qualities of competent technical teachers should be:-

- a) Good manager, facilitator, and counsellor
- b) Educational background and industrial experience
- c) Mastery of instructional techniques
- d) Competence in the subject
- e) Resourcefulness and creativeness
- f) Ability to develop good personal relationship with students
- g) Knowledge of performance evaluation procedures

Promotional Activities

During education various co-curricula activities develop and promote interest, positive attitudes and commitment. Following activities may be utilized to promote Vocational and Technical Education:

1. Technical club
2. Bulletin Board
3. Exhibition corner

4. Display of Projects
5. Quiz Contests
6. Technical & Science exhibition
7. Technical & Science Fair
8. Technical & Science Olympiad etc.

Assessment of Student Achievement

The procedure in vogue for evaluation is the examination. It is however, suggested that in addition to annual examination, the teachers should also evaluate class work on completion of each lesson/unit followed by periodic tests in the subject. Besides periodic and annual tests, skill standards prepared by National Training Bureau should be used at the end of the year.

For the purpose of class-room appraisal, individual as well as group technique may be used. The tests should comprise both short answer and objective type questions. Assessment should focus knowledge, skills, competencies, and application of concepts and ability to use the techniques and tools. It is therefore, suggested that a comprehensive scheme of knowledge, skills, competencies etc. be prepared to assess students' achievements. Rigorous efforts are needed to prepare such items. Standardized test items, be prepared for the use of the examining Boards and also for the classroom teachers.

It is to be kept in mind that students study habits are influenced by the teacher's method of testing. It is therefore, suggest that examination should be a meaningful activity.

Recommended Scheme of Studies

Each vocational subject is being divided into two parts – theory and practical, of 50 marks each. Geometrical and Technical Drawing is included as an essential part of the engineering trades. Questions of 20 % marks will be from Geometrical and Technical Drawing and the rest of the examination will be of 80% marks covering the whole theory and practical course of the respective trade.

Relative Marks distribution in Examination is as under:

Theory Paper: 50	(i)	Trade	40 Marks
	(ii)	Geometrical & Technical Drawing	10 Marks
Practical Paper: 50	(i)	Trade	40 Marks
	(ii)	Geometrical & Technical Drawing	10 Marks
Total:100			

In the examination, the level of learning abilities to be tested may be taken as:

Knowledge – The ability to recall facts, nomenclature, classifications, practical techniques, laws and theories, straight-forward calculation and computation.

Comprehension – The ability to translate data from one form to another (verbal into mathematical, tabular or graphical and vice versa) to interpret or deduct the significance of data, and to solve problems.

Application – The ability to apply knowledge, experience and skill to new situations presented in a novel manner.

In the theory examination paper such questions may be set which facilitate to test learning abilities related to *Knowledge*, *Comprehension* and *Application*.

The questions asked may provide the students an opportunity to give reasoned arguments, to apply his knowledge to the theoretical and practical problems, or to interpret given data and apply in the situation described thereby.

In the practical examination, the student will be required to perform a practical, to use tools and equipment, to observe and tabulate data, perform calculations and draw graphs, to locate fault, to make physically required circuits, to troubleshoot and repair desired circuit/unit etc.

In the practical examination, the level of competencies and skill to be tested may be taken into five categories as:

Imitation - The ability to observe skill and attempt to repeat it.

Manipulation - The ability to perform skill according to instruction rather than observation.

Precision - The ability to reproduce a skill with accuracy, proportion, and exactness.

Articulation- The ability to combine more than one skill in sequence with harmony and consistency.

Naturalisation – The ability to comprehend one or more skills with ease and adapt automatically with limited physical or mental exertion.

Use of Tools - The skills and competencies to use tools and equipment.

Approximate percentage of marks allotted to each of the above abilities may be:-

<i>Knowledge</i>	20 %
<i>Comprehension</i>	25 %
<i>Application</i>	15 %
<i>Skills and competencies</i>	40 %