

WELDING (ARC & GAS)
COURSE CONTENTS - 10TH CLASS

THEORY

| Text | Scope |
|--|--|
| Chapter No.1 | |
| 1. Engineering Material: (06 weeks/ periods) | |
| 1.1 Definition | • Define engineering materials. |
| 1.2 Ferrous metals | • Describe ferrous metals, their properties and uses. |
| 1.3 Non-Ferrous metals | • Describe Non-Ferrous metals, their properties and uses. |
| Chapter No.2 | |
| 2. Arc Welding Equipment (06 Weeks/ periods) | |
| 2.1 Transformer | • Describe welding transformers and its types. |
| 2.2 Generator | • Describe various types of welding generators. |
| 2.3 Rectifier | • Describe welding rectifiers. |
| 2.4 Accessories | • Describe arc welding accessories. |
| 2.5 Safety | • Describe safety in arc welding equipment handling. |
| Chapter No.3 | |
| 3. Welding Current (05 Weeks/ periods) | |
| 3.1 Transfer of Arc | • Describe transformation of molten metal from electric arc to work/base metal |
| 3.2 AC Welding Current | • Describe AC Welding Current |
| 3.3 DC Welding Current | • Describe DC Welding Current |
| 3.4 Polarity | • Describe polarity, its types, and application |
| 3.5 Arc Length | • Describe arc length, its kind and application. |
| 3.6 Arc Blow | • Describe arc blow, its causes, and controlling methods. |
| Chapter No. 4 | |
| 4. Arc Welding Electrodes (05 Weeks/ periods) | |
| 4.1 Definition | • Define Arc welding electrodes. |
| 4.2 Types | • Describe various types of Arc welding electrodes and their application. |
| | • Describe identification of welding electrodes |
| | • Describe classification of welding electrodes |

4.3 Selection

4.4 Care & Handling

- Describe function of electrode coating
- Describe selection of suitable welding current as per electrode.
- Describe proper selection of Arc welding electrodes.
- Describe care and handling of Arc welding electrodes.

Chapter No.5

5. **Welding Joints and Positions**
(02 Weeks/ periods)

5.1 Types of Joints

5.2 Positions

- Describe various types of Butt and overlap joints
- Describe various types of grooves and their methods of making.
- Describe welding positions and their applications.

Chapter No. 6

6. **Inspection & Quality Control**
(02 Weeks/periods)

6.1 Definition

6.2 Advantages

6.3 Internal Welding Defects

6.4 External Welding Defects

6.5 Distortion

6.6 Quality Control Methods

- Define inspection and quality control
- Describe advantages of inspection
- Describe internal welding defects and their causes.
- Describe external welding defects and their causes.
- Describe distortion, causes, and controlling methods.
- Describe various Quality Control Methods.

Chapter No. 7

7. **Oxy-acetylene gas cutting Process**
(02 Weeks/periods)

7.1 Principle

7.2 Technique

7.3 Cutting torch

7.4 Safety

- Describe Principle of high pressure oxy-acetylene gas cutting process.
- Describe oxy-acetylene gas cutting techniques.
- Identify various types of gas cutting torches and their selection
- Describe safety in gas cutting.

Chapter No. 8

8. **Introduction to modern welding processes** (02 Weeks/ periods)

8.1 Modern welding processes

8.2 TIG Welding process

8.3 MIG/MAG Welding process

- Describe various modern welding processes and their applications.
- Describe TIG Welding process.
- Describe MIG/MAG Welding process.

WELDING (ARC & GAS)
LIST OF PRACTICALS - CLASS X
(30 Weeks = 180 Periods)

Electric Arc Welding Exercises

- 1.1 Setting up of Arc Welding equipment and its operation.
- 1.2 Arc Striking practice.
- 1.3 Welding electrode manipulation practice.
- 1.4 Straight bead running practice on MS plate in Flat position.
- 1.5 Padding practice on MS Plate in flat position.
- 1.6 Bead stops and restart practice.
- 1.7 Tack welding practice on MS plat of fillet, lap, corner and butt-welding joint in flat position.
- 1.8 Fillet weld practice on MS plate in flat position.
- 1.9 Over lap weld practice on M.S. plate in flat position.
- 1.10 Sq. Edge butt weld practice with out gap in flat position.
- 1.11 Corner weld practice on mild steel plate without gap in flat position.
- 1.12 Corner weld practice with gap in flat position.
- 1.13 Open butt weld practice on mild steel plate in flat position.
- 1.14 Multi layer fillet weld practice on Mild steel plate in flat position.
- 1.15 Weaving bead practice on M.S. plate in flat position.
- 1.16 Single-V butt weld practice on mild steel plate in flat position.
- 1.17 Simple project making practice.

Oxy-Acetylene Cutting Practice

- 2.1 Setting of gas cutting equipment and torch
- 2.2 Flame making for gas cutting
- 2.3 Cutting practice on various shapes and size on metal plates

WELDING (ARC & GAS)
LIST OF TOOLS, EQUIPMENT & CONSUMABLE MATERIAL
(FOR 30 STUDENTS)

LIST OF TOOLS

| 1. | COMMON HAND TOOLS | QTY. |
|------|--|--------------------|
| 3.1 | Work Benches | 5 Nos. |
| 3.2 | Bench vices | 20 Nos. |
| 3.3 | Hammer all types and shapes | 12 Nos (each type) |
| 3.4 | Chisels (all types and shapes) | 24 Nos (each type) |
| 3.5 | Hacksaw (Adjustable Frames) | 24 Nos. |
| 3.6 | Fitted with 12" double side cutting blade. | |
| | Outside calipers | 12 Nos. |
| 3.7 | Inside Calipers | 12 Nos. |
| 3.8 | Files all types, shape and sizes with handles. | 24 No (each type) |
| 3.9 | Tongs small and large | 12 Nos. |
| 3.10 | Try Square small and large | 24 Nos. (each) |
| 3.11 | Combination Pliers insulated, 8" long. | 12 Nos. |
| 3.12 | Open end spanner set (double end) | 2 set |
| 3.13 | Screw Driver set straight and Phillips type | 4 sets (each type) |
| 3.14 | Spanner adjustable 12", 10", 8" | 6 Nos. (each type) |
| 3.15 | Anvil with stand | 2 Nos. |
| 3.16 | Box spanner sets | 2 sets. |
| 3.17 | Allen key set | 2 sets. |
| 3.18 | Tin snip/sheet cutter | 06 Nos.(each type) |
| 3.19 | Blow lamp | 2 Nos. |
| 3.20 | Soldering Iron (Manual) | 06 Nos. |

MEASURING TOOLS:

| | | |
|------|------------------------------|---------|
| 3.21 | Steel rule 30 and 15 cm | 24 Nos. |
| 3.22 | Steel Tape 3 mtrs. & 5 mtrs. | 24 Nos. |
| 3.23 | Sprit level | 6 Nos. |

LIST OF EQUIPMENT/MACHINES:

| | | |
|-----|-------------------------|--------|
| 2.1 | Pedestal grinder | 1 No. |
| 2.2 | Disc Grinder 4" | 6 Nos. |
| 2.3 | Disc grinder 7" | 6 Nos. |
| 2.4 | Power saw | 1 No. |
| 2.5 | Bench Shear | 1 No. |
| 2.6 | Soldering Iron electric | 6 Nos. |
| 2.7 | Hand Drill Machine | 1 No. |

Gas Welding Tools and Accessories:

| | | |
|----|---------------------|--------|
| 1. | Cylinder trolley | 6 Nos. |
| 2. | Oxygen cylinder | 6 Nos. |
| 3. | Acetylene cylinder | 6 Nos. |
| 4. | Oxygen Regulator | 6 Nos. |
| 5. | Acetylene Regulator | 6 Nos. |

| | | |
|-----|---|-------------|
| 6. | Flash Back Arrestor Oxygen | 6 Nos. |
| 7. | Flash Back Arrestor DA | 6 Nos. |
| 8. | Rubber Hose Oxygen | 100 meters. |
| 9. | Rubber Hose Acetylene | 100 meters. |
| 10. | Hose clamps | 24 Nos. |
| 11. | Blow pipe complete kit box including blow pipe, Cutting torch set of welding and cutting nozzles and tip cleaner etc. | 4 kits |
| 12. | Spark lighter. | 12 Nos. |
| 13. | Welding table with five bricks top. | 4 Nos. |
| 14. | Welding goggle. | 24 Nos. |
| 15. | Low pressure injector type torch set with nozzle. | 4 Nos. |
| 16. | Low pressure Acetylene generator. | 2 Nos. |
| 17. | Cylinder valve opening key. | 6 Nos. |

ARC Welding Equipment :

| | | |
|-----|-------------------------------------|--------------|
| 18. | AC Welding transformer 50-250 Amp. | 6 Nos. |
| 19. | DC Welding Generator 50-350 Amp. | 1 No. |
| 20. | AC/DC Arc Welder (Rectifier type). | 1 No. |
| 21. | Welding Cable. | 200 mtrs. |
| 22. | Electrode holder 500 Amps. | 12 Nos. |
| 23. | Earth clamps with work return lead. | 12 Nos. |
| 24. | Welding Helmet and hand screens. | 12 Nos. each |
| 25. | Chipping hammer. | 12 Nos. |
| 26. | Steel wire Brush. | 48 Nos. |
| 27. | Welding Booth | 8 Nos. |
| 28. | Hot box / Electrode heating box. | 1No. |

3 CONSUMABLES (MINIMUM MATERIAL REQUIRED FOR ONE YEAR)

| | | |
|------|---|-----------|
| 3.1 | M.S. Gas Welding Filler wire, 1.5mm dia. | 10 KG |
| 3.2 | M.S. Gas Welding Filler wire, 2 mm dia. | 10 KG |
| 3.3 | Brass Filler wire, 2.4 mm dia. | 3 KG |
| 3.4 | Brazing Flux. | 2 tins |
| 3.5 | Welding Flux. | 2 tins |
| 3.6 | Arc Welding M.S Electrodes E-6013, 2.4 mm Dia. | 250 KG |
| 3.7 | Arc Welding M.S Electrodes E-6013, 3.2 mm Dia. | 300 KG |
| 3.8 | Arc Welding M.S Electrodes E-6013, 4 mm Dia. | 100 KG |
| 3.9 | Arc Welding Electrodes E-7018, 2.4 mm Dia. | 50 KG |
| 3.10 | Arc Welding Electrodes E-7018, 3.2 mm Dia. | 50 KG |
| 3.11 | Mild Steel Strip Size 150x50x1.6 mm. | 800 pcs. |
| 3.12 | Mild Steel Strip Size 150x50x2 mm. | 800 pcs. |
| 3.13 | Mild Steel Strip Size 150x50x3.2 mm. | 1000 pcs. |
| 3.14 | Mild Steel Strip Size 150x50x6 mm. | 600 pcs. |
| 3.15 | Silver Solder 50:50 | 4KG |
| 3.16 | Calcium Carbide. | 10 KG |
| 3.17 | Filter Glasses 11 No. & 12 No. for Arc Welding Screen. | 100 Nos. |
| 3.18 | Clear glasses for protection of filter glasses. | 300 Nos. |

REFERENCE BOOKS FOR TEACHERS

1. "Modern Welding"
by A.D ALT House / Turnguist / Bow Ditch USA
2. Welders Trade Theory (GTZ)
3. "Welding Skills" an apt publication, Giachino Weeks. USA
4. "New Lesson in ARC Welding"
Lincoln Electric Company, USA.
5. "Arc Welding projects for the school shops"
By Lincoln Electric Company.
6. "Procedure handbook of Arc Welding Design and practice"
By Lincoln Electric Company. USA

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 |
| <hr/> | | | |
| Total:100 | | | |
| <hr/> | | | |

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 % |