ENGINEERING WORKSHOP PRACTICE I
(ENG 101 WORKSHOP MANUAL)

CENTRE FOR INDUSTRIAL STUDIES

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SAFETY

Hazards within the working environment cannot be eliminated unless person is safety conscious by adhering strictly to the safety attached to each work, e.g. grinding processes are extensively used for preparation of plate for welding and the residues of the process consist of flying particles and dust. It is mandatory to wear eye protection goggle with sides shield during such operation.

1. **Clothing**: method of dressing is very important, loose clothing may result to entangle with running machinery, sleeve must be rolled up and there must be no flowing ties.

2. Safety booth is recommended. Experience has shown mat in most cases the feet are exposed to damage from falling objects like, scrap metals, sharp wood work tools and metal cutting tools; that are associated with the workshop.

3. Workshop is not a place of relaxation, idle and lazy persons are more vulnerable to accident.

4. Avoid the use of any machine or equipment until you are familiar with its operation.

5. It is recommended to use gan-ways/wackways provided in the workshop rather than crossing through the main workshop, on no account should you run or play about in the workshop.
MEASUREMENT

The use of measuring equipment:

1. **The Rule**: engineer's rule are used for taking direct measurement by placing the rule alongside the object being measured and a reading is taken from the graduations on the Rule.

2. Folding rule is also use as engineer's rule for taking linear measurement some folding rules have a line of chords on one of the sides which enables the rule to be used for measuring and marking out angles. As its name implies it can be folded to convenient size.

3. **Steel rule**:

4. **The scribing block**: (sketch)
   Surface gauge or scribing block used with the surface plate for accurate mark-out.

   Surface plate: A shape block of cast iron with a perfectly flat top surface use for checking objects for flatness, squareness.

5. **Vernier caliper**:
   A measuring device introduced by a Frenchman for obtaining an accurate measurement.
   
   a. **Main scale**: it is marked in a similar manner to a rule and is graduated in millimeters.

   b. **Vernier scale**: this slides along the scale and a length the same as a chosen length on the main scale is divided into divisions slightly smaller than those 0.11 the main scale.

   Two vernier scales in use
   
   > 25 division
   > 50 divisions

25 scale, the vernier scale 12mm long is divided into 25 equal divisions Therefore length of one division on the vernier is 12/25=0.48mm. Mail scale is graduate in half millimetres, difference in length between a mail scale division and a vernier division is 0.50mm (which is half c millimeter)
**Examples 1:25 scale**

Main scale divided into $\frac{1}{2}$mm divisions

Vernier Scale length = 12mm
Divided into 25 equal parts
a division on the vernier scale
Represents 0.02mm

**Examples 2:50 scale**

Main scale divided into 1mm divisions
Vernier scale total scale length 49mm
Divided into 50 equal parts
A division on the vernier scale
Represents 0.02mm

**Note:**
To obtain the reading; reading of the main scale first:

The vernier scale is properly examined to determine which of its divisions coincide with a division on the main scale. The number of these 0.02 divisions are added to the main scale reading to give the total reading.

![Neutral Flame](image)

**Neutral Flame**

![Oxidizing flame](image)

**Oxidizing flame**

![Carburizing flame](image)

**Carburizing flame**

a. **Neutral flame** is used for fusion welding of mild style, copper, aluminum, stainless steel and cast iron

b. **Oxidizing flame** is used for bronze welding, soldering and cutting, it can be used also for fusion welding, of copper zinc alloy and galvanise steel

c. **Carburizing flame** is used when depositing, hard facing and wear resistance material on to the surface of steel and cast iron. It can be used for flame brazing of aluminum.

**Multi-Stage Oxygen regulator**

**Flash-back Arrester**: a mechanical device used to check flash back. Flash bask can occur when there is back-feeding of gases has taken place. Mixture of gas is present in the oxygen or fuel hose.
Process of Development and fabrication of funnel
Fig 1A: Development of a frustum of 140mm x 100mm x 30mm by first angle projection method, using
1. Drawing board
2. T-square
3. Cardboard/drawing sheet
4. Engineering sets to develop a pattern of fig. 1A as template

Fig 1B: The same method used in fig 1A, to develop a pattern using 30mm x 60mm x 15mm

Process of fabricating fig 1A and fig 1A are as follows:
1. Cut out the pattern as template with razor.
2. Place the pattern/template into a tin sheet as work piece provided.
3. Use scriber or pencil to trace the pattern/template
4. Use hard snip to cut out the pattern/template.
5. Use a stake with the help of table vice and hammer/mallet to fold the top edge and to bend for the groove.
6. Use bie anvil to fold the pattern/template to a shape if frustum as in fig 1A and fig 1A.
7. Use a grooving tool with the help of bie anvil and hammer to form the groove joint.

Process of soldering after folding pattern/template for fig. 1A and fig. 1B to join them together as funnel
1. Use emery cloth to sandpaper the two edges to join by removing the coated surface that will prevent soldering taking place
2. Clean the joint after sandpapering with liquid flux with the help of ordinary cloth.
3. Place the joint together and apply liquid flux on the joint
4. Use hot soldering iron with the help of smooth flat file to clean the hot surface of soldering iron.
5. Dip the soldering iron inside the flux, then use it to collect soldering lead and finally run it along the joint.

6. If the soldering iron, then collect more of lead and start from where you stopped on the joint.

**Tools for the fabrication**
1. Scribe/pencil
2. Steel rule
3. Small hammer/mallet
4. Chisel
5. Smooth Hat file
6. Bench vice
7. Bic anvil
8. Hard snip
9. Stake
10. Hand groover

**Tools for soldering**
1. Soldering iron
2. Emery cloth
3. Liquid flux
4. Soldering lead
CONSTRUCTION OF An OPENER/SEQUENC OPERATION

1. Obtain a mild steel sheet of gauge 14 of length 100mm. x 40mm

2. Mark out to the desired dimensions as shown on fig 3

3. Cut off the unwanted portions as shaded or indicated c drawing

4. Take to the drilling machine and hold the work piece on machine to drill the 2 end points of the elliptical hole be drilling, centre punch the points of intersection for the hole be drilled.

5. Hold the work piece on the bench vice to chisel the elliptical hole with ball-pen hammer and chisel.

6. Hold on the machine vice to trill the 5mm hole as indicated point of the hole should be centre punched

7. With flat file, round, file and warden files, file to finish the elliptical hole.

8. File out the shape of the opener to the required shape and size

9. Remove sharp edges and submit for inspection.
WORKING TOOLS FOR ENG 101 METAL WORK PRACTICALS

1. Steel Rule
2. Try Square
3. Flat File
4. Hack Saw
5. Scriber
6. Centre Punch
7. Twist Drill
8. Emery Cloth paper
9. Vice
10. Hammer
11. Pair of Dividers
12. Chisel
SEQUENCE OF OPERATION:

1. In Fig 4 a working drawing of a rake handle is given
2. Re-draw in a cardboard sheet or template paper
3. Cut out the template with sharp razor
4. Place the template onto a metal work piece provided and trace with scriber
5. Use centre punch and hammer to make a light indentation on the lines for visibility
6. Place work piece on the anvil and cut with chisel, remember not to cut exactly on the lines
7. After cutting, finish to the lines with half round file
8. Roll to a shape of pipe with a metal former provided in the workshop by attaching the work piece against the metal former and lightly apply hammer blow to it
SEQUENCE OF OPERATION

1. In fig 6 of the working drawing, a detail working drawing is given for the production of rake

2. Check dimensions m/s 3x 305 x 90mm

3. Establish a reference point or a datum by squaring and getting a right angle on the work piece

4. Take all measurement from the datum

5. Centre punch all the holes to be drilled

6. Begin your drilling with smaller diameter twist drill, that is 0.6,08, 013 and finish with diameter 1.5 mm

7. Cut the spaces in the drawing with Hacksaw, remember not to cut exactly on the lines and therefore finish to the line : with, flat hand file

8. Join the rake handle earlier produced with flat head rivet that will be issued in the workshop.

9. Then hammer lightly with ball pen hammer on the Anvil

10. Curve the forks slightly with a 0.50mm pipe to add. Strength

11. Submit for inspection
SEQUENCE OF OPERATIONS

Check dimensions:
- M/s 2 x 55 x 120mm
- M/s 2 x 52 x 120mm
- M/s 12 x 120mm

1. Square to size to conform with the measurements given in the drawing.
2. Mark out from one end of the workplace.
3. After marking out pass for inspection before any other operations.

ALL DIMENSIONS IN MM

DOOR BOLT
DOOR LATCH FOR PADLOCK

WORKING TOOLS

1. Scriber
2. Steel rule
3. Try square
4. Centre punch
5. Files (flat, half round, round, square files and warding file)
6. Hammer
7. Hacksaw
8. Bench Vice
9. Twist drill (16, 17, 13mm)
10. Machine Vice
11. Chisel (flat)
12. Emery cloth

Material M/s 2.5 x 35 x 175mm
M/s 2.5 x 45 x 95mm

SEQUENCE OF OPERATION
Check dimensions M/s 2.5 x 35 x 175mm
M/s 2.5 x 45 x 95mm
Square to size as in the drawing
- Mark out both ends of the work piece
- Pass for inspection before cutting
CONSTRUCTION DETAILS OF KITCHEN STOOL

1. Produce a cutting list with the aid of the above drawing
2. Prepare the given materials to match with your cutting list
3. Carry out the out operation
4. Cut out the Mortice and Tenon joints
5. Match them together according to your marking
6. Having matched them to fit, do the final assembly

TOOLS
1. Steel rule or meter rule
2. Pencil
3. Try square
4. Metal jack or smooth plane
5. Panel saw or tenon saw
6. Wooden mallet
7. Sash clamps
ISOMETRIC DRAWING OF SIDE STOOL

PLAN

SECTION A

RAIL
WOOD WORK HAND TOOLS

1. **Holding and Supporting** tools: such as follows:
   i. G-clamp
   ii. Bench hold fast
   iii. Workbench and its appliance fig. 1 (iii)

2. **Cutting tools: they are as follows**
   i. Saws (Rip & cross-cut) fig 2(1)
   ii. Gouges: inside and outside ground gouge
   iii. Chisels: such as; Bevelled edge, firmer, mortise etc as shown in fig 2(iii)

3. **Geometrical Tools (marking and testing) such as:**
   i. Try square
   ii. Straight edge
   iii. Marking gauge
   iv. Mortise gauge etc

These are tools which can be used for measuring purposes as shown in fig. 3

4. **Impelling & percussion tools: such as;**
   i. Pinches,
   ii. Screw driver
   iii. Crow bar
iv. Hammer

v. Mallet etc.

These are used for driving in and removal of objects in a wood workshop as shown in Fig 4.

5. i. **Abrading & shaving tools**: such as planes, they are used for obtaining the smooth surface of a wood material.

ii. **Spoke shaves**: this is used for planning or smoothing irregular shape or curves as shown in Fig. 5(ii) others are

iii. **Rasp**: this is used for shaping irregular shapes by filing method

iv. **Scraper**: this is used for smoothing rough surfaces after planning

v. **Sandpaper**: this is used for obtaining the final smoothness of a wood material before polishing is applied.

**WOODWORK JOINTS**

**FIGURE 1**

Center Bridle Joint

**FIGURE 2**

Single Pin Dovetail Joint
FIGURE 3
Cross-Halving Joint

FIGURE 4
Comb Or Finger Joint

FIGURE 5
Simple Butt Joint

FIGURE 6
Mitre Joint

FIGURE 7
Rebate Joint

FIGURE 8
Birds Mouth Joint
In wood work industries, there are several types of joints in use for different purposes. Most of these joints are named after their shapes and uses. The diagram above shows some of these joints.

Fig 1 shows the center bridle joint. This joint is always at centers where both component members are to surface or flush with each other. The tools used are:

1. Tenon saw
2. Bevel edge chisel and the wooden mallet

Fig 2 as its name implies is a single pin dove tail joint. This joint resembles the tail of a dove. There are 2 types of dove tail joint:

i. The vertical

ii. The horizontal dove tail joint and each may have more than one pin depending on the width of the component members. The tools used for this practice are; the dovetail saw, the wooden mallet and the firmer chisel.

In fig. 3, we have the cross halving joint which resembles a cross and it is used at centers as well. The tools used are the panel saw, the firmer chisel and the wooden mallet.

The diagram in fig. 4 is a comb or finger joint and it is used as a comber joint. Figure 5 is the simple butt joint, though it is widely used, but it is a weak joint. The tools used are hammer and pincers.

Figure 6 is the miter joint and it is highly use in the furniture industries. It is one of the recognized joint because of its strength and appearance. It is also an angular joint that cuts at 45: the tools used are the mitre saw and the metal hand plane.

The diagram in figure 7 shows the rebated joint comprising of three members. This joint is a widening joint and the tools used are the hammer and sash clamp.

Figure 8 shows the birds mouth joint and this joint is a widening joint mainly used in roofing work where rafters are to be elongated.
TOOLS AMD MACHINES USED
1. Pillar Drilling machine
2. Bench sheer
3. Foot operated guillotine
4. Metre rule or measuring tape
5. Straightedge
6. Scriber
7. Center punch
8. Ball- pein hammer
9. Try square
10. Chisel
11. Files/ warden files
12. Twist drills (8mm and 5mm diameter)
13. Machine vice
14. Bench vice
15. Steel rule
CUTTING TOOLS

Saw

Cross-cut saw

Rip Saw

Chisel

GEOMETRICAL TOOLS

Tri-square

Marking Gauge

Pencil
PERCUSSING/IMPELLING TOOLS

Pincers     Crow - Bar     Screw-driver

Harmer     Mallet

ABRADING & SHAVING TOOLS

Smoothing-Plane     Spoke Shave

HOLDING AND SUPPORTING TOOLS

STOPPER

BENCH VICE

Workbench
FEDERAL UNIVERSITY OF TECHNOLOGY
OWERRI

ENGINEERING WORKSHOP PRACTICE III
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