

**COURSE CODE: AGE 204**

**COURSE TITLE: WORKSHOP PRACTISE**

**NUMBER OF UNITS: 2 Units**

**COURSE DURATION: 1 hour Lecture**

**2 hour Practical**

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## COURSE CONTENT:

- WORKSHOP SAFETY MEASURES, INTRODUCTION TO WORKSHOP HAND AND POWER TOOLS EMPHASIZING SAFETY MEASURE TO BE TAKEN DURING OPERATION. WORKSHOP MATERIALS VARIOUS GAUGES AND MEASUREMENT GENERAL DESCRIPTION OF THE FUNCTION AND CAPABILITIES OF GRINDING MACHINE, DRILLING MACHINE, LATHE MACHINE, MILLING MACHINE, SHAPING MACHINES, AND CUTTING MACHINES. PRACTICE IN USE OF MACHINES. WELDING, BRACING SOLDERING AND RIVETING. CARPENTRY: HAND TOOLS, MATERIALS, TYPES OF JOINTS, PROCESSING OF TIMBER. MANUFACTURING OF SIMPLE COMPONENTS USING STEEL AND WOOD.

## COURSE REQUIREMENTS:

This is a compulsory course for all students in the department of Agricultural Engineering. In view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examination.

1. READING LIST: *Khurmi R. S. and Gupta I. K. A text book of workshop technology (manufacturing processes). Publication Division of NIRJA Construction and Development Co (D) LTD. Ramnagar New Delhi-110055*
2. *Chapman Workshop practice 1*

# SAFETY IN THE WORKSHOP

SAFETY OF PERSONELS IN THE WORKSHOP IS ESSENTIAL TO PREVENT ACCIDENTS FROM OCCURING IN THE WORKSHOP.

MOST CASES OF ACCIDENTS THAT OCCUR IN THE WORK ARE DUE TO THE INABILITY OF THE PERSONEL AND VISITORS TO BE SAFETY CONCIOUS.

HENCE IT IS PARAMOUNT FOR INDIVIDUAL WORKERS TO TAKE PRECAUTIONS WHILE WORKING IN THE WORKSHOP.

- THERE ARE SAFETY MEASURES THAT MUST BE PUT IN PLACE BY EMPLOYERS OF LABOUR TO PREVENT ACCIDENTS FROM OCCURRING IN THE WORKSHOP
- MANY ACCIDENTS CAN BE PREVENTED FROM OCCURRING IF THE WORKSHOP OWNERS WILL PROVIDE SAFE WORKING CONDITIONS AND AS WELL AS TRAIN ITS PERSONNEL IN SAFE WORKING TECHNIQUES.
- THE DUTY OF THE EMPLOYER IS TO PROVIDE;

- PROTECTIVE CLOTHING AND ATTIRE
- WELL PLANNED WORKSHOP LAYOUT WITH ADEQUATE WORKING SPACE THAT IS NOT CONGESTED WITH GOOD LIGHTNING AND VENTILATION.
- PROPER MACHINE GUARDS FOR REVOLVING PARTS
- FUNDS TO REPAIR AND MAINTAINANCE OF ALL MACHINERY TO BE IN GOOD WORKING CONDITION.
- SAFE TOOL STORAGE AREA

● FIRST AID AND FIRE FIGHTING EQUIPEMENT

● TRAIN PERSONNEL ON:

THE CORRECT WAY TO PROSECUTE A JOB

THE CORRECT USE OF TOOLS AND MACHINES

THE CORRECT WAY TO CARE AND MAINTAIN TOOLS

OTHER FACILITIES SUCH AS ADEQUATE EMERGENCY EXITS ,PROVISION OF EXTRACTOR FANS, HOODS, HIGH CEILING DESIGN, EMERGENCY SHOWERS, CONVENIENCIES SUCH AS LAVATORIES AND FREE SPACE FOR PEOPLE TO MOVE AROUND WITHOUT COMING TO CLOSE MACHINES MUST BE PROVIDED TO MEET THE MINIMUM REQUIREMENT FOR WORKSHOP CERTIFICATION.

# SAFETY GUIDE FOR PERSONNEL

THE DUTY OF THE PERSONNEL IS TO MAKE SURE THAT WHENEVER PERFORMING ANY JOB IN THE WORKSHOP IT MUST BE DONE WITH UTMOST CARE NOT HAVE ANY INJURY OR ACCIDENT BY ADHERING TO SAFETY GUIDES. HE OR SHE MUST KEEP THE WORKSHOP TIDY AND ORGANIZED . AVOID OVER CONFIDENCE , THOUGHTLESSNESS, FOOLISHNESS AND BEING ABSENT MINDED.



○ PERSONNEL MAKING USE OF THE WORKSHOP MUST ADHERE TO FOLLOWING GUIDES:

1. DO NOT WEAR LOOSE GARMENT
2. MUST WEAR TIGHT FITTING CLOTH
3. WEAR PROTECTIVE CLOTHING'S SUCH AS EYE SHIELD, HELMET, NOSE PROTECTOR .
4. AVOID PLAYING IN THE WORKSHOP
5. ALWAYS WALK AND NOT TO RUN IN THE WORKSHOP
6. REMOVE WRISTWATCHES OR ANY JEWELRIES WHEN IN THE WORKSHOP

7. WEAR SHOES WITH STRONG TOECAP AND HIGH SOLED
8. REMOVE TIE TO WHILE WORKING IN THE WORKSHOP
9. AVOID SPILLAGE OF OIL ON THE FLOOR OF THE WORKSHOP.
10. AVOID POURING OF WATER ON THE FLOOR OR ANY MACHINERY IN THE WORKSHOP.
11. NEVER OPERATE ANY MACHINERY YOU DO NOT KNOW HOW TO USE.
12. DO NOT LEAN ON ANY MACHINERY

13. ALWAYS KNOW THE CONDITION OF ANY MACHINE BEFORE OPERATING IT
14. NEVER MANAGE A FAULTY MACHINE
15. AVOID ANY ACTION THAT CAN LEAD TO INJURY E.G. FORGETTING THE JACOBS' CHUCK KEY IN MACHINE CHUCK
16. CHECK TERMINALS AND CABLES OF ELECTRICAL APPLIANCES FOR ANY EXPOSED PARTS MUST BE INSULATED.

# INTRODUCTION TO TOOLS AND MACHINE TOOLS

## ● MEASURING TOOLS OR GAUGES

THESE ARE TOOLS USED TO MEASURE DIMENSIONS ON WORKPEICE .

- i. ENGINEER'S STEEL RULE : THIS MADE OF STEEL ON ONE OF THE FLAT FACE GRADUATIONS ARE MARKED IN CENTIMETER AND INCHES. USED TO SET OUT DIMENSIONS.
- ii. FOLDING RULE IS OF 2 METERS LONG USED TO MEASURE AND LAYOUT LARGER WORK.
- iii. STEEL TAPE ARE OF LONGER LENGTH AND MADE OF FLEXIBLE STEEL CAN BE ABOVE 2 METERS IN LENGTH.
- iv. STEEL SQUARE IT IS L-SHAPED OF HARDENED STEEL

WITH GRADUATIONS MARKS ON THE EDGES FOR MEASUREMENT AND TO SET OUT  $90^{\circ}$  ON WORK PIECE.

- v. UNIVERSAL BEVEL MADE OF STEEL. USED TO MEASURE OUT ANGLES ON JOB. OTHER TOOLS IN THIS CATEGORY ARE THE COMBINATION SET, PROTRACTOR, ADJUSTABLE BEVEL
- vi. CALIPERS ARE NON-PRECISION LINEAR MEASURING TOOLS FOR TRANSFERRING OR COMPARING DIMENSION FROM ONE OBJECT TO ANOTHER USING THE STEEL RULE OR THE VERNIER CALIPERS.
  - a. OUTSIDE CALIPERS FOR CHECKING OR MEASURING OUTSIDE DIMENSIONS OR PLATE THICKNESS.
  - b. INSIDE CALIPERS FOR CHECKING OR MEASURING INTERNAL DIMENSIONS OF HOLE DIAMETERS.
  - c. HERMAPHRODITE OR ODD LEG CALIPERS USED TO SET OUT PARALLEL LINES TO THE EDGE OF WORK AND FOR LOCATING CENTRE POINTS OF CYLINDRICAL WORK.

d. OTHER CALIPERS ARE INSIDE AND OUTSIDE SPRING CALIPERS AND INSIDE AND OUTSIDE TRANSFER CALIPERS.

vii. PRECISION MEASURING TOOL

a. MICROMETERS: THESE ARE PRECISION MEASURING TOOLS ARE OF VARIOUS TYPES:

- OUTSIDE MICROMETERS
- INSIDE MICROMETERS
- SCREW THREAD MICROMETERS
- DEPTH GAUGE MICROMETERS

THE OUTSIDE MICROMETER CAN MEASURE DIMENSION OF 2.54 MICROMETERS (0.0001 IN). THE ACCURACY OF A MICROMETER IS BASED ON THE TURNING OF A FINE SCREW THREAD KNOWN AS THE RATCHET. TO USE A MICROMETER, THE OBJECT TO BE

MEASURED IS PLACED AT THE OPENING BETWEEN THE ANVIL AND SPINDLE OF THE MICROMETER FRAME. WHILE THE THIMBLE, IS ROTATED UNTIL THE OBJECT IS HELD IN PLACE. THE READINGS IS TAKEN ON THE THIMBLE AND BARREL SCALES TO DETERMINE THE PRECISE MEASUREMENT.

b. VERNIER CALIPER USED TO MEASURE THE INSIDE AND OUTSIDE DIAMETER OF SHAFTS, THICKNESS OF PARTS, DEPTH OF HOLES AND SLOTS. IT IS USED FOR LONGER DIMENSION WHERE YOU CANNOT USE A MICROMETER SCREW GAUGE. THE ACCURACY FOR VERNIER CALIPER IS 0.002mm.

c. OTHER GAUGES USED IN THE WORKSHOP ARE:

- DEPTH GAUGE
- TELESCOPIC GAUGE
- SCREW THREAD MICROMETER
- DEPTH GAUGE MICROMETER
- VERNIER HEIGHT GAUGE

- VERNIER DEPTH GAUGE

- VERNIER GEAR-TOOTH CALIPER

d. SPECILIASED MEASURING TOOLS (GAUGES)

GAUGES ARE FIXED-DIMENSION INSTRUMENT USED TO CROSS CHECK PARTICULAR DIMENSION IN WORK PIECE FOR SPECIFIED TOLERANCE. IT REQUIRES MINIMUM TIME AND SKILL WHEN USED (GUPTA 1981). GAUGES DO NOT HAVE GRADUATIONS AND CANNOT BE ADJUSTED THEY ARE MADE TO CARRYOUT SPECIFIC MEASUREMENT FOR A SOME PARTICULAR JOB WHICH IS TO BE PRODUCED IN LARGE QUANTITIES.

GAUGES CAN BE CLASSIFIED :

-ACCORDING TO TYPES(E.G. STANDARD AND LIMIT GAUGES) (GUPTA 1981)

- ACCORDING TO THEIR PURPOSE AND

- ACCORDING TO THE FORM OF THE TESTED SURFACE. TYPES(E.G. SNAP , RING AND

THREAD GAUGES) (GUPTA 1981)



- i. THREAD GAUGE: ARE USED TO CHECK THE PITCH DIAMETER OF SCREW THREADS.
- ii. SNAP GAUGE: USE TO CHECK EXTERNAL DIMENSIONS.
- iii. RING GAUGE: FOR CHECKING DIAMETERS OF SHAFTS OR STUDS
- iv. PLUG GAUGE: TO TEST ACCURACY OF HOLES
- v. SLIP GAUGE: ALSO KNOWN AS PRECISION GAUGE BLOCK. ARE USED TO CROSS CHECK THE ACCURACY OF MEASURING INSTRUMENT SUCH AS MICROMETERS, CALIPERS, SNAP GAUGES , DIAL INDICATORS ETC
- vi. FEELER GAUGE TO CHECK AND SET CLEARANCE BETWEEN TWO SURFACES. MADE OF MANY THIN STEEL SHEET ( LEAVES) . EACH LEAF IS MARKED WITH ITS THICKNESS WHICH VARY FROM 0.05mm TO 1mm.
- vii. SCREW PITCH GAUGE TO CHECK THE PITCH OF SREWS IT IS SIMILAR TO A FEELER GAUGE EXCEPT THE LEAVES ARE NOTCHED AT ONE EDGE ACCORDING TO THE VARIOUS PITCHES OF SPECIFIC THREADS.

## ● MARKING OUT TOOLS

MARKING OUT TOOLS ARE TOOLS USED TO MARK OUT LINES, ARCS, CIRCLES AND POINTS ON SURFACE OF SHEET METALS OF AREAS TO WORK ON. UNDER THIS CATEGORY OF TOOLS YOU HAVE THE FOLLOWING:

- a) SCRIBER MADE OF HARDENED STEEL. BOTH ENDS ARE SHARP POINTED. ONE OF THE END IS BENT. USED TO SCRATCH OUT LINES ON METAL SURFACE.
- b) DIVIDER USE TO TRANSFER DIMENSIONS. TO DRAW ARCS AND CIRCLES.

- c) TRAMMEL POINTS USE FOR DRAWING LARGER ARCS AND CIRCLES.
- d) PUNCHES ARE MADE OF TOOL STEEL .PUNCHES ARE OF TWO TYPES:
  - PRICK PUNCH: THE END HAS TAPER ANGLE OF  $60^{\circ}$  FOR MAKING SMALL INDENTATIONS. ESTABLISHING POINTS FOR THE DIVIDER AND TRAMMEL POINTS
  - CENTRE PUNCH THE END HAS TAPER ANGLE OF  $90^{\circ}$  FOR MAKING BIG INDENTATIONS FOR POINTS TO DRILL.

## ○ CUTTING TOOLS

1. CHISEL COLD CHISEL ARE USED TO CUT AND SHEAR METAL .THERE ARE DIFFERENT TYPES
  - FLAT
  - CAPE
  - DIAMOND POINT
  - ROUND
2. SNIPS: ARE SIMILAR TO A PAIR OF SCISSORS BUT ARE HEAVIER AND USED TO CUT SHEET METALS OF LESS THICKNESS

# ◎ STRICKING TOOLS

HAMMERS ARE OF VARIOUS TYPES

## 1. HARD FACE HAMMERS

- i. BALL PEEN HAMMER
- ii. CROSS PEEN HAMMER
- iii. FLAT PEEN
- iv. STRAIGHT PEEN

## 2. SOFT FACE HAMMERS

- i. MALLET

● PLIERS ARE USED FOR GRIPPING OR HOLDING SHEET METALS ARE OF VARIOUS TYPES WHICH ARE:

1. FLAT NOSE PLIER
2. ROUND NOSE PLIER
3. SLIP JOINT PLIER

● HACKSAW FOR CUTTING METALS

● FILES ARE USED FOR REMOVING SMALL AMOUNT OF MATERIAL FROM METALS .

- **ENGINEERING MATERIALS:**

- a. **Pig Iron**: -product of the blast furnace and the basis of all ferrous metals, used for the manufacture of cast iron, carbon steel and alloy steels. never used as a structural material. It is weak and brittle, easily broken with a sudden blow; this is due to the presence of 4% carbon,
- **Wrough Iron**: - pure iron left after the removal of carbon. Its ferrite content is about 99.95%, the remaining 0.05% consisting of slag inclusions picked up during the smelting process carried out in a puddling furnace. It is a soft yet tough metal, easily bent or twisted while cold, yet king excellent resistance to corrosion is very good owing to the formation of film / scale of iron oxide which tends to prevent further oxidation / scaling.

- **c. Grey Cast Iron**: -Reheating of pig iron refines it to produce this iron provided the resulting liquid, cast iron, is allowed to cool slowly. It contains 3½% carbon, and the presence of this carbon gives great fluidity to the molten cast iron, allowing it to be poured into sand moulds to produce castings. N/B wrought iron does not contain carbon, and even when heated it does not become liquid and cannot be poured into a mould. Because of the carbon presence as graphite this iron cannot stand up to sudden blows. Although this graphite promotes a very good low-friction bearing surface.
- **White Cast Iron**: - If liquid cast iron is rapidly cooled or chilled it resulted to a very hard cast iron which could not be machined using ordinary tools; (cannot be filed or turned on a lathe). Engineers has little use for this iron except when certain parts of a casting are required to be dead hard.
- **Carbon Steel**: - Carbon steels are made in steelmaking furnaces, where very careful control over the carbon percentage is maintained. Rounded the carbon does not exceed 1 1½% it combines chemically with ferrite, producing a very strong structure. The percentage of Carbon determines the type of carbon steel.



- **Alloy Steel:** - These are used when carbon steels are unsuitable for the kind of conditions to which the component will be subjected. For example, if a very strong steel is required, a nickel-chrome steel is much stronger than a plain carbon steel; if the component is required to resist corrosion, or in other words to be 'stainless', an alloy steel is used. They are also very suitable for making the wide range of cutting tools required to machine metals at high speed. The addition of metals such as Chromium, nickel, cobalt molybdenum and vanadium increases a plain carbon steel into an alloy steel.

- **Non-Ferrous Metals**: -They are much weaker than ferrous metals. However, they have a great advantage over most ferrous metals, such as their resistance to corrosion, from figure 2 non-ferrous metals divided into 2 groups.
- **Pure metals** – single metal
- **Non-ferrous alloys** – 2 or more metals e.g. nickel- chrome, brass (copper & zinc)
- **Pure Non-Ferrous Metals**
- (i) **Copper** – attractive red colour, soft and excellent conductor of heat and electricity
- (ii) **Tin** – Silvery in colour, soft, excellent resistance to corrosion, most expensive metal, seldom used in its pure state except as a protective coating for mild-steel sheet. So-called ‘tin’ cans are made from this sheet, known as tinplate, which has a very thin layer of tin on the surface.
- (iii) **Lead** – Silvery also in colour, good resister of corrosion, easily cold worked (easily bent, twisted or hammered into shape with little risk of fracture or cracking).
- (iv) **Zinc** - Also silvery, easily bent and hammered into shape. Its excellent resistance to corrosion makes it suitable for covering mild-steel sheet, producing the easily recognized corrugated sheets.

(v) **Aluminum** - Silvery, 1/3 weight of steel, very soft when in its pure state, easily rolled into very thin sheet or foil. Most protective coverings for chocolates and cigarettes are made from aluminum foil.

**Non Ferrous Alloys** – All the pure metals given above possess very little strength; they are used, mainly because of the ease with which they can be worked, or because of their excellent resistance to corrosion.

(i) **Bronze** – Dark red-brown colour, an alloy of copper and tin. The amount of tin added to copper seldom exceeds 15%, thus copper is the parent metal. Bronze was highly prized in previous civilizations, finding extensive use in the engineering field is restricted, as it is now mainly a decorative metal, although with the addition of small amounts of phosphorus a very useful bearing metal is produced. Bronze has very good resistance to corrosion.

(ii) **Brass** – Addition of Zinc to Copper gives brass. Several types of brass are in use depending on the amount of Zinc added to Copper colour ranging from a rich gold to a light yellow. All brasses have a good resistance to corrosion.

(iii) **Duralumin** – It is a strong, light metal having a strength much superior to that of pure aluminum, and the metal had a close resemblance to aluminum, being silvery in colour.



● NON-METALLIC

● NATURAL  
WOOD  
SAND  
STONE

● SYNTHETIC  
PLASTIC  
GLASS

- a. Natural Materials

- Stone and sand are essential for the building industry

- Wood is used in modern engineering manufacture; it is light, strong and easily worked, and it is available in a wide range of attractive colours. Engineers make much use of suitable woods in the manufacture of wooden patterns from which metal castings

## b. Synthetic materials

Synthetic are man made materials. All have great advantages over natural materials, since they may be manufactured to suit particular requirements.

- ⦿ A wide range of components, radio parts, toys and fabrics are manufactured from plastic.
- ⦿ N/B: The choice of a material to make a component depends on three factors.
  - (i) Its ability to stand up to the conditions likely to be encountered when the component is put to use.
  - (ii) Its suitability for the manufacturing process adopted.
  - (iii) Its cost.

- Carpentry: woodworker's job
- The woodworker's tool kit is his prime means of obtaining job satisfaction in his chosen , career .
- Carpentry tools can be divided into five (5) broad categories :
- (i)Tools for marking , measuring and testing
- (ii) Cutting tools
  - Boring tools
  - Percussion tools –(hammers)
  - Screwdrivers and pincers .
- (i) Tools for marking, measuring and testing
- (a) Rules –These are available in various forms such as bar rules, folding rules and flexible tapes .

## ● MATERIALS

- The basic raw materials of the carpenter and joiner, is Timber which is the product of the woody perennial plant which is know as a tree.
- Trees are divided into two main groups, hardwoods and softwoods. Hardwoods are the broadleaved trees such as oak, ash, teak and mahogany. While the softwoods include the conifers whose laves are generally in the form of needles or scales as borne by the pines, firs and spruices.



- Timber in its natural form is one of the most useful and versatile of the materials used by man. It however has certain inherent shortcomings which tend to limit its usefulness in its solid form. These include
- Width of boards – tapering – diameter not constant
- Stability – especially in large sizes, timber is likely to warp, shrink or swell.
- Strength – strong longitudinally, relatively poor across the grain. Large knot can seriously weaken it even in the direction of its maximum strength.

- Man-made boards – These boards are an attempt to overcome the shortcomings of solid timber. Examples are:
  - Plywood – available in large, standard size sheets in a range of the t
  - Thickness from 1mm upwards.
  - Peeled and sliced veneers
  - Blockboard
  - Laminboard
  - Battenboard
  - Particle boards
  - Fibre boards
- Processing / Seasoning of Timber:
  - Removal of water in the form of sap is known as “seasoning”.
  - Two main methods
    - ‘air frying – natural seasoning
    - Kiln drying – mechanical means.
  - Advantages of kiln seasoning
    - the speed at which the seasoning is carried out
    - the facility to dry timber