FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI
DEPARTMENT OF MATERIALS & METALLURGICAL ENGINEERING

LABORATORY MANUAL & ASSIGNMENTS

For

(ENGINEERING WORKSHOP PRACTICE II)

ENG 102

- **SURNAME:** _
- **OTHER NAMES:** _
- **REG. NUMBER:** _
- **DEPARTMENT:** _
- **SCHOOL:** _
- **MANUAL SERIAL NUMBER:** _

UNIT ONE

INTRODUCTION

This booklet is a laboratory manual and assignments. It is intended to assist students effectively carry out practical work as well as provide opportunity to do **assignments** and exercises that will enhance knowledge of the course.

Engineering Workshop Practice II (ENG 102) at the Federal University of Technology, Owerri is the second in the series of four compulsory workshop courses for engineering students. It coversthe following four thematic areas, which shall also be the focus of this manual:

- *Industrial safety*
- *Machine shop work*
- *Automobile work, and*
- *Electrical work*

The author(s) hereby acknowledge gleaning the information contained in this manual fromseveral sources, particularly "**Fundamentals of Engineering Workshop Practice: Materials and Processes**", edited by O.E. Okorafor (2011) and published by M.C. Computer Press, Nnewi. This is the official Departmental Textbook for the first three Engineering Workshop Practice Courses in the University, namely; ENG 101, ENG 102, and ENG 201.

The principles or theory behind the assignments in this manual are available in the above reference text, and will also be discussed in class during lectures.

UNIT TWO

INDUSTRIAL SAFETY

Safety at work is so important to engineers that "Safety First" is a common slogan in factories and industries. No job or task is more important than the health and safety of the workers. If a job cannot be done safely; then it should not be done at all. We know that when a doctor makes a mistake, someone else may die; but when an engineer makes a mistake, he is likely to be the first victim. Every engineer must take his safety and the safety of other workers around him very seriously.

Many countries have enacted their own version of ***safety legislation*** in compliance with ILO Convention. In Nigeria, it is currently the **Factories Act of 1990** (Cap. 126).

The purpose is to among others,

- Secure the health, safety and welfare of persons at work.
- Protect persons other than those at work, against risks to health or safety arising out of or in connection with the activities of persons at work.
- Involve everyone, both management and employees, and make them all aware of the importance of safety and health.

Problem 2.1:

Enumerate two safety measures you would employ to combat **dust and fumes** in industrial atmospheres:

a. ____

____

b. ____

____

Problem 2.2:

State two safety strategies you would use in the event of **noise pollution**:

a. ____

____

____

____

b. ____

____

____

____

Problem 2.3:

What three safety precautions would you use to prevent the condition known as **industrial dermatitis**?

a. ____

____

____

b. ____

____

____

c. ____

____

____

Problem 2.4:

Give the appropriate name for the disease condition resulting from inhalation of the fumes or dust of the following toxic substances:

a. Aluminium: ____

b. Silicon: ____

Problem 2.5:

a. The part of files and rasps where handles are fitted is called

____

b. The moving parts of machine tools are usually protected to prevent accidental access. This protection is done by means of________________________________

Problem 2.6:

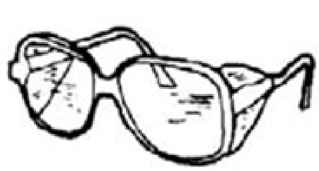
A safety device that is aimed at stopping electrically powered equipment in an emergency is called ____ **Problem 2.7:**

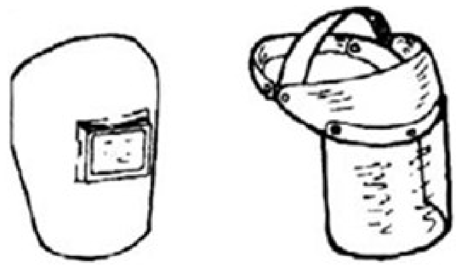
a. By means of a **fire triangle** show, the basic elements required to initiate and sustain fire.

b. By means of a suitable **fire triangle**, show the basic methods of extinguishing fire.

Problem 2.8:

Identify the following safety equipment (PPE) by writing the correct name beneath the corresponding equipment.





UNIT THREE

MACHINE SHOP WORK

Machining is a manufacturing technology whereby useful products are made by material removal operations. In machining, we use a machine tool like ***lathe***, ***shaper***, ***planer***, ***slotter***, ***drilling***, ***milling*** and ***grindingmachines*** etc. and a cutting tool made of a much harder material than the material of the part to be machined i.e. the ***workpiece*** (WP). Material removal from the workpiece is achieved by the relative movement between the cutting tool and the workpiece. The cutting tool is given a sharp cutting edge and it is forced to penetrate inside the workpiece surface to a small depth. The relative motion between the tool and workpiece results in a thin strip of material being sheared off from the workpiece reducing the thickness of the workpiece. This process has to be repeated several times before the entire surface of the workpiece can be covered and reduced in depth. The thin strip of the material sheared from the workpiece in form of shavings or swarf is called '***chip***'.

Substantial amount of power is required for machining. The function of the machine tool is to provide this power and the required motion of workpiece relative to the tool. In some cases of machining, motion is given to the workpiece and tool remains stationary. In some other cases, the workpiece is stationary and the machine tool provides motion to the cutting tool. In yet other cases, motion is given both to tool as well as the workpiece.

Cutting tools can be of ***single point cutting tools*** type or ***multipoint cutting tools*** type. It is a body having teeth or cutting edges on it. A single point cutting tool (such as turning, shaper, planner and boring tools) has only one cutting edge, whereas a multi-point cutting tool (such as milling cutter, drill, reamer and broach) has a number of teeth or cutting edges on its periphery. Figures 3.1 and 3.2 illustrate both the single point cutting tool and the multipoint cutting tool.

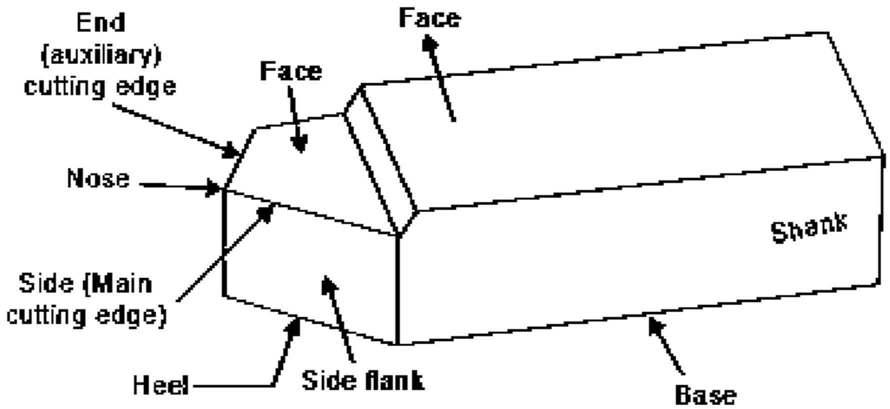


Figure 3.1: Geometry of a single point cutting tool

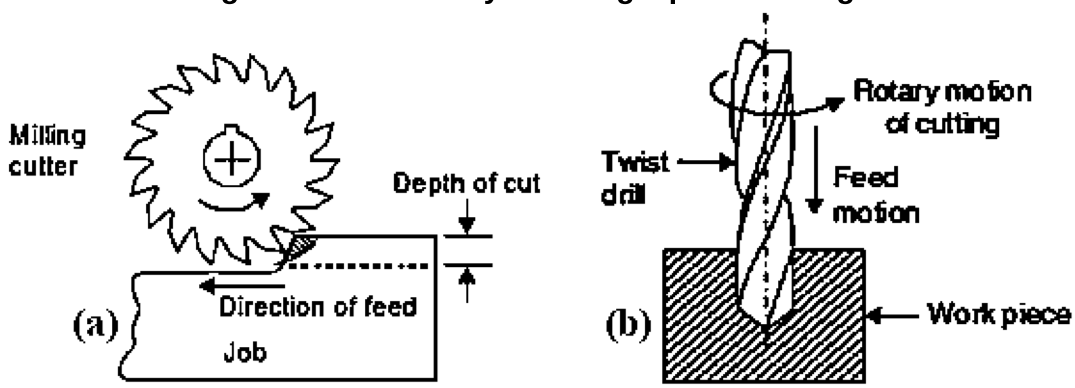


Figure 3.2: Multipoint cutting tools; (a) Mill cutter and (b) Drill

<u>Problem 3.1:</u>

a. A manufacturing process that involves material removal in order to shape useful products is generally referred to as: ___________________________________

b. Four major property requirements of cutting-tool materials are:

i. ____

ii. ____

iii. ____

iv. ____

c. Name any three cutting-tool materials:

i. ____

ii. ____

iii. ____

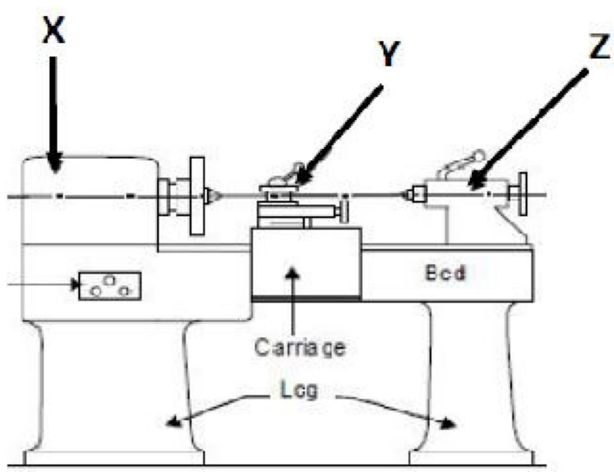
d. Two functions of **cutting fluids** include:

i. ____

ii. ____

Problem 3.2:

a) Identify the parts/components labeled X, Y and Z in the figure below by writing their names above the letters as appropriate.Which machine tool is shown in the figure? ____.



Problem 3.3:

A cylindrical job 120 mm diameter is to be turned at a cutting speed of 30 m/min, the feed being 1.8 mm/rev. if the length of the job is 200 mm find the time required for 1 cut. (Use the space below for your calculations)

Problem 3.4 (LATHE):

In the space below, sketch:

(i) A four-jaw independent chuck and

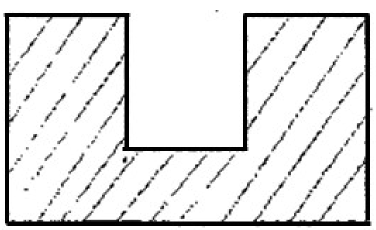
(ii) A three-jaw self-centered chuck of a lathe machine.

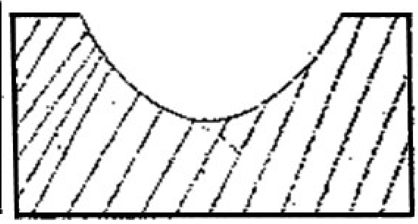
Problem 3.5 (USING A LATHE):

In the space below, draw a schematic sketch to illustrate the external threading procedure using a lathe machine. (Use a cylindrical work held by the chuck for this sketch.)

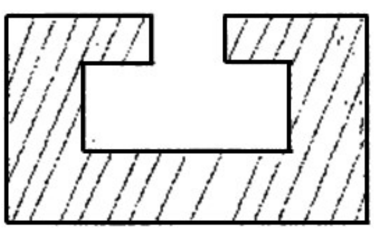
Problem 3.6 (MILLING):

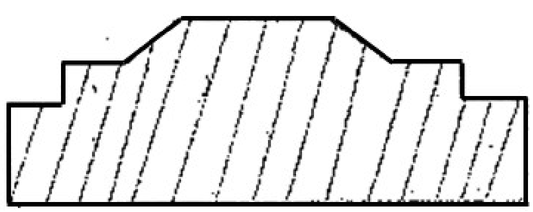
Use the blank space on pages9 and 10 to draw the appropriate milling cutters that will produce the following shapes on work pieces. Show the directions of motion of work pieces and the direction of rotation of the cutters.





(a) Rectangular Slot (b) A Semicircular Slot

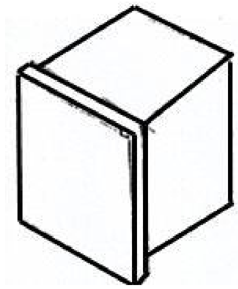


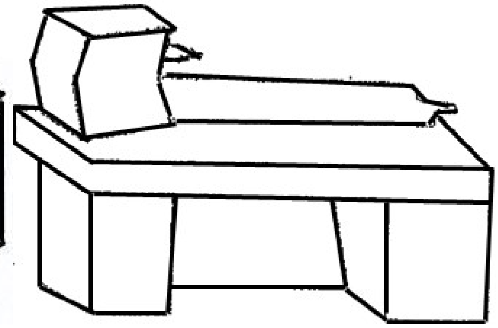


(c) Dovetail Slot(d)A Complex Surface Configuration

Problem 3.7 (SAFETY DEVICES IN MACHINE TOOLS):

Re-sketch the following in the space below and include the missing precautionary safety devices.

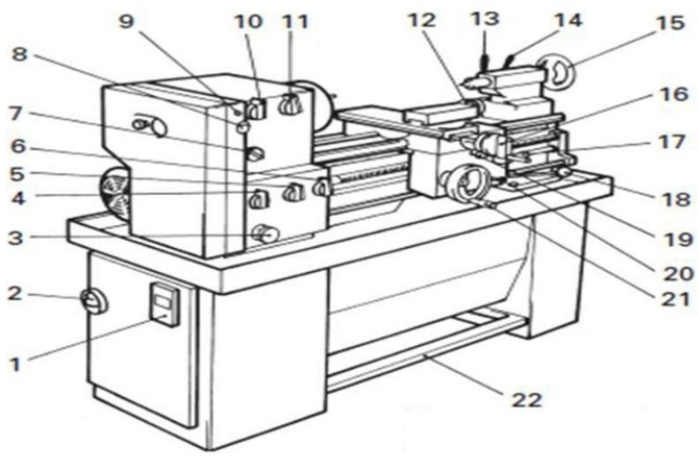




(a) Stop button on a machine (b) Centre lathe **Problem**

3.8 (IDENTIFICATION OF PARTSIN MACHINE TOOLS):

In the figure below, name the parts labelled 2, 15, 21 and 22 and state their functions



UNIT FOUR

AUTOMOBILE WORK

The ***automobile*** or ***motor car*** (or simply ***car***)is a road vehicle, usually with four wheels and powered by an internal-combustion engine, designed to carry a small number of passengers. Like the human body in which cells make up tissues, and tissues make up organs, and organs constitute the various body systems such as nervous, circulatory, respiratory, digestive, reproductive, excretory, etc.; we have automobile assemblies, systems and parts. A modern automobile comprises as many as 15, 000 separate parts which can be grouped conveniently into four basic **assemblies**, namely: (i) **engine**, (ii) **drive train**, (iii) **chassis** or **support** and **control**, and (iv) **body**. The term **power train** describes the combination of both the engine and the drive train. Each assembly can be grouped further into **systems** and **subsystems** e.g. brake system, ignition system, cooling system, fuel system, transmission system, exhaust system, steering and control systems, etc. Figure 4.1 shows some parts of a car with the systems listed.

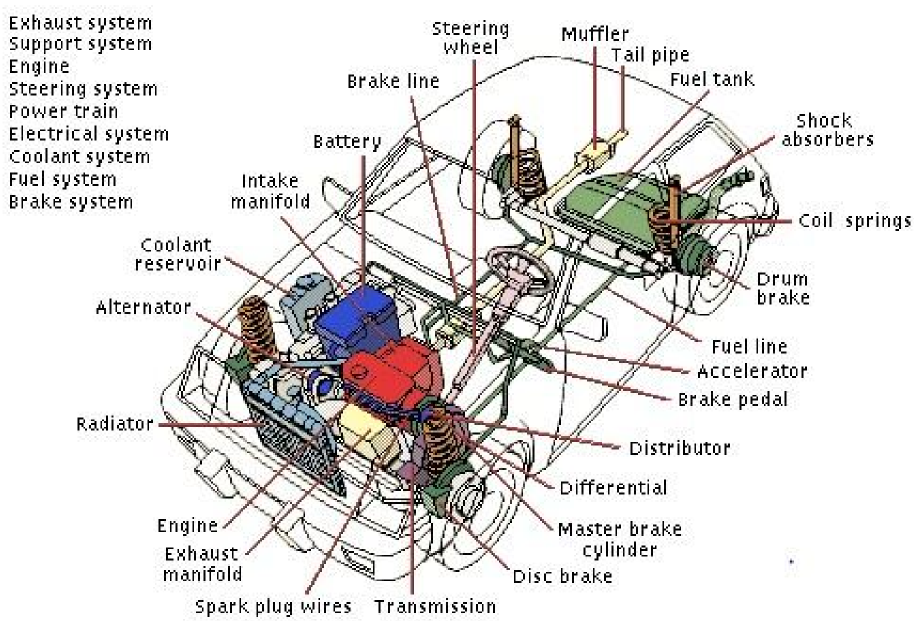


Figure 4.1: Automobile systems and subsystems

Internal Combustion Engines

The development of internal combustion engines made possible the realization of the dream of horseless carriages. In an internal combustion engine (ICE), the ignition and combustion of the fuel occurs within the engine itself. Combustion or burning is the basic chemical process of releasing energy from a fuel and air mixture. The engine then partially converts the energy from the combustion to work. The engine consists of a fixed cylinder and a moving piston. The expanding combustion gases push the piston, which in turn rotates the crankshaft. Ultimately, through a system of gears in the powertrain, this motion drives the vehicle's wheels.

There are two kinds of internal combustion engines currently in production: the **spark ignition gasoline engine** and the **compression ignition diesel engine**. Most of these are **four-stroke cycle engines**, meaning four piston strokes are needed to complete a cycle. The cycle includes four distinct processes: intake, compression, combustion/power stroke, and exhaust.

Spark ignition gasoline and compression ignition diesel engines differ in how they supply and ignite the fuel. In a spark ignition engine, the fuel is mixed with air and then inducted into the cylinder during the intake process. After the piston compresses the fuel-air mixture, the spark ignites it, causing combustion. The expansion of the combustion gases pushes the piston during the power stroke. In a diesel engine, only air is inducted into the engine and then compressed. Diesel engines then spray the fuel into the hot compressed air at a suitable, measured rate, causing it to ignite.

Along with gasoline or diesel, they can also utilize renewable or alternative fuels (e.g. natural gas, biodiesel or ethanol). They can also be combined with hybrid electric powertrains to increase fuel economy or plug-in hybrid electric systems.Figure 4.2 shows the basic diagram of a cylinder as found in 4-stroke gasoline or petrol engines.

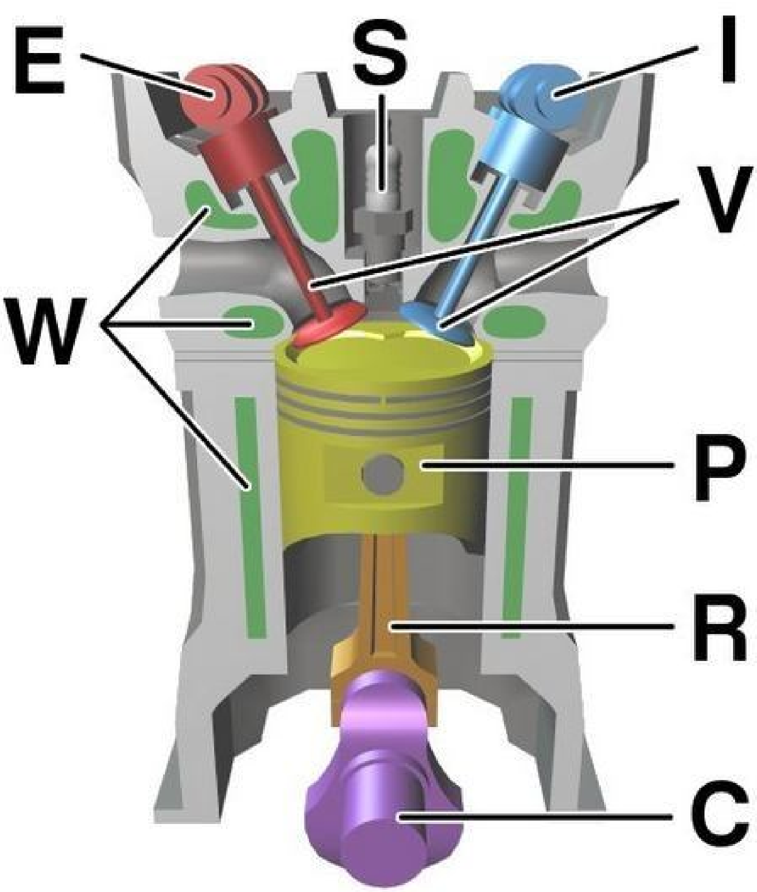


Figure 4.2: Diagram of a cylinder as found in 4-stroke gasoline engines:C – crankshaft,**E** – exhaust camshaft, **I** – inlet camshaft,**P** – piston,**R** – connecting rod,**S**

– spark plug,**V** – valves (left: exhaust valve, right: intake valve),**W –** cooling water jacket, all housed inside the engine block. [Source: https://en.wikipedia.org/wiki/Internal_combustion_engine#/media/File:Four_stroke_e ngine_diagram.jpg]

ENGINE SIZE OR CAPACITY

There are two positions in the cycle of an engine when the pressure on the piston for each cylinder will have no turning effect on the crankshaft. They are known as bottomdead centre (BDC) and top dead centre (TDC)respectively. They mark the extreme limits of the piston's travel as illustrated in Figure 4.3a and 4.3brespectively. Movement of the piston from one deadcentre to another is called a **stroke**, and there are twostrokes of the piston to every revolution of thecrankshaft.

The internal diameter of the engine cylinder is called the **bore**, while the distance the piston moves between TDC and BDC is called the **stroke**.The usual method of indicating the size of an engine isto state the volume of air and fuel taken into the engineduring each complete cycle of operations. In effect, thisis the usable volume within the cylinder between theTDC and BDC positions of the piston.The volume of a cylinder can be calculated by using:

$$= \quad = \quad \frac{}{}\Big) \qquad [4.1]$$

where *V* is the volume of the cylinder, *r and d are*the cylinderbore radius and bore diameter respectively, and *h* the stroke (between TDC andBDC).

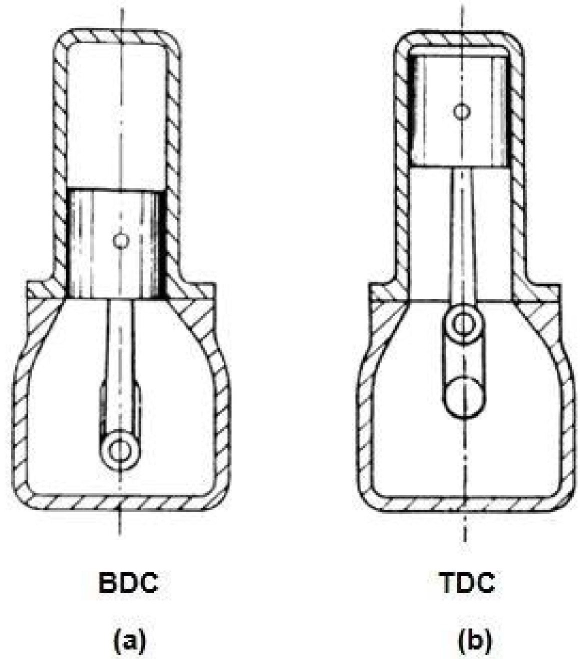


Figure 4.3: Illustration of top and bottom dead centres of an engine cylinder

Since this is the volume displaced or swept by thepiston, it is called the **displacement volume** or **swept volume** of the cylinder. If the engine has severalcylinders, as most have, the **engine size** or **engine capacity** is the total swept volume of theengine which equals the swept volume of each cylindermultiplied by the number of cylinders. That is,

, = ( ) × = ____ × [4.2]

where*n*is the number of cylinders in the engine.
Note that when the bore is equal to the stroke, the engine is called a ***'square engine'***. Similarly, when the bore is larger than the strokethe engine is called ***'over square'***, or if the bore issmaller than the stroke it is called ***'under square'***.

Problem 4.1:

1. All the systems of the automobile can be grouped into four basic assemblies, namely:

   a. ____
   _

   b. ____
   _

c. ____
_

d. ____
_

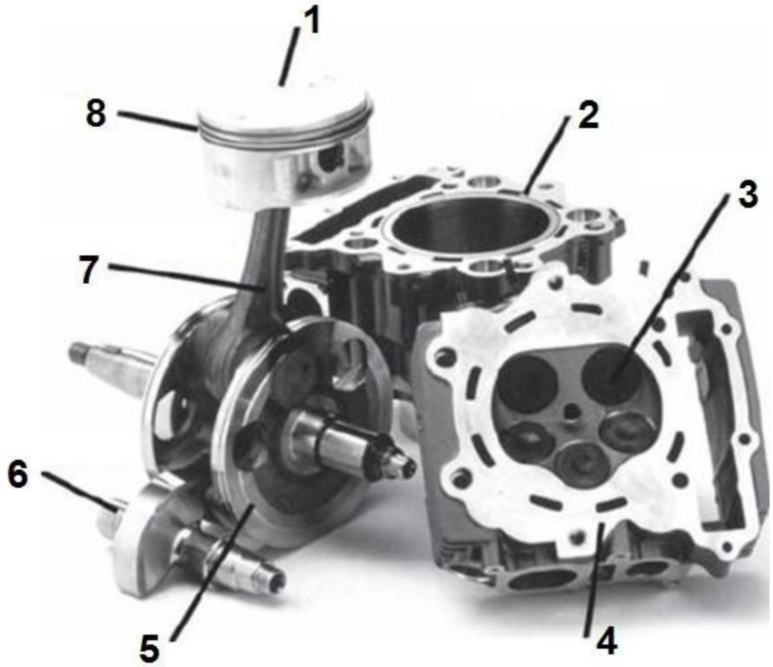
Problem 4.2:
Explain the following terms as used in automobile diagnosis and repairs:

a. **Redlining:**

b. **Tune-up:**

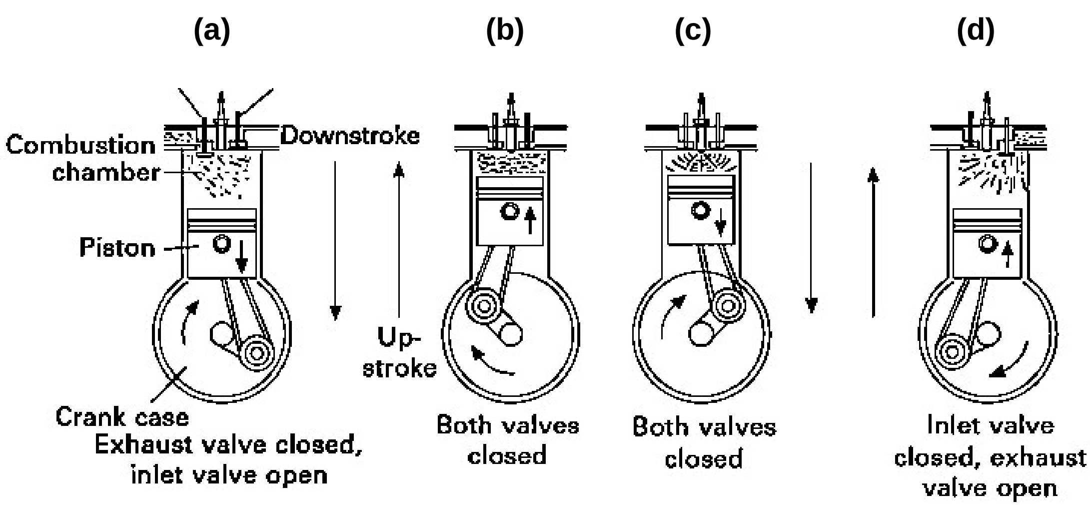
Problem 4.3:

Eight parts of a four-stroke cycle engine are indicated in the figure below. Identify them.



Problem 4.4:

Identify the various stages of the engine operations shown below



(a) ______________________________

(b) ______________________________

Problem

(c) ____

(d) ____

__________4.5:

In the space below sketch the crankshaft and the flywheel assembly for a 4 cylinder in-line engine

Problem 4.6:

Provide the full meanings of the following abbreviations as encountered in automobile work:

(a) TDC: ____

(b) BDC: ____

(c) AWD: ____

(d) RWD: ____

(e) FWD: ____

(f) 4WD: ____

Problem

Problem 4.7:

The automobile ignition switch has four positions, name them:

i. ______________________________

ii. ______________________________

iii. ______________________________

iv. ______________________________

______ 4.8:

Use the space below to answer the following questions:

a) An eight cylinder engine has bore of 90mm and stroke of 73mm. Determine the approximate engine capacity in (i) cubic centimeters (cc), and (ii) litres.

b) A six cylinder engine has bore of 80mm and stroke of 70mm. Calculate the engine capacity approximately in (i) cubic centimeters (cc), and (ii) litres.

Problem

DO YOUR CALCULATIONS ON THIS PAGE

4.8(a)	**4.8(b)**

UNIT FIVE

ELECTRICAL WORK

Electricity is used to power all rotating and heating equipment in machine shop, woodwork shop or metalwork shop, etc. Every engineer should be conversant with basic electrical principles and operations. However, electricity is both a good friend and a terrible enemy. Safety precautions must be followed when dealing with electrical installations, circuits and equipment.

HEALTH AND SAFETY CONSCIOUSNESS IN ELECTRICAL WORKSHOP

1) All tools used in electrical workshop insulation must be insulated to avoid shock hazards.
2) Regard all circuits as being alive and make sure they are OFF from its control point (supply) before working on any equipment.
3) Make sure that the supply is switched OFF while working. Ifpossible, isolate the supply by removing the fuses or by locking the panel room after switching off tile supply.
4) Always work with your shoe on in the workshop.
5) Make sure that there is no water in your hands while working in electrical work shop.
6) Anyone working on or near electrical equipment should be given the necessary equipment/tools so that he can work safely i.e. special tools shall he provided. Protective clothing and insulating materials necessary to undertake safe working on or near live electrical equipment must be worn.
7) The main purpose of health and safety is to prevent death or personal injury to any person from electrical causes in connection with safety rules and regulations.

ACCIDENT PREVENTION (SAFETY RULES)

1) Disconnection of equipment from service: Make sure that the equipment you are working on is disconnected from the supply. All current carrying parts on which work is to carried out should be disconnected from the line. This also applies to all current carrying parts, which personnel may accidentally touch or approach closer.
2) Placing of temporary guards and warning notices: Notices should he hung on the operating mechanisms of all circuit breakers and isolators as well as control keys with which the voltage may be applied to the equipment where men work e.g. 'DO NOT SWITCH ON', 'MEN AT WORK'. In indoor substation "STOP HIGH VOLTAGE" notices should be placed on the solid walls of the compartments.
3) Attachment of temporary safety earthing set: Temporary safety earthing sets are attached to earth and short all three phases of the equipment to be installed or repaired e.g. HIGH VOLTAGE OVERHEAD LINE.
4) Installation of electrical protective aids: Protective aids include instruments and fixtures issued to personnel working on or near electrical equipment remaining "HOT" in other to protect them against electric shock and arcs.

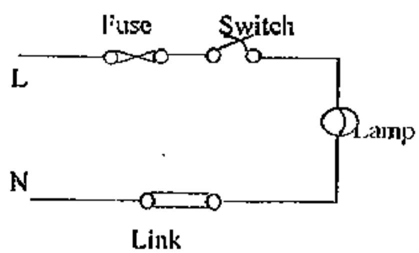
These protective aids includes:

1) Portable voltage indicators and clap-on meter.
2) Temporary safety earthing sets, portable guards and warning notices.
3) Protective goggle, canvas, gloves and gas masks forprotection against arc, fumes and mechanical injury particular during welding.
4) Non-conducting (rubber) gloves, non-conducting (rubber) boot, and nonconducting rubber mat.

BASIC ELECTRICAL WIRING

A system of electric conductors, components and operators forconveying electric power from one source to the point of use, is called ***electricwiring***. A length of a conductor which is usually insulated is referred to as***cable***. For a piece of electrical equipment to work efficiently and effectively itmust be correctly connected to an electrical circuit.

ELECTRICAL CIRCUITS



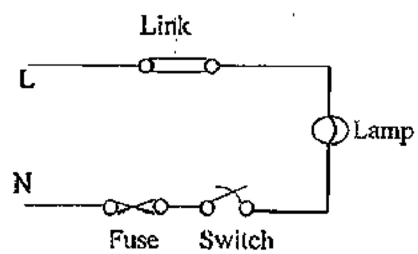


Figure 5.1a **Figure 5.1b**

A circuit is completed only when it has live and neutral conductors, so when you want to connect a lamp controlled by a switch, you should follow the illustration given in Figure 5.1 below.

Supply is given at the terminals L and N as shown in Fig. 5.1(a), if the switch is closed, the current passes through the fuse on the live side, then through the switch and lamp and back through a link in the fuse box to the neutral terminal, and the lamp is alight. When the switch is opened, this circuit is interrupted, the current can no longer pass and the lamp is out.

Now let us turn to Fig. 5.1(b). The same thing happens, but the making and breaking of the circuit by switch is done on the neutral side of the lamp, the circuit is broken on the switch is done on the neutral side of the lamp; the circuit is broken on the neutral pole. Note that the circuit given in Fig.5.1(a) is the right connection while Fig.5.1(b) is wrong connection. The reason is as follows. If switch and fuse are on the live side whenever you switch OFF, the light will go OFF and current will not be in the lamp terminal any more, but if switch and fuse are on the neutral side, whenever you switch OFF, the light will go OFF, but there would still be current in the lamp terminals except you knock off the supply from the source. Hence, the switch and fuse must be on the live conductor.

SWITCHES IN CIRCUITS

A switch is a device for making or breaking an electrical contact i.e. opening or closing an electric circuit.In lighting installations, **two-way switches** find their chief use when a means has to be provided for switching the same lamp ON or OFF from two separate positions, as for instance, on a stair case or corridor (Figure 5.2). A two-way switch has three terminals one of which is known as the common terminal and can he connected to either of the others by moving the switch knob up or down, but not to neither, that is to say, the switch has no intermediate position.

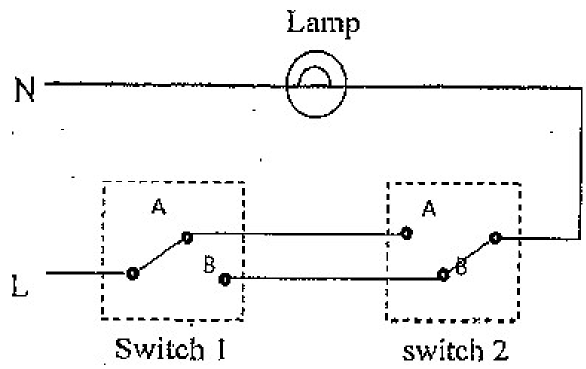


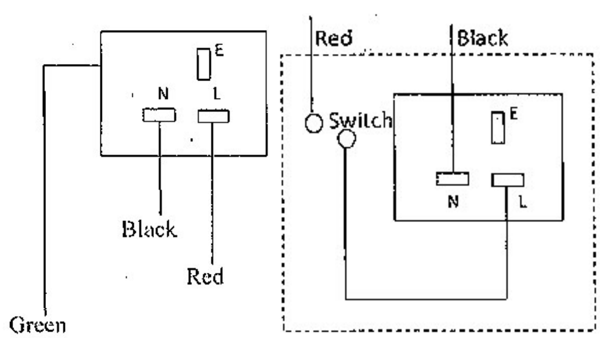
Figure 5.2: Two-way switches

SOCKET–OUTLETS AND PLUGS

Socket outlets and plug forconnecting portable apparatus may be divided into two main classes.

(1) Those for 3-phase motors, having 4-pin connection or a 3-pin and earth connection, are used mainly on industrial installations.

(2) Three-pin, which is the standard socket outlet and plug for all new domestic purposes.



Three-pin socket-outlet and switch on same base

Three-pin socket-outlet

CABLE AND WIRES/CONDUCTORS

The terms wire and cable are used in connection with wiring.An insulated wire whether single or stranded together is known technically as a **cable**.A cable consists of two main parts, the conductor which is the metal wire or stranded wires carrying

the current, and the insulation, which is a covering of insulating material to prevent current leakage away from the conductors. There may be additional protective coverings such as steel or wiring armouring.
Copper is the metal mostly used as it is the best conductor, with the exception of silver. Expressed in another way, a given length of copper wire of given cross-sectional area has a lower electrical resistance than that of a similar sample of any other conductor except silver.Steel-cored aluminium is frequently used in place ofcopper for bare electric cables for long-distance power transmission. It is cheaper than copper for longer sizes.

Colour Coding of Wires

To distinguish wires from each other, the insulation is normallycoloured. On single phase systems, the phase or live is coloured **red**, theneutral **black** and the earth green or yellow.With multiphase systems (where there is more than one phase supplyterminal), yellow and blue are also used to denote phase wires. In certaintypes of wiring, the earth conductor (called the protective conductor) is abovewire, or stands of wire, and this is not colour-coded except at the terminations.The red (phase) wire is the one which is broken by the switch; this ensuresthat the apparatus is electrically disconnected from the supply when the switchis on.

CABLE SIZES FOR DIFFERENT JOBS

There are different types of cable used for different jobs (Table 5.1). Cables are used due to their **current carrying capacity**. The law of cable says that, the bigger the cable, the lesser the current it consumes.

Table 5.1: Cable sizes for different jobs

SN	SURFACE WIRING	CONDUIT WIRING
Cable Sizes For Residential Buildings		
1	For lighting points, ceiling fans points and call-bell points use 1mm^{2}pvc twin cable	For the same points use 2x1mm^2 PVC single core cable through PVC pipe
2	For socket outlets of 5A/1.3A. Use 1.5mm^2 twin and earth cable	For the same points use 3x1.5mm^2 PVC single core cable
3	For water heater, use 2.5mm^2 PVC & earth cable	For the same point use 3x2.5mm^2 PVC single core cable through PVC pipe
4	For cooker control unit, air conditioner and 15A switch socket. Use 4mm^2 PVC twin & earth cable	For the same point use 3x4mm^2 PVC single core cable through PVC pipe
5	LOAD WIRE; use from 6mm^2, 10mm^2, 16mm^2 PVC cable or armoured cable	16mm^{2}PVC single core preferably use
Cable Sizes For Commercial Buildings		

1	For lighting points, ceiling fans points and call-bell points use 1.5mm^2 PVC twin cable but cut off the earth wire	For the same points use 2x1.5mm^2 PVC single core cable through PVC pipe
2	For Socket Outlets Of 5A/1.3A And Water Heater Point 2.5mm^2 PVC twin & earth cable	For the same points use 3x2.5mm^2 PVC single core cable through PVC pipe
3	For cooker control unit, air conditioner and 15A switch Socket. Use 4mm^2 PVC twin & earth cable	For the same points use 3x4mm^2 PVC single core cable through PVC pipe
4	LOAD WIRE; use armoured cable from	LOAD WIRE; use armoured cable from
	16mm^2, 4 core, 25mm^2 4 core	35mm^2 4 core, 50mm^2 4 core, etc.

RESISTOR COLOUR CODE

Small resistors are marked with a series of **coloured bands** as shownin the table below. These are read according to the standard colour code todetermine the resistance. The bands are located on the component towards oneend. If the resistor is turned so that this end is forwards the left, the bands arethen read from left to right. Band (a) gives the first number of the componentvalue, band (b) the second number and band (c) the number of zeros to beadded after the first numbers (i.e. the multiplier such as 10, 10^2, 10^3, etc.). Band (d) indicates the resistor tolerance whichis commonly gold or silver indicating a tolerance of 5% or 10% respectively (Figure 5.3).If the bands are not oriented towards one end, first identify the toleranceband and turn the resistor so that this is towards the right before commencingto read the colour code as described. This way, one can know the value of resistance at a glance by understanding the use of the resistor colour code, which is given in Table
5.2.

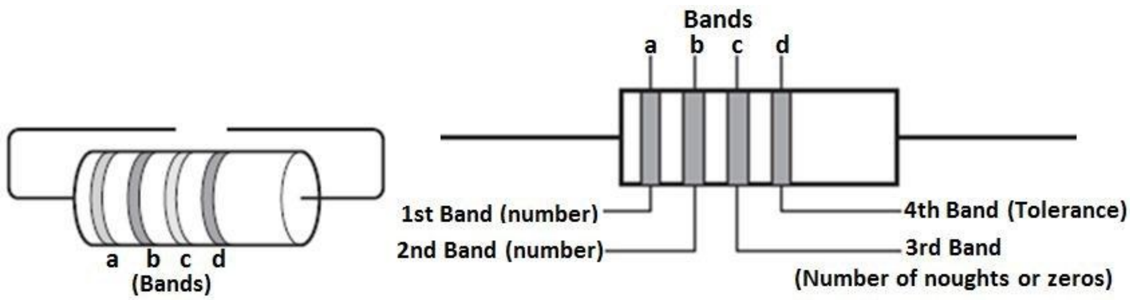


Figure 5.3: Bands and colour coding of resistors

Table 5.2: Colour code for resistors

COLOUR	DIGIT	MULTIPLIER	TOLERANCE
Black	0	10^0	
Brown	1	10^1	±1%
Red	2	10^2	±2%
Orange	3	10^3	
Yellow	4	10^4	

Green	5	10^5	
Blue	6	10^6	
Violet	7	10^7	
Gray	8	10^8	
White	9	10^9	
Gold		10^{-2}	±5%
Silver		10^{-2}	±10%

The tolerance band indicates the maximum tolerance variation in thedeclared value of resistance. Thus a 100Ω resistor with a 5% tolerance willhave a valve somewhere between 95 and 105Ω since 5% of 100Ω is ±5Ω.

Example5.1:

Given a resistor with the colours brown, red and orange printed on its body. Find the resistance rating.

Solution:

To know the value of this resistor we should bear in mind that the last colour tells us number of zero's to he added after the first two colours. For orange as the last colour, 3 zeros are added since it signifies three. The first and second colours are brown and red, which means 1 and 2 respectively. Therefore, we are actually givena 12,000 ohms resistor.

Example 5.2:

A resistor is colour coded yellow, violet, red and gold. Determine the value of the resistor.

Solution:

From the resistor colour code table above, we obtain the following:
1st Band – yellow has a value of 4,
2nd Band – violet has a value of 7,
3rd Band – red has a value of 2, i.e. 2 zeros or 10^2.
4th Band – gold indicates a tolerance of 5%.
So, the value is 4700 Ω ± 5% which can be written as 4.7 kΩ ±5% or 4 k7Ω.

The 1 and 2% resistors have five colour bands while 5 and 10% resistors have four colour bands. Some resistors have only three colour bands. These are resistors with tolerances of±20%. They are not very common any more. Also, some 5 and 10 percent resistors manufactured to military specifications have five colour bands. In this case, the first four bands are read the same as with the four-band system (the 4th band is either gold or silver). The 5th band indicates reliability. The reliability of a resistor tells what percentage of the resistors fails within 1000hrs.

TOLERANCE

This expresses the maximum deviation in resistance values from its normal value. For instance, if the tolerance value of a 1000Ω resistor is$\pm$10% (silver); it means that the actual value of resistance is in the range of (1000 – 0.1 x 1000 = **900 ohms** to1000 + 0.1 x 1000 = **1100 ohms**).

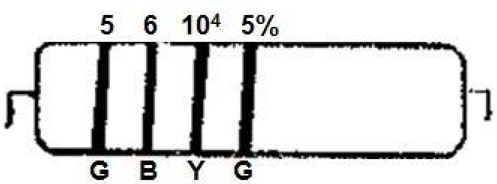
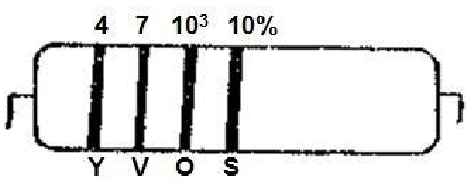
Example 5.3:

(a) If a given resistor has green, blue, yellow, and gold painted on its body, represent the resistor in a diagrammatic form and calculate the value of the resistor.

(b) Do as in (a) above if the colours are yellow, violet and orange, and the fourth band is silver.

Solution:

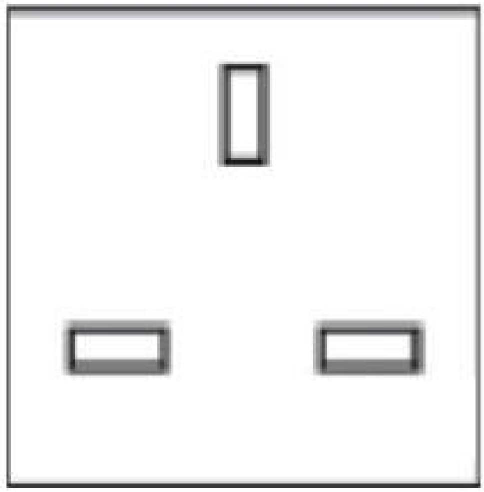
Using information supplied in the table of colour codes for resistors, the following diagram and calculations apply to the resistor in question.

Diagrammatic Representation of Resistor	Calculation of Resistor Value
	□ = 5, = 6, = 0000, = 5% $\Rightarrow 560000\Omega \pm 5\%$ $\Rightarrow 560000 - 0.05 \times 560000 =$, to $\Rightarrow 560000 + 0.05 \times 560000 =$,
	□ = 4, = 7, = 000, = 10% $\Rightarrow$ $47000\Omega \pm 10\%$ $\Rightarrow 47000 - 0.1 \times 47000 =$, to $\Rightarrow 47000 + 0.1 \times 47000 =$,

NOTE: When the band rate reaches 4 and above, there should be a tolerance. When you pick a resistor to read, observe that the area bearing the tolerance is smaller than the colour bands.

Problem 5.1:

The figure below shows a socket-outlet viewed from the front. Label the rectangular holes accurately for proper connections.



Problem 5.2:

a) When is an electrical circuit said to be complete?
b) Explain the terms wire and cable
c) What does the law of cable say?

Problem 5.3:

a) Given a resistor with the colour bands Black, Red, and Yellow. What is the value of the resistor?
b) Represent this resistor diagrammatically.

Problem 5.4:

a) What do you understand by the term resistance of a resistor?
b) Given a resistor with the colour blue, green, yellow, and gold painted on its body.

What is the value of the resistor?

c) Represent this resistor diagrammatically.

Problem 5.5:

Draw the symbols for:(i.) A circuit breaker, (ii.) A change-over switch, and (iii.)A circuit with a lamp showing a two-way switch.

LABORATORY MANUAL &ASSIGNMENTS

For

(ENGINEERING WORKSHOP PRACTICE II)

ENG 102