Section A

Sources of Farm Power

A farm power for various agricultural operations can be broadly classified as:

(i) Tractive work such as seed bed preparation, cultivation, harvesting & transportation, and

2) Stationary work like silage cutting, feed grinding, threshing, winnowing & lifting of irrigation water.

type fodder made from green foliage crops which have been preserved by acidification achieved through fermentation it can fed to cattle, sheep & other such ruminants.

These operations are done by different sources of power, namely human, animal, oil engine, tractor, power tiller, electricity & renewable energy (biogas, solar & wind).

Human Power: Human beings are the main source of power for operating small tools & implements. They are also employed for doing stationary work like threshing, winnowing, chaff cutting & lifting irrigation water. It is generally believed that there is surplus human power available for agriculture operations in India. Acc to 2001 census figures, the total Indian rural population is about 74 crores. Of the total rural population only 30 percent is available for dong farm work. Hence the total no. of persons available would be about $74 \times 0.30 = 22.2$ crores. This figures includes both the landless labourers as well as the

owners of farms in the country. On the av. of a man develops nearly 0.1 horsepower (hp). ∴ the total power available through human source may be about 2.2 crore hp. But there is a steady decline in the no. of landless labours available for doing farm work in rural area.

Managing labour Peaks:- In crop prodⁿ system, labour peaks develop due to high labour demands in operations, which cannot be or have not been mechanized so far. For ex, the operations like transplanting of paddy, weeding and inter culture operations or harvesting of crops demand large no. of human labour on each of the farms in the region, such peaks have got to be managed if one desires to have high return from his enterprise. In general, the peaks are managed as follows:

1) Using the working hours
2) Extending the time period of operations
3. Adjusting the cropping pattern.
4) Mechanizing the operations, wherever possible.
5) Decreasing the intensity of some operations.

Adv:- Easily available & used for all types of work.

Disadv:- Costliest power compared to all other forms of power, very low efficiency, requires full maintenance when out in use and affected by weather condition & seasons.

Animal Power :- The most imp. source of power on the farm all over the world & particularly in India is animal. It is estimated that nearly 80 percent of the total draft power used in agriculture throughout the world is still provided by animals, although the no. of agricultural tractors now become double after every ten years since 1930. India with its 22.68 crore cattle possesses the largest number of cattle in the world. Among them the bullocks and buffaloes happen to be the principal sources of animal power of Indian farms. However, camels, horses, donkeys, mules & elephants are also used for the farm work. The av. force of bullock can exert is nearly equal to one tenth of its body wt. But for a very short period, it can exert many more times the av. force. Generally a medium size bullock can develop between 0.5 to 0.75 hp. Thus the variation in power developed by animals is considerable. Actually small size bullocks are not able to develop even 0.50 hp & most of them are not fit for heavy work. Animals can be very cheap source of farm power if raised by the farmer himself. It becomes the most costly source if the animal has to be bought from outside.

Adv :- Easily available, Used for all types of work, low initial investment, supplies manure to the field & fuels to farmer and living on farm product.

Disadv :- Not very efficient, seasons & weather affect the efficiency, cannot work at

a stretch, Require full maintenance when there is no farm work, Creates unhealthy & dirty atmosphere near the residence & very slow in doing work.

Mechanical Power :- The 3rd imp source of farm power is mechanical power that is available through tractor and oil engines. The oil engine is highly efficient device for converting fuel into useful work. The efficiency of diesel engine varies b/w 32 & 38 percent, whereas carburettor engine is in the range of 25 & 32%. In recent years, diesel engines and tractor have gained considerable popularity in agricultural operations. Small pumping sets within 3 to 10hp range are very much in demand. Likewise, oil engines of low to medium speed developing about 14 to 20 hp are successfully used for flourmills, oil ghanis, cotton gins etc. Diesel enegine of the large size are used on tractors.

Adv :- Efficiency is high; not affected by weather; fuel is can run at stretch; requires less space & cheaper form of power.

Disadv :- Initial capital investment is high; fuel is costly and repair & maintenance needs technical knowledge.

Electrical Power :- Now-a-days electricity has become a very imp. source of power on farms in various stages of the country. It is steadily becoming more & more

available with the increase of various river valley projects and thermal stations. On the an av. about 1/10th of the total electrical power generated in India is consumed for the farm work. The largest use of electric power in the rural areas is for irrigation & domestic water supply. Besides this, the use of electric power in dairy industry, cold storage, fruit processing & cattle feed grinding has tremendously increased.

Adv:- very cheap form of power, high efficiency, can work at a stretch; maintenance & operating cost is very low and not affected by weather conditions.

Disadv:- Initial capital investment is high, requires good amount of technical knowledge & it causes great danger, if handled without care.

Wind Power:- The availability of wind power for farm work is quite limited, when the wind velocity is more than 32 kmph, wind mills can be used for lifting water. Even today in India the wind power has not been fully harnessed The most imp. reason is its uncertainty. Experimental results show that a wind mill having 3.6 diameter wheel mounted on 12.0m tower is able to produce from 0.1 to 0.9 hp with the wind velocity varying from 6.4 to 37 km/h. Thus the av. capacity of a wind mill would be about 0.50 hp. There are about 2540 mills installed in India.

Ministry of Non-Conventional Energy, Govt. of India have been making efforts to popularise the wind mill for power generation & water lifting in rural areas. But this source could not become attractive due to following limitations of the system:-

- Initial investment is high
- Repair facilities are not available in rural area
- Even the matching pump sets & electric generators are not readily available in the country.
- It not suitable for all situations in the country.

For the present, the wind mills have limited scope of the use in the country.

A comparision of Tractor & Animal Power. Phone.

Safety on the farm and on the road:-

Farm safety:- Contary to the popular image of fresh air and peaceful surroundings, a farm is not a hazard-free work setting. Every year, thousands of farm workers are injured and hundreds more die in farming accidents. Acc to the National safety council, agriculture is the most hazardous industry in the nation.

- Health and safety hazards on Farms

Farm workers - including farm families and migrant workers - are exposed to hazards such as the following:-

- Chemicals / Pesticides

- Cold • Dust • Electricity • Grain bins • Hand tools
- Highway traffic • Lifting • Livestock handling
- Machinery / Equipment • Manure pits • Mud
- Noise • Ponds • Silos • Slips / Trips / Falls • Sun / Heat • Toxic gases • Tractors • Wells.

⊙ High Risk Factors on Farms: The following factors may increase risk of injury or illness for farm workers.

- Age :- Injury rates are highest among children age 15 and under & adults over 65.
- Equipment & machinery: Most farm accidents & fatalities involve machinery. Proper machine guarding & doing equipment maintenance acc. to manufacturer recommendations can help prevent accidents.
- Protective Equipment :- Using protective equipment, such as seat belts on tractors, and personal protective equipment (such as safety glasses, coveralls, boots, hats, aprons, goggles, face shields) could significantly reduce farming injuries.
- Medical care - Hospitals & emergency medical care are typically not readily accessible in rural areas near farms.

⊙ How you can improve Farm safety :- You can start by increasing your awareness of farming hazards & making a conscious effort to prepare for emergency situations including fires, vehicle accidents

electrical shocks from equipment injuries and chemical exposures. Be especially alert to hazards that may affect children and the elderly. Minimize hazards by carefully selecting the products you buy to ensure that you provide good tools & equipment. Always use seat belts when operating tractors & establish & maintain good housekeeping practices. Here are some other steps you can take to reduce illness and injuries on the farm.

- Read & follow instructions in equipment operators manuals & on product labels.
- Inspect equipment routinely for problems that may cause accidents.
- Discuss safety hazards & emergency procedures with your workers.
- Make sure that guards on farm equipment are replaced after maintenance.
- Review & follow instructions in material safety data sheets (MSDSs) and on labels that come with chemical products & communicate info. on the hazards to your workers.
- Be aware that methane gas, CO_2, ammonia, and hydrogen sulfide can form in unventilated grain bins & manure pits & can suffocate or poison workers or explode.
- Take adv. of safety equipment, such as bypass starter covers, power take-off master shields, & slow-moving vehicle emblems.

Benefits of Improved Safety & Health Prac.

Better safety and health practices reduce worker facilities, injuries, and illnesses as well as associated costs such as workers compensation insurance premiums, lost production, and medical expenses. A safer & more healthful workplace improves morale & productivity.

~~Additional inf. on safety and Health:-~~ For more inf. about ~~farm safety, visit OSHA's X~~

- Safety on the Road :- Local laws may require a SMV emblem on vehicles travelling on the road slower than 25 mph. Point the triangle up, and replace the emblem when it fades.
- Mark the edges of agricultural equipment with reflective tape & reflectors.
- Turn on your lights, but turn off rear spotlights when going on the road.
- Avoid the highway during bad weather & rush hour. Make sure you had appropriate lighting after sunset or before sunrise.
- Use pilot cars if you are going a considerable distance.
- Consider cameras to increase visibility.

Rear view safety offers a variety of backup camera systems for agricultural vehicles for use on the road & on the farm.

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* IC Engine and teminology

Heat Engine:- A heat engine is a device which transforms the chemical energy of a fuel into thermal energy & uses this energy to produce mechanical work. It is classified into 2 types:-

(a) External combustion engine
(b) internal combustion engine

Ex:- In this engine, the products of combustion of air & fuel transfer heat to a second fluid which is working fluid of the cycle.

IC Engine:- In this engine, the combustion of air & fuels take place inside the cylinder & are used as direct motive force. It can be clanified into the following type

1. According to basic engine design - (a) Reciprocating engine (Use of cylinder piston arrangement)
(b) Rotary engine (use of turbine)
2. According to the type of fuel used - (a) Petrol engine, (b) diesel engine, (c) gas engine (CNG, LPG), (d) alcohol engine (ethanol, methanol etc)
3. According to the number of strokes per cycle
(a) Four stroke (b) Two stroke engine
4. According to the method of igniting the fuel
(a) Spark ignition engine, (b) compression ignition engine (c) Hot spot ignition engine.
5. According to the working cycle:- (a) Otto cycle (constant volume cycle) engine (b) diesel cycle

(constant pressure cycle) engine, (c) dual combustion engine (semi diesel cycle).

6. According to fuel supply & mixture preparation (a) Carburetted type (fuel supplied through the carburettor), (5) Injection type (fuel injected into inlet ports or inlet manifold, fuel injected into the cylinder just before ignition).
7. Acc. to the number of cylinder - (a) single cylinder and (b) multi cylinder engine
8. Method of cooling - water cooled or air cooled
9. Speed of the engine - cooled. slow speed, medium speed & high speed engine.
10. Cylinder arrangement - vertical, horizontal, inline, V-type, radial, opposed cylinder or piston engines.
11. Valve or port design and location - overhead (I head), side Valve (L head), in two stroke engines: cross scavenging, loop scavenging, uniflow scavenging.
12. Method governing - Hit & miss governed engines, quantitatively governed engines & qualitatively governed engine.
13. Application - Automotive engines for land transport, marine engines for propulsion of ships, aircraft engines for aircraft propulsion, Industrial engines, prime movers for electrical generators.

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Main components of reciprocating I.C engines:

Cyclinder: It is the main part of the engine inside which piston reciprocates to and fro. It should have high strength to withstand high pressure above 50 bar and temp above 2000°C. The ordinary engine is made of cast iron and heavy duty engines are made of steel alloys or aluminium alloys. In the multi-cyclinder engine, the cyclinders are cast in one block known as cyclinder block.

- Cyclinder head :- The top end of cyclinder is covered by cyclinder head over which inlet and exhaust value, spark plug or injection are mounted. A copper or asbestos gasket is provided between the engine cyclinder and cyclinder head to make an air tight joint.
- Piston: Transmit the force exerted by the burning of charge to the connecting rod. Usually made of aluminium alloy which has good heat conducting property and greater strength at higher temp.
- Piston rings:- These are housed in the circumferential grooves provided on the outer surface of the piston and made of steel alloys which retain elastic properties even at high temp. 2 types of rings - compression and oil rings. Compression ring is upper ring of the piston which provides air tight seal to prevent leakage of the burnt

gases into the comm portion. Oil ring is lower ring which provides effective seal to prevent leakage of the oil into the engine cylinder.

- Connecting rod :- It converts reciprocating motion of the piston into circular motion of the crank shaft, in the working stroke. The smaller end of the connecting rod is connected with the crank with crank pin. The special steel alloys are used for the manufacture of connecting rod.
- Crankshaft :- It converts reciprocating motion of the piston into circular motion of the crank shaft the rotary motion with the help of connecting rod. The special steel alloys are used for the manufacturing of the crankshaft. It consists of eccentric portion called crank.
- Crank case :- It houses cylinder & crankshaft of the IC engine and also serves as sump for the lubricating oil.
- Flywheel :- It is a big wheel mounted on the crankshaft, whose function is to maintain its speed constant. It is done by storing excess energy during the power stroke, which is returned during other stroke.

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② Terminology Used in IC Engine :-

1. Cylinder bore (D) : The nominal inner diameter of the working cylinder.
2. Piston area (A) : The area of circle of diameter equal to the cylinder bore.

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3. Stroke (L): The nominal distance through which a working piston moves b/w two successive reversals of its direction of motion.

4. Dead centre :- The position of the working piston and the moving parts which are mechanically connected to it at the moment when the direction of the piston motion is reversed (at either end pt of the stroke).

(a) Bottom dead centre (BDC): Dead centre when the piston is nearest to the crankshaft.

(b) Top Dead centre (TDC): Dead centre when the position is farthest from the crankshaft.

5. Displacement volume or swept volume (V_s): The nominal vol. generated by the working piston when travelling from the one dead centre to next one and given as

$$V_s = A \times L$$

6. Clearance volume (V_c): The nominal volume of the space on the combustion side of the piston at the top dead centre.

7. Cylinder Volume (V): Total Vol. of the cylinder

$$V = V_s + V_c$$

8. Compression ratio (ε): $\varepsilon = \frac{V_s}{V_c}$

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⊙ Working principles of two stroke & four stroke engines :- Almost every car sold today has a 4 stroke engine. So do a lot of motorbikes, lawnmowers, snowblowers and other mechanical equipment. But there are still a lot of 2 stroke engines about in smaller motorbikes, smaller lawnmowers, leaf-blowers, snow blowers and such.

The difference between the two stroke and four stroke engine types is the no. of times the piston moves up & down in the cylinder for a single combustion cycle. A combustion cycle is the entire process of the suck, squeeze, bang and blow (sucking fuel and air into the piston, pressurizing it, igniting it and expelling the exhaust)

⊙ Working principle of a 4 stroke Engine :-

4 stroke engines are typically much larger capacity than 2 stroke ones, and have a lot more complexity to them. Rather than relying on the simple mechanical concept of reed values, 4 stroke engines typically have values at the top of the combustion chamber. The simplest type has one intake and one exhaust valve. More complex engines have two of one & one of the other, or two of each. So when you see "16V" on the badge on the back of a car, it means it's a 4-cylinder engine with 4 values per cylinder - two intake and two

exhaust - thus 16 values, or "16V". The values are opended and closed by a rotating cam-shaft at the top of the engine. The camshaft is driven by either gears directly from the crank, or more commonly by a timing belt. The following animation shows a 4 stroke combustion cycle. As the piston (red) retreats on the first stroke, the intake value (left green value) is opended and the fuel - air mixture is sucked into the combustion chamber. The value closes as the piston bottoms out. As the piston begins to advance, it compresses the fuel - air mix. As it reaches the top of its stroke, the spark plug ignites the fuel - air mix and it burns. The expanding gases force the piston back down on its second stroke. At the bottom of this stroke, the exhaust value (right green value) opens, and as the piston advances for a second time, it forces the spent gases out of the exhaust port. As the piston begins to retreat again, the cycle starts over, sucking a fresh charge of fuel air mix into the combustion chamber.

Because of the nature of 4 stroke engines, you won't often find a single-cylinder 4 stroke engine. They do exist in some off-road motorbikes but they have such a thump-thump-thump motion to them that they require some large balancing shafts or counterweights on the crank to try to make the ride smoother. They also take a little longer to start from cold because you need

to crank the single piston at least twice before a combustion cycle can start. Any more than one piston and the engine gets a lot smoother, starts better, and is nowhere near as thumpy. That's one of the advantages of V-6 and V-8 engines. Apart from the increased capacity, more cylinders typically means a smoother engine because it will be more in balance.

② Working principle of a 2 stroke engine :- The 2 stroke engine is different from a 4 stroke engine in two basic ways. First, the combustion cycle is completed within a single piston stroke as oppose to two piston strokes, and second, the lubricating oil for the engine is mixed in with the petrol or fuel. In some cases, such as lawnmowers, you are expected to pre-mix the oil and petrol (or fuel). In some cases, such as yourself in a container, then pour it into the fuel tank. In other cases, such as small motorbikes, the bike has a secondary oil tank that you fill with 2 stroke oil and then the engine has a small pump which mixes the oil and petrol together for you.

The simplicity of a 2 stroke engine lies in the reed valve and the design of the piston itself. The pic. on the right shows a 4 stroke piston (left) and a 2 stroke piston (right). The 2 stroke piston is generally taller than 4 stroke version, and it has two slots cut

into one side of it. These slots, combined with the reed value, are what make a 2 stroke engine work the way it does. The following animation shows a 2 stroke combustion cycle. As the piston (red) reaches the top of its stroke, the spark plug ignites the fuel air-oil mixture. The piston begins to retreat. As it does, the slots cut into the piston on the right begin to align with the bypass port in the cylinder wall (the green oblong on the right). The receding piston pressurizes the crank case which forces the reed or flapper value (purple in this animation) to close, and at the same time forces the fuel-air-oil mixture already in the crankcase out through the piston slots and into the bypass port. This effectively routes the mixture up the side of the cylinder and squirts it into the combustion chamber above the piston, forcing the exhaust gas to expel through the green exhaust port on the left. Once the piston begins to advance again, it generates a vaccum in the crank case. The reed or flapper value is sucked open and a fresh charge of fuel-air-oil mix is sucked into the crank case. When the piston reaches the top of its travel, the spark plug ignites the mixture and the cycle begins again.

Different System of tractor, types and selection

Tractor is a self-propelled power unit having wheels or tracks for operating agricultural implements and machines including trailers. Tractor engine is used as a prime mover for active tools and stationary farm machinery through power take-off shaft (PTO) or belt pully.

→ Classification of Tractors :- Tractor can be classified into three classes on the basis of structural design.

(i) Wheel tractor: Tractors, having three of four pneumatic wheels are called wheel tractors. Four wheel tractors are most popular everywhere.

(ii) Crawler tractor: This is also called track type tractor or chain type tractor. In such tractors, there is endless chain or track in place of pneumatic wheels.

(iii) Walking tractor (Power tiller): Power tiller is a walking type tractor. This tractor is usually fitted with two wheels only. The direction of travel and its control for field operation is performed by the operator, walking behind the tractor.

On the basis of purpose, wheeled tractor is classified into three groups:

(a) General purpose tractor:- It is used for major farm operations; such as ploughing, harrowing, sowing, harvesting and transporting work. Such tractors have (i) low ground clearance

(ii) increased engine power (iii) good adhension
by wide tyres

(b) Row crop tractor: It is used for crop cultivation. Such tractor is provided with replacable driving wheels of different tread widths. It has high ground clearance to save damage of crops. Wide wheel track can be adjusted to suit inter row distance.

(c) Special purpose tractor: It is used for definite jobs like cotton fields, marshy land, hillsides, garden etc. special designs are there for special pupose tractor.

Tractor Components: A tractor is made of following main components:

1. I.C Engine (2) Clutch (3) Transmission gears (4) Differential Unit (5) Final drive (6) Rear wheels (7) Front wheels (8) Steering mechanism (9) Hydraulic control and hitch system (10) Brakes (11) Power take-off unit (12) Tractor pulley and (13) control panel.

Every tractor is fitted with I.C Engine, the engine may be carburettor type or diesel type but nowadays almost all the tractors are diesel tractors.

⑤ Selection of tractor: Selection of tractor depends upon following factors:

(1) land holding: Under a single cropping pattern, it is normally recommended to consider 1hp for every 1 hectares of land. In

other words, one tractor of 20-25 hp is suitable for 20 hectares farm.

4. Cropping pattern: Generally less than 1.0 hectare have been recommended where adequate irrigation facilities are available and more than one crop is taken. For a 30-35 hp tractor is suitable for 25 hectares farm.

5. Soil Condition:- A tractor with less wheel base, higher ground clearance and low overall weight may work succesfully in lighter soil but it will not be able to give sufficient depth in black cotton soil.

4. Climatic condition:- For very hot zone and desert area, air cooled engines are preferred because water is liable to be frozen at higher altitude.

5. Repairing facilities: It should be ensured that the tractor to be purchased has a dealer at near by place with all the technical skills for repair and maintenance of machine.

6. Running cost: Tractor with less specific fuel consumption should be preferred over others so that running cost may be less.

7. Initial cost and resale value:- While keeping the resale value in mind, the initial cost should not be very high; Otherwise higher amount of interest will have to be paid.

8. Test report:- Test report of tractors released from farm machinery testing stations should be consulted for guidance.

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③ Control board or Dash board of a tractor :- The control board of tractor generally consist of :- (1) Main switch (2) Throttle lever (3) Decompression lever (4) Hour meter (5) Light switch (6) Horn button (7) Battery charging indicator (8) Oil pressure indicator and (9) water temperature gauge.

Tractor Tyres and Front Axle

Tyres :- The tyres are available in many sizes with the ply ratings as 4, 6 or 8. The ply rating of tyres indicate the comparative strength of tyres. The higher the rating, the stronger are the tyres. The tyre sizes 12-38 means, that the sectional diameter of tyres is 12" and it is mounted on a rim of 38" diameter. Useful life of the pneumatic tyres under normal operating condition may be about 5000 working hours for drawbar work.

Front Axle :- Front axle is the unit on which front wheel is mounted. This wheel is an idler wheel by which tractor is steered in various directions. The axle is a rigid tubular or I-section steel construction pivoted at the centre. There are various adjustments of front wheel.

Hitching system of Tractor Drawen Implements

Tractor drawen implements poses higher working capacity and are operated at higher speeds. These implements need more technical knowledge for operations and maintenance work.

Tractor drawn implements may be (a) Trail type (b) Semi-mounted type (c) Mounted type

(a) Trailed type implement: It is one that is pulled and guided from single hitch point but its weight is not supported by the tractor.

(b) Semi-mounted type implement: This type of implement is one which is attached to the tractor along a hinge axis and not at a single hitch point. It is controlled directly by tractor steering unit but its weight is partly supported by the tractor.

(c) Mounted type implement: A mounted type implement is one which is attached to the tractor, such that it can be controlled directly by the tractor steering unit. The implement is carried fully by the tractor when out of work.

Some important terms connected with tractor:-

Wheelbase:- Wheel base is a horizontal distance between the front and rear wheels of a tractor, measured at the ground contact.

Ground clearance:- It is the height of the lowest point of the tractor from the ground surface, the tractor being loaded to its maximum permissible weight.

Track:- Track is the distance between the two wheels of the tractor on the same axle, measured at the point of ground contact.

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Turning space:- It is the diameter of the smallest circle, described by the outermost point of the tractor, while moving at a speed, not exceeding 2 km/hr with the steering wheels in full lock.

Cage wheel:- It is a wheel or an attachment to a wheel with spaced cross bars for improving the traction of the tractor in a wet field. It is generally used in paddy fields.

Power Tiller:- It is a prime mover in which the direction of travel and its control for field operation is performed by the operator walking behind it. It is also known as hand tractor or walking type tractor. The concept of power tiller came in the world in the year 1920. Japan is the first country to use power tiller on large scale. Indian power tiller was introduced in the year 1963. Manufacturing of several makes of power tillers like Iseki, Sato, Kishi, Kubota, Yanmar & Mitsubishi started in India after 1962.

In agricultural power tillers are used for ploughing, sowing, spraying, harvesting and transporting work. It is most wanted machine for pudding operation in rice cultivation.

Components of power tiller

1. Engine
2. Transmission gears
3. Clutch
4. Brakes
5. Rotary Unit

All power tillers are fitted with an I.C engines. At present makes like Kubota, Kirloskar, Yanmar and Satoh use diesel engine. Iseki make use kerosene engine.

(again search)

* → Maintenance of Prime movers and agricultural machinery :-

Maintenance is a service, not an end in itself, and is justified only in so far as it assists, in the most efficient and economical way, the production of goods or of other services such as power. Its importance and treatment depend on the type and use of the plant being maintained, and on the consequences of complete or partial failure of the plant in terms of loss of production or hazards to life or property. Prime movers in industry may be used very little or very much. The auxiliary lighting set at a hospital may be required once or twice a year, all maintenance and no work; while the diesel power unit of an off-shore oil drilling rig may run virtually without stopping between overhauls. Some of the main uses of prime movers which would affect the maintenance approach are set out below.

PRIME MOVERS IN INDUSTRY :- Standby auxiliaries, usually diesel or gas turbine.

(1) Installed in case of failure of mains power supply because of power cut or breakdown. This use is unlikely for factories except for special processes

where interruption of power supply would mean heavy loss or danger. Duplication of full power would be too costly and unjustified by the demands made upon it. The most likely use of emergency equipment is in hospitals, airports, and other places where major hazards arise, with lighting capacity up to full load, but use is likely to be infrequent.

(2) Installed to operate at peak loads and so limit maximum demands on the mains supply, thereby obtaining a cheaper tariff. Use may be fairly regular or infrequent.

As main or only source of power, usually steam turbine or diesel. (1) Installed where external mains supply is not available; eg in remote locations or underdeveloped countries. Use is likely to be regular and full.

(2) In cases where prime movers are cheaper than the main supply; eg where the same boiler can supply process steam and serve turb-electric generators; regular and full use. Large diesel-electric plants have in fact a much lower installed kilowatt-hour cost than power station and at least equal conversation efficiency.

Automotive and marine prime movers; spark ignition, diesel, Wankel, gas turbine, steam turbine. Prime movers in this field may be very large single units, as in ocean-going ships or locomotives, but relatively few in number, or they may be small units in great number. Eg motor transport fleets. The subject really

comes into its own where prime movers are the main source of power, in regular use, and opportunities for carrying out maintenance are few.

Selection of prime movers:- Before selecting a particular prime mover, one should consider certain relevant aspects of maintenance of the unit.

Physical Aspects:

- Design for maintenance: This shows itself in such things as balancing the lives of components, either of all major components or of groups of components in close proximity, so that they are all due to fail, and may be replaced, at the same time. Design should allow for repair by replacement wherever possible, so that individual components or complete sub-assemblies, such as engine pods in an aircraft, are quickly exchanged for breakdown repair or overhaul.

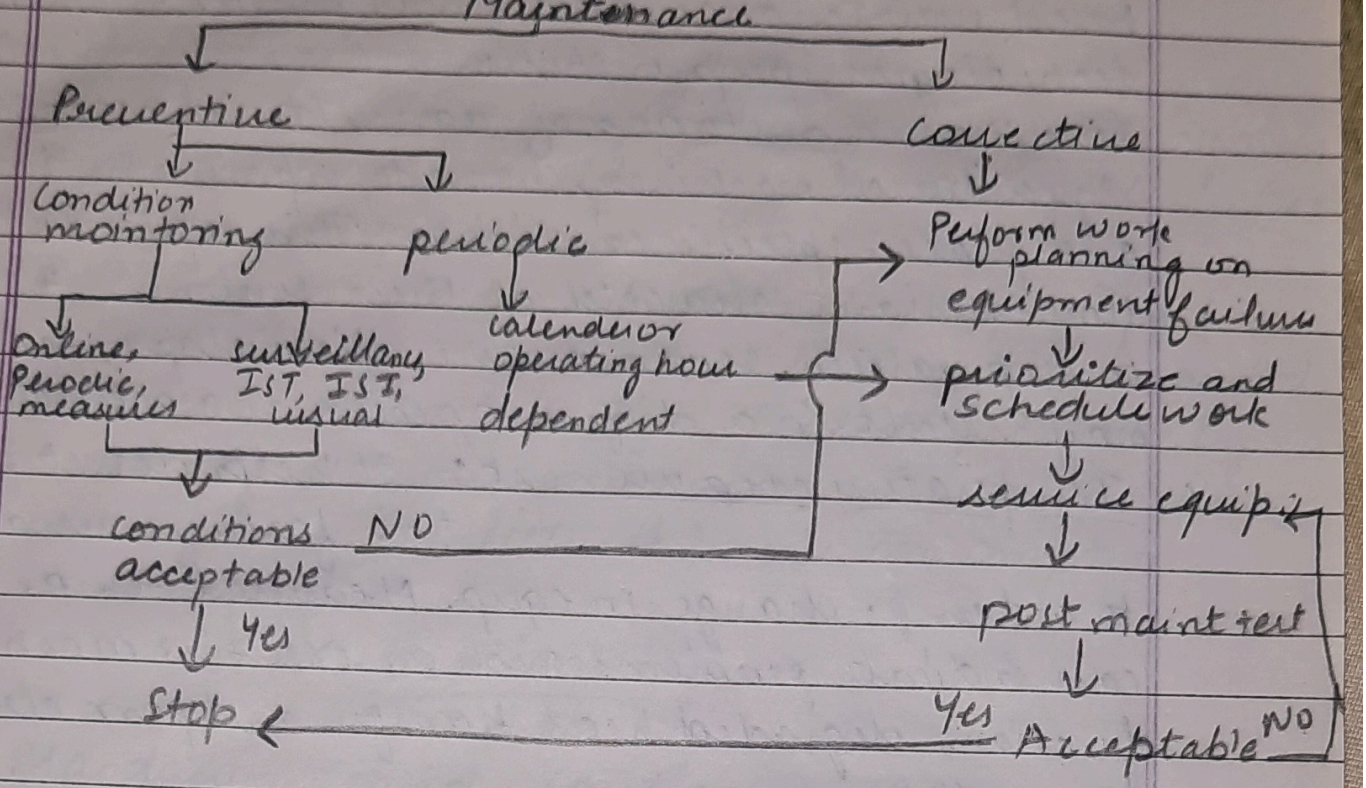
Financial aspects: Money is the common denominator of all maintenance factor, and at the time of purchase of prime movers estimates are required of total capital and operating costs throughout the life of the plant. These are for comparison of alternative investments before purchase, and for budgetary control afterwards. Capital items. These include acquisition and installation cost, subsequent capital replacements or additions, and final salvage value if any. Cost of interest on capital invested is relevant

relevant to the purchasing decision, and loss of interest on deferment of disposal to later plant replacement decisions. Operating cost items. They include direct and indirect labour costs and overheads of the maintenance department, the cost of carrying spares and of those consumed, & the cost of fuel as affected by maintenance.

⑤ Agricultural machinery maintenance is very crucial for successful agriculture production. It aims the availability of machines and related eqp. for cultivation operation. Moreover, it is one major cost for agriculture operations. Thus, the increased competition in agricultural production demands maintenance improvement, aiming at the reduction of maintenance expenditures while keeping the safety of operations. Preventative maintenance is an extensive term that consists of a set of activities includes inspection, cleaning, lubrication, adjustment, alignment, and/or replacement of sub-systems and sub components that are fatigued. Preventive maintenance activities can be classified in one of two ways, component maintenance, and component replacement.

Maintenance strategies:- Maintenance is needed to ensure that the components carry on the purposes for which they are designed. The basic objectives of the maintenance activity are to deploy the mini-

mum resources required to make sure that components perform their intended purposes properly, to ensure System reliability and to recover from breakdowns.



Maintenance elements :- Maintenance is of two types, Preventive and corrective. The corrective is carried out when agricultural machinery stop working or failures occur in any of the components. Immediate replacement of parts may be necessary and unscheduled downtime will result. But this is costly must be avoided. By contrast, the objective behind preventive maintenance (PM) is to either repair or replace components before they fail. In fig. PM includes periodic and condition based maintenance. Periodic maintenance may be done at calendar intervals, after a specified number of operating cycles, or a certain no.

operating hours. These intervals are established based on manufactures' recommendations. An alternative is to lessen against major component breakdown and system failure with condition based maintenance (CBM). CBM process requires technologies, people skills.

- Condition monitoring of agricultural machinery. Agricultural machinery have to cope with time and place-specific conditions. This explains the time-variant character of these systems. A change in crop variety, crop moisture, field slope, temp etc. may result in a different process characteristic.

1. Temperature measurement:- It helps detect potential failures related to a temp. change in equp. Measured temp. changes can indicate problems such as excessive mechanical friction, degraded heat transfer and poor electrical connections.
2. Dynamic monitoring:- It involves measuring and analyzing energy emitted from mechanical equp. in the form of waves such as vibration, pulses. Measured changes in the vib. characteristics from equp. can indicate problems such as wear, imbalance, misalignment & damage.
3. Oil Analysis:- It can be performed on different types of oils such as lubrication, hydraulic or insulation oils. It can indicate problems such as machine degradation, oil contamination.

Corrosion monitoring: It helps provide an

• Also read it from ph.

indication of the extent of corrosion, the corrosion rate and the corrosion state of material. The proper adjustment and application of different tools can easily checked observing corrosion areas on tillage tools such as moldboard.

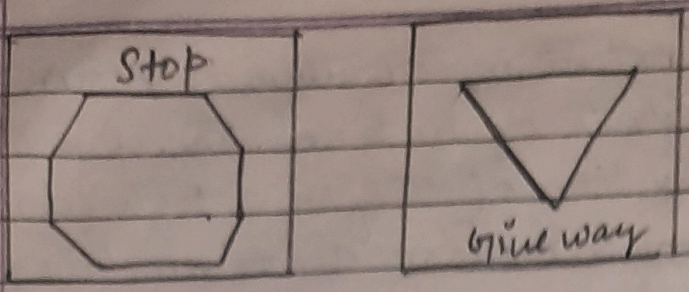
5. Electrical testing monitoring: This tec. involves measuring changes in system properties such as resistance, conductivity, dielectric strength and potential.

6. Performance monitoring:- Monitoring equip. performance is a condition based maintenance technique that predicts problems by monitoring changes in variables such as pressure, temp, flow rate, electrical power consumption.

Section - B

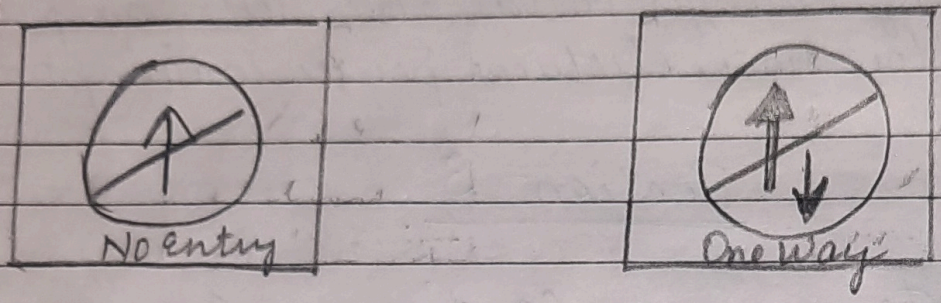
Mandatory and Cautionary Signs

* Mandatory Road Signs: These signs are obligatory on the traffic which uses a specific area of road. These signs indicate what must one do, rather than must to do. Mandatory road signs are generally round in shape with red borders. Some of them are blue in colour. 'Stop' and 'Give way' are octagon and triangular, respectively, in shape. Violation of these signs attracts heavy fines and punishments. Importantly violation of these could lead to major accidents also.



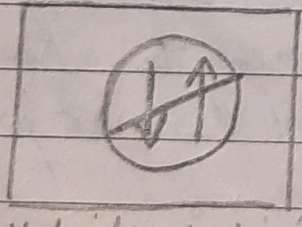
This one of the most important and prominent road sign. This sign indicates that Driver should immediately stop. Usually police, traffic and toll authorities use this sign at check posts.

This is one of the most important and prominent road sign. This sign



Certain pockets of an area or road are ~~decorated~~ demarcated as no entry areas for traffic. This could be entry to a restricted area or no traffic zone. So the driver should obey it and divert his route.

This indicates that the traffic flow is allowed in only one direction. The way beyond this sign restricts entry of the traffic however, the oncoming traffic flow remains normal.

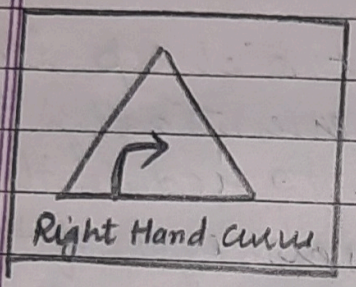


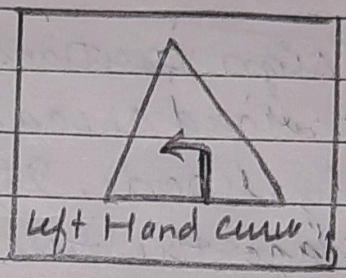
Vehicles prohibited in Both directions

This sign indicates that the demarcated area beyond it is prohibited for traffic flow from both sides. There could be

number of reasons for installing this sign such as pedestrian area only, area under repair, security reasons etc.

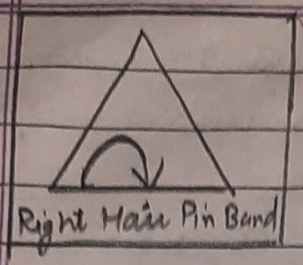
② Cautionary Road Signs : These signs are meant to warn the driver about the hazards/situation lying ahead on the road. The driver should obey these for their safety. Though violation of these road signs do not attract any legal action, they are very important for the fact that avoiding them could result in major accidents. Cautionary signs are triangular in shape with red border.

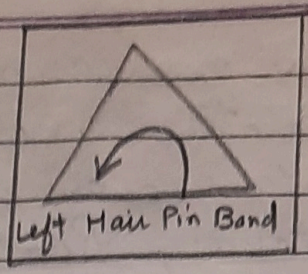




This signs cautions you about a Right Hand curve on the road ahead. This helps you in maneuvering vehicle accordingly and nullify the possibility of accident due to sudden appearance of turn.

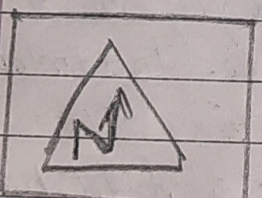
This sign cautions you about a left hand curve on the road ahead. This also helps you in maneuvering vehicle accordingly. You get time to slow your speed and set your eyes on the curve. It also reduces the possibility of accident due to sudden appearance of turn.

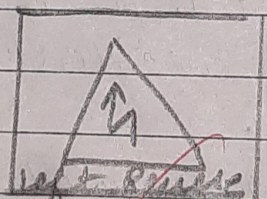




Hair Pin bends are sharp turns especially on hilly roads. This sign cautions you about a sharp Right turn on the road ahead. It gives time to reduce the speed to manage the turn and also sets eyes of the driver on turn. Absence of this sign could lead to major accidents as sharp bends in hilly road don't get sighted easily.

This sign cautions you about a sharp left turn on the road ahead. These are essentially erected on hilly roads. It gives time to reduce the speed to manage the turn and also sets eyes of the driver on turn. Absence of this sign could lead to major accidents, as sharp bends in hilly road don't get sighted easily.





This road sign indicates the actual design, i.e, a sort of Z formation of the road ahead. It cautions the driver about reduce the speed at the sight of this sign & maneuver the vehicle cautiously.

This road sign indicates the actual design, i.e. sort of Z formation of the road ahead. It cautions the driver about reduce the speed at the sight of this sign and maneuver the vehicle continously. It cautions the driver about the zigzag turn towards left.