MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION
B.Sc.(Hons) Agriculture
MODEL ANSWER SHEET

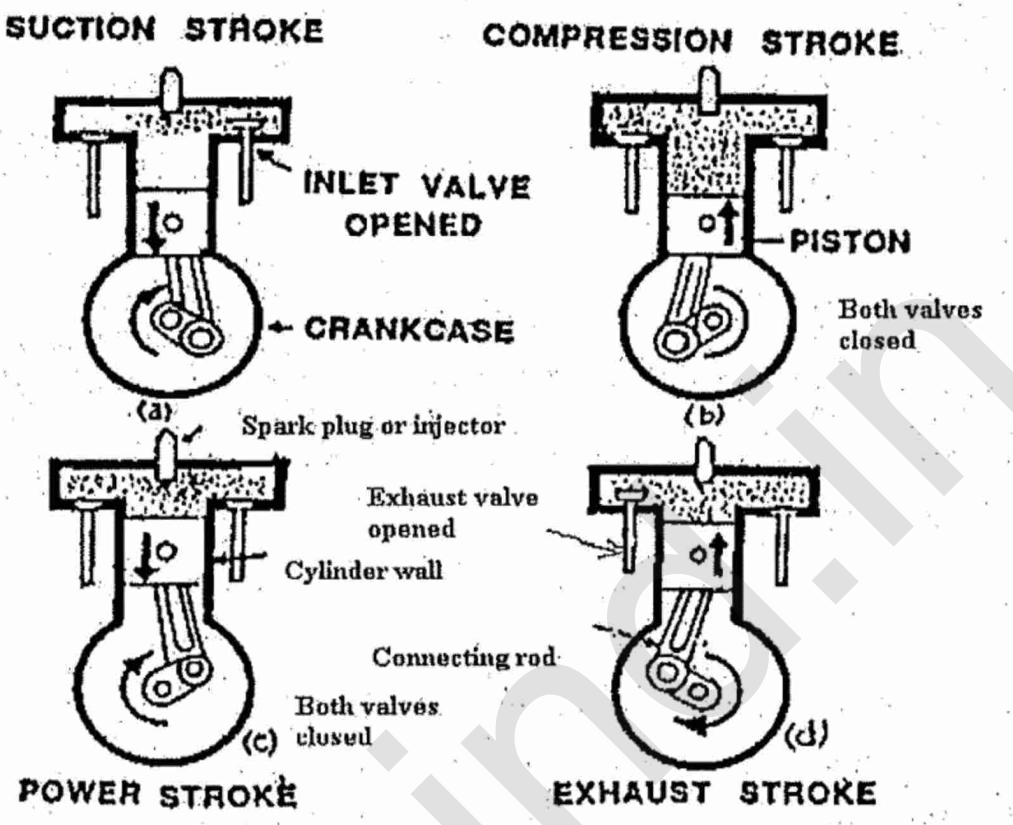
Semester	: III(New)	Academic Year	: 2023-24
Course No.	: ENGG-232	Title	: Farm Machinery and Power
Credits	: 2 (1+1)		
Day & Date	:	Time :	Total Marks : 40

Note : 1) Solve ANY EIGHT questions from SECTION "A"
2) All questions from SECTION "B" are compulsory
3) All questions carry equal marks
4) Draw neat diagrams wherever necessary

SECTION "A"

Q. 1		Classify farm tractors. Discuss the factors considered for the selection of tractor.	(4)
Ans		**Classification of tractors:** Tractors can be classified into three classes on the basis of structural design: (i) Wheel tractor (ii) Crawler tractor (track type or chain type) and (iii) Walking tractor (power tiller). On the basis of purpose, wheeled tractor is classified into three groups: (a) General purpose (b) Row crop (c) Special purpose (d) Orchard tractors **The factors considered for theSelection of tractor:** **(i) Land holding:** Under a single cropping pattern, it is normally recommended to consider 1hp for every 2 hectares of land. In other words, one tractor of 20-25 hp is suitable for 40 hectares farm. **(ii) Cropping pattern:** Generally 1.5 hectare/hp has been recommended where adequate irrigation facilities are available and more than one crop is taken. So a 30-35 hp tractor is suitable for 40 hectares farm. **(iii) Soil condition:** A tractor with less wheel base, higher ground clearance and low overall weight may work successfully in lighter soil but it will not be able to give sufficient depth in black cotton soil. **(iv) Climatic conditions:** For very hot zone and desert area, air cooled engines are preferred over water cooled engines. Similarly for higher altitude, air cooled engines are preferred because water is liable to be frozen at higher altitude.	

		(v) Repairing facilities: It should be ensured that the tractor to be purchased has a dealer at nearby place with all the technical skills for repair and maintenance of machine. **(vi) Running cost:** Tractors with less specific fuel consumption should be preferred over others so that running cost may be less. **(vii) 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. **(viii) Test report:** Test report of tractors released from farm machinery testing stations should be consulted for guidance.	
Q. 2		Describe working of four stroke cycle engine.	(4)
Ans	:	**Working of four stroke cycle engine:** In four stroke cycle engine, all the events taking place inside the engine cylinder are completed in four strokes of the piston i.e., suction, compression, power and exhaust stroke . This engine has got valves for controlling the inlet of charge and outlet of exhaust gases. In two stroke cycle engine, all the events take place in two strokes of the piston. The four strokes of the piston are as follows: 1. **Suction stroke:** During this stroke, only air or mixture of air and fuel are drawn inside the cylinder. The charge enters the engine through inlet valve which remains open during admission of charge. The exhaust valve remains closed during this stroke. The pressure in the engine cylinder is less than atmospheric pressure during this stroke. 2. **Compression strike:** The charge taken in the cylinder is compressed by the piston during this stroke. The entire charge of the cylinder is compressed to a small volume contained in the clearance volume of the cylinder. If only air is compressed in the cylinder (as in the case of diesel engine), the fuel is injected at the end of the compression stroke. The ignition takes place due to high pressure and temperature. If the mixture of air and fuel is compressed in the cylinder (as in the case of spark ignition engine i.e., petrol engine), the mixture is ignited by spark plug. After ignition, tremendous amount of heat is generated, causing very high pressure in the cylinder which pushes the piston backward for useful work. Both valves are closed during this stroke. 3. **Power stroke:** During power stroke, the high pressure developed due to combustion of fuel causes the piston to be forced downwards. The connecting rod with the help of crankshaft transmits the power to the transmission system for useful work. Both valves are closed during this stroke.	



Working of four stroke cycle engine

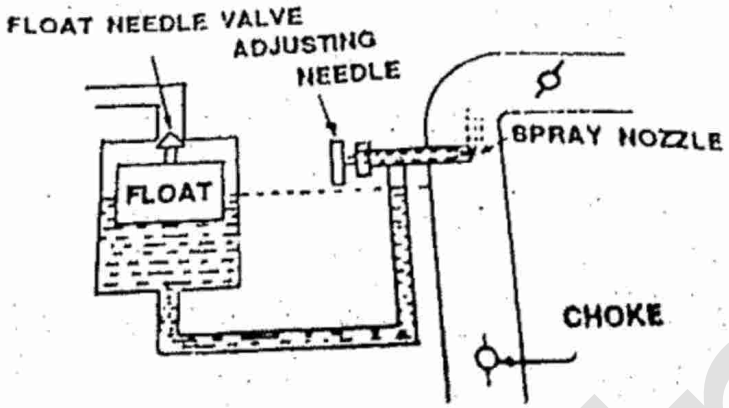
4. **Exhaust stroke:** Exhaust gases go out through exhaust valves during this stroke. All the burnt gases go out of the engine and the cylinder becomes ready to receive the fresh charge. The inlet valve is closed and exhaust valve remains open during this stroke. The exhaust valve is closed just after the end of the exhaust stroke, and the inlet valve is opened just before the burning of the suction stroke to repeat the cycle of operation. Thus it is found that out of four strokes, there is only one power stroke and three idle strokes. The power stroke supplies necessary momentum for useful work.

Q. 3		Calculate the BHP of a 4 stroke, 4 cylinder I.C. engine which has cylinder bore of 12.5cm, stroke length of 15cm, crankshaft speed of 1000 rpm, frictional horse power of 30hp and mean effective pressure is 7kg/cm^2.	(4)
Ans	:	**Solution:** Data given: D = 12.5cm ; L = 15 cm=0.15m ; N = 1000 rpm; FHP =30 and P=7 kg/cm^2 IHP = IHP ={ [PLAN] /4500}n/2 = [7 x 0.15 x(π /4) (12.5 x 12.5) x 100 /4500] x (4/2) = **57.26 hp** I.H.P = B.H.P + F.H.P BHP = IHP – FHP = 57.26 – 30 = **27.26 hp**	

Q. 4		What is the purpose of cooling? Give the principle, advantages and disadvantages of air cooling system of an I.C. engine.	(4)
Ans	:	**Purpose of cooling:** (i) To maintain optimum temperature of engine for efficient operation under all conditions. (ii) To dissipate surplus heat for protection of engine components like cylinder, cylinder head, piston, piston rings and valves. (iii) To maintain the lubricating property of the oil inside the engine cylinder for normal functioning of the engine. There are two different methods of cooling: (i) air cooling and (ii) water cooling. **Principle of air cooling:** The cylinder of an air cooled engine has fins to increase the area of contact of air for speedy cooling. The cylinder is normally enclosed in a sheet metal casing called *Cowling*. The flywheel has blades projecting from its face, so that it acts like a fan drawing air through a hole in the cowling and directing it around the finned cylinder. For maintenance of air cooling system, passage of air is kept clean by removing grasses etc. This is done by removing the cowling and cleaning out the dirt etc. by a stiff brush or compressed air. When separate fan is provided, the belt tension is to be checked and adjusted if necessary. **Advantages of air cooling:** It is simpler in design and construction. Water jackets, radiators, water pump, thermostat, pipes, hoses etc. are not needed. It is more compact. It is comparatively lighter in weight. **Disadvantages:** There is uneven cooling of the engine parts. Engine temperature is generally high during working period.	
Q. 5		Enlist the different sources of farm power. Give merits and demerits of animal power and mechanical power.	(4)
Ans	:	Sources of power: namely human, animal, mechanical power (oil engines and tractors), electrical power and renewable energy (solar energy, biogas, biomass and wind energy). **Animal power :** The most important source of power on the farm all over the world and particularly in India is animal. It is estimated that, nearly 80% of the total draft power used in agriculture throughout the World is still provided by animals. India is having 22.68 crore cattle, which is the highest in the World. Mainly, bullocks and buffaloes happens to be the principle sources of animal power on Indian farms. However, camels, horses, donkeys and elephants are also used for the farm work. The average force a bullock can exert is nearly equal to one tenth of its body weight. Power developed by an average pair of bullocks is about 1 hp for usual farm work. **Advantages:** 1. Easily available. 2. Used for all types of work. 3. Low initial investment. 4. Supplies manure to the field and fuels to farmers. 5. Live on farm produce.	

		Disadvantages: 1. Not very efficient. 2. Seasons and weather affect the efficiency. 3. Cannot work at a stretch. 4. Require full maintenance when there is no farm work. 5. Creates unhealthy and dirty atmosphere near the residence. 6. Very slow in doing work. **Mechanical power:** It is available through tractors, power tillers and oil engines. The oil engine is a highly efficient device for converting fuel into useful work. The efficiency of diesel engine varies between 32 and 38%, where as that of the carburetor engine (Petrol engine) is in the range of 25 and 32%. In recent years, diesel engines, tractors and power tillers have gained considerable popularity in agricultural operations. It is estimated that, about one million tractors of 25 hp range are in use for various agricultural operations in India. Similarly, total number of oil engines of 5 hp for stationery work is 60 lakhs. Normally, stationery diesel engines are used for pumping water, flour mills, oil ghanis, cotton gins, chaff cutter, sugarcane crusher, threshers and winnowers etc.. **Advantages:** Efficiency is high; not affected by weather; can run at a stretch; requires less space and cheaper form of power. **Disadvantages:** Initial capital investment is high; fuel is costly and repairs and maintenance needs technical knowledge.	
Q. 6		Calculate the area covered per day of 8 hours by a tractor drawn four bottom 35cm plough, if the speed of ploughing is 5km/hr and the time lost in turning is 10 percent.	(4)
Ans	:	**Solution:** Area covered = **[(W x S) /1000] x (E / 100) x Time** = (4 x35 x 5 x 90 x 8) / 1000 x 100 = **5.04 Ha**	
Q.7		Give objectives of tillage. Enlist different types of tillage implements.	(4)
Ans	:	**Objective of tillage:** 1. to obtain deep seed bed, suitable for different type of crops. 2. to add more humus and fertility to soil by covering the vegetation. 3. to destroy and prevent weeds. 4. to aerate the soil for proper growth of crops. 5. to increase water absorbing capacity of the soil. 6. to destroy the insects, pests and their breeding places and 7. to reduce the soil erosion. List of tillage implements: Primary tillage implements-indigenous plough, mould-board plough, disc plough, subsoil plough, chisel plough. Secondary tillage implements- different types of harrow, cultivators, levelers.	

Q.8		How many hectares per day of 10 hours can be cut by a combine harvestor with 4 metre cutter bar, when it is running at 4km/hr.	(4)
Ans	:	**Solution :** **Actual Area covered, Ha, A = [(W x S) /1000] x (E / 100) x Time** **= (4 x100 x 4/1000) (100/100) x 10** **= 16 ha.**	
Q.9		What is the purpose and main functions of sprayers? Give the advantages and disadvantages of spraying.	(4)
Ans	:	Sprayer is used for the following **purpose:** (i) application of fungicides to minimize fungal diseases, (ii) application of insecticides to control insect pests, (iii) application of herbicides to remove weeds and (iv) application of micronutrients on the plants. The main **functions** of sprayer are: (i) to break the liquid into droplets of effective size, (ii) to distribute them uniformly over the plants, and (iii) to regulate the amount of liquid to avoid excessive application **Advantages and disadvantages of Spraying :** **Advantages :** (i) Spray deposits adhere to the foliage very well. (ii) Sprays are most effective than dust against many insects and diseases. (iii) Cost of spraying is comparable with or slightly cheaper than that of dusting **Disadvantages :** (i) More expensive equipment is required. (ii) More time and labour are required (iii) Heavy load has been carried along. (iv) Slightly heavy and concentrated doses may cause burning of the foliage. (v) Spraying is not convenient for small area.	
Q. 10		Write short notes on (Any two)	(4)
		i) Carburetor ii) Mould board plough iii) Seeding methods	
Ans	:	**i) Carburetor:** **Carburetor :** The process of preparing an air fuel mixture away from the cylinders of an engine is called carburetion and the device in which this prosess takes place is called carburetor. **Priciple of Carburetor :** The basic principle of all carburetor design is that when air flows over the end of a narrow tube or jet containing liquid some liquid is drawn into the air stream.the fuel level in the jet is maintained by a float chamber. Float and the needle valve maintain a constant level in the float chamber.	



Carburetor

Functions of carburetor : i) To mix the air and fuel thoroughly.ii) to atomise the fuel.iii) To regulate the air fuel ratio at different speeds and loads. iv) To supply correct amount of mixture at different speeds and loads.

Components of Carburetor:

ii) Venturi Tube : It is provided to produce low pressure in the throat of the caburetor.

iii) Float Chamber : Float Chamber is a reservoir to maintain a constant level of fuel in the caburetor.

iv) Throttle : It is a butterfly valve between the mixing chamber of the carburetor and the inlet manifold of the engine to regulate the quantity of charge.

v) Choke : It is a device for restricting the air supply in the carburetor. It is a type of butterfly valve fitted in the air passage of the carburetor unit.

vi) Main Jet : It is a small opening of exact size through which fuel passes from the float chamber to the throat of the carburetor in form of spray.

vii) Idling Jet : It is a special type of jet which supplies fuel at idling speed or low speed of the engine.

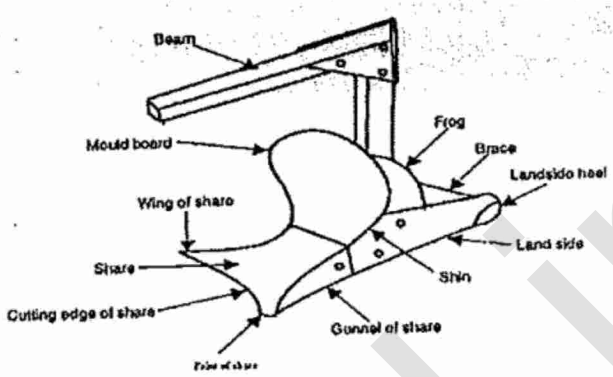
viii) Compensating jet: When maim jet supplies richer mixture at higher speed the compensating jet supplies leaner mixture at that speed.

(ii)Mould board plough

A mouldboard plough is very common implement used for primer tillage operations. This plough performs several functions at a time such as (1) Cutting the furrow slice (2) Lifting the furrow slice (3) turning the furrow slice (4) Pulverizing the soil.

Components M.B. Plough consists of (a) Share, (b) Mould Board, (c) Landside and (d) Frog .

Share It is the part of the plough bottom , that penetrates into the soil and cut the soil in horizontal direction below the soil surface is called share. It is a sharp, well polished and pointed component. Different portions of the share are called by different names such as (i) share point, (ii) cutting edge, (iii) wing of the share (iv) gunnel (v) clevage edge.



Components M.B. Plough

The forward end of the cutting edge which actually penetrates into the soil is called share point. The front edge of the share which makes horizontal cut in the soil is called cutting edge of the share. The outer end of the cutting edge of the share is called wing of the share. It supports the plough bottom. The vertical face of the share which slides along the furrow well is called gunnel. It takes the side thrust of the soil and supports the plough bottom against the furrow wall. The edge of the share which forms joint between mould board and share on the frog. The shares are made of chilled cast iron or steel. The steel mainly contains about 0.7-0.8% carbon and about 0.5-0.8% manganese besides other minor elements.

(i) General purpose mould board- It is the best for all round general farm use to give through pulverization. It is a mould board having medium curvature lying between stubble and sod. The sloping of the surface is gradual. It turns the well-defined furrow slice and pulverizes the soil thoroughly. It has a fairly long mould board with a gradual twist, the surface being slightly convex.

(ii) Stubble bottom mould board-It is adopted for ploughing an old ground where good pulverization is desired. Its curvature is not gradual, but it is abrupt along the top edge. This causes the furrow slice to be thrown off quickly, pulverization is much better than the other type of mould board. It is best suited in stubble soil i. e under cultivation for years together. Stubble soil is that, soil in which stubble of the plants from the previous crop is still left on the land at the time of ploughing. This type of mould board is not suitable for lands with full of grasses.

(iii) Sod and breaker type mould board- It is a long mould board with gentle curvature which lifts and inverts the furrow slice. It is used in tough soils of grasses. It turns over thickly covered soil. This is very useful where complete inversion of soil is required by the farmer.

iv) Slat type mould board- It is a mould board whose surface is made of slats placed along the length of the mould board, so that there are gaps

between the slats. This type of mould board is often used, where the soil is sticky, because the solid mould board does not score well in sticky soils.this type has been designed for use in sod soils.

(v) **High speed type mould board-** Most of the high speed bottoms are used on tractor ploughs for general farm use.

(iii) Seeding methods:

Common methods used for seeding crops are :

(1) Broadcasting (2) Dibbling (3) Drilling (4) Seed dropping behind the plough (5) Transplanting (6) Hill dropping (7) Check planting.

(1) Broadcasting : Broadcasting is the process of random scattering of seeds on the surface of seed beds. It can be done by manually or mechanically.

(2) Dibbling : Dibbling is the process of placing the seeds in holes made in seedbed and covering them. In this method, seeds are placed in holes made at definite depth at fixed spacing. The equipment used for dibbling is called Dibbler.

(3) Drilling : Drilling consists of dropping the seeds in furrows lines in a continuous flow and covering them with soil. Seed metering may be done either manually or mechanically. This method is very helpful in achieving proper depth, proper spacing and proper amount of seed to be down in the field.

Drilling can be done by : (a) Sowing behind the plough (b) Bullock drawn seed drill (c) Tractor drawn seed drill.

(4) Seed dropping behind the plough : It is very common method used in village. It is used for seeds like maize, gram, peas, wheat and barley. A man drops seeds in the furrow behind the plough.

(5) Transplanting : Transplanting consists of preparing seedlings in nursery and then planting these seedlings in the prepared field. It is commonly done for paddy, vegetables and flowers. Equipment for placing plants in the soil is called Trans planter.

(6) Hill dropping : In this method, seeds are dropped at fixed spacing and not in a continuous stream . Thus the spacing between plant to plant in a row is constant.

(7) Check row planting : In this method of planting in which row to row and plant to plant distance is uniform. In this method, seeds are planted precisely along straight parallel furrows. The rows are always in two perpendicular direction. A machine used for check row planting is called Check row planter.

SECTION "B"

Q. 11		Define the following terms			(4)
	i)	Indicated horse power	ii)	Tractor	
	iii)	Compression ratio	iv)	Harrowing	
Ans	:	i) **Indicated horse power:** It is the total horse power developed by all the cylinders and received by pistons, without friction and losses within			

		the engine. ii) **Tractor:** Tractor is a self propelled power unit having wheels or tracks for operating agricultural implements and machines including trailers. iii) **Compression ratio:** It is the ratio of the volume of the charge at the beginning of the compression stroke to that at the end of compression stroke, i.e., ratio of total cylinder volume to clearance volume. iv) **Harrowing:** It is secondary tillage operation which pulverizes, smoothens and packs the soil in seed bed preparation and/or to control weeds.	
Q. 12		Fill in the blanks	(4)
Ans	i)	The thermal efficiency of petrol engine varies from **25 to 32** percent.	
	ii)	A man can develop of about **0.1hp** for doing farm work.	
	iii)	The disc angle of a good plough varies between 42^0 to 45^0.	
	iv)	**Seeding or sowing** is an art of placing seeds in the soil to have good germination in the field.	

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