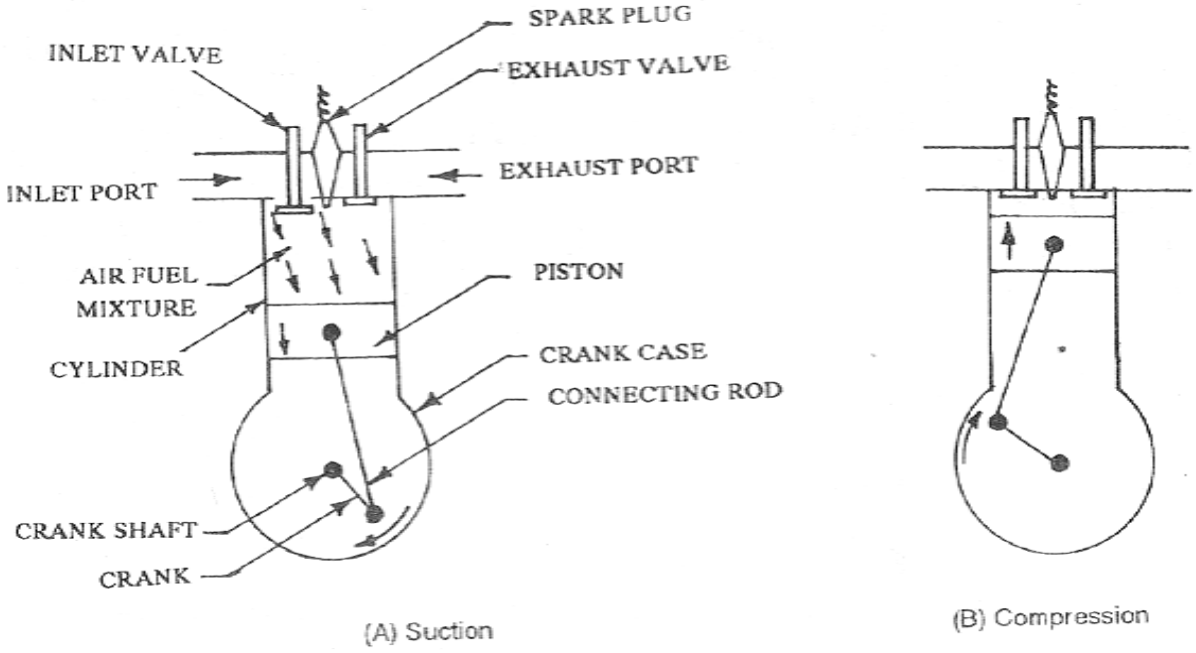
Summer – 15 EXAMINATION

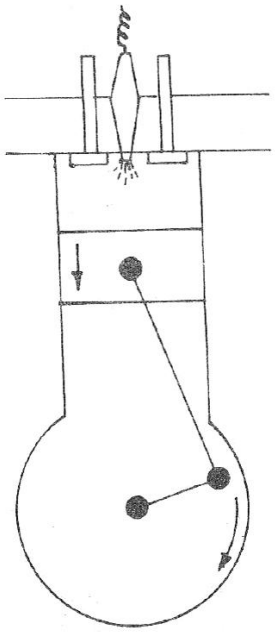
Subject Code: **17408** **Model Answer** Page No: 1/18

Important Instructions to examiners:
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

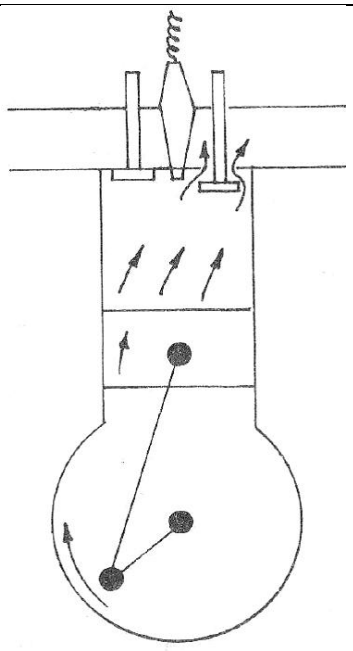
……

	Marks
1. a) Attempt any SIX:	**12**
a) What is meant by IC Engine?	2
Answer : **Meaning of IC Engine:** The I. C. engine means Internal combustion engine. The heat engine in which combustion takes place inside the closed volume i.e. in combustion chamber is called as I. C. engine. e.g. Petrol engine, diesel engine etc.	2
b) Write the relation between stroke length and crank radius.	2
Answer: Relation between stroke length and crank radius: In an engine design, centre to centre distance between crankpin and crankshaft i.e. the crank radius is half of the piston displacement during a stroke i.e. the stroke length. Thus one complete revolution of crankshaft makes two strokes of piston. i.e. $R = 1/2 \times L$, Where L - Stroke length, R - crank radius	2
c) List four processes required to complete 4 stroke cycle engines.	2
Answer: Four processes required to complete 4 stroke cycle in an engine are: 1. Suction 2. Compression 3. Expansion (Power) 4. Exhaust	2
d) Classify the IC engine on the basis of cooling system.	2
Answer: IC engine on the basis of cooling system are classified as :- 1. Air cooled engine 2. Water cooled engine	2
e) Write the function of water pump used in cooling system of engine**.**	2
Answer: A pump is used in the water cooling system to increase the velocity of the circulating water and to circulate water under pressure in the system	2

f) Define mechanical efficiency.	2
Answer: Mechanical efficiency: It is the ratio of brake power available at the crankshaft to the indicated power generated inside the cylinder. Mechanical efficiency, $\eta_{mech} = \frac{B.P.}{I.P.}$	2
g) Write the function of Inlet and Exhaust valve.	2
Answer: Function of: **Inlet Valve:** To open the inlet port at the time of suction stroke and allow the charge to enter inside the cylinder. **Exhaust valve:** To open the exhaust port at the time of exhaust stroke and allow the exhaust gases to escape from the cylinder.	1 1
h) Write the meaning of air-fuel ratio.	2
Answer: Meaning of air-fuel ratio: Air - fuel ratio (AFR) is the ratio of mass of air to mass of fuel. $A/F \text{ Ratio} = \frac{\text{Mass of air}}{\text{Mass of Fuel}}$ The mixture of air and petrol burns completely only when they are mixed in particular ratio, called the air fuel ratio.	2
(B). Attempt any TWO:	8
a) Draw neat sketch to show 4-strokes of petrol engine and give proper names of it.	4
Answer: 4-strokes of petrol engine: *(Note: Each sketch carry 1 mark)*  	4



(C) Power.



(D) Exhaust.

b) Compare 4 –stroke and 2-stroke petrol engine. 4

Answer: Comparison of 4 –stroke and 2-stroke petrol engine: *(Any four points)* 4

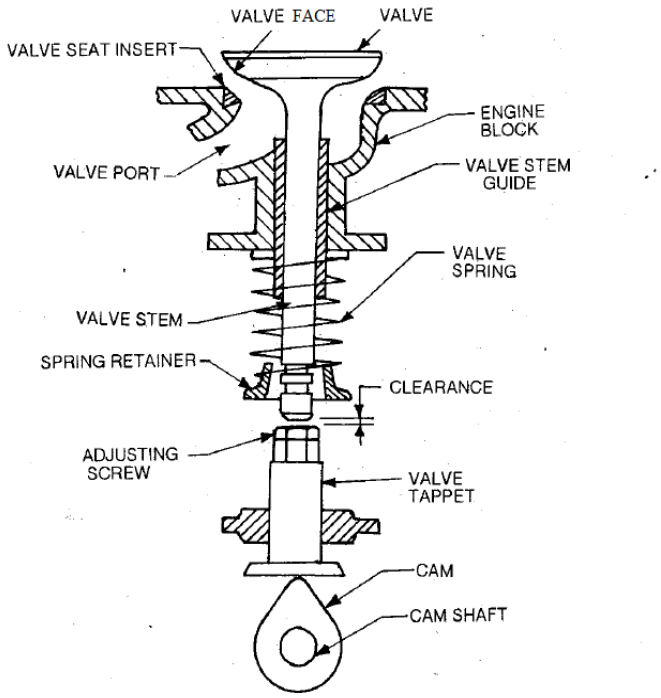
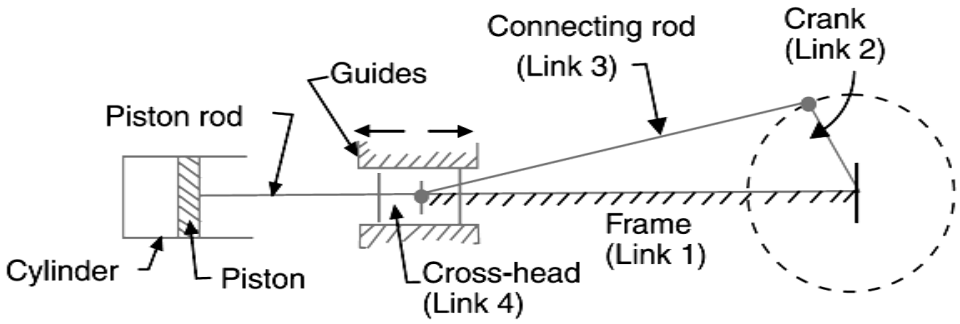
Sr No.	**Four Stroke Engine**	**Two Stroke Engine**
1	One working stroke for every two revolutions of the crankshaft.	One working stroke for each revolutions of the crankshaft.
2	Turning moment on the crankshaft is not even due to one working stroke for every two revolutions of the crankshaft. Hence heavy flywheel is required and engine runs unbalanced	Turning moment on the crankshaft is more even due to working stroke for each revolution of the crankshaft .hence lighter flywheel is required and engine runs balanced.
3	Engine is heavy	Engine is light
4	Engine design is complicated	Engine design is simple
5	More cost	Less cost
6	Less mechanical efficiency due to more friction on many parts.	More mechanical efficiency due to less friction on few parts.
7	More output due to full fresh charge intake and full burnt gases exhaust.	Less output due to mixing of fresh charge with burnt gases.
8	Engine runs cooler	Engine runs hotter.
9	Engine is water cooled	Engine is air cooled
10	Engine requires more space.	Engine requires less space.

c) Why two stroke cycle engines have more fuel consumption?	4
Answer: Two stroke engines have more fuel consumption due to following reasons: *(Any four)* 1. Because of scavenging of the engine some amount of fresh charge is lost to remove the exhaust gases from the cylinder. 2. Volumetric efficiency of the engines is very low. 3. Due to port arrangement there are chances of leakage. 4. As the fuel is mixed with the oil, this leads to incomplete burning of the charge. 5. Premixed oil makes the charge lean.	4
2. Attempt any FOUR :	16
a) Classify the IC engine on the basis of cycle of operation, fuel, method of charging, cylinder arrangement.	4
Answer: The I.C. Engines are classified as follows: **1. Cycle of operation:** a) Otto cycle engine b) Diesel cycle engine c) Duel combustion cycle engine or semi- diesel cycle engine. **2. Type of Fuel used:** a) Petrol engine (or Gasoline engine) b) Diesel engine **c)** Gas engine 3. **Method of charging:** a) Naturally aspirated engines b) Supercharged aspirated engines **4. Arrangement of cylinder:-** a) Vertical engine b) Horizontal engine c) Radial engine d) V-engine e) Opposed cylinder engine	4
b) Write the function and material used for Cylinder block, piston, Crank shaft and Tappet Cover.	4

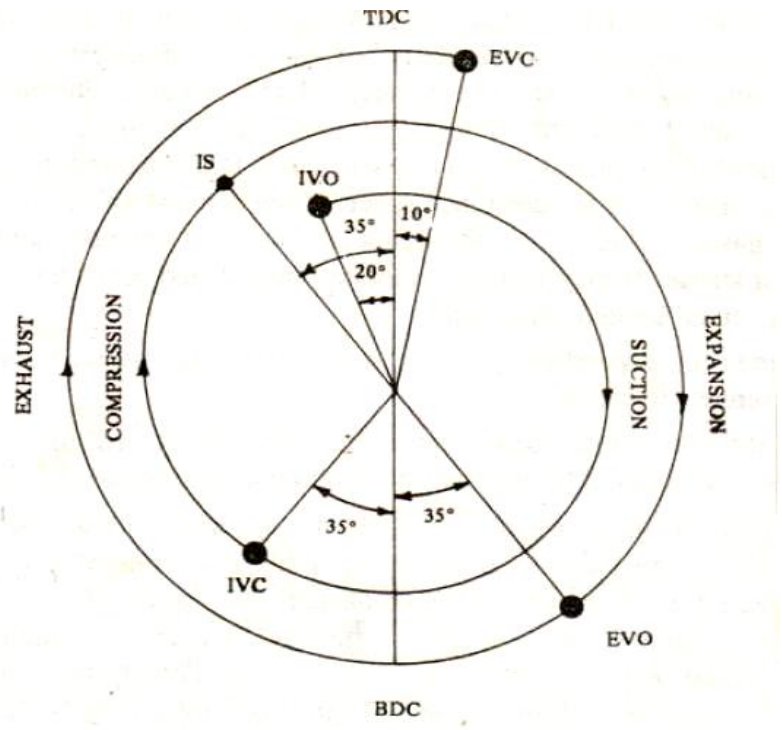
Answer :

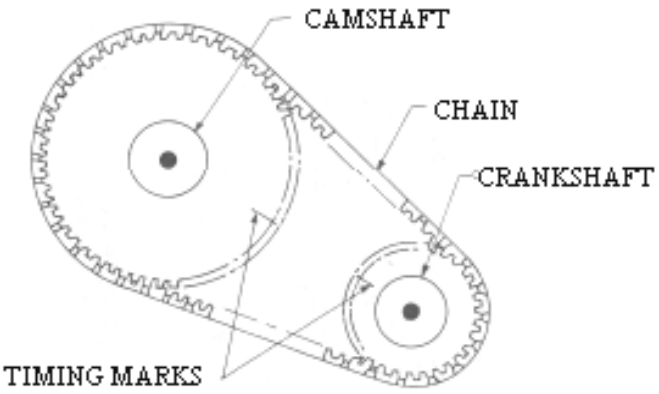
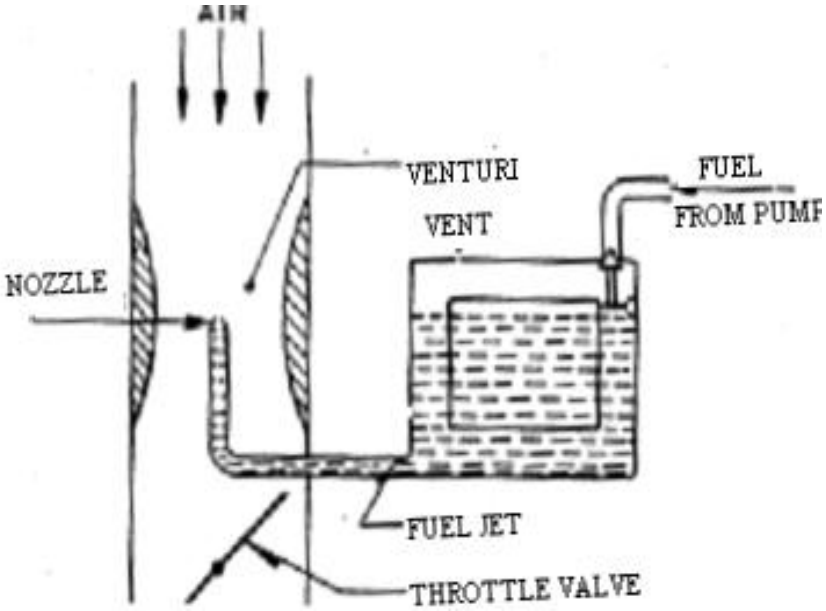
Sr.	Component	Material	Function
1.	Cylinder block	Cast iron, Aluminum alloy	1. To form the main supporting structure
2.	Piston	Cast iron, Aluminum alloy	1. To transmit the force of explosion to the crankshaft. 2. To form seal so that the high pressure gases in combustion chamber do not escape into crankcase. 3. To serve as guide and bearing for connecting rod small end.
3.	Crank Shaft	Alloy steel, SG iron	1. It converts the reciprocating motion of piston to rotating motion. 2. It transmits power to flywheel. 3. It receives power from flywheel.
4.	Tappet cover	Pressed steel	1. To form the top cover for the valve mechanism.

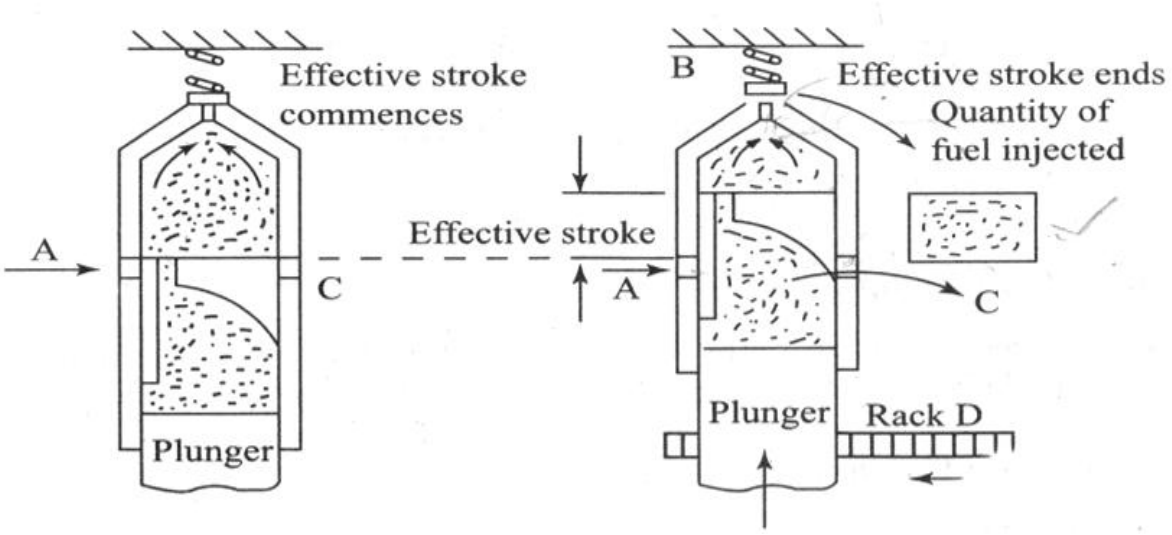
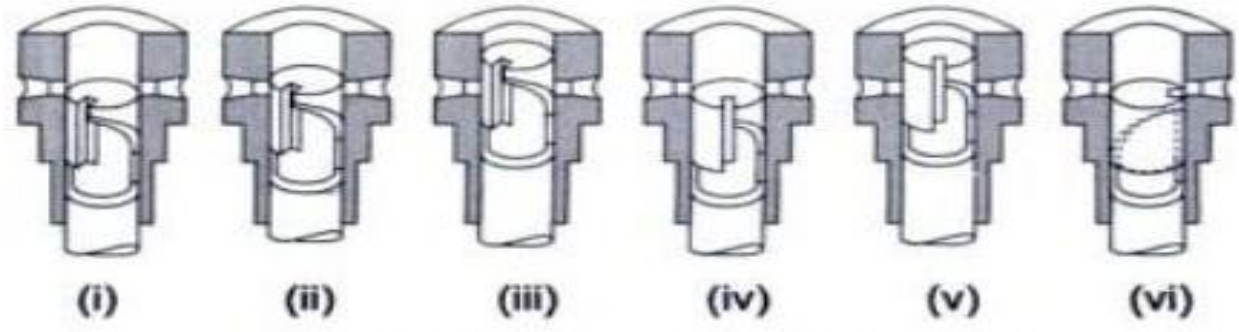
4

c) Draw neat sketch to show straight poppet overhead valve mechanism and give names to all components	4
Answer: Straight poppet overhead valve mechanism:  Figure: Straight poppet Overhead valve operating mechanism	4
d) Draw a neat sketch to show slider crank mechanism and give names to it.	4
Answer: Slider crank mechanism:  	4
e) Compare dry and wet type cylinder liners used in IC engine.	4
Answer: Comparison of Dry and Wet type cylinder liners:	4

Dry type cylinder liner	Wet type cylinder liner
1) Dry liner is not in direct contact of cooling water hence it is known as dry liner.	1) Wet liners is in direct contact with cooling water on the outside and hence is known as wet liner.
2) It is difficult to replace.	2) It is easy to replace.
3) No leak proof joint is provided in the case of dry liner.	3) A leak proof joint between the cylinder casting and the liner has to be provided.
4) In dry liners the casting of cylinder block is complicated.	4) In wet liners the casting of cylinder block is very simplified.

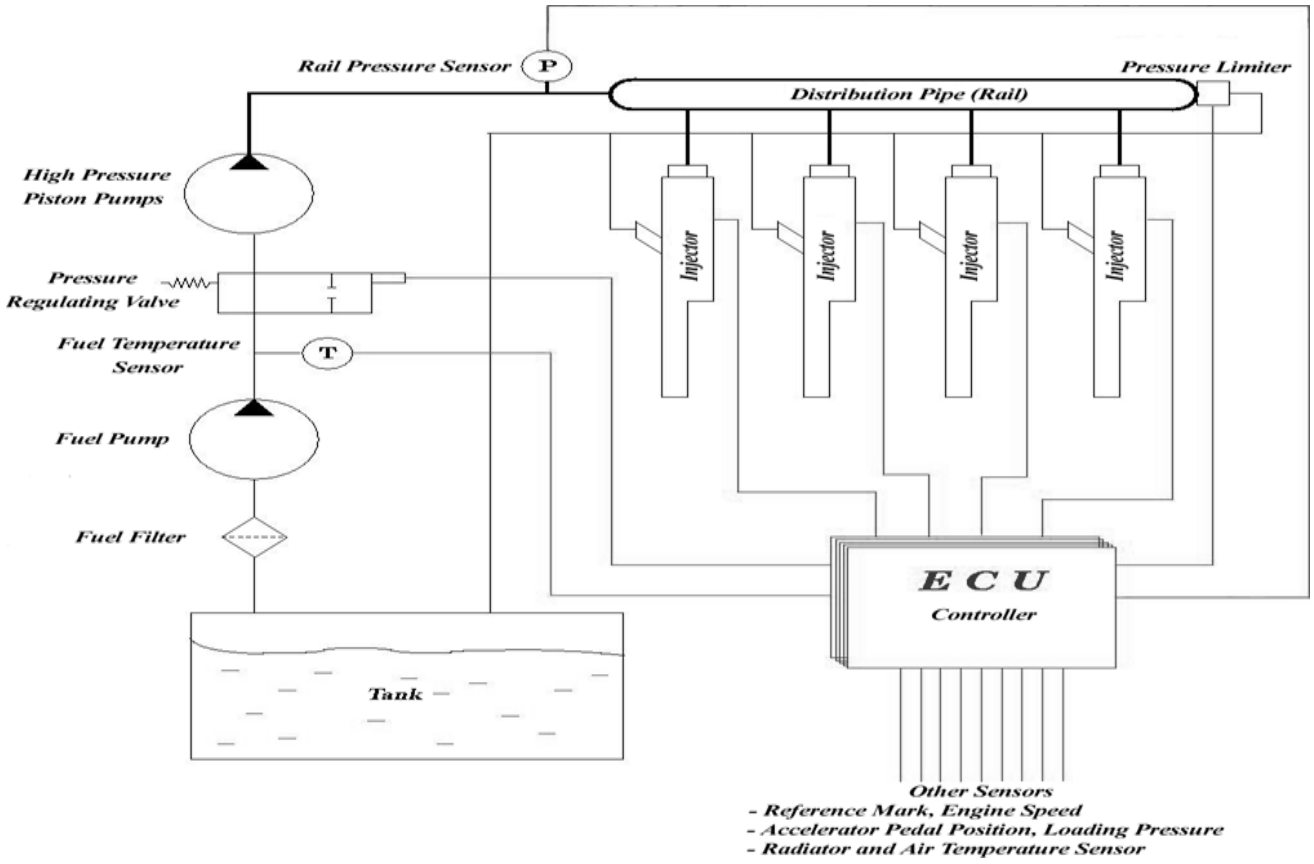
5) A cylinder block with dry liners is generally more robust.	5) A cylinder block with wet liners is less robust as compare to dry liner	
6) For perfect contact between the liner and the block casting in case of dry liner, very accurate machining of block and outer liner surface is required.	6) Where as there is no such necessity in case of wet liner.	
7) A dry liner cannot be finished accurately before fitting because of the shrinkage stresses produced.	7) A wet liner can be finished accurately before fitting.	
f) Draw figure to show valve timing diagram four stroke petrol engine.		4
Answer: Valve timing diagram four stroke petrol engine:  Figure: Valve timing diagram of 4 stroke SI engine		4
3. Attempt any **FOUR**		16
a) Draw a neat sketch of gear-gear drive and explain the relation between speed of crank shaft.		4
Answer: **Relation between camshaft speed and crankshaft speed:** Camshaft is driven by the crankshaft either by a pair of meshing gears (timing gears) or by means of a pair of timing sprocket connected by a chain. The cam shaft gear or sprocket has twice as many teeth as the gear or the sprocket on the crankshaft. This gives 1:2 gear ratio, the camshaft turns at half the speed of the crankshaft. Thus every two revolutions of the camshaft produce one revolution of the camshaft and one opening and closing of each valve in the four cylinder engine. The gear and sprocket maintain a definite time relationship between the camshaft and crankshaft to ensure opening the valves exactly at the correct time in relation to piston position		2

 Figure: Timing Chain	2
b) Draw a neat sketch of simple carburetor used in petrol engine and name it.	4
Answer: *Note: Neat sketch with correct labeling – 4marks*  Figure: Simple Carburetor.	4
c) List the air fuel ratio required for starting, Idling, normal running and acceleration in petrol engine.	4
Answer: Requirement of air fuel ratio: **Starting:** For starting a very rich mixture must be supplied, as much as 5 to 10 times the normal amount of petrol (Air fuel ratio 1:1 to 8:1)	1
Idling: Idling requires a rich mixture about 10:1 to 12:1	1
Normal Running: For normal running it is desired to run the engine on maximum economy conditions around 16:1 to 18:1	1
Acceleration: For acceleration rich mixture 12:1 is required.	1

d) How fuel is metered in diesel engine?	4
Answer: **Fuel Metering in the inline type fuel injection pump**:  OR  	2 2
The position of the plunger in the fuel injection pump can be varied by means of a control rod having a rack and pinion arrangement. By operating this rod, the position of the plunger can be changed, and by changing the position of the plunger, the supply to the injection nozzle can either be increased or stopped. When the supply to the injection nozzle is stopped, the engine is also stopped. Various positions of the plunger are shown in Figure. In Fig., (i) is the position of the plunger when it is at the bottom stroke. The position of the plunger when it is closing both the ports is shown in (ii). The maximum amount of supply is shown in (iii). Only at this position is the plunger working at full load. The position of the plunger at (iv) shows a normal load. The position at (v) shows a part load. The position at (vi) shows that no fuel is being supplied to the injector, i.e, the engine has stopped.	

e) Draw layout to show fuel supply system of diesel engine and name the components. 4

Answer: **Layout of common rail system for diesel engine:** 4

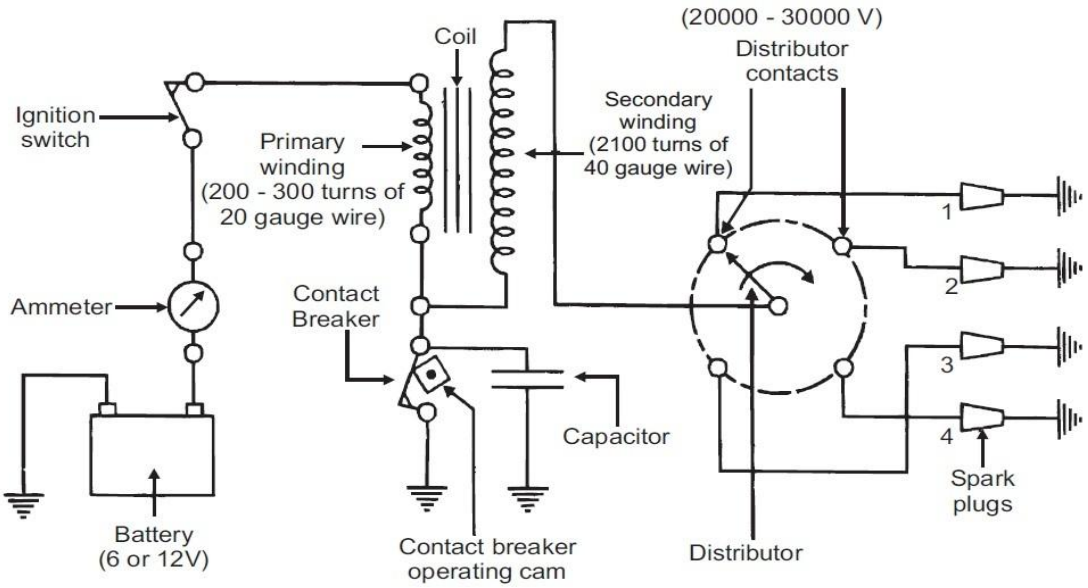


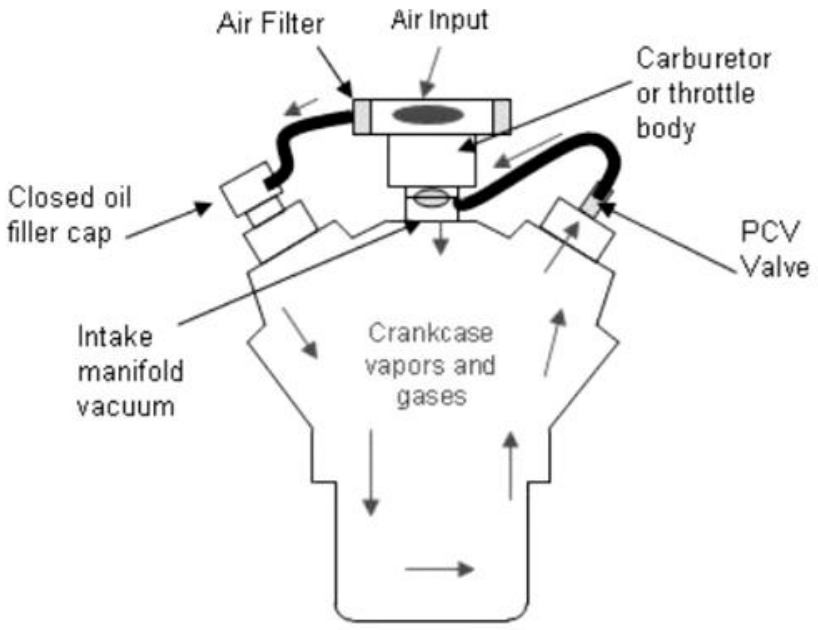
Note: Equivalent credit shall be given to any other suitable sketch.

f) Write the location of the following components with reason- fuel tank, fuel pump- mechanical type and electrical. 4

Answer: **Location of components with reason:**

Component	**Location**	**Reason**	
Fuel Tank	Rear of the vehicle	1. To avoid direct contact of the fuel with engine heat. 2. To avoid explosion fuel during front collision.	2
Fuel Pump-			
a) Mechanical Type	Side wall of cylinder block	As the pump is driven by camshaft it needs to be located close to it.	1
b) Electrical Type	Inside the fuel tank	1. As it is driven electrically the pump can be located any where 2. To reduce the fuel line length between the pump and tank.	1

4. Attempt any FOUR of the following:	16
a) Why ignition system is required in SI engine?	4
Answer: **Requirement of ignition system in SI engine:** In SI engines, as compression ratio is lower, and self-ignition temperature of gasoline is higher, for igniting the mixture for the initiation of combustion an ignition system is must. Therefore Ignition system of a SI engine is intended to ignite the fuel mixture by an electric spark in the cylinder at the end of compression stroke. In a four stroke engine, a spark should occur in each cylinder after two revolutions of the crankshaft, whereas in a two-stroke engine spark in each cylinder is required every revolution of the crankshaft.	4
b) Draw neat sketch to show circuit diagram for battery coil ignition system.	4
Answer: Circuit diagram for battery coil ignition system: *(Correct labeled sketch-4 marks)*  **Figure : Schematic Diagram of Coil/Battery Ignition System**	4
c) Why 1-3-4-2 firing order is preferred than the 1-2-3-4 in 4 cylinder engine?	4
Answer: The firing order must be considered on the basis of engine vibrations and engine cooling. Also the firing order affects the balancing of engine. **Reasons for preferring 1-3-4-2 than the 1-2-3-4 in 4 cylinder engine:** 1. The power impulses are evenly distributed and are 180 degree apart. Therefore the firing order for the engine is 1-3-4-2. 2. This balance load on two bearings would be further reducing the engine vibrations. 3. It is required to cool the portion of engine by changing the sequence. So that problem of overheating can be mitigated. 4. To provide sufficient travel time to exhaust gases. So that development of high back pressure would be avoided.	4

d) Why cooling system is required in IC engines?	4
Answer: **Requirement of cooling system in IC engines:** The cooling system is needed to keep the engine from not getting so hot as to cause problems and yet to permit it to run hot enough to ensure maximum efficiency of the engine. During the process of converting the thermal energy to mechanical energy, high temperatures are produced in the cylinders because of combustion process. A large portion of this heat is transferred to the cylinder head and walls, piston and valves. Unless this excess heat is carried away and these parts are adequately cooled, the engine will be damaged. So the adequate cooling system must be provided to prevent the damage of mechanical parts as well as to obtain maximum performance of the engine.	4
f) State different properties of coolant.	4
Answer: **Properties of coolant:** 1. Low freezing temperature 2. High boiling point 3. Large latent heat of vaporisation 4. Non corrosive 5. Easily and cheaply available 6. Chemically inert 7. Should not deposit foreign matter on the water jackets and radiator	4
5. Attempt any **FOUR:**	16
a) What is meant by positive crankcase ventilation?	4
Answer: **Positive Crankcase Ventilation System:** *(Sketch-2 marks, Description-2 marks)*  Figure: PCV system.	2

Since water vapour in exhaust and blow by gases enter crankcase due to various reasons there is every chance that these contaminants will cause sludge and corrode metal parts. Therefore a mean of removing these contaminants before they can act on the oil is essential. In Positive Crankcase Ventilation system the un-burnt gases are re-circulated into the combustion chamber and burnt with the fresh charge. Another reason of using crankcase ventilation is to relieve any pressure build-up in the crankcase which may cause crankshaft seal leakage. — 2

The figure shows the intake manifold return PCV system. It has a tube leading from the crankcase or else the rocker arm cover through a flow control valve into the intake manifold usually just below the carburetor. To provide proper ventilation of the interior of the engine, fresh air is usually drawn through a rocker arm cover opposite that containing the PCV system

b) What is the difference between wet sump and dry sump lubrication? — 4

Answer: Difference between wet sump and dry sump lubrication: *(Any four points)* — 4

Wet Sump Lubrication	**Dry Sump Lubrication**
1. Lubricating oil is stored in the oil sump	1. Lubricating oil is not stored in the oil sump
2. Single oil pump is used	2. Two oil pumps are used
3. It is used in ordinary vehicles/ cars	3. It is used in racing cars
4. Lubrication difficulties arise during maneuvers.	4. No such difficulties arise as the oil is stored in separate tank.
5. The temperature of the oil is more difficult to control.	5. The temperature of oil can easily be controlled.
6. The oil becomes contaminated and oxidizes more easily as always in contact with hot engine	6. As the oil is stored in separate tank it does not oxidizes easily

c) Draw a neat sketch of gear type pump used in lubrication system and name the parts. — 4

Answer: Gear type pump used in lubrication system: *(Correct labeled sketch-4 marks)* — 4

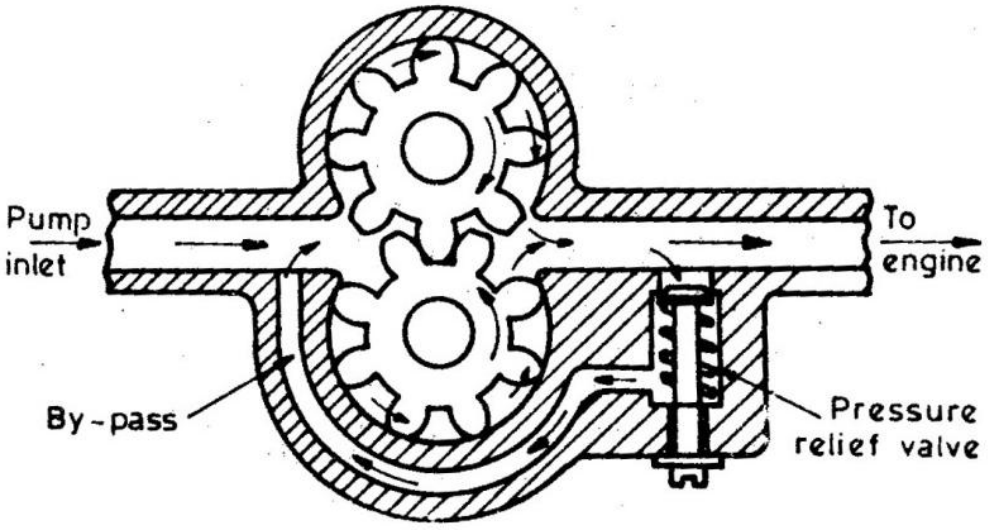


Figure: Gear type pump

d) List the properties of lubricating oil used in lubrication system of IC engine.	4
Answer: Essential properties of lubricating oil: *(Any eight properties- ½ mark each)* 1) Viscosity 2) Flash Point 3) Resistance to corrosion 4) Physical stability 5) Pour point & Cloud Point 6) Adhesiveness 7) Chemical Stability 8) Cleanliness 9) Resistance agents extreme pressure 10) Specific Gravity 11) Oiliness 12) Colour 13) Acidity and Neutralisation Number	4
e) Define: IP, BP, FP and air standard efficiency.	4
Answer: **Indicated Power:** It is the power developed by the engine above the piston in the combustion chamber. $\text{I.P.} = \frac{nPLAN'}{60 \times 1000} kw$ **Brake power:** The brake power is the power obtained at the engine flywheel and is measured with the help of dynamometer, it is measured in kW $B.P. = \frac{2\Pi NT}{60000} \text{kW}$ Where, N = Engine speed in R.P.M. T = Torque in Newton meters **Friction Power:** It is the power consumed by the engine to overcome the frictional loses. F. P. = I.P - B.P. **Air Standard efficiency:** It is a thermodynamic efficiency which is mainly a function of compression ratio. It gives the upper limit of the efficiency obtainable from an engine.	1 1 1 1
f) Write the working principle of dynamometers used to measure torque of the IC engine.	4
Answer: **Working principle of eddy current dynamometer**: The details of eddy current dynamometer are shown in figure. It consists of a stator on which are fitted a number of electromagnets and a rotor disc made of copper or steel and coupled to the output shaft of the engine. When the rotor rotates eddy currents are produced in the stator due to magnetic flux set up by the passage of field current in the electromagnets. These eddy current oppose the motion, thus loading the engine. These current are dissipated in producing heat so that this type of dynamometer also requires some cooling arrangement. The torque is measured exactly as in other types of absorption dynamometer i.e. with the help of a movement arm. The load is controlled by regulating the current in the electromagnets.	2

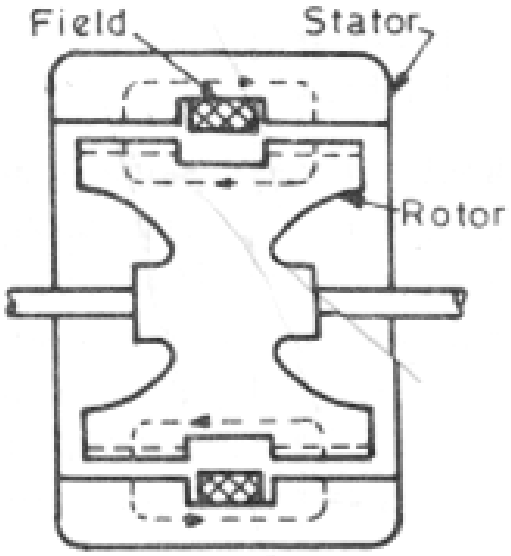


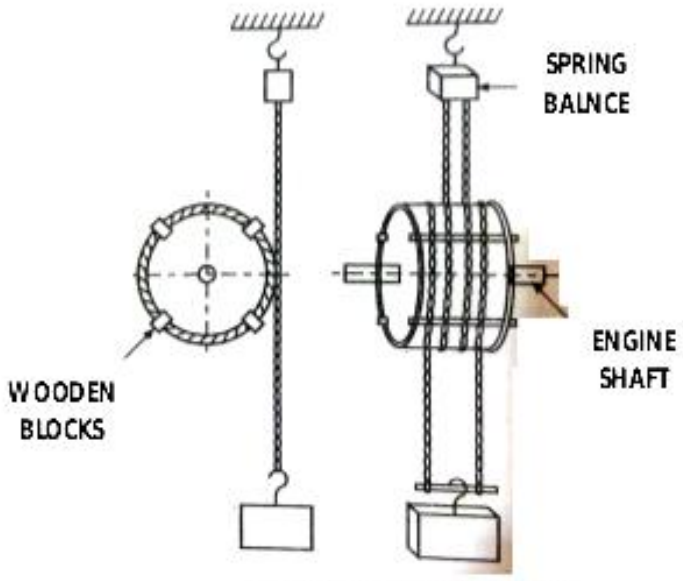
Figure:Working principle of Eddy current dynamometer

2

OR

Working principle of rope brake dynamometer:

Dynamometer is a device for measuring force and torque and hence power. It may work on the principal of absorption Transmission, in which case it is known as Transmission Dynamometers.
In a rope brake dynamometer a rope is wrapped over the rim of a pulley keyed to the shaft of the engine. The diameter of the rope depends upon the power of the machine. The spacing of the rope on the pulley is done by 3 to 4 U-shaped wooden blocks which also prevent rope from slipping of the pulley. The upper end of a rope is attached to the spring balance whereas the lower end supports the weight of suspended mass.



ROPE BRAKE DYNAMOMETER

6. Attempt **any TWO** of the following:	16
a) Write the procedure to conduct Morse test and Willian's line method to measure friction power.	8

Answer:

Procedure to conduct Morse Test:

This test is applicable to multi cylinder engines. The engine is run at the required speed and the torque is measured. One cylinder is cut out by shorting the plug if an S.I. engine is under test or by disconnecting an injector if a C.I. engine is under test .The speed falls because of the lass of power with one cylinder cut out but is restored by reducing the load .The torque is measured again when the speed has reached its original value. If the value of I.P. if the cylinders are denoted by I_1, I_2, I_3 and I_4 (considering a four –cylinder engine) and the power losses in each cylinder are denoted by L_1, L_2, L_3 and L_4 then the value of B.P.,B at test speed with all cylinders firing is given by

$$B = (I_1 - L_1) + (I_2 - L_2) + (I_3 - L_3) + (I_4 - L_4) \ldots\ldots\ldots (i)$$

If number 1 cylinder is cut out then the contribution I_1 is lost; and if the losses due to that cylinder remain the same as when it is firing then the B.P., B_1 now obtained at the same speed is

$$B = (0 - L_1) + (I_2 - L_2) + (I_3 - L_3) + (I_4 - L_4) \ldots\ldots\ldots (ii)$$

Subtracting eqn. (ii) from eqn.(i) we get,

$$B - B_1 = L_1$$

Similarly $B - B_2 = L_2$ When cylinder number 2 is cut out

and $B - B_3 = L_3$ When cylinder number 3 is cut out

and $B - B_4 = L_4$ When cylinder number 4 is cut out

Then for the engine-

$$I = I_1 + I_2, + I_3 + I_4$$

In Morse test frictional power can be found by subtracting $(B.P.)_n$ from $(I.P.)_n$

i.e. $F.P. = (I.P.)_n - (B.P.)_n$

Where n^{th} is the number of cylinders. 4

Willian's Line Method :

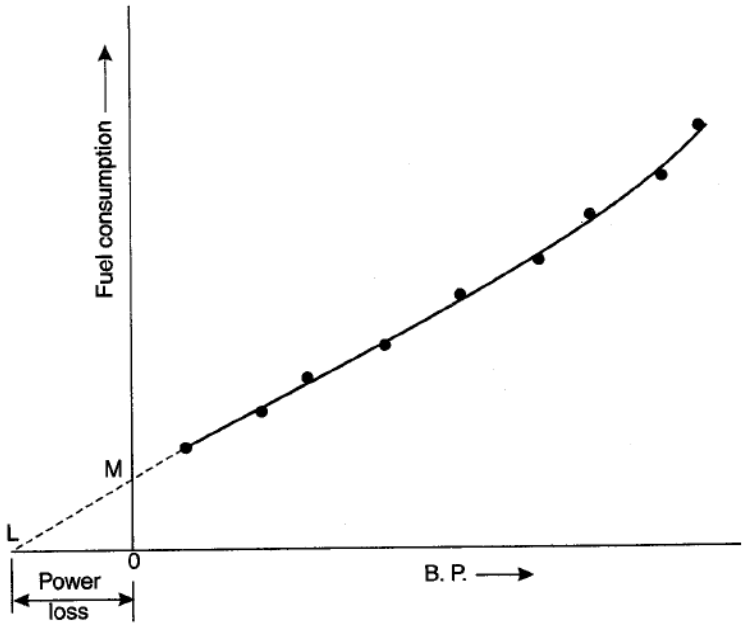


Fig.Willan's line method. 4

At a constant engine speed the load is reduced in increments and corresponding B.P. and gross fuel consumptions readings are taken. A graph is then drawn of fuel consumption against B.P. as in Fig. The graphs draw is called the Willian's line (analogous to Willian's line for a steam engine) and extrapolated back to cut the B.P. axis at the point L. The reading OL is taken as the power loss of the engine at that speed. The fuel consumption at zero B.P. is given by OM ; and if the relationship between fuel consumption and B.P. is assumed to be liner then a fuel consumption OM is equivalent to a power loss of OL Frictional power loss (F.P.) = OL	
b) Write the procedure to calculate Heat Balance Sheet of IC engine.	8
Answer: The procedure to calculate Heat Balance Sheet of IC engine: The performance of an engine is generally given by heat balance sheet. To draw a heat balance sheet for I.C. engine, it is run at constant load and at constant speed. The Indicator diagram is drawn with the help of an indicator. The quantity of fuel used in a given time and its calorific value, the amount, inlet and outlet temperature of cooling water and the mass of exhaust gases are recorded. After calculating I.P. and B.P. the heat in different items is found as follows:	2
i) Heat in fuel supplied: For petrol and oil engines, $\text{Heat in fuel supplied per minute} = M_f \times C_v$ Where, m_f and C_v are mass used per minute (kg) and lower calorific value (kJ or kcal) of the fuel respectively.	1
ii) Heat equivalent of I.P.: Heat equivalent of I.P. (per minute) = $\text{I.P.} \times 60$ kJ.	1
iii) Heat taken away by cooling water: If m_w = Mass of cooling water used per minute, t_1 = Initial temperature of cooling water, and t_2= Final Temperature of cooling water, Then, heat taken away by water = $m_w \times C_w \times (t_2 - t_1)$, *Where, C_w = specific heat of water.*	1
iv) Heat taken away by exhaust gases: If m_e = Mass of exhaust gases (kg/min) C_{pg} = Mean specific heat at constant pressure, t_e = Temperature of exhaust gases, and t_r = Room temperature, Then heat carried away by exhaust gases = $m_e \times C_{pg} (t_e - t_r)$ Note, The mass of exhaust gases can be obtained by adding together mass of fuel supplied and mass of air supplied. The heat balance sheet from the above data can be drawn as follows:	1

Item	kJ	Percent
Heat supplied by fuel	….	…..
i) Heat absorbed in I.P. ii) Heat taken away by cooling water iii) Heat carried away by exhaust gases iv) Heat unaccounted for (by difference)	…. …. …. ….	….. ….. ….. …..
Total	……	……

2

c) A diesel engine develops 5kW of power. Its indicated thermal efficiency is 30 % and mechanical efficiency is 57 %. Estimate the fuel consumption of engine in — 8

i) Kg./hr.
ii) Lit./hr.
iii) Indicated specific fuel consumption
iv) Brake specific fuel consumption

Answer: Given:

$$\text{I.P.} = 5\,\text{kw}$$
$$\eta_{\text{mech}} = 0.57$$
$$\eta_{ith} = 0.30$$

Assume: Calorific value of diesel = 44800KJ/kg, Density of diesel = 0.85 Kg/lit.

Solution:

We know that, Mechanical efficiency,

$$\eta_{mech} = \frac{B.P.}{I.P.}$$
$$\text{B.P.} = 0.57 \times 5$$
$$\text{B.P} = 2.85\,\text{kW}$$

Indicated thermal efficiency,

$$\eta_{ith} = \frac{I.P.}{m_f\,(kg/\text{sec}) \times C.V.\,(KJ/kg)}$$

$$0.30 = \frac{5}{m_f\,(kg/\text{sec}) \times 44800}$$

$$i.e\ \text{m}_\text{f} = 3.72 \times 10^{-4}\,kg/\text{sec}$$

$$\text{m}_\text{f} = 3.72 \times 10^{-4} \times 36000\ \text{kg/hr}$$

$$\therefore \text{m}_\text{f} = 1.34\ \text{kg/hr}$$

i) Fuel consumption of engine in kg/hr is - $\mathbf{m_f}$ = 1.34 kg/hr. — 2

Since,

$$\text{m}_\text{f} = \frac{1.34}{0.85} = 1.57\text{lit/hr}$$
$$\therefore \text{m}_\text{f} = 1.57\ \text{lit/hr}$$

ii) Fuel consumption of engine in lit/hr is - $\mathbf{m_f}$ = 1.57 lit/hr. — 2

Now, Indicated Specific fuel consumption is - $$IFSC = \frac{m_f}{I.P.}$$ $$= \frac{3.72 \times 10^{-4}}{5} \times 3600$$ **iii)** $\therefore$ **Indicated Specific fuel consumption = 0.267 kg/kw - hr**	2
Now, $$BSFC = IFSC \times \eta_{mech}$$ $$= 0.267 \times 0.57$$ **iv) Brake specific fuel consumption = 0.152 kg/kw - hr**	2