



# SNS COLLEGE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

19MEB203 - THERMAL ENGINEERING



## UNIT -II

### INTERNAL COMBUSTION ENGINES

#### TWO MARK QUESTION:

1. What is meant by IC engine?

In the Internal Combustion Engine, the chemical energy of the fuel is released as a heat by the way of combustion inside the engine cylinder where power is produced. The heat produced is nothing but the products of combustion. By expansion of this hot medium inside the cylinder, heat energy is converted into useful work. The name “Internal Combustion Engine” is a misnomer since the fuel is burnt internally.

2. What is the function of push rod and rocker arm?

The push rod and rocker arm actuates valves according to the engine stroke by cams.

3. What are the basic requirements of a fuel injection system of a diesel engine?

(i) The beginning as well as end of injection should take place sharply.

(ii) Inject the fuel at correct time in the cycle throughout the speed range of the engine.

(iii) The injection of fuel should occur at the correct rate and in correct quantity as required by the varying engine load.

(iv) Atomize the fuel to the required degree.

(v) Distribute the fuel throughout the combustion chamber for better mixing.

4. What are types of piston rings?

- Compression ring
- Oil ring

5. State the purpose piston providing piston in the IC engine.

- It acts as a movable gas tight seal to keep the gases inside the cylinder.

- It transmits the force of explosion in the cylinder to the crankshaft through connecting rod.

6. What is use of connecting rod?

The connecting rod inter connects the piston and the crank-shaft and transmits the gas forces from the piston to the crankshaft. It has two ends called small end and big end. The small end of the connecting rod is connected with piston by using a pin called gudgeon pin. The big end of the connecting rod is connected with crank pin by using a pin called crank pin.

7. What is meant by highest useful compression ratio?

The compression ratio which gives maximum efficiency is known as useful compression ratio

8. What is meant by scavenging in IC engines?

The process of removing the burnt gases from the combustion chamber of engine cylinder is known as Scavenging.

9. Define clearance volume and swept volume.

**CLEARANCE VOLUME:** The volume of the cylinder when the piston is at TDC is known as clearance volume.

**SEEPT VOLUME OR DISPLACEMENT VOLUME:** It is the volume generated by the working piston when it is travelling form dead center to next one.It is the product of piston area and stroke.

$$V_s = A \times L$$

10. Compare two stroke and four stroke engines.

<b>Four Stroke Cylinder Engine</b>	<b>Two Stroke Cylinder Engine</b>
1. For every two revolution of the crank shaft, there is one power stroke.	1. For every one revolution of the crank shaft, there is one power stroke.
2. Because of the above, turning moment is not so uniform and hence heavier flywheel is needed.	2. Because of the above, turning moment is more uniform and hence a lighter flywheel is used.
3. For the same power more space is required.	3. For the same power less space is required.

<p>4. Because of one power stroke in two revolutions, lesser cooling and lubrication requires. Lower rate of wear and tear.</p> <p>5. Valves are required – inlet and exhaust valves.</p> <p>6. Because of heavy weight, complicated valve mechanism and water cooled, making it complicated design and difficult to maintain.</p> <p>7. The air-fuel mixture is completely utilized thus efficiency is higher.</p> <p>8. Volumetric efficiency is high due to more time for induction.</p> <p>9. Lower fuel consumption per horse power.</p> <p>10. Used in heavy vehicles, e.g. Buses, lorries, trucks etc.</p> <p>11. The engine cost is more.</p> <p>12. The exhaust is less noisy.</p>	<p>4. Because of one power stroke for every revolution, greater cooling and lubrication requirements. Higher rate of wear and tear.</p> <p>5. Ports are made in the cylinder walls – inlet, exhaust, and transfer port.</p> <p>6. Simple in design, light weight and air cooled and easy to maintain.</p> <p>7. As inlet and exhaust port open simultaneously, some times fresh charges may escape with exhaust gases. The exhaust gases are not always completely removed. This cause lower efficiency.</p> <p>8. Volumetric efficiency is low due to lesser time for induction.</p> <p>9. The fuel consumption per horse power is more because of fuel dilution by the exhaust gas.</p> <p>10. Used in light vehicles, e.g. Motor cycle, scooter, etc.</p> <p>11. The engine cost is less.</p> <p>12. The exhaust is noisy due to short time available for exhaust.</p>
---	---

11. List out the various parameters involved in engine performance.

Brake power

Indicated power

Friction power

Total fuel consumption

Specific fuel consumption

Thermal efficiency

Mechanical efficiency

Mean effective pressure.

12. Compare SI and CI engines.

S.I. Engines	C.I. Engines
<ol style="list-style-type: none"> <li>1. The fuel used is gasoline (Petrol).</li> <li>2. Air + Fuel mixture is taken during suction.</li> <li>3. For mixing air and fuel a separate device called carburetor is required.</li> <li>4. Since homogeneous mixture is produced in carburetor, no need of injector.</li> <li>5. Pressure at the end of compression is about 10 bar.</li> <li>6. A spark plug is used to ignite the air fuel mixture.</li> <li>7. Self ignition temperature of fuel is not attained. In other words, the fuel is not self ignited.</li> <li>8. S.I. Engines works on Otto cycle (i.e) combustion takes place at constant volume.</li> <li>9. Compression ratio is around 6 to 10.</li> <li>10. Cold starting of engine is easy.</li> <li>11. These are very lighter.</li> <li>12. Cost is comparatively low.</li> <li>13. Running cost is high.</li> <li>14. Less maintenance.</li> <li>15. <math>\eta_{\text{thermal}}</math> is about 25%.</li> <li>16. Over heating trouble is more.</li> <li>17. Spark plug needs frequent maintenance.</li> <li>18. These are high speed engines.</li> <li>19. Noiseless operation due to less</li> </ol>	<ol style="list-style-type: none"> <li>1. Fuel used is Diesel.</li> <li>2. Only air taken during suction.</li> <li>3. No need of carburetor.</li> <li>4. For atomizing and spraying the fuel inside the cylinder, fuel injector is necessary.</li> <li>5. Pressure at the end of compression is about 35 bar.</li> <li>6. Spark plug is not necessary.</li> <li>7. The fuel get ignited due to the high temperature of compressed air.</li> <li>8. C.I. Engines works on diesel cycle (i.e) combustion takes place at constant pressure.</li> <li>9. Compression ratio is around 15 to 25.</li> <li>10. Cold starting of engine is difficult.</li> <li>11. Heavier engine.</li> <li>12. Cost is high.</li> <li>13. Running cost is not high.</li> <li>14. High maintenance is needed.</li> <li>15. <math>\eta_{\text{thermal}}</math> is about 35 to 45%.</li> <li>16. Over heating trouble is less.</li> <li>17. Fuel injector needs less maintenance.</li> <li>18. These are low speed engines.</li> <li>19. Very noisy operation due to high</li> </ol>

compression ratio.	compression ratio.
20. Engine weight / kW is less.	20. Engine weight / kW is more.
21. Vibration is less.	21. More vibration is there.
22. Generally employed for light duty vehicles e.g. two wheeler, Otto etc.	22. Generally employed for heavy duty vehicles e.g. trucks, buses, etc.

13. Name the basic thermodynamic cycles of the two types of internal combustion reciprocating engine.

Otto cycle - S.I engine

Diesel cycle - C.I engine

14. What is the use of flywheel?

Flywheel serves as a energy reservoir. It stores energy during power stroke and release during other strokes.

15. Define compression ratio.

It is the ratio of total volume of the cylinder to clearance volume of the cylinder.

$$r = V_1/V_2$$

$$= V_1/V_c$$

$$= (V_s + V_c) / V_c$$

Compression ratio of S.I engine= 6 to 10

Compression ratio of C.I engine= 12 to 16

16. Define the term mean effective pressure.

It is defined as the algebraic sum of the mean pressure acting on the piston during one complete cycle.

17. Why the actual cycle efficiency is much lower than the air standard cycle efficiency? List and explain the major losses in an actual engine.

Theoretically, the compression and expansion are followed adiabatically. But in actual cycle it is not so. Because of the heat and pressure losses are involved.

Actual area on p-v diagram per cycle is less than theoretical because of lower pressure rise and pumping losses.

Major losses in an actual engine:

- Heat rejected to the cooling water
- Heat carried away by exhaust gas
- Heat loss during radiation

18. State the air fuel ratio requirements of SI engine under varying operating conditions.

For normal running = 1:15

For maximum power = 1:12

For idling and slow running = 1:14

For cold starting = 1:8

19. Differentiate between ideal and actual valve timing diagram of petrol engine.

**THEORETICAL VALVE TIMING DIAGRAM:**

The theoretical Valve Timing Diagram, inlet valve and exhaust valve open and close at both dead centers. Similarly, all the process sharply completed at the TDC and BDC.

**ACTUAL VALVE TIMING DIAGRAM:**

The inlet valve opens 10-30° before the TDC. The air fuel mixture is sucked in to the cylinder till the inlet valve close.

The inlet valve closes 30-40° or even 60° after the BDC. The charge is compressed till the spark occurs.

The spark is produced 20-40° before the TDC. This gives sufficient time for the fuel to burn. The pressure and temperature increase. The burnt gases expand till the exhaust opens.

The exhaust valve opens 30-60° before the BDC. The exhaust gases are forced out from the cylinder till the exhaust valve closes.

The exhaust valve closes 8-20° after the TDC. Before it closes, again the inlet valve opens 10-30° before the TDC

20. Define the term valve timing diagram.

The timing of sequence of events such as inlet valve opening, inlet valve closing, ignition exhaust valve opening and exhaust valve closing can be represented graphically in terms of crank angles from dead centre position. This diagram is known as "Valve Timing Diagram.

21. Describe briefly the determination of friction power.

Friction power of an engine may be defined as the difference between the indicated power and the brake. Two kinds of losses occur in the engine. They are pumping losses and friction losses. The friction loss is made up of the friction between the piston and cylinder walls, piston rings and cylinder walls, and between the crank shaft and cam shaft and their bearings etc. The friction power can be determined by using

Friction power = Indicated power – Brake power

$$F.P = I.P - B.P$$

22. Differentiate between brake power and indicated power of an I.C Engine.

(i) Indicated power is defined as the power actually developed by the engine in the engine cylinder

(ii) Brake power is defined as the power available at the crankshaft. It is always less than the indicated power.

23. Differentiate between SFC and TFC in the engine performance.

SFC means specific fuel consumption which is defined as the fuel consumed by the engine in Kg for producing 1Kw-hr of power.

TFC means total fuel consumption which is defined as the fuel consumed by the engine in kg for 1hr operation.

24. Which is better efficient two stroke or four stroke engines? Why?

Two-stroke engine gives always lesser efficiency than four strokes due to incomplete combustion and poor scavenging.

25. What is carburetion and carburetor?

(i) The process of vaporizing the fuel and mixing it with air in a carburetor is called as carburetion

(ii) A carburetor is a device which vaporizes the fuel and mixed it with the air.

26. State any four function of carburetor

- It maintains a small reserve of petrol in a float chamber at a constant head.
- It atomizes and vaporizes the fuel
- It prepares a mixture of petrol and air in correct proportions.
- It supplies a fine spray of petrol.

27. Why a choke is used in carburetor and what is meant by automatic chocking?

Initially, more fuel is required to reduce high starting torque which is done by using a choke. After reaching average torque, the excess fuel supply until will be cut off by a choke called automatic chocking.

28. What are the limitations of simple carburetor?

(i) It gives correct air-fuel mixture at only one engine speed and load. Not suitable for varying speed and load conditions.

(ii) Because at high speed engine requires weak or lean mixture and at slow speed engine requires rich mixture.

(iii) The working of a simple carburetor is affected by the changes in atmospheric conditions like pressure and temperature.

29. List the various circuits' available in solex carburetor.

- Starting circuit
- Normal running circuit



- Acceleration circuit
- Idling circuit and slow running circuit.

30. What are the important requirements of fuel injection system?

- The beginning as well as end of injection should take place sharply
- The Injection of fuel should occur at the correct rate and in correct quantity as required by the vary engine load
- Inject the fuel at correct time in the cycle throughout the speed range of the engine.
- Atomize the fuel to the required degree.
- Distribute the fuel throughout the combustion chamber for better mixing.

31. Mention different types of fuel injection system in C.I engines.

(a) Air injection system

(b) Airless or solid injection

- Common rail system
- Individual pump system

32. What do you understand by air injection and solid injection?

AIR INJECTION SYSTEM:

In this method, initially air is compressed to a very high pressure by means of compressor. The fuel was metered and pumped to the nozzle, which was also connected to a source of high-pressure air. When the nozzle was opened, the air would sweep the fuel into the engine and deliver a well atomized spray

AIRLESS INJECTION:

The fuel under pressure is directly injected into the combustion chamber in atomized state. It requires a pump to deliver the fuel at high pressure (as high as 300 bar as).

33. What are types of nozzles?

- Single hole nozzle
- Multihole nozzle pintle type
- Pintex type

34. Define governing?

Governing is the process of varying the fuel supply. It is done to maintain constant speed through the load is changed.

35. What are the functions of governor?

- When the load is increased, it must supply more fuel to the engine to maintain same speed.
- When the load is decreased, it must supply less fuel to the engine to maintain the same speed.

36. What are the different types of governing systems?

- Quantity governing
- Quality governing
- Combined Quantity and Quality governing
- hit and miss governing

37. List the advantage of electronic ignition system over the conventional systems.

- The parts such as regulator, magnetic pickup and electronic module are not subjected to wear and tear as a mechanical contact breaker.
- Periodic adjustment of engine timing is not necessary.
- It gives very accurate control timing.

38. What is the necessity of cooling in I.C engine?

- (i) The high temperature reduces the strength of the materials used for piston and piston rings.
- (ii) The large temperature differences between the engines parts may cause unequal expansion, resulting in cracking of the parts and thereby the engine failure.
- (iii) At high temperature, the lubricating oil may be heated up to such an extent heat decomposition of lubricating oil occurs and viscosity changes may render it unfit for effective lubrication.
- (iv) At high temperatures, the lubricating may even evaporate and burn, injuring piston and cylinder surfaces. Piston seizure due to overheating, resulting from the failure of the lubrication is quite common.
- (v) The overheating causes excessive thermal stresses in the engine parts, which may lead to their distortion.
- (vi) The overheating may cause burning of valves and valve seats.
- (vii) In petrol engines, the pre-ignition of the charge is possible, if the ignition parts initially are at high temperature.

(viii) The overheating reduces the efficiency of the engine.

39. Define delay period with respect to a CI engine.

The physical delay is the time between the beginning of injection and the attainment of chemical reaction conditions. During this period fuel is atomized, vapourised, mixed with air and raised to its self ignition temperature.

During the chemical delay reactions start slowly and then accelerate until ignition takes place. Generally the chemical delay is larger than physical delay.

40. What is the purpose of a thermostat in an engine cooling system?

A thermostat valve is used in the water-cooling system to regulate the circulation of water in system to maintain the normal working temperature of the engine parts during the different operating conditions.

41. What are the methods of water cooling system?

- Direct or non-return system
- Thermosyphon system
- Forced circulation cooling system
- Evaporative cooling system
- Pressure cooling system

42. Define function and types of lubrication system.

The function of the lubrication system is to provide sufficient quantity of cool, filtered oil to give used for internal combustion engines may be classified as

- (i) Petrol lubrication system
- (ii) Wet sump lubrication system
- (iii) Dry sump lubrication system

43. List the properties of lubrication system.

- Viscosity
- Viscosity Index
- Cloud Point and Pour Point

- Flash Point
- Specific Gravity
- Carbon Residue
- Oil ness
- Oxidation Stability
- Cleanliness
- Colour

44. State any four functions of lubrication.

- It reduce friction between moving parts
- It reduce wear and tear of the moving parts
- It minimizes the power loss due to friction.
- It provides cooling effect

45. Name the eight air pollutants.

Carbon monoxide	Oxide of nitrogen
Hydrocarbons	photochemical smog
Smoke	Lead
Particulate	Sulphur oxide.

46. Explain exhaust blow down in case of I.C engines.

The opening of the exhaust valve during the expansion stroke itself before the piston reaches BDC which enables the exhaust gas to leave under pressure is known as exhaust blow down.

47. What is ignition delay?

Time interval between the instant of spark and the instant of pressure raise is due to combustion. This time interval or time lay is known as Ignition lag or Ignition delay or delay period.

48. Define after burning.

The burning of fuel after maximum pressure is known as after burning. The velocity decrease during this stage. The rate of combustion becomes low due to lower flame velocity and reduced flame front surface.

49. What is mean by auto-ignition?

If the temperature of an air-fuel mixture is raised high enough, the mixture will self-ignite without the need of a plug. This phenomenon is called as self-ignition or auto ignition. The temperature above which self-ignition occurs called the self ignition temperature.

50. What do you understand by the term knocking?

If the temperature of the unburnt mixture exceeds the self-ignition temperature during the ignition delay period, auto ignition occurs at various locations in the cylinder. This will generate pressure pulses. These high-pressure pluses can cause damage to the engine and quite often are in the audible frequency range. This phenomenon if often called knocking or detonation.

51. What do you understand the diesels knock?

If the delay period is long, a large amount of fuel will be injected and accumulated in the combustion chamber. The auto-ignition on this large amount of fuel may cause high rate of pressure raise. This high pressure rise causes the heavy vibration of the engine and creates lot of noise. This phenomenon of combustion causing heavy pressure raise during uncontrolled combustion is known as Diesel knock.

52. What do you by mist lubrication?

About 3 to 6% of lubrication oil mixed with petrol in the fuel tank. Here, there is no separate sump and pump. The oil mixing with petrol acts as a lubricant. It is the simplest types of lubrication. This method is used in light vehicle such as motor cycle and scooters.

53. What is doping?

Detonation in S.I engines can be suppressed or prevented addition of only a small quantity of tetraethynal lead. This process is called Doping.

54. Mention any four methods to prevent the knocking.

- By reducing the delay period by doping
- By increasing the turbulences' of the compressed air injected, promotes homogenous mixture by strapping the fuel from the spray.
- By arranging the fuel injector in such a way as to inject only a small quantity of fuel in the beginning.
- By supercharging to increase inlet pressure air.

55. List down any two effects of knocking.

- The lack of control of combustion process leads to pre-ignition and local over-heating. Therefore piston may be damaged by over-heating.
- Detonation results in increased carbon deposits on the wall of the cylinder.