**ME 2041 – ADVANCED IC ENGINES**

**UNIT II**

**COMPRESSION IGNITION ENGINES**

**1. What are the stages of combustion in C.I engine?**

The stages of combustion in C.I engine are four tages:

Stage 1: ignition delay period (preparatory phase)

Stage 2: Period of rapid combustion.

Stage 3: Period of controlled combustion.

Stage 4: Period of after burning.

**2. What is ignition delay period?**

The fuel does not ignite immediately upon injection into the combustion chamber. There is a definite period of inactivity between the time when the first droplet of fuel hits the hot air in the combustion chamber and the time it starts through the actual burning phase. This period is known as ignition delay period.

**3. What are two delays occur in ignition delay period?**

The two delays occur in ignition delay period are the physically delay and chemically delay. Physical delay is the time between the beginning of injection and the attainment of chemical reaction conditions. Chemical delay is the reaction starts slowly and then accelerates until the inflammation or ignition takes place.

**4. List the factors affecting the delay period?**

The factors affecting the delay period are:

1. Compression ratio. 2. Atomization of the fuel. 3. Quality of the fuel. 4. Intake temperature and pressure.

**5. Explain the effect of quality of fuel factor on the delay period?**

Self-ignition temperature is the most important property of the fuel which affects the delay period. A lower self-ignition temperature and fuel with higher cetane number give lower delay period and smooth engine operation. Other properties of the fuel which affects the delay period are latent heat, viscosity and surface tension.

**6. Give a comparative statement various characteristics that reduces knocking in S.I and C.I engine (any four).**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.NO** | **CHARCTERISTICS** | **S.I ENGINE** | **C.I ENGINE** |
| 1 | Ignition temperature of fuel | High | Low |
| 2 | Ignition delay |  Long | Short |
| 3 | Compression ratio |  Low | High |
| 4 | Inlet temperature and pressure |  Low |  High |

**7. Write the classification of combustion chamber in C.I engine.**

Combustion chamber in C.I engine is classified into two categories:

1. Direct-injection type 2. Indirect-injection type.

**8. What is called direct injection type of combustion chamber?**

Direct injection type of combustion chamber is also called an open combustion In this type the entire volume of the combustion chamber is located in the main cylinder and the fuel is injected into this volume.

**9. What are the types of open combustion chamber?**

In open combustion chamber there are many designs some are

a. Shallow depth chamber b. Hemisherical chamber

c. Cylindrical chamber d. Toroidal chamber

**10. What are the advantages and disadvantages of open combustion chamber type?**

**Advantages:**

1. Minimum heat loss during compression because of lower surface area to volume ratio

2. No cold starting problems

3. Fine atomization because of multihole nozzle

**Disadvantages:**

1. High fuel injection pressure required and hence complex design of fuel injection pump

2. Necessity of accurate metering of fuel by the injection system, particularly for small engines.

**11. What is indirect injection type of combustion?**

Indirect injection type of combustion chamber in which the combustion space is divided in to two or more distinct compartment connected by restricts passages. This creates considerable pressure difference between them during the combustion process.

**12. Write the classification of indirect injection chamber (divided combustion**

 **chamber)**

 Classification of divided combustion chamber is,

a. Swirl chamber – in which compression swirl is generation.

b. Precombustion chamber – in which combustion swirl is induced.

c. Air cell chamber – in which both compression and combustion swirl are induced.

**13. What are the applications of swirl chamber?**

Swirl chamber type finds application,

a. Where fuel quality is difficult to control.

b. Where reliability under adverse condition is more important than fuel

 economy.

c. Use of single hole of larger diameter for the fuel spray nozzle is

 often important consideration for the choice of fluid chamber engine.

**14.) List the advantages and drawbacks of indirect injection chamber.**

**Advantages:**

1. Injection pressure required is low

2. Direction of spraying is not very important

**Disadvantages:**

1. Poor cold starting performance required heater plugs

2. Specific fuel consumption is high

1**5. Why specific fuel consumption is high in indirect injection type combustion chamber?**

Specific fuel consumption is high because there is a loss of pressure due to air motion through the duct and heat loss due to large heat transfer area.

**16. What is turbo charging?**

Energy available in the engines exhaust gas is used to drive the the turbocharger compressor, which raises the inlet fluid density prior to entry to each engine cylinder. This is called turbo charging.

**17. What are the major parts of a turbocharger?**

The major parts of a turbocharger are turbine wheel, turbine housing, turbo shaft, compressor wheel, compressor housing and bearing housing.

**18. Explain the term turbo lag.**

In case of turbo charging there is a phenomenon called turbo lag, which refers to the short delay period before the boost or manifold pressure, increase. This is due to the time the turbocharger assembly takes the exhaust gases to accelerate the turbine and compressor wheel to speed up.

**19. Explain the function of waste gate.**

In the turbocharger assembly there is a control unit called waste gate. It is a diaphragram operated value that can bypass part of the gases around the turbine wheel when manifold pressure is quite high this unit limits the maximum boost pressure to prevent detonation in S.I engines and engine damage.

**20. Why there is a large pressure differences across the injector nozzle are required:**

The fuel is introduced in to the cylinder of a diesel engine through a nozzle with a large pressure differences across the nozzle jet will enter the chamber at high velocity to

1. Atomize in to small sized droplets to enables rapid evaporation and

2. Traverse the combustion chamber in the time available and fully utilize the air charge.

**21. What is called break up length?**

The liquid column bearing the nozzle disintegrates within the cylinder over a Finite Length called the break up length in to drops of different sizes.

**22. What are the different designs of nozzle used?**

The different design of nozzle used is single orifice, multiorifice, throttle or pintle depending on the needs of the combustion system employed.

**23. What are the two types of photographic technique used?**

To distinguish the liquid – containing core of the jet and the extracts of the fuel vapor region of the spray, which surrounds the liquid core, two types of photographic technique used are backlighting and shadow graph.

**24. Explain photographic techniques method:**

Back lighting identifies region where sufficient liquid fuel (as ligaments or drops) is present to attenuate the light.

The shadowgraph technique responds to density gradients in the test section so it identifies regions where fuel vapor exists.

**25. List the droplet size depends on various factors:**

The droplet sizes depends on various factors are,

1. Mean droplet size decreases with increases in

a. Injection pressure b. Air density

2. Mean droplet size increases with increases in fuel viscosity.

3. Size of droplets increases with increases in the size of the orifice.

**26. Define flame development angle:**

The crank angle interval between the spark discharge and the time when a small but significant fraction of the cylinder mass has burned or fuel chemical energy has been released.

**27. Define rapid burning angle:**

The crank angle interval required to burn the bulk of the charge is defined as the interval between the end of the flame development stage and the end of the flame propagation process.