

# QUESTION BANK

## SUB: APPLIED THERMODYNAMICS

### Unit No. I

#### Part A: Basics of IC Engines

1. Define the following terms:
  - a. Engine b. Heat engine c. IC engine d. EC engine
2. Discuss the relative merits and demerits of IC and EC engines. Give their examples.
3. Write a short note on classification of IC engines.
4. List the basic components of IC engine. Explain their functions and name their materials.
5. Explain the working of 4 stroke SI engine with the help of a schematic sketch.
6. Explain the working of 4 stroke CI engine with the help of a schematic sketch.
7. Compare 4 stroke and 2 stroke engines.
8. Discuss the field of applications of IC engines.
9. Compare SI and CI engines.
10. With a neat sketch explain the working of 2 stroke engine.
11. With the help of neat diagram, explain the engine nomenclature.
12. Draw a valve timing diagram of 4 stroke petrol engine and explain.
13. Draw a valve timing diagram of 4 stroke diesel engine and explain.
14. Explain intake and exhaust systems of IC engine with the help of block diagram. State the function of each component.
15. Define intake and exhaust manifold explain their design requirements.

#### Part B: Fuel Air Cycle and Actual Cycle

1. Explain the importance / significance of fuel air cycle and how far it is useful in predicting the performance of actual engines.
2. Explain the characteristics features of fuel air cycle.
3. Give the limitations of air standard cycle. Explain with suitable graphs, the effect of dissociation on maximum temperature and brake power. How does presence of CO affect dissociation?
4. What are the effects of operating variables on the performance of fuel air cycle?
5. What will be the effect of variables on engine performance, viz.:
  - i) Compression ratio on thermal efficiency.
  - ii) Fuel air ratio on thermal efficiency.
  - iii) Fuel air ratio on maximum pressure and maximum temperature.
  - iv) Fuel air ratio on exhaust gas temperature.
6. Why the actual cycle efficiency is much lower than the air standard efficiency? List the major losses in an actual engine.
7. Explain how does actual cycle deviates from theoretical cycles.

8. Why actual cycle does differ from fuel air cycle?
9. Explain the following losses associated with actual engine:
  - i) Time loss
  - ii) Direct heat loss
  - iii) Exhaust blow down loss
  - iv) Pumping loss
  - v) Rubbing friction loss
10. Draw theoretical and actual P-V diagrams for an Otto cycle and list the assumptions made.

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**Unit II**  
**SI Engine**  
**Part A: Fuel Supply system of SI engine**

1. What is carburetion? Explain the various factors affecting the process of carburetion.
2. Explain different types of mixtures used in I.C. engines.
3. Explain the mixture requirements with necessary graphs for power and economy.
4. Explain the mixture requirements with necessary graphs:
  - i) For steady state operation
  - ii) For transient conditions.
5. What are the air fuel ratio requirements of a petrol engine at different loads and speeds?
6. Explain the working principle of carburetor. What are the limitations of a simple carburetor?
7. Explain the various systems used in modern carburetor viz. main metering system, idling system, economizer system, acceleration pump system, choke.
8. What are different types of carburetor? Sketch and explain any one type of complete carburetor.
9. Write a short note on MPFI system / petrol injection. What are the advantages of it over carburetion system

## **Part B: Combustion in SI Engines**

1. Discuss the effects of following engine variables on flame propagation:
  - a. Fuel air ratio
  - b. compression ratio
- 2.. Explain the factors which affect the tendency of detonation.
3. Explain any three types of combustion chambers used in SI engines.
4. What is surface ignition (pre-ignition)? How does it lead to detonation in SI engines?
5. What is ignition lag in SI engines? Discuss the effect of various engine variables on ignition lag of SI engine.
6. How the knock can be detected in SI engine? What are the methods to control knocking in SI engine? What are its harmful effects?
7. Describe with the help of neat diagram the combustion phenomenon in SI engines.
8. What are the effects of engine variables on detonation of SI engines?
9. What are the requirements of combustion chambers for SI engines?
10. Explain Sir Recardo's combustion chamber.
11. Write a short note on fuel rating of SI engine.
12. Explain the factors which influences flame speed in SI engines.
13. Explain the difference between  
Pre-ignition, Auto-ignition, Detonation
14. Auto-ignition is the cause of detonation. Justify the statement.

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**Unit III**  
**CI Engine**  
**Part A: Fuel Supply system of CI engine**

1. State the functional requirements of fuel injection system. How the injection systems classified?
2. What are the basic elements of CI fuel injection system? Explain their functions with the help of neat diagram.
3. Explain different types of solid fuel injection systems.
4. Explain with neat sketch construction and working of fuel injection pump / Bosch fuel pump / Jerk type fuel pump.
5. Explain the principle of helix bypass pump and draw sketches for different types of plunger helix in use.
6. Explain the working of fuel injector / automatic fuel injector with the help of neat sketch.
7. Enumerate the functions carried out by nozzle in an injector.
8. Explain with neat sketches different types of nozzles used in injectors.

## **Part B: Combustion in CI Engines**

1. Explain phenomenon of diesel knock. Compare it with phenomenon of detonation in SI engines.
- 2.. Explain the following factors which affect the ignition delay period:
  - a. Fuel
  - b. Injection pressure
  - c. Compression ratio
  - d. Speed
3. Explain the stages of combustion in CI engine.
4. What is swirl in CI engine? Explain different methods of swirl generation. State advantages and disadvantages of compression swirl.
5. What is direct injection type combustion chamber for a CI engine? What are different types of this combustion chamber? Explain any one type.
6. Write a short note on fuel rating of CI engine.
7. Differentiate between DI and IDI (pre) combustion chambers.
8. Explain the difference between the combustion process in SI and CI engines.
9. What are desirable characteristics of combustion chamber for CI engine.

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**Unit No. IV**  
**Part A: Testing and Performance of I.C. Engines**

1. What is the dynamometer? Name various types of it and explain prony brake type with neat sketch. *Note any type can be asked*
- 2.. Write short notes on
  - a. Importance of heat balance sheet
  - b. Various factors affecting volumetric efficiency.
3. Explain in brief following terms used in testing of I.C. engines:
  - a. Indicated mean effective pressure
  - b. Indicated power
4. Discuss Morse test used during performance testing of I.C. engines.
5. What is the necessity of I.C. engine testing? What are the basic measurements carried out for I.C. engine testing?
6. List the different method used to determine the frictional power of I.C. engines. Explain any one method with the help of neat diagram.
7. What are I.C. engine performance characteristics (SI and CI both)? How are they used for engine performance evaluation?
8. What is a trial (testing) of I.C. engines? Write the importance of the following performance parameters in connection with I.C. engines:
  - a. Mechanical efficiency
  - b. Thermal efficiency
  - c. Specific fuel consumption
  - d. Volumetric efficiency
  - e. Mean effective pressure
  - f. BP, IP, FP
  - g. Air fuel ratio [2 Marks each]
9. Explain Willan's line method of finding out frictional power of I.C. engines.

## **Part B: – Supercharging and Turbocharging**

1. Write short notes on the following:
  - a. Supercharging
  - b. Turbocharging
2. What is the effect of supercharging on following operating parameters of CI engines?
  - a. Power output
  - b. Fuel consumption
  - c. Mechanical efficiency
3. What is constant pressure turbocharging? State its advantages and disadvantages over other methods of turbocharging in CI engine.
4. Why single cylinder engines are not generally supercharged? What are the advantages and disadvantages of turbocharging?
5. What are different methods of supercharging?
6. What is turbocharging? Explain the thermodynamic cycle with turbocharging.
7. Write a short note on pulse turbocharging.
8. Differentiate between supercharging and turbocharging.

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## **Unit V**

### **Part A: I.C. Engine Systems**

#### **Cooling System**

1. What is the necessity of cooling of I.C. engines? Sketch and explain thermostatic cooling system.
2. What are the harmful effects of overheating of I.C. engines?
3. What are the requirements of good cooling system?
4. Compare water cooling and air cooling?
5. Explain with neat sketches radiator and thermostat valve.
6. What are the advantages of pressurized water cooling? Discuss the working of such a system.
7. Explain radiator. What is the purpose of the fan in the radiator system?
8. What are the types of water cooling systems? Explain any one of them with neat sketch.
9. Differentiate between evaporative cooling and forced cooling.
10. What are antifreeze solutions? Which properties they should have? State any for commonly used antifreeze solutions mentioning the most preferred among them with reasons.

#### **Lubrication System**

1. State the functions of lubrication system in I.C. engines. List down the components to be lubricated.
2. What is meant by mist lubrication system? List down its advantages and disadvantages.
3. Explain any one type of wet sump lubrication system with neat sketch.
4. Explain pressurized lubrication system.
5. Explain dry sump lubrication system.
6. What are the desirable properties of ideal lubricant?

#### **Ignition System**

1. What are the requirements of good ignition system? Explain battery ignition system with sketch.
2. Explain with neat sketch working of magneto ignition system.
3. Compare battery ignition system with magneto ignition system.
4. Explain the components and working of transistor controlled ignition system. What are its advantages over conventional contact breaker system?
5. Explain with the help of neat diagram the working of capacitive discharge ignition system.

6. Explain with the help of neat diagram any one type of ignition / spark advance mechanism used on engine.
7. Explain firing order for I.C. engines.

### **Governing and Starting System**

1. Why governing of I.C. engine is required? Explain hit and miss governing.
2. What is governing of I.C. engines? State the types of governing. Explain the Quality and Quantity governing.
3. CI engines are quality governed and SI engines are quantity governed. Explain.
4. What are the requirements of good governor?
5. Why starting system is necessary for I.C. engines? List various methods describing any one of them.

### **Part B: I.C. Engine Emissions and Control**

1. What is air pollution? Discuss various types of exhaust emissions from an automobile (SI and CI both). Which of these are harmful?
- 2.. What are Euro-III and Bharat Norms? List these norms for petrol and diesel engines.
3. What are the major pollutants found in SI and CI engine emissions?
4. Write a short note on emission norms in India.
5. Explain with the help of neat diagram exhaust gas recirculation system. Or how to reduce Nox emissions from the engine?
6. Write a short note on effects of different automobile pollutants on human life.
7. What are the sources of HC formation in petrol engine? Explain various factors which affect the HC formation.
8. Write short notes on the following:
  - a. Factors affecting formation of Nox
  - b. Diesel engine emissions
9. State PUC norms in India for different types of vehicles.
10. What are various emission control methods used in I.C. engines.
11. Explain with the help of neat sketch the working of catalytic converter (3 way).

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**Unit No. VI**  
**Positive Displacement Compressors (Reciprocating and Rotary)**  
**Part A: Reciprocating Compressor**

1. Derive an expression for volumetric efficiency of a reciprocating air compressor.

OR

Prove the volumetric efficiency of an air compressor is given by

$$\eta_v = 1 + C - C \left[ \frac{P_2}{P_1} \right]^{\frac{1}{n}} \text{ with usual notations.}$$

2. Define:

- i. Isothermal efficiency
- ii. Volumetric efficiency

3. Derive an expression for intermediate pressure for two stage compression with perfect intercooling. State the assumptions.

OR

Prove that, for multistage reciprocating air compression, the intermediate pressure, with perfect intercooling and for minimum work input, is geometric mean of its neighboring pressures.

4. Explain actual indicator diagram of a single stage reciprocating compressor. Explain with the help of neat sketch, any one capacity control method used for reciprocating compressors.
5. Draw P-V and T-S diagram for a single stage reciprocating air compressor, without clearance. Derive the expression for work done when compression is isothermal and isentropic.
6. Explain throttle control of compressors.
7. What are the advantages of multistaging of reciprocating compressor.
8. Explain the methods to improve isothermal efficiency of a compressor.
9. Define the following terms for reciprocating compressors:
- i. Mechanical efficiency
  - ii. FAD
10. Explain why multistaging is required in case of compressors.

**Part B: Rotary Compressor**

1. Explain any one type of rotary compressor with neat sketch.
2. Compare reciprocating compressor with rotary compressor.

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