` SYED AMMAL ENGINEERING COLLEGE
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Established in 1998 - An ISO 9001:2008 Certified Institution
Dr. E.M.Abdullah Campus,Ramanathapuram – 623 502.
Phone: 304001, 304002 (04567) Fax: 304123(04567)
Web: www.syedengg.ac.in E.mail:saec@syedengg.ac.in

ME6404 THERMAL ENGINEERING

2Marks Question and Answers

Prepared by C.Thirugnanam AP/Mech

UNIT I - GAS POWER CYCLES

1. What is a thermodynamic cycle?

Thermodynamic cycle is defined as the series of processes performed on the system, so that the system attains its original state.

2. What are the assumptions made for air standard cycle analysis?

(i)The working medium is a perfect gas throught i.e., It follows the law

PV = mRT

(ii)The working medium does not undergo any chemical change throughout The Cycle.

(iii)The compression and expansion processes are reversible adiabatic i.e., There is no loss or gain of entropy.

(iv)The operation of the engine is frictionless.

3. Mention the various processes of dual cycle.

(i) Isentropic compression.

(ii) Constant pressure heat supplied.

(iii) Isentropic expansion, and

(iv) Constant pressure heat rejection.

4. Define air standard cycle efficiency.

Air standard efficiency is defined as the ratio of work done by the cycle to heat supplied to the cycle.

5. Define mean effective pressure as applied to gas power cycles.

Mean effective pressure is defined as the constant pressure acting on the piston during the working stroking. It is also defined as the ratio of work done to the stroke volume or piston displacement volume.

6. Define the following terms (i) Compression ratio (ii) Cut off ratio and (iii) Expansion ratio?

(i) Compression ratio is defined as the ratio between total cylinder volumes to clearance volume.

(ii)Cut off ratio is defined as the ratio of volume after the heat addition to volume before the heat addition.

(iii) Expansion ratio is the ratio of volume after the expansion to the volume before expansion.

7. Which cycle is more efficient with respect to the same compression ratio?

For the same compression ratio, Otto cycle is more efficient than diesel
cycle.

8. For the same compression ratio and heat supplied, state the order of decreasing air standard efficiency of Otto, diesel and dual cycle.

η Otto > η Dual > η Diesel

9. Name the factors that affect air standard efficiency of Diesel cycle.

Compression ratio and cut-off ratio.

10. What is the effect cut-off ratio on the efficiency of diesel cycle when the compression ratio is kept constant?

When cut-off ratio of diesel cycle increases, the efficiency of cycle is decreased when compression ratio is kept constant and vice versa.

11. Write any four major differences between Otto and diesel cycle.

S	**Otto cycle**	**Diesel cycle**
1	It consists of two isentropic and two constant volume processes.	It consists of two isentropic, one constant volume and one constant pressure processes.
2	Heat addition takes place	Heat addition takes place of constant
3	Compression ratio is equal	Compression ratio is greater than
4	Efficiency is more than diesel cycle for the same compression ratio and heat input.	Efficiency is less.

UNIT II –INTERNAL COMBUSTION ENGINES

1. List the various components of engine.

(i)Cylinder block
(ii)Cylinder head
(iii)Crankcase
(iv) Cylinder liners
(v) Piston& piston rings

2. Name the basic thermodynamic cycles of the two types of internal combustion reciprocating engines.

Otto cycle in S.I engines and diesel cycle in C.I engines.

3. Define compression ratio of an IC engine?

It is the ratio of volume when the piston is at BDC to the volume when the piston is at TDC.

4. Define the terms Mean effective pressure?

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

5. What is meant by highest useful compression ratio?

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

6. Why compression ratio of petrol engines is low while diesel engines have high compression ratio?

Since fire point of petrol is less as compared to diesel, petrol engine has low compression ratio.

7. Compare the thermal efficiency of petrol engines with diesel engines. Give reasons.

Thermal efficiency of diesel engine is greater than petrol engine this is due to high
compression ratio.

8. What do you mean by scavenging in I.C. Engines?

The process of removing the burnt gases from the combustion chamber of engine cylinder by using fresh air fuel mixture is known as Scavenging.

9. Define Cetane number?

The property that quantities the ignition delay is called as Cetane number.

10. Which is better efficient two stroke or four stroke engines?

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

11. 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 supply unit will be cut off by a choke called automatic choking.

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

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

13. Mention different types of fuel injection systems in C. I engines.

a) Air injection system
b) Airless or Solid injection
(i) Common rail system
(ii) Individual pump system.

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

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

During the chemical delay reactions start slowly and then accelerate until ignition takes place.

15. What is the purpose of providing spark plug in SI engine?

The function of a spark plug is to produce an electric spark for the ignition of compressed air-fuel mixture inside the engine cylinder.

16. 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.

17. State any three functions of lubrication?

a) It reduces friction between moving parts.
b) It reduces wear and tear of the moving parts. c) It minimizes power boss due to friction.

UNIT III -STEAM NOZZLES AND TURBINES

1. What are the various types of nozzles and their functions?

Nozzle is a duct of varying cross-sectional area in which the velocity increases with the corresponding drop in pressure.

2. What are the effects of friction on the flow through a steam nozzle?

1. The final fraction of the steam is increased as the part of the kinetic energy gets converted into heat due to friction and absorbed by steam with n increase in enthalpy.
2. The expansion is no more isentropic and enthalpy drop is reduced thereby resulting in lower exit velocity.
3. The specific volume of steam is increased as the steam becomes drier due to this frictional reheating.

3. Define nozzle efficiency and critical pressure ratio.

Nozzle efficiency: It is defined as the ratio of actual enthalpy drop to the isentropic enthalpy drop

Nozzle efficiency = Actual enthalpy drop / Isentropic enthalpy drop

Critical pressure ratio: There is only one value of the ratio (P2/P1) which produces maximum discharge from the nozzle. The ratio is called critical pressure ratio.

$$\text{Critical pressure ratio } P_2/P_1 = (2/n+1)^{n/n+1}$$

Where,

P_1 = Initial pressure

P_2 = Throat pressure.

4. ***Explain the phenomenon of super saturated expansion in steam nozzle.***

Or

What is Meta stable flow*?*

When the supersaturated steam is expanded in the nozzle, the condensation should occur in the nozzle. Since the steam has a great velocity, the condensation does not take place at the expected rate. So the equilibrium between the liquid and vapour phase is delayed and the steam continues to expand in a dry state.

The steam in such set of condition is said to be supersaturated or meta stable flow.

5. What are the conditions that produce super saturation of steam in nozzles?

When the superheated steam expands in the nozzle, the condensation will occur in the nozzle. Since, the steam has more velocity, the condensation will not take place at the expected rate. So, the equilibrium between the liquid and vapour phase is delayed and the steam continues to expand in a dry state. The steam in such set of condition is said to be supersaturated or meta stable flow.

6. What are the effects of super saturation in a steam nozzle?

The following effects in a nozzle on steam, in which super saturation occurs, may be summarized as follows.

1. The dryness fraction of the steam is increased.
2. Entropy and specific volume of the steam are increased.
3. Exit velocity of the steam is reduced.
4. Mass of stream discharged is increased.

7. What are the differences between supersaturated flow and isentropic flow through steam nozzles?

Supersaturated flow	Isentropic flow
Entropy is not constant	Entropy is constant
Reduce in enthalpy drop .	No reduce in enthalpy drop
We cannot use mollier diagram to solve problems	We can use mollier diagram to solve problems.

8. What is a steam turbine?

Steam turbine is a device which is used to convert kinetic energy of steam into mechanical energy.

9. Explain the need of compounding in steam turbines. (Or)
Explain the purpose of compounding in steam turbines.

In simple impulse turbine, the expansion of steam from the boiler pressure to condenser pressure takes place in a single stage turbine. The velocity of steam at the exit of turbine is very high. Hence, there is a considerable loss of kinetic energy (i.e. about 10to 12%). Also the speed of the rotor is very high (i.e. up to 30000rpm). There are several methods of reducing this speed to lower value. Compounding is a method of absorbing the jet velocity in stages when the steam flows over moving blades.

10. What are the different methods of compounding?

1. Velocity compounding
2. Pressure compounding
3. Pressure-velocity compounding

11. What is meant by carry over loss?

The velocity of steam at exit is sufficiently high thereby resulting in a kinetic energy loss called "Carry over loss" or "Leading velocity loss".

12. What is the fundamental difference between the operation of impulse and reaction steam turbines?

Impulse Turbine	Reaction turbine
It consists of nozzles and moving blades.	It consists of fixed blades and moving blades.
Pressure drop occurs only in nozzles not in moving blades.	Pressure drop occurs in fixed as well as moving blades.
Steam strikes the blades with kinetic energy.	Steam passes over the moving blades with pressure and kinetic energy.
It has constant blade channels area.	It has varying blade channels area.

UNIT IV - AIR COMPRESSOR

1. Classify the various types of air compressors.

1. According to the and principle of operation
    a)Reciprocating compressors
    b) Rotary compressors.
2) According to the action
    a)Single acting compressor
    b) Double acting compressors
3) According to the number of stages
    a) Single stage compressors
    b) Multistage compressors
4) According to the pressure limit
    a)Low pressure compressors
    b)Medium pressure compressors
    c) High pressure compressors
5) According to the capacity
    a)Low capacity compressors
    b) Medium capacity compressors
    c) High capacity compressors

2. What is meant by single acting compressors?

In single acting reciprocating compressor, the suction, compression and delivery of air takes place on both sides of the piston

3.What is meant by single stage compressor?

In single stage compressor, the compression of air from the initial pressure to the final .pressure is carried out in one cylinder only.

4.What is meant by double acting compressor?

In double acting reciprocating compressor, the suction, compression and delivery of air takes place on both sides of the piston.

5. Indicate the application of reciprocating compressors in industry?

The applications of compressed air as follows:

a) Pneumatic brakes
b) Pneumatic jakes.
c) Pneumatic drills.
d) Pneumatic lifts.
e) Spray painting.
f) Shop cleaning.
g) Injecting fuel in diesel engines.
h) Supercharging internal combustion engines.
i) Refrigeration, and air conditioning systems.

6. What are the advantages of multi stage compression with internal cooling over single stage compression for the same pressure ratio?

a) It improves the volumetric efficiency for the given pressure ratio.
b) It reduces the leakage loss considerably.
c) It gives more uniform torque and hence a smaller size flywheel is required.
d) It reduces the cost of the compressor

7. Define the terms as applied to air compressors: Volumetric efficiency and isothermal compression efficiency.

(or)

Define the mechanical efficiency and isothermal efficiency of a reciprocating air compressor.

Volumetric efficiency:

Volumetric efficiency is defined as the ratio of volume of free air sucked into the compressor per cycle to the stroke volume of the cylinder.

Volumetric efficiency= Va/Vs.

Isothermal compression efficiency:

Isothermal efficiency is defined as the ratio between isothermal work to the actual work of the compressor.

Isothermal efficiency = brake power / Indicated power

8. Define clearance ratio?

Clearance ratio is defined as the ratio of clearance volume to swept volume (or) stroke volume.

$C = \frac{Vc}{Vs}$ Vc=Clearance volume Vs=Swept volume

9. Discuss the effect of clearance upon the performance of an air compressor.

The volumetric efficiency of air compressor increases with decrease in clearance of the compressor.

10. Give two merits of rotary compressor over reciprocating compressor.

1. Rotary compressor gives uniform delivery of air where compared to reciprocating compressor.
2. Rotary compressors are small in size for the same discharge as compared with reciprocating compressors.
3. Lubricating system is more complicated in reciprocating compressor where as it is very simple in rotary compressor.

1 1 . Name the methods adopted for increasing isothermal efficiency of reciprocating air compressor.

Isothermal efficiency is increased by perfect inter cooling.

12. Why clearance is necessary and what is its effect on the performance of reciprocating compressor?

When the piston reaches top dead center in the cylinder, there is a dead space between piston top and cylinder head. This space is known as clearance space and the volume occupied by this space is known as clearance volume.

13. What is meant by inter cooler?

An inter cooler is a simple heat exchanger. It exchanges the heat of compressed air from the low-pressure compressor to the circulating.

14. What are the factors that affect the volumetric efficiency of a reciprocating compressor?

1. Clearance volume.

2. Compression ratio.

15. What is compression ratio?

Compression ratio is defined as the ratio between total volume and clearance volume.

$$\text{Compression ratio} = \frac{\text{Total volume.}}{\text{Clearance volume.}}$$

UNIT V- REFRIGERATION AND AIR–CONDITIONING

1. Define tonne of refrigeration.

A tonne of refrigeration is defined as the quantity of heat required to be removed from one tonne of water (1000kg) at 0 C to convert that into ice at 0 C in 24 hours. In actual practice,

1 tonne of refrigeration= 210kJ/min=3.5kW

2. Define tonne of refrigeration. Heat is removed from a space at a rate of 42,000kJ/h. Express this heat removal rate in tons.

A tonne of refrigeration is defined as the quantity of heat required to be removed from one tonne of water (1000kg) to convert that into ice at 0˚ C 24 hours.

3. The vapour compression refrigerator employs the ---- cycle.

Reversed Carnot.

4. The door of a running refrigerator inside a room was left open. What will happen?

The room will be gradually warmed up.

5. In a vapor compression refrigeration system, where the lowest temperature will occur?

At inlet of evaporator

6. How does the actual vapour compression cycle differ from that of the ideal cycle?

1. In actual cycles, pressure losses occur in both condenser and evaporator.

2. Friction losses occur in compressor.

7. Name four important properties of a good refrigerant.

1. Low boiling point.

2. High critical temperature and pressure.

3. Low specific heat of liquid.

8. What is the difference between air conditioning and refrigeration?

Refrigeration is the process of providing and maintaining the temperature in space below atmospheric temperature.

Air conditioning is the process of supplying sufficient volume of clean air containing a specific amount of water vapour and maintaining the predetermined atmospheric condition with in a selected enclosure.

9. What is the function of the throttling valve in vapour compression refrigeration system?

The function of throttling valve is to allow the liquid refrigerant under high pressure and temperature to pass to controlled rate after reducing its pressure and temperature.

10. Name any four commonly used refrigerants.

1. Ammonia (NH3)

2. Carbon dioxide (CO2).

11. Explain unit of Refrigeration.

Unit of refrigeration is expressed in terms of tonne of refrigeration.

A tonne of refrigeration is defined as the quantity of heat required to be removed from one tonne of water (1000kg) to convert that into ice at 0˚ C in 24 hours.

12. Why throttle valve is used in place of expansion cylinder for vapour compression refrigerant machine.

In throttling process, enthalpy remains constant and pressure is reduced so throttle valve is used.

13. What are the effect pf superheat and sub cooling on the vapour compression cycle?

Superheating increases the refrigeration effect and COP may be increased or decreased. But sub cooling always increase the COP of the refrigeration and also decrease the mass flow rate of refrigerant.

14. What are the properties of good refrigerant?

An ideal refrigerant should possess the following desirable properties.

1. The refrigerant should have low freezing point.
2. It must have high critical pressure and temperature to avoid large power requirements.
3. It should have low-specific volume to reduce the size of the compressor
4. It should be nonflammable, non-explosive, non-toxic and non- corrosive.

15. What is net refrigerating effect of the refrigerant?

Refrigerating effect is the total heat removed from the refrigerant in the evaporator.

$$\text{COP} = \frac{\text{Refrigeration effect}}{\text{Work done}}$$

$$\text{Refrigeration effect} = \text{COP} * \text{Work done.}$$

16. Name the various components used in simple vapour absorption system.

1. Absorber
2. Pump
3. Generator
4. Condenser.
5. Throttle valve.
6. Evaporator.

17. Define refrigerant.

Any substance capable of absorbing heat from another required substance can be used as refrigerant.

18. How does humidity affect human comfort?

If the humidity is above a certain level, water vapour from human body moisture cannot be absorbed by the atmospheric air. It results in discomfort because of sweating.