2 MARKS QUESTION WITH ANSWERS

UNIT-1

1. **Define Froude efficiency, what is its effect on thrust?**

   From the propulsion power and the thrust power, we can derive the propulsive efficiency _prop, also known as the Froude efficiency. It is given by

$$\text{Propulsive efficiency} = P_{thrust}/P_{prop}$$

2. **Compare air breathing engine and rocket engine**.

air breathing engine are combustion engines that use the oxygen in atmospheric air to oxidize ('burn') the fuel carried, rather than carrying an oxidizer, as in a rocket. Theoretically, this should result in a better specific impulse than for rocket engines.

A continuous stream of air flows through the Air-breathing engine. This air is compressed, mixed with fuel, ignited and expelled as the exhaust gas. Thrust produced by a typical air-breathing engine is about eight times greater than its weight. The maximum velocity of Air-breathing engines is limited to 1-3 km/s due to extreme temperature and dissociation of the exhaust gas; however, the maximum velocity of a hydrogen-breathing engine of the same design is about 4 times higher.

3. **Define SFC.Write down its significance.**

   SFC, is an engineering term that is used to describe the fuelefficiency of an engine design with respect to thrust output. It allows the efficiency of different sized engines to be directly compared.

   SFC is dependent on engine design, but differences in the SFC between different engines using the same underlying technology tend to be quite small. Increasing overall pressure ratio on jet engines tends to decrease SFC.

4. What are the factors affecting thrust?

The Jet engine is much more sensitive to operating variables . Those are:

1.) Engine rpm.

2.) Size of nozzle area.

3.) Weight of fuel flow.

4.) Amount of air bled from the compressor

6. Define by pass ratio.
It is defined as the ratio between the mass flow rate of air drawn through a fan disk which bypasses the engine core (un-combusted air), to the mass flow rate passing through the engine core which is involved in combustion to produce mechanical energy

8. Differentiate between Scramjet & Ramjet engine.
In a ramjet, the combustion chamber - where the air is mixed with fuel and ignited - only works at subsonic speeds. So the intake slows the air down, releasing some of its energy as a shock wave, but this reduces fuel efficiency. The scramjet is an innovation on the ramjet in which the combustion chamber is specially designed to operate with supersonic airflow. Scramjet is simply an acronym for 'supersonic combustion' ramjet.

10. What are the advantages and disadvantages of cooling gas turbine blades?
There are three main types of cooling used in gas turbine blades; convection, film, and transpiration cooling. While all three methods have their differences, they all work by using cooler air (often bleed from the compressor) to remove heat from the turbine blades.

11. Mention relative merits of jet engines over piston engines.

- Simple design with few moving parts, giving a compact engine with low maintenance costs and reduced frictional losses.

- The operational flexibility through the variable compression ratio allows operation optimisation for all operating conditions and multi-fuel operation. The free-piston engine is further well suited for homogeneouschargecompressionignition (HCCI) operation

UNIT-II

1. What are the requirements of an aircraft intake?
The air intake requires enormous effort properly to control airflow to theengine.
The intake must be designed to provide the appropriate amount of airflow required by the engine .Furthermore this flow when leaving the intake section to enter thecompressor should be uniform stable and of high quality.
Good air intake design is therefore a prerequisite if installed engineperformance is to come close to performance figures obtained at thestatic test bench

2. Write notes on pressure recovery factor of the intake?
The ratio between pressure of air intakes the engine to the pressure level of atmosphere
$P_{01}/P_a = P_{01}/P_a x P_{0a}/P_a$

3. What are the starting problems in supersonic inlets?

For air-breathing engines on supersonic vehicles,
usually want to slow flow down to subsonic speeds
inside engine
– need diffuser (M>1→M<1) for engine inlet
– exception: supersonic combustion (e.g., SCRAM jets)
• Goal
– lowestpo loss (highest thrust)
• given flight M
• mass flow rate requirement (thrust)
• stable operation (nothing drastic for small changes in
flight conditions)

4.What are the factors to be considered while designing a subsonic inlet?

1. High total pressure ratio
2. Good uniform of flow
3. Low installation drag
4. Good starting and stability.

5.What are the factors to be considered while designing a supersonic inlet?

1. Provide adequate subsonic performance
2. High pressure recovery factors
3. Good pressure distribution at the compressor inlet

6. What is meant by sub critical mode of inlet operation? State its advantages and disadvantages.

Some inlets are designed to operate in the subcritical mode with a margin of stable operation. Stagnation
pressure recovery is normally equal to or less than the value for critical operation. The capture area ratio is less than one, since air is expelled from the inlet opening, with a resulting increase in drag due to the subsonic air-stream passing over the cowl lip.

UNIT-III

1. Define equivalence ratio and stochiometric fuel air ratio.

A **stoichiometric amount** or **stoichiometric ratio** of a reagent is the optimum amount or ratio where, assuming that the reaction proceeds to completion:

1. all reagent is consumed
2. there is no shortfall of reagent
3. no residues remain.

2. Define efficiency of the combustion.

Combustion efficiency is a calculation of how well your equipment is burning a specific fuel, shown in percent. Complete combustion efficiency would extract all the energy available in the fuel. However 100% combustion efficiency is not realistically achievable. Common combustion processes produce efficiencies from 10% to 95%. Combustion efficiency calculations assume complete fuel combustion and are based on three factors:

The chemistry of the fuel.

The net temperature of the stack gases.

The percentage of oxygen or CO_2 by volume after combustion.

3.What is the purpose of primary air in combustion chamber?

The purpose of the primary air is as follows,

1. 30% of the air intakes the engine used in combustion process
2. 20% of air used in compression process
3. Remaining 50% of used primary used in cooling process

4.What is the purpose of secondary air in combustion chamber?

The purpose of the secondary air is as follows,

1. Used in external turbine cooling
2. Thrust reversal operation
3. Afterburner operation

5.What is the purpose of dilution air in combustion chamber?

Dilution air is also called as tertiary air, It is used in cooling the burning surfaces.

6.Define combustion intensity?

The ratio between heat released by the combustor and the addition of combustion volume and pressure

7.State the advantages and disadvantages of annular combustor.

i)The burner at the left is an **annular** combustor with the liner sitting inside the outer casing which has been peeled open in the drawing. Many modern burners have an annular design.

ii)The burner in the middle is an older **can** or tubular design. The photo at the top left shows some actual burner cans. Each can has both a liner and a casing, and the cans are arranged around the central shaft.

iii)A compromise design is shown at the right. This is a **can-annular** design, in which the casing is annular and the liner is can-shaped. The advantage to the can-annular design is that the individual cans are more easily designed, tested, and serviced.

UNIT-IV

1. What is choked nozzle?

An expansion nozzle in which the gas velocity has reached sonic level at the throat

2. What are the types of nozzle in gas turbine engine?

1. Convergent nozzle
2. CD nozzle

3. Give any four functions of an exhaust nozzle.

1. Allow for cooling of walls,
2. Allow for thrust reversing
3. Thrust vector should be controllable

4. Define under expanded nozzle.

An under expansion nozzle in which the gas exit pressure at the nozzle is greater than the back pressure.

5. Define over expanded nozzle.

An over expansion nozzle in which the gas exit pressure at the nozzle is lesser than the back pressure.

6. Define optimum expansion nozzle.

An optimum expansion nozzle in which the gas exit pressure at the nozzle is equal to the back pressure

UNIT-V

1. Write down the difference between centrifugal and axial flow compressor.

*Axial compressors are rotating, airfoil based compressors in which the working fluid principally flows parallel to the axis of rotation. This is in contrast with centrifugal, axi-centrifugal and mixed-flow compressors where the air may enter axially but will have a significant radial component on exit.

*Centrifugal fan/blowers are more suited to continuous-duty applications such as ventilation fans, air movers, cooling units, and other uses that require high volume with little or no pressure increase. In contrast, multi-stage reciprocating compressors often achieve discharge

pressures of 8,000 to 10,000 psi (59 MPa to 69MPa). One example of an application of centrifugal compressors is their use in re-injecting natural gas back into oil fields to increase oil production

2. Define Elementary Airfoil Theory

When a single airfoil is parallel to the velocity of a flowing gas, the air flows over the airfoil as shown in figure 7a. The airdivides around the body, separates at the leading edge, and joins again at the trailing edge of the body. The main stream itself suffers no permanent deflection from the presence of the airfoil. Forces are applied to the foil by the local distribution of the steam and the frictionof the fluid on the surface. If the airfoil is well designed, the flow is streamlined with little or no turbulence.

3. Define laminar flow airfoils.

Just before and during World War II, much attention was given to laminar-flow airfoils. These airfoils are designed so that the lowest pressure on the surface occurs as far back as possible. The reason for this design is that the stability of the laminar boundary layer increases when the external flow is accelerated (in the flow with a pressure drop), and the stability decreases when the flow is directed against increasing pressure. A considerable reduction in skin friction is obtained by extending the laminar region in this way, provided that the surface is sufficiently smooth.

5. Define degree of reaction of axial compressor.

The degree of reaction in an axial-flow compressor is defined as the ratio of the change of static head in the rotor to the head generating the stage

6. Define radial equilibirium.

The flow in an axial-flow compressor is defined by the continuity, momentum, and energy equations. A complete solution to these equations is not possible because of the complexity of the flow in an axial-flow compressor. Considerable work has been done on the effects of radial flow in an axial-flow compressor. The first simplification used considers the flow axisymmetric. This simplification implies that the flow at each radial and axial station within the blade row can be represented by an average circumferential condition. Another simplification considers the radial component of the velocity as much smaller than the axial component velocity, so it can be neglected.

7. Define Diffusion Factor

The diffusion factor should be less than 0.4 for the rotor tip and less than 0.6 for the rotor hub and the stator. The distribution of the diffusion factor throughout the compressor is not properly defined. However, the efficiency is less in the later stages due to distortions of the radial velocity distributions in the blade rows. Experimental results indicate that even though efficiency is less in the later stages, as long as the diffusion loading limits are not exceeded, the stage efficiencies remain relatively high.