SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)

Department of Aerospace Engineering

23AST101-Fundamentals of Aerospace Engineering

UNIT-4:
POWER PLANTS

TURBOFAN ENGINE

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A **turbofan engine** is a type of gas turbine engine widely used in modern aircraft propulsion. It is known for its efficiency, thrust capability, and quieter operation compared to older turbojet engines. Here's a breakdown of its key components and working principles:

Key Components of a Turbofan Engine

Fan

- Located at the front, it draws in air and accelerates it.
- A portion of this air (called **bypass air**) flows around the engine core, providing additional thrust.
- The rest enters the **core** for combustion.

Compressor

- Compresses incoming air to high pressure before combustion.
- Typically has **low-pressure (LP)** and **high-pressure (HP)** stages.

Combustor (Combustion Chamber)

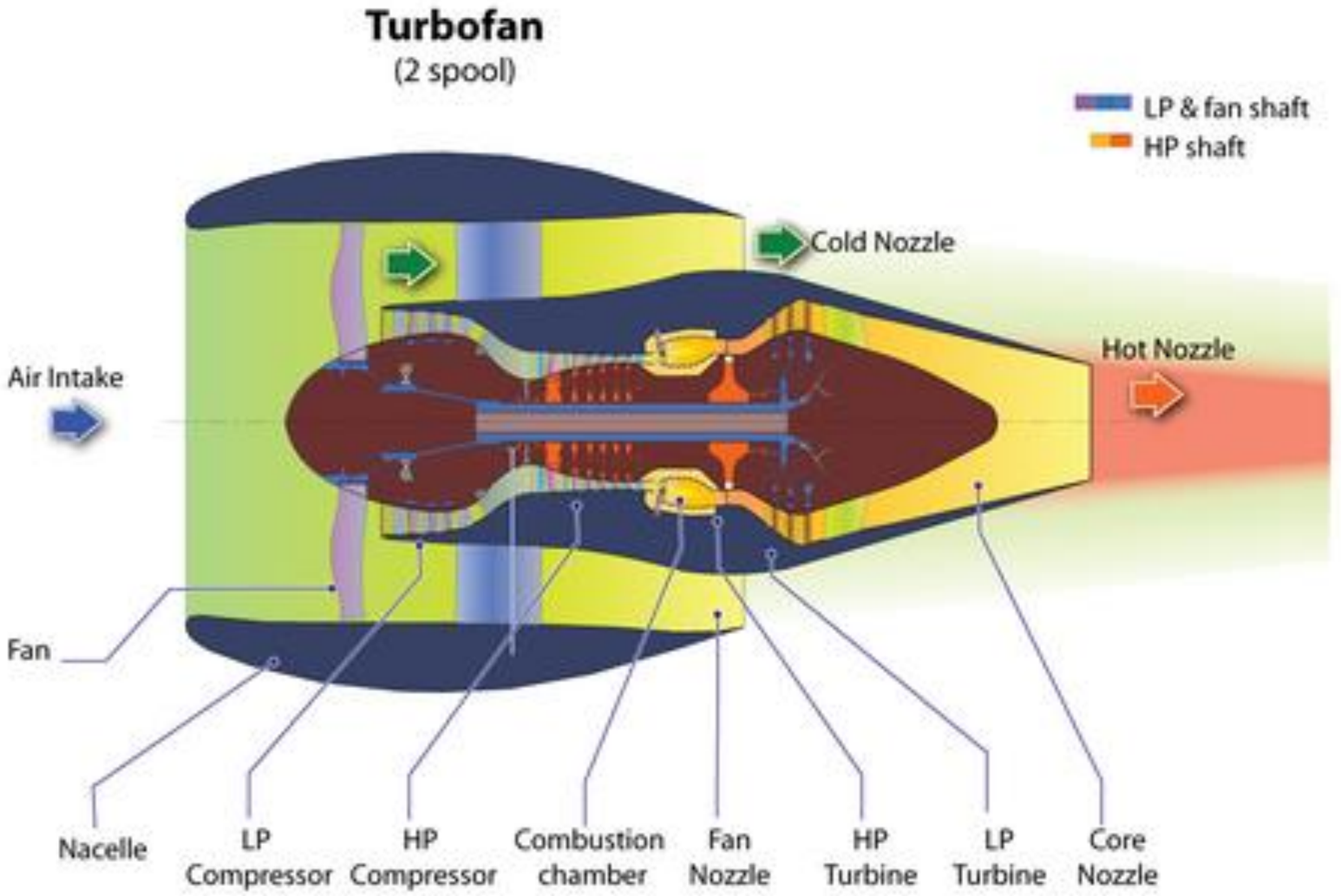
- Fuel is injected and burned with compressed air, producing high-energy exhaust gases.

Turbine

- Extracts energy from hot gases to power the compressor and fan.
- Consists of **HP turbine** (drives the HP compressor) and **LP turbine** (drives the fan and LP compressor).

Nozzle (Exhaust)

- Expels exhaust gases to produce thrust.
- In high-bypass turbofans, most thrust comes from the bypass air.


Turbofan
(2 spool)
LP & fan shaft
HP shaft
Cold Nozzle
Hot Nozzle
Air Intake
Fan
Nacelle
LP Compressor
HP Compressor
Combustion chamber
Fan Nozzle
HP Turbine
LP Turbine
Core Nozzle

How a Turbofan Works

Air Intake → Air enters through the fan.
Bypass & Compression → Some air bypasses the core, while the rest is compressed.
Combustion → Fuel burns in the combustor, generating high-pressure gas.
Turbine Drive → Hot gases spin the turbines, powering the compressor and fan.
Thrust Generation → Bypass air and core exhaust merge, producing thrust.

Types of Turbofans

High-Bypass Turbofan

- Most common in commercial airliners (e.g., Boeing 737, Airbus A320).
- Bypass ratio (BPR) of **5:1 to 12:1** (more air bypasses the core).
- Quieter, more fuel-efficient, better for subsonic flight.

Low-Bypass Turbofan

- Used in military jets (e.g., F-15, F-16).
- BPR of **0.5:1 to 2:1**.
- Higher thrust-to-weight ratio, suitable for supersonic speeds.

Afterburning Turbofan

- Used in fighter aircraft (e.g., F-22, Su-35).
- Additional fuel burned in the exhaust for extra thrust (lowers efficiency).

Advantages Over Turbojets

✓ **Higher fuel efficiency** (especially high-bypass engines).
✓ **Quieter operation** (bypass air reduces noise).
✓ **Better thrust at subsonic speeds** (ideal for commercial aviation).

Applications

Commercial Aviation: Airbus A350, Boeing 787.
Military Aircraft: F-35 (low-bypass with afterburner).
Business Jets: Gulfstream G650.


THANK YOU!