

AIRCRAFT PISTON ENGINE

DETAILED SYLLABUS

OBJECTIVES

To enable the students to gain a thorough knowledge about the working of Piston engines and to identify its different components, their location and function.

UNIT- I GENERAL REQUIREMENTS OF AIRCRAFT POWER PLANTS AND CLASSIFICATION

General requirements of aircraft power plants- Basic concept of power and weight: Requirement of power for a type of aircraft keeping view of operational needs, at what altitude the aircraft operates, distance normally covered in each flight, conditions of operation, weight considerations of the power plant keeping in view of power to weight ratio, basic pay load of the aircraft that is to be carried-cargo/bombs/rockets/passengers.- Durability of power plants, its importance: The importance of service life/durability of the power plant considering the economics of operation, mean time between servicing /failures and down time of the aircraft due to service life of aircraft.- Reliability of the power plant and its importance: Explanation of the importance of reliable operation of the aircraft considering the safety of passengers/assured operation under all adverse conditions/ability to deliver the payloads to the destinations or during air operations in defence requirements- Fuel economy of the power plant and its significance: Importance of fuel economy considering economics of operation- Operating flexibility of operation of power plants: Explain the flexibility to operate the engine in all conditions of weather, in the assured altitudes- Compactness of power plants and its importance: Need for compactness of engine considering the wind resistance it will offer when it is fitted /streamlined into the structure of the aircraft- Introduction to reciprocating engines Classification of reciprocating engines based on cylinder arrangement- In line type of reciprocating engines: Explanation of engine layout with all cylinders arranged linearly or with one cylinder block.- Opposed type of reciprocating engines: Explanation of horizontally opposed cylinder banks located in the same plane on opposite side of the crank shaft.- V-type of reciprocating engines: Description of engine which has two banks of cylinders inclined at an angle to each other and with one crank shaft. Radial type of reciprocating engines: Explanation of engine which has more than two cylinders in each row, which are equally spaced around the crank shaft.

UNIT- II ENGINE OPERATING PRINCIPLES

Know how the energy conversion takes place: 1 Explanation of working principles of internal combustion engine and the sequence of events that have to take place for chemical energy conversion in the fuel into mechanical work. Understand the basic energy conversion laws: Basic laws-gas law, first and second laws of thermodynamics, constant pressure process, constant volume process, Isothermal process adiabatic process, steady flow energy equation and operating principles of external and internal combustion engines are explained giving examples of a steam engine, internal combustion engine. Simple application problems- Understand the basic Piston engine terminology: A brief description of important components of the internal combustion engine are given. Understand the basics of an Otto cycle and its efficiency: The various processes in the spark ignition (SI) internal combustion engine, compression ignition engine are explained with the help of Otto cycle and Diesel cycle. The terms like thermal efficiency, work ratio and mean effective pressures are also explained. Understand the basic operation of two stroke and four stroke operating cycles: Explanation of working cycles, principles of two stroke, four stroke spark ignition, compression ignition engines are given and diagrams are also shown to make students appreciate in better way. A comparison of two stroke engine and four stroke engine is done for various parameters/properties and explained to students. A comparison of SI and CI engines are made and explained for the various parameters of the engines. Understanding concepts of Valve timing-lead, lag and overlap in timing: Explanation with simple diagram for the valve opening /closing cycles, importance of valve timings-lead, lag, and overlap is explained. Understanding the concept of Engine firing order-opposed, inline, v-type and radial engines: Engine firing order for opposed, in-line, V-type and radial type of engines are explained, giving practical reasons for the firing order in an engine. Understanding basics of Engine power, engine rating, engine efficiency: Following engine performance parameters are explained with simple application problems, indicated power of an engine, brake power of an engine, Thermal efficiency, Mechanical efficiency, Volumetric efficiency, Compression ratio, Specific fuel consumption- Explanation of important factors affecting engine performance, Density altitude, Humidity, Carburettor air temperature, Exhaust back pressure, Super charging, Compression ratio, Fuel-air mixture ratio- Understanding the importance of Critical altitude of operation for piston engine aircrafts:- Explanation of requirement air for charging /supercharging the fuel-air mixture is given to the students bringing out the limits and critical altitude up to which piston Engine aircrafts can operate reliably.

UNIT- III ENGINE COMPONENTS AND THEIR CONSTRUCTION

Construction details of various engine sections/components are explained with diagrams: Crank case-function, basic constructional features, Basic constructional features of crankshaft, Purpose and features of connecting rods, Basic constructional features of engine cylinder, Basics of valves and valve operating mechanism- Basics of propeller reduction gear, accessories case: Explanation is given for the requirement of propeller reduction gear and Accessories case, functions of propeller reduction gear and accessories case are explained.- Types of propeller reduction gear: brief study in spur gear and Planetary gear system

UNIT- IV FUEL AND CARBURETION SYSTEM

Explanation of important characteristics of Aviation fuel: Basic explanation of aviation fuel(gasoline) and its properties, Gasoline rating and its significance- Vapour lock in engine fuel system-reasons for the vapour lock: phenomenon of vapour lock in aircraft fuel system is explained- Explanation of carburetion principles: fuel, air mixture requirements: Carburetion – principles, venturi effect, fuel air mixture requirement ,variation of air in the mixture with increase in altitude, supercharging. Explanation of types of carburetors, principle of operation: Float type, Pressure injection type- Direct injection type and direct fuel injection system- Explanation of Carburettor icing and reasons for carburettor icing- Explanation of a basic fuel system of an aircraft: Description of basic fuel system of a piston engine type of aircraft is given and explained with the help of a diagram.

UNIT- V INDUCTION, COOLING, LUBRICATION AND EXHAUST SYSTEMS

Explanation of a basic induction system: The basic theory of induction is explained and discussed- Principles of supercharging and turbo charging and blower charging: The density of available per given volume will reduce with the increase of altitude. The effect of this reduced air on the fuel air mixture is discussed and methods available for compensation also are explained. Principle of super ---charging and turbo charging and blower charging are explained to the students. Various types of Engine cooling system: The purpose and requirements of engine cooling system, effect of improper cooling on the engine performance are discussed. Two common methods available for engine cooling are discussed. They are, Air cooling system, Liquid cooling system- Lubrication system: Introduction, effect of improper lubrication is explained, Necessity of engine lubrication-basic explanation, Explanation of Important functions of lubricant, characteristics of lubricant, Explanation of Contamination of

lubricants and its control, Lubrication system: dry sump system and wet sump system, Properties of Lubrication oil, Explanation of basic Components of lubrication system- Explanation of basic Engine exhaust systems

UNIT- VI STARTING SYSTEM, IGNITION SYSTEMS, FIRE DETECTION AND PROTECTION

Explanation of principle of operation of starter: Description various types of starters: Cartridge starter, Hand inertia starter, Electric inertia starter, Combination inertia starter, Direct- cranking electric starter and its advantages and disadvantages are discussed. Types of ignition systems used in aircraft piston engine: Battery ignition system and Magneto ignition system discussed in detail. Explanation of timing devices, Explanation of Auxiliary ignition unit, Explanation of Spark plugs and their general construction- Engine fire detection and protection systems, Introduction and Description of fire detection and protection system in piston engines

TEXT BOOKS AND REFERENCES

1. Internal combustion engine V Ganesh Tata Mc graw hill
2. Internal combustion engine Mathur & Sharma
3. Aircraft piston engine Daewoo