

AIRCRAFT SYSTEMS

DETAILED SYLLABUS

OBJECTIVES

It aims at enabling the student to understand & analyze the operations of various types of aircraft system.

UNIT- I INTRODUCTION TO AIRCRAFT SYSTEM

Systems concept-Introduction, Requirements of a system, Stability, Reliability, Flexibility, Maintainability- AIRCRAFT SYSTEMS- Primary performance systems:, Aircraft structural system, Propulsion system, Primary flying control surface system, Under carriage System- Performance Aid systems, Secondary and tertiary flying control Surfaces- Active air Induction system- Augmentation & Thrust reversal systems- Environmental Systems:, Ventilation system, Air conditioning system, Oxygen system, Pressurisation system- Safety systems, Fire warning & extinguishing systems, Escape Aid systems- Media systems, Mechanical, Hydraulic, Pneumatic, Electro-Hydraulic, Electro-Pneumatic, Electrical

UNIT- II AIRCRAFT FUEL SYSTEM

AIRCRAFT FUEL SYSTEM- Classification based on functional basis- Airframe fuel system- Power plant fuel system- Basic airframe fuel system- Additional features of airframe fuel system- Venting-Basic purpose of venting system- Booster Pump- need for booster pump and limitations of gravity fuel feed system- Filter-Need for strict quality control for aviation fuel. Information system, Fuel contents, Fuel Pressure, Low/critical fuel level warning- Modern airframe fuel systems, Explanation with basic schematic for a multi -engine fuel system- Weight of dispersed fuel :- Affect on stability & manoeuvrability of aircraft- Flexibility-minimum vulnerability to total system failure by any one of the components.- Safety-Protection of the systems from hazards of requirement, various operating conditions.

UNIT- III AIRCRAFT FLIGHT CONTROL SYSTEM

Aircraft flight control systems- Introduction to flight control systems- Axes of Motion- Vertical Longitudinal -Lateral- PRIMARY CONTROL SURFACES-Elevator/Stabilizer, Aileron & Rudder- SECONDARY CONTROL SURFACES-Flaps, slats, spoilers dive brakes- Tertiary Control Surfaces-Trim Tabs. Primary flight controls:-Pitch-Roll- Yaw – Throttle- Secondary effects of controls, Pitch-elevator-how speed is controlled by Secondary effects of elevator., Roll-Aileron-how yaw is achieved, Yaw-Rudder-Aileron less rudder only- Main Control

Surfaces:, Ailerons-Placing, purpose, action, Elevators-Placing, purpose, action, Rudder-Placing, purpose, action- Trim Tabs: Purpose, Placing, action- Spoilers-Purpose, use,- Flaps-Placing, purpose, action,- Slats-Placing, purpose, action- Air Brakes-Placing, purpose, action- General arrangement of Aircraft Flight Control Systems (AFCS):, Control yoke for roll that moves AILERONS,, Control column for PITCH that moves the elevators,, Rudder pedals for YAW that moves the rudder- Classification of flight control systems (FCS), Mechanical FCS, Hydro-Mechanical FCS/Powered flight control units (PFCU), Fly-by-wire (FBW), Analog Fly by wire FCS, Digital fly by wire FCS, Power-by-wire FCS, Intelligent FCS

UNIT- IV AIRCRAFT REMOTE CONTROL SYSTEMS MEDIA, UNDERCARRIAGE SYSTEM

Introduction-concept of remote control system, basic principles used.- Explanation of basic manual control system using mechanical media.- Advantages and disadvantages of mechanical media in Aircraft remote Control systems- Application areas for mechanical media systems- Flying controls, Engine controls, Operation of control valves and Selector valves.- Examples of commonly used mechanical media systems, units brief explanations:- Multi stranded cable system with pulleys, drums etc, Chain & sprocket system – common examples. Explanation of a typical mechanical media push-pull control system- with diagram- Chain and cable controls-Introduction- Chain control- Brief explanation of how chain control is used for controlling aircraft, control surface movements- Inspection and maintenance on chain control system: Routine and periodical- Aircraft cables-control cables, their specifications and strands.- Cable Maintenance.- Introduction to hydraulic system and brief discussion on properties of fluids useful for this system.- Hydraulic fluid medium, General properties of hydraulic fluid, Incompressibility of hydraulic fluid., Liquid pressure and PASCAL'S law.- Aircraft hydraulic fluid-Important properties of aircraft hydraulic fluids:- Viscosity, Low Freezing point, High Boiling point, Flight flash and fire points, Chemical and physical stability, Compatibility, Lubricity- Aircraft hydraulic fluid specifications & colours of Fluids- Explanation of a simple closed loop- HYDRAULIC SYSTEM- Vehicle Brake System.- Description of a simple pump-powered hydraulic system.- AIRCRAFT REMOTE CONTROL SYSTEM- PNEUMATIC MEDIA- Introduction-Pneumatic media systems, Special qualities of Air and typical applications in aircraft:, Pressure energy storage-under carriage blow-down systems,, Compression-shock absorbers- AIRCRAFT UNDERCARRIAGE SYSTEMS- Purpose and functions of Aircraft under carriage system.- Systems requirement for under carriages. Classification of under carriages- By general configuration of the 3 point support with reference to the Airframe., Tail under carriage type with 2 main- Undercarriages located in wings- Nose undercarriage type with their main undercarriage located in the fuselage or under wings

(Tricycle base)- By constructional features:- Single nose wheel and main wheel undercarriage- Double nose wheel and single main wheel undercarriage- Double nose wheel and double tandem undercarriage.- By operating features, Non retractable undercarriage mounted on fuselage or wings, Retractable undercarriage:

UNIT- V AIRCRAFT ENVIRONMENT SYSTEMS

Cabin pressurization and air conditioning systems: Introduction- Altitude limits of tolerance for human being- Effect of rate of change of altitude on human body.- Normal composition of cabin atmosphere in an aircraft.- Temperature, humidity and comfort zone inside aircraft cabin.- Cabin altitude, differential pressure ambient pressure- Pressurization systems-introduction- Supply of Air-engine bled supply and ram air supply, Cabin pressure control-cabin pressure control valve (CPCV). Important functions of CPCV., Compression and explosive de-compression of aircraft cabin-cause and effects- Aircraft air conditioning systems-introduction- Air conditioning units-boot Strap or Air cycle principle.

UNIT- VI AIRCRAFT EMERGENCY SYSTEMS

Aircraft fire warning systems-Introduction, Common causes of fire in aircraft: Fuel Hot gases Electrical/Mechanical, Purpose and function of fire detection system., Ancillary systems: Fire extinguisher systems, Cabin protection in civil transport aircraft-modern trend- ICE AND RAIN PROTECTION SYSTEMS- Ice and Rain Protection Systems Introduction-Common flight hazards due to ice pitot tubes, control systems etc., Areas sensitive for ice formation:, Aero foil surfaces, Engine intakes, Engine internal surfaces, Rotor blades & propellers, Wind screens, Instrument probes & vanes, Control hinges & linkages- Principles of operation, Active system, Passive system- Ice protection systems, Thermal (Hot Air)-Air frame, Thermal (Hot Air)-Engine, Thermal (Electrical), Ground De-icing-Aircraft on open parking.

TEXT BOOKS

1. Aircraft systems by Lalit gupta & Dr.O P sharma.
2. Aircraft powerplant by Michael kroes
3. FAA Aircraft mechanics handbook AC 65-15A

REFERENCES

1. Aircraft systems by Lalit gupta & Dr.O P sharma.
2. Aircraft powerplant by Michael kroes
3. Internet website :- wikipedia
4. Aircraft Systems: Mechanical, electrical, and avionics subsystems integration, Third Edition Copyright © 2008 John Wiley & Sons, Ltd
5. Aircraft Systems: Mechanical, electrical, and avionics subsystems integration, Third Edition Author(s): Ian Moir, Allan Seabridge Published Online: 10 APR 2008