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DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19MCE402 – AUTOTRONICS

IV YEAR / VII SEMESTER

Unit 3 – Engine Control System

Engine Control Systems

- To allow the engine to perform at **maximum efficiency** for a given condition
- Aids the pilot to **control and monitor** the operation of the aircraft's power plant
- Originally, engine control systems consisted of simple mechanical linkages controlled by the pilot then evolved and became the responsibility of the **third pilot-certified crew member, the flight engineer**

Engine Control Systems

- By moving throttle levers directly connected to the engine, the pilot or the flight engineer could control **fuel flow, power output, and many other engine parameters**.
- Following mechanical means of engine control came the introduction of **analog electronic engine control**.
- Analog electronic control varies an electrical signal to communicate the desired **engine settings**
- It had its *drawbacks* including common **electronic noise** interference and **reliability issues**
- Full authority analogue control was used in **the 1960s.**

Engine Control Systems

- In the **1970s - NASA** and **Pratt and Whitney** experimented with the first experimental **FADEC**, first flown on an F-111 fitted with a highly modified Pratt & Whitney TF30 left engine

ECS- Functions

- FADEC works by ***receiving multiple input*** variables of the current flight condition including **air density, throttle lever position, engine temperatures, engine pressures, and many other parameters**
- The inputs are received by the **EEC** and analyzed **up to 70 times per second**
- Engine operating parameters such as fuel flow, stator vane position, bleed valve position, and others are **computed** from this data and **applied as appropriate .**

ECS- Functions

- It controls engine **starting** and **restarting**.
- Its basic purpose is to **provide optimum engine efficiency** for a given flight condition.
- It also allows the manufacturer *to program engine limitations and receive engine health and maintenance reports.* For example, to avoid exceeding a certain engine temperature, the FADEC can be programmed to automatically take the necessary measures without pilot intervention.

ECS- Functions

- The flight crew first enters **flight data** such as wind conditions, runway length, or cruise altitude, into the flight management system (**FMS**). The FMS uses this data to calculate power settings for different phases of the flight.
- At takeoff, the flight crew advances the throttle to a predetermined setting, or opts for an auto-throttle takeoff if available.
- The FADECs now apply the calculated takeoff thrust setting by sending an electronic signal to the engines

ECS- Functions

- There is **no direct linkage to open fuel flow**. This procedure can be repeated for any other phase of flight
- In flight, small changes in operation are constantly made *to maintain efficiency.*
- Maximum thrust is available for emergency situations if the throttle is advanced to full, but limitations can't be exceeded
- The flight crew has no means of manually overriding the FADEC

ECS- Functions

- True full authority digital engine controls have no form of manual **override available,** placing full authority over the operating parameters of the engine in the hands of the computer
- If a total FADEC **failure occurs, the engine fails**
- If the engine is controlled digitally and electronically but allows for manual override, it is **considered solely an EEC or ECU.**
- An EEC, though a **component** of a FADEC

ECS- Applications

- FADECs are employed by **almost all current generation jet engines**, and increasingly in piston engines for fixed-wing aircraft and helicopters.
- The system replaces both magnetos in piston-engined aircraft, which makes costly magneto maintenance obsolete **and eliminates carburetor heat, mixture controls and engine priming.**
- Since, it controls each engine cylinder independently for optimum **fuel injection and spark timing**, the pilot no longer needs to monitor fuel mixture.

ECS- Advantages

- Better **fuel efficiency**
- Automatic engine protection against **out-of-tolerance operations**
- Safer as the multiple channel FADEC computer provides **redundancy in case of failure**
- **Care-free** engine handling, with guaranteed thrust settings
- **Ability to use single engine type** for wide thrust requirements by just reprogramming the FADECs

- Provides **semi-automatic engine starting**

- **Better systems integration** with engine and aircraft systems

ECS- Disadvantages

- **No form of manual override available**, placing full authority over the operating parameters of the engine in the hands of the computer.
- If a total FADEC failure occurs, the engine fails.
- In the event of a total FADEC failure, pilots have no way of manually controlling the engines for a restart, or to otherwise control the engine.
- With any single point **of failure, the risk can be mitigated** with redundant FADECs

Thank You !