Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – April/May– 2017**

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| **Code :** | **14AE2017** | **Duration :** | **3hrs** |
| **Sub. Name :** | **AIRCRAFT PROPULSION** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

**(Standard Atmosphere Table & Gas Table are permitted)**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | Derive the thrust equation for turbojet engine. | CO1 | 10 |
| b. | A turbofan operates at 9100 m and moves at Mach 0.75. It ingests 86 kg/s of air into the core and 1.2 times this amount into the fan, which all exits through the fan exhaust. The fuel flow is 2 kg/s. the exit areas of the fan and core are 0.6 m2 and 0.58 m2, respectively. The exit pressure from the fan and core are 32 kPa and 65 kPa, respectively. The exhaust velocities from the fan and core are 412 m/s and 573 m/s, respectively.  Find the thrust, what proportions arise from the fan and core? Do this problem for two contions; first consider fuel flow to be negligible; then include the effect of finite fuel flow.   |  |  |  |  | | --- | --- | --- | --- | | Altitude  Z, m | Pressure  P, kPa | Temperature  T, K | Speed of Sound a, m/s | | 9100 | 30 | 229 | 303.77 | | CO2 | 10 |
| (OR) | | | | |
| 2. | a. | Briefly explain the ideal cycle for gas turbine engine. Derive the pressure ratio and thermal efficiency. | CO1 | 10 |
| b. | A simple ideal Brayton cycle with air as the working fluid has a pressure ratio of 10. The air enters the compressor at 290K and the turbine at 1100K. Accounting for the variation of specific heats with temperature, determine (i) the air temperature at the compressor exit, (ii) the back work ratio, and (iii) the thermal efficiency. | CO2 | 10 |
| 3. |  | Briefly explain the working principle of centrifugal compressors with sketches and Derive the workdone and pressure rise equation. | CO1 | 20 |
| (OR) | | | | |
| 4. |  | Briefly explain the elementary theory of axial compressors with sketches and Derive the work input and pressure rise equation. | CO1 | 20 |
| 5. |  | At a certain operating condition the mid-radius velocity triangles for an axial compressor stage are as shown in figure. Here subscripts 1 and 2 denote entrance to rotor and stator, respectively. The stagnation temperature and pressure at entrance to the rotor are 340 K and 185 kPa.  Neglecting frictional effects, determine:   1. The specific work (kJ/kg); 2. The stagnation and static temperatures between rotor and stator; 3. The stagnation and static pressures between rotor and stator; 4. The mid-radius pressure coefficient     C:\Users\MR. GOPALSAMY\Desktop\Capture.JPG | CO2 | 20 |
| (OR) | | | | |
| 6. | a. | What are the differences between axial turbine and axial compressor. | CO1 | 5 |
|  | b. | Briefly explain the elementary theory of axial flow turbine with sketches and Derive the pressure ratio, temperature drop cooefficient, degree of reaction equation. | CO1 | 15 |
| 7. |  | The following data refer to a single-stage axial flow gas turbine with convergent nozzle:  Inlet stagnation temperature, T­01 1100 K  Inlet stagnation pressure, P01 4 bar  Pressure ratio, P01/P03 1.9  Stagnation temperature drop 145 K  Mean blade speed 345 m/s  Mass flow rate 24 kg/s  Rotational speed 14500 rpm  Flow coefficient 0.75  Angle of gas leaving the stage 12o  (Cp= 1.148 kJ/kg k, Gamma γ = 1.333, Nozzle loss coefficient = 0.05)  Assuming the axial velocity remains constant and the gas velocity at inlet and outlet are the same; determine the following quantities at the mean radius:   1. The blade loading coefficient 2. Degree of reaction 3. The gas angles 4. The nozzle throat area | CO2 | 20 |
| (OR) | | | | |
| 8. | a. | What are the types of nozzle? Explain various operating condition of a C-D nozzle with suitable sketch. | CO1 | 10 |
|  | b. | Briefly explain operational principle of the subsonic inlet with flow pattern. Derive the area ratio equation for subsonic inlet. | CO1 | 10 |
|  | | **Compulsory:** |  |  |
| 9. | a. | What is the need for matching of compressor and turbine? Write down the matching procedure with suitable sketches. | CO1 | 10 |
|  | b. | Briefly discuss the methods of turbine blade cooling and mention its advantages and disadvanteges. | CO1 | 10 |