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



**End Semester Arrear Examination – April / May – 2022**

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| **Code :** | **18AE2011** | **Duration :** | **3hrs** |
| **Sub. Name :** | **PROPULSION-I** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Define the second law of thermodynamics. | CO1/R | 1 |
| 2. | Mention the function of reheat in the modified cycle. | CO1/U | 1 |
| 3. | State the reason for increase in compressor exit temperature in a practical cycle. | CO2/U | 1 |
| 4. | Mention the purpose of intercooler in modified Brayton cycle. | CO2/U | 1 |
| 5. | Define surging. | CO4/R | 1 |
| 6. | Draw the velocity triangle for axial flow compressor. | CO4/R | 1 |
| 7. | Mention the function of liners in combustion chamber. | CO5/U | 1 |
| 8. | Mention how the aviation fuel differs from other fuels. | CO5/U | 1 |
| 9. | Draw the velocity diagram of turbine blade. | CO4/R | 1 |
| 10. | State the various types of blade cooling. | CO4/R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | A gas turbine operates on a pressure ratio of 4. The inlet air temperature to the compressor is 280 K and the air entering the turbine is at a temperature of 777 C. Assume that the cycle operates under ideal condition. Determine compressor exit temperature in Kelvin Take k = 1.4, Cp = 1.005 kJ/kg K. | CO1/A | 3 |
| 12. | Mention the influence of pressure thrust on the overall thrust of an aircraft. | CO2/U | 3 |
| 13. | State the importance of pre-whirl in the inlet of the compressor. | CO4/A | 3 |
| 14. | With the help of neat sketches, explain the variation of pressure and velocity in an axial compressor. | CO4/U | 3 |
| 15. | State the mechanism of the catalyst influencing the reaction rate. | CO5/U | 3 |
| 16. | Mention the purpose of stator, rotor, shroud and case of an axial flow turbine. | CO4/A | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | |
| 17. | a. | A gas turbine operates on a pressure ratio of 4. The inlet air temperature to the compressor is 270 K and the air entering the turbine is at a temperature of 677 ̊C. If the volume rate of air entering the compressor is 280 m3/s. Calculate the net power output of the cycle in MW. Also compute its efficiency. Assume that the cycle operates under ideal condition. | CO1/An | 12 |
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| 18. | a. | In a gas turbine plant air enters the compressor at 1.1 bar and 277 K. It is compressed to 5.5 bar with an isentropic efficiency of 82%. The maximum temperature at the inlet to the turbine is 1000 C. The isentropic efficiency of the turbine is 85%. The calorific value of the fuel used is 43.1 MJ/kg. Calculate the following  1.Compressor work in KJ/kg  2. Heat supplied in KJ//kg  3. Turbine work in KJ/kg  4. Net-work in KJ/kg  5.Thermal efficiency  6. Air/Fuel ratio  7. Specific fuel consumption in kg  Take Cpa = 1.005 kJ/kg K, ϒa = 1.4, Cpg = 1.147 kJ/kg K,ϒg = 1.33 | CO2/An | 12 |
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| 19. | a. | Determine the impeller diameters and the width at the impeller exit and the power required to drive the compressor, from the following given data  Speed N = 12,500 rev/min  Mass flow rate = 15 kg /s  Pressure ration = 4:1  Isentropic efficiency = 75 %  Slip factor =0.9  Flow coefficient at the impeller exit = 0.3  Hub diameter of the eye = 15 cm  Axial velocity of air at the entry to and exit from the impeller = 150 m/s  Stagnation temperature at the inlet = 295 K  Stagnation pressure at inlet = 1 bar  Assume equal pressure ratio in the impeller and diffuser. | CO4/An | 12 |
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| 20. | a. | Air at a temperature of 273 K enters a ten stage axial flow compressor at the rate of 7 kg/s. The pressure ratio is 6.5 and the isentropic efficiency is 92%, the compression process being adiabatic. The compressor has symmetrical blades. The axial velocity of 110 m/s is uniform across the stage and the mean blade speed of each stage is 190 m/s. Determine the direction of the air at the entry to the exit from the rotor and the stator blades and also the power given to the air. Assume Cp = 1.005 kJ/kg K and ϒ= 1.4. | CO6/An | 12 |
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| 21. | a. | Discuss the behavior of turboprop engine for fuel flow rate as function of true air speed with the help of a neat sketch. | CO1/A | 8 |
| b. | Mention the advantage and disadvantage of a turboprop engine. | CO1/U | 4 |
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| 22. | a. | List the requirement of a good atomizer. | CO3/R | 4 |
| b. | With the help of a neat sketch explain the breakup mechanism for a swirl injector. | CO3/R | 8 |
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| 23. | a. | Briefly explain the working of afterburner with neat sketch. | CO3/U | 12 |
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|  |  | **Compulsory:** | | |
| 24. | a. | Differentiate between impulse stage and reaction stage turbine. | CO4/A | 4 |
| b. | Explain the various methods used for turbine blade cooling. | CO4/A | 8 |