

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

A Constituent Institution of Manipal University

## IV SEMESTER B.TECH. (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, APRIL/MAY 2017

SUBJECT: AIRCRAFT PROPULSION [AAE 2202]

## REVISED CREDIT SYSTEM (24/04/2017)

Time: 3 Hours

MAX. MARKS: 50

## Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitable assumed.
- **1A.** Define specific fuel consumption. Explain the effect of different performance (4) parameters on engine with neat plots.
- **1B.** For an ideal cycle of a reciprocating IC engine, in which heat is added to the working medium air at constant volume. The conditions for one Kg of working medium are given as  $P_a=1bar$ ,  $T_a = 330$  K, Compression ratio 4 and pressure ratio 4, find out (i) Amount of heat added and rejected (ii) Thermal efficiency of Carnot cycle for the given working conditions (iii) thermal efficiency of the cycle (iv) The indicative mean effective pressure.
- **2A.** Derive the equations for thermal efficiency  $(\eta_{th})$ , turbine efficiency  $(\eta_T)$ , (4) Compressor efficiency  $(\eta_c)$  of Ideal Brayton cycle With P-V and T-S Diagrams
- 2B. Explain the thermodynamic analysis of turbine. Show the compressor efficiency (η<sub>c</sub>) through Enthalpy/Temperature Entropy diagram, also write first mean index (k<sub>1</sub>) and second mean index (k<sub>2</sub>).
- 3A. A centrifugal compressor has a pressure ratio of 4:1 with an isentropic efficiency of 80% when running at 15000 rpm and inducing air at 293 K. Curved vanes at the inlet give the air a pre whirl of 25°c to the axial direction at all radii. The tip diameter of the eye of the impeller is 250 mm. the absolute velocity at inlet is 150 m/sec and impeller diameter is 600 mm. calculate the slip factor.
- 3B. Explain with all notations the analysis of piston prop engine in terms of Power (P), Frictional horse power (FHP), Brake horse Power (BHP), Indicated horse power (IHP), Volumetric efficiency (ηνοL), Propeller efficiency (ηP) and mechanical efficiency (ηm).

- **4A.** Derive the net thrust  $(F_n)$ , Overall efficiency  $(\eta_o)$  and propulsive efficiency  $(\eta_p)$  of the **(4)** bypass jet engine.
- **4B.** With neat diagrams explain clearly with all the notations the velocity triangle for both axial flow compressor and centrifugal compressor. Also write the equations for work done per unit mass. (6)
- **5A.** Explain about the single spool, double spool and multi spool turbofan engine (4) concept with neat diagrams.
- 5B. An axial flow compressor has a tip diameter of 0.95 m and hub diameter of 0.85 m. The absolute velocity of air makes an angle of 28° measured from the axial direction and relative velocity angle is 56°. The absolute velocity outlet angle is 56° and the relative velocity angle is 28°. The rotor rotates at 5000rpm and the density of air is 1.2 kg /m<sup>3</sup>. Determine; (i) The axial velocity (ii) The mass flow rate (iii) The power required (iv) The flow angles at the hub (v) The degree of reaction at the hub.