Reg. No. :

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B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Sixth Semester

Mechanical Engineering

ME 2351/ME 64/10122 ME 602 – GAS DYNAMICS AND JET PROPULSION

(Regulation 2008/2010)

(Common to PTME 2351/10122 ME 602 – Gas Dynamics and Jet Propulsion for B.E. (Part-Time) Fifth Semester – Mechanical Engineering – Regulation 2009/2010)

Time : Three hours Maximum : 100 marks

(Use of Gas Tables is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by gas dynamics?

2. Define Mach number.

3. What is meant by stagnation pressure?

4. What is 'Fanno flow'?

5. What is Oblique shock?

6. What is prandtl-meyer relation?

7. Define Propulsive efficiency.

8. What is the type of compressor used in turbo jet?

9. What is monopropellant?

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11. (a) An air craft flies at a velocity of 700 kmph in an atmosphere where the pressure is 75kPa and temperature is 5°C. Calculate the Mach number and stagnation properties.

Or

(b) Air expands isentropically through the convergent nozzle from constant inlet conditions $P_0 = 4$ bar, $T_0 = 550$K. Exit area of nozzle is $1000cm^2$. Determine the exit velocity and mass flow rate for the following two cases at exit.

(i) $M = 1$

(ii) $M = 0.85$.

12. (a) The stagnation temperature of air is raised from 85°C to 376°C in a heat exchanger. If the inlet Mach number is 0.4, determine the final Mach number and percentage drop in pressure.

Or

(b) Air at $P_0 = 11$ bar, $T_0 = 420$K enters at 45 mm diameter pipe at a Mach number of 3 and the friction co-efficient for the pipe surface is 0.001. If the Mach number at exit is 0.8. Determine (i) Masslow rate (ii) Length of the pipe.

13. (a) A Jet of air at 270K and 0.7 bar has an initial mach number of 1.9. If it passes through a normal shockwave, determine the following for downstream of the shock.

(i) Mach number

(ii) Pressure

(iii) Temperature

(iv) Speed of sound

(v) Jet Velocity

(vi) Density.

Or

(b) A gas at a pressure of 340m bar, temperature of 355K and entry Mach number of 1.4 is expanded isentropically to 140m bar. Calculate the following :

(i) Deflection angle

(ii) Final Mach number

(iii) Final temperature of the gas. Take $\gamma = 1.3$.

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14. (a) Explain with neat sketches the principle of operation of (i) Turbofan engine and (ii) Turbojet engine.

Or

(b) An aircraft propeller flies at a speed of 440 kmph. The diameter of the propeller is 4.1m and the speed ratio is 0.8. The ambient conditions of air at the flight altitude are $T = 255\,K$ and $P = 0.55$ bar. Find the following :

(i) Thrust

(ii) Thrust Power

(iii) Propulsive efficiency.

15. (a) List the main components of Liquid Propellant Rocket Engine and explain.

Or

(b) A rocket engine has the following data :

Effective jet velocity = 1200 m/s

Flight to jet speed ratio = 0.82

Oxidizer flow rate = 3.4 kg/s

Fuel flow rate = 1.2 kg/s

Heat of reaction per kg of the exhaust gases = 2520 kJ/kg.

Calculate the following :

(i) Thrust

(ii) Specific impulse

(iii) Propulsive efficiency

(iv) Thermal efficiency

(v) Overall efficiency.

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