Q. Code: 401130

Reg. No. | | | | | | | | | |

M.E. / M.TECH. DEGREE EXAMINATIONS, DEC 2019

Third Semester

IC18017 – AIRCRAFT AND SPACE PROPULSION

(Internal Combustion Engineering)

(Regulation 2018)

Time: Three Hours **Maximum : 100 Marks**

(Use of gas table is permitted)

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	A plane travels with a velocity of 1000 kmph at an altitude where the pressure and temperature are 40 kPa and –35ºC. Find the Mach number.	1	U
2.	Explain the choking in Fanno flow.	1	R
3.	Give the differences with merits and demerits of turbo-prop and turbo jet engines.	2	R
4.	What is the need of Aircraft matching?	2	R
5.	Explain the variation of flight speed with propulsion efficiency for various propulsion system.	3	R
6.	Explain the thrust augmentation.	3	R
7.	Distinguish between monopropellant and bipropellant.	4	R
8.	A rocket nozzle has a throat area of 18 cm^2 and combustion chamber pressure of 25 bar, if the specific impulse is 127.42 sec, and weight flow rate 44.145 N/s, determine thrust coefficient.	4	U
9.	What are the various losses occurring in chemical rocket engines?	5	R
10.	Explain the Rocket heat transfer.	5	R

PART B - (5 X16 = 80 Marks)

11.	(a)	(i)	A conical air diffuser has an inlet diameter of 40 cm and an exit diameter of 80 cm. Air enters the diffuser with a static pressure of 200 kPa, static temperature 37ºC and a velocity of 265 m/s. Calculate (i). Mass flow rate and (ii). Properties at exit.	**(12)**	1	AP

		(ii)	A fluid flows through a variable area (CD) duct. Assume that the favorable pressure gradient is maintained throughout the duct. Now using this condition fill in the following blanks with the words decreasing or increasing (a) if M < 1(and dA is ----------), then dp and dv must be ---------- and ---------- (b) if M > 1 (and dA is ----------), then dp and dv must be ---------- and ----------	**(4)**	**1**	**U**
			(OR)			
	(b)	(i)	The data for a combustion chamber employing a hydrocarbon fuel is given below: entry: gas velocity = 152 m/s, pressure = 4 bar, temperature = 400 K, Exit Mach number = 0.8, Take γ = 1.3, Cp = 2.144 kJ/kg-K for the products of combustion. Calorific value of the fuel burnt = 43 MJ/kg. Determine (a) entry Mach number (b)Pressure, temperature and velocity of the gas at exit.	**(10)**	**1**	**AP**
		(ii)	A jet of air at 275 K and 0.69 bar has an initial Mach number of 2.0. It passes through a normal shock wave determine, Mach number, pressure, temperature, and jet velocity downstream of the shock.	**(6)**	**1**	**AP**
12.	(a)	(i)	What is bypass engine? With the neat sketch explain the working of turbofan engine?	**(8)**	**2**	**U**
		(ii)	Explain the following terms as applied to Jet propulsion and derive equation for them: (i). Propulsive efficiency (ii) Specific impulse, (iii) thermal efficiency, (iv) overall efficiency.	**(8)**	**2**	**U**
			(OR)			
	(b)	(i)	What is after burning in turbojet engines? Explain briefly with the aid of a diagram.	**(8)**	**2**	**U**
		(ii)	Describe the working of a scramjet engine.	**(8)**	**2**	**U**

13.	(a)	(i)	The diameter of the propeller of an aircraft is 2.5 m, if it flies speed of 500 Kmph at an altitude of 8000m. for a flight to jet speed ratio of 0.75, determine (i) the flow rate of the air through the propeller(ii) thrust produced (iii) specific thrust (iv) specific impulse (v) the thrust power.	**(8)**	**3**	**AP**
		(ii)	Explain the layout of aircraft matching.	**(8)**	**3**	**AN**
			(OR)			
	(b)	(i)	An aircraft flies at 960kmph. One of its turbojet engines takes in 40 kg/s of air and expands the gases to the ambient pressure. The air-fuel ratio is 50 and lower calorific value of the fuel is 43 MJ/kg. for maximum thrust power determine (a) jet velocity (b) thrust (C) specific thrust (d) thrust power (e) propulsive, thermal and overall efficiency and TSFC.	**(10)**	**3**	**AP**
		(ii)	Write down the steps involved for design of nozzle and diffuser in aircraft propulsion system.	**(6)**	**3**	**AN**
14.	(a)	(i)	The data for a rocket engine is given below combustion chamber pressure = 38 bar, combustion chamber temperature = 3500 K, oxidizer flow rate = 41.67 kg/s, mixture ratio 5.0, if the expansion in the rocket nozzle takes place to the ambient pressure of 583.58 N/m^2, calculate nozzle throat area, thrust, thrust coefficient, characteristic velocity, exit gas velocity and maximum possible velocity. Take $\gamma = 1.3$, R = 287 J/kg k.	**(8)**	**4**	**AP**
		(ii)	A rocket nozzle has a throat area of 18 cm^2 and combustion chamber pressure of 25 bar, if the specific impulse is 127.42 sec, and weight flow rate 44.145 N/s, determine thrust coefficient, propellant weight flow coefficient, SPC and characteristic velocity.	**(8)**	**4**	**AP**
			(OR)			
	(b)	(i)	A missile has a maximum flight speed to jet speed ratio of 0.2105 and specific impulse equal to 203.88 seconds. Determine for a burn out time of 8 seconds (a) effective jet	**(8)**	**4**	**AP**

			velocity (b)mass ratio and propellant mass fraction(c)maximum flight speed.			
		(ii)	Explain with neat sketch the working of a multi stage rocket vehicle.	**(8)**	**4**	**U**
15.	(a)	(i)	What are the various methods of ignition employed in liquid propellant rocket?	**(8)**	**5**	**U**
		(ii)	Describe with the aid of illustrative diagrams two arrangements of solid propellant grains for restricted and unrestricted burning.	**(8)**	**5**	**U**
			(OR)			
	(b)	(i)	Explain the propellant feed system (turbo pump feed system) used for the liquid propellant rocket engine.	**(8)**	**5**	**U**
		(ii)	Compare the properties of solid and liquid propellant.	**(8)**	**5**	**U**