Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course : Propulsion I **Semester : IV**
Course Code : ASEG 2003 **Time : 03 hrs.**
Programme : B.tech ASE, ASE+AVE **Max. Marks : 100**
Nos. of pages : 2
Instructions:

1. **The Question paper has three sections: Section A, B and C.**
2. **Section B and C have internal choices.**
3. **Assume the suitable data if needed**

SECTION A

Q. No.		Marks	CO
1	Differentiate between CI and SI engine based on construction and working principle.	**4**	**CO2**
2	Classifies the types of compressor based on working principle, pressure ratio and volume handling capacity.	**4**	**CO4**
3	Explain the Slip phenomenon in centrifugal compressor	**4**	**C04**
4	Explain the factor affecting carburetion.	**4**	**C03**
5	A 1500 kg helicopter is powered by a 12 m diameter rotor. When the helicopter is landing it descends at an uniform rate under sea level conditions, and the induced velocity is 1/3 the rate of descent of the helicopter. Compute the velocity at which the helicopter is descending [helicopter weight = $2.A.\rho (V- \upsilon)\upsilon$]	**4**	**C01**
	SECTION B		
6	Calculate the air standard efficiency of the cycle of an oil engine works on diesel cycle, which has maximum compression ratio is 16. At the beginning of compressor temperature is 20^oC and 750 KJ/Kg of air of heat is supplied at constant pressure and it reaches to 430^0C temperature at the end of adiabatic expansion. What would be the theroratical workdone per Kg of air. take Cv = 0.717 KJ/Kg K and specific heat ratio = 1.4.	**10**	**CO2**
7	Discuss the requirements of the fuel injection system and explain the typical fuel feed system for CI Engine. **OR** Explain in detail the injection system used in TATA Safari ligh motor vehicle with neat sketch.	**10**	**C03**
8	A speed of an axial flow compressor is 15000 RPM and mean dia is 0.6 mt the axial velocity of flow is constant and it is 225 m/s. the velocity of whirl at the inlet is 85 m/s and the workdone/ stage is 45 KJ/Kg of air the inlet condition are 1 bar and 300K. assuming the stage efficiency as 89% calculate a) Fluid deflection angle	**10**	**CO4**

	b) Pressure ratio c) Degree of reaction		
9	Derive the equation of blade element theory for the estimation of total thrust produced by the propeller and total torque required for running the propeller.	**10**	**CO1**
	SECTION-C		
10	1. Explain the types of blades used in compressor through velocity tringle and select the proper blade for high speed compressor application. **[10]** 2. Calculate the quantity of fuel to be injected per cycle per cylinder in a four cylinder four stroke diesel engine develops 100 KW at 3500 rpm. Its brake specific fuel consumption is 180 gm per KW h.. Specific gravity of the fuel may be taken as 0.88. **[10]** **OR** Solve a turbomachinery unit centrifugal compressor which runs at 10,000 rpm delivers 650 m^3/min of air corresponding to inlet condition of 1 bar and 25^0C the pressure ratio is 4 with isentropic efficiency is 82% blade are radial and outlet of impeller and velocity of flow is constant throughout and it is 62 m/s , $D_2 = 2D_1$, slipfactor = 0.9 and power input factor = 1.04 & K_1 =0.9. draw the velocity tringle at inlet and outlet with the effect of slip and calculate . a) Final temperature of air b) Power reqired in Kw c) Impeller dia at inlet and outlet d) Width of impeller at inlet e) Impeller blade angle at inlet f) Diffuser blade angle at inlet	**20**	**CO4 & CO3**
11	Analyze the performance in terms of work net, heat supply and overall efficiency of gas turbine engine in the following cases Case-I engine having regeneration, reheat and having single stages of intercooler and Case-I engine having regeneration, reheat and having two stages of intercooler Refer the following data for the analysis Air entering at 1 bar and 300K into compressor 1 and passes to intercooler 1 and cooled up to 280K and 4 bar pressure in intercooler. Now the second compressor compressed up to 10 bar and having 10 % pressure loss at the exit side of the compressor. Exit of compressor passes through the regenerator having effectiveness is 85%. Maximum temperature in the cycle is 1400K, subsequently turbine expanded upto 4 bar pressure and reheating done after the expansion of first turbine and its temperature reaches up to 1300K further expansion of turbine up to 1.2 and there will be loss of pressure in the exit side of second turbine about 0.2 bar. Consider the compression and expansion process to be non-isentropic and its efficiency will be 85% and 90 % respectively, assume air is the working fluid throughout the cycle. In the second case highest and lowest pressure in the cycle are remains constant and for second stage of intercooling intermediate pressure is about 6 bar and cooled up to 310 K.	**20**	**C04**

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SECTION A

Q. No.		Marks	CO
1	Explain the working of theoretical dual cycle through P-V and T-S plot.	**4**	**CO2**
2	Discuss the selection of airfoil from hub to tip in a propeller blade.	**4**	**C01**
3	Define the need of inlet guide vane at the inlet of compressor.	**4**	**C04**
4	Discuss the ideal characteristics of the Fuel for SI engine.	**4**	**C03**
5	Explain the principal of rotating machine through velocity tringle.	**4**	**C04**
	SECTION B		
6	A 2.7 litre cubic capacity six cylinder, four stroke otto engine has a compression ratio of 10. The engine develops 138 kW at 5000 rpm. Calculate a) Air standard efficiency b) The necessary rate of heat addition c) The mean effective pressure of the cycle d) And the peak temperature and pressure of the cycle **OR** Compare the efficiency and work done of Otto, diesel and dual cycles through PV and TS plot in following cases. a) Compression ratio and heat addition constant b) Same maximum pressure and heat input	**10**	**CO2**
7	Define the working principle of simple carburetor with neat sketches.	**10**	**C03**
8	Estimate the power available for the airscrew in a turboprop engine if the axial compressor of a gas turbine delivers 20 kg/s of air at a pressure ratio of 5.0 with an isentropic efficiency of 80% inlet temperature and pressure are 22 ^{0}C and 1 bar. Calculate the power required by the compressor.	**10**	**CO4**

	After heating at constant pressure to 870 ^{0}C the gas is expanded to 1 bar through a turbine with efficiency of 85 %. The turbine is direct coupled to the compressor and to an airscrew reduction gear which has an efficiency of 95% .		
9	A small aircraft is propelled by a 3.05 m diameter propeller, which produces 4.45 kN of thrust. The aircraft is flying at 160 km/hr at an altitude where the atmospheric conditions are such that the density of air is 1.003 kg/m3. Using momentum theory compute a) The induced velocity through the disk, b) The final velocity of the flow in the far wake	**10**	**CO1**
	SECTION-C		
10	a) Explain the gasoline injection system, its importance and their components for proper operation. **[10]** b) Discuss the impulse effect , centrifugal effect and diffusion effect in a centrifugal compressor through velocity triangle. **[10]** **OR** a) Calculate the quantity of fuel to be injected per cycle per cylinder in a four cylinder four stroke diesel engine develops 150 KW at 4000 rpm. Its brake specific fuel consumption is 200 gm per KW h.. Specific gravity of the fuel may be taken as 0.75. b) Air enters the compressor of a gas turbine at a pressure of a 1 bar and temperature of 300 K . the pressure after compression is 7 bar air fuel ratio is 60 the isentropic effecniy of compressor is 85% and that of turbine is 90% Calculate the power developed by the unit and its overall efficiency . assuming the value of specific heat ratio is 1.4 for both air and gas and C_P (air) = 1.005 and Cp (gas) = 1.11 KJ/kgK mass flow rate of air = 5 kg/s and calorific value of fuel = 45,000 KJ/kg	**20**	**CO3 & C04**
11	Discuss the relative merits and demerits of axial flow compressor over centrifugal compressor. Air at temperature of 300 ^{0} K enters a ten stage axial flow compressor at the rate of 3.5 kg/ sec. the pressure ratio is 6 and isentropic efficiency is 90%. The process is adiabatic and compressor has symmetrical stages. The axial velocity of 120 m/sec is uniform across the stages and mean blade speed is 200 m/sec. assume the temperature change is same in all stages. Determine the direction of air at entry to and exit from rotor and stator blades. Also, find the power given to air.	**20**	**C04**