Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Programme Name: B.Tech Mechanical ME-spz- MD, ME-spz- Ms&NT, ME-spz-prod, ME-spz- ther

Semester : V

Course Name : Fluid Machinery **Time : 03 hrs**

Course Code : MHEG 367 **Max. Marks : 100**

Nos. of page(s) : 2

Instructions: Assume the suitable data if it is required

SECTION A

S. No.		Marks	CO
Q 1	Explain the impulse effect and reaction effect in a hydraulic turbine. Give examples.	4	CO1
Q 2	Explain the need for a foot valve and strainer in a centrifugal pump system.	4	CO1
Q 3	Explain the term volumetric efficiency of the compressor. How clearance volume and pressure ratio effects the volumetric efficiency of the reciprocating compressor?	4	CO3
Q 4	Describe the principle of operation, construction and working of centrifugal compressor.	4	CO2
Q 5	Explain the Brayton cycle with p-v and T-s diagrams.	4	CO4

SECTION B

Q 6	Explain the working of a Kaplan turbine with sketches. Draw velocity diagrams and derive the equation for hydraulic efficiency.	10	CO1
Q 7	A centrifugal pump discharges 0.15 m^3/s of water against a head of 12.5 m, the speed of the impeller being 600 r.p.m. The outer and inner diameters of the impeller are 500 mm and 250 mm respectively and the vanes are bent back at 35^0 to the tangent at exit. If the area of flow remain 0.07 m^2 from inlet to outlet calculate: i) Monomeric efficiency of the pump ii) Vane angle at the inlet	10	CO2 CO3
Q 8	Explain the working of reheat gas turbine plant with the help of a p-v & T-s diagram.	10	CO1
Q 9	a) A single acting air compressor has a bore of 15 cm and the piston stroke is 25 cm. The crank speed is 600 RPM. Air taken from atmosphere (1 atm., 27^0 C) is delivered at 11 bars. Assuming isentropic compression, find the power required to drive the compressor, when its mechanical efficiency is 80%. The compressor has a clearance, which is $1/20^{th}$ of the stroke volume. Also find the volumetric efficiency of the compressor. (OR) A two stage reciprocating compressor with perfect intercooling delivers 8 kg/min of air at 36bar. The inlet pressure and temperatures are 1bar and 300K respectively. Assuming polytrophic process n=1.25 calculate (i) power required (ii) isothermal	10	CO2 CO3

	efficiency (iii) Heat transfer in each cylinder (iv) heat rejected in intercooler.		
	SECTION-C		
Q 10	A Pelton wheel operates with a jet of 150mm diameter under the head of 500m. Its mean runner diameter is 2.25m and it rotates with a speed of 375rpm. The angle of bucket tip at outlet as 15^0, Coefficient of velocity is 0.98, mechanical losses equal to 3% of power supplied and the reduction in relative velocity of water while passing through bucket is 15%. Find (a) the force of jet on the bucket, (b) the power developed (c) hydraulic efficiency and (d) the overall efficiency.	**20**	**CO1 CO2**
Q 11	a) A single-sided centrifugal compressor has the internal diameter of eye 15 cm. The compressor delivers air at the rate of 9 kg/s with a pressure ratio of 4.4 to 1 at 20,000 rpm. The axial velocity is 150 m/s with no pre-whirl. Initial condition of air are pressure 1 bar and temperature 20°C. Assuming adiabatic efficiency as 80%, the ratio of whirl speed to tip speed as 0.95 and neglecting all other losses, calculate [20] ▪ The rise of total temperature, ▪ Tip speed, ▪ Tip dia and ▪ External dia of eye. (OR) b) Consider an open gas turbine installation working on Brayton cycle and provided with intercooling, regenerator and reheating systems. 15kg/s of air enters the low pressure compressor at 1 bar, 290 K and after compression to 4 bar is cooled upto 295 K. After subsequent compression to 8 bar in the high pressure compressor, the air passes through a regenerator which has an effectiveness of 80%. The air is next led to combustion chamber where it is heated upto 1250 K. The heated air enters the high pressure turbine where it expands to 4 bar. The air is then reheated to 1200 K before being expanded to 1 bar in the low pressure turbine. The exhaust passes through regenerator being discharged out of cycle. Assume that compression and expansion processes are isentropic and **mechanical** efficiency of turbine and compressor are 98% and 96%, respectively. Find out: ▪ Power Output ▪ Thermal Efficiency	**20** **20**	**CO2 CO3 CO4**