Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

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

Course: Hydraulic Machines
Semester: IV
Program: BTech PSE **Time 03 hrs.**
Course Code: MECH 2011 **Max. Marks: 100**

Instructions: Draw velocity triangle to solve numerical problems

SECTION A

S. No.		Marks	CO
Q 1	.Give a brief description of the following terms: a) Compression ratio b) Mean effective pressure c)swept volume	**4**	**CO1**
Q 2	Explain negative slip of a reciprocating pump. When does it occur?	**4**	**CO1**
Q 3	Write the difference between vortex casing and volute casing with the help of diagram.	**4**	**CO1**
Q 4	Write the effects of cavitation in hydraulic machines.	**4**	**CO2**
Q 5	Explain the advantages of multistage compression.	**4**	**CO2**

SECTION B

Q 6	Explain hydraulic ram with the help of suitable diagram. Also write the mathematical expression for efficiency of hydraulic ram.	**10**	**CO4**
Q 7	Derive the work done of a reciprocating air compressor during polytropic compression. (Draw p-v diagram)	**10**	**CO3**
Q 8	A jet of water of diameter 95mm moving with a velocity of 18 m/s, strikes a curved fixed plate tangentially at one end at an angle 30^{o} to the horizontal. The jet leaves the plate at an angle 17^{o} to the horizontal. Find the force exerted by the jet in the horizontal and vertical direction.	**10**	**CO2**
Q 9	A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 rpm works against a total head of 75 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle 30^{o} at outlet. I f the outer diameter of the impeller is 600 mm and width at outlet is 50 mm, determine a) Work done per second by the impeller b) Manometric efficiency	**10**	**CO3**

	OR A centrifugal pump is running at 1000 rpm. The outlet vane angle of the impeller is 30^{o} and velocity of flow at outlet is 3 m/s. The pump is working against a total head of 30m and the discharge through the pump is 0.3 m^3/s. If the manometric efficiency of the pump is 75%, determine a) The diameter of the impeller b) The width of the impeller at outlet		
SECTION-C			
Q 10	The three-jet Pelton turbine is required to generate 10000 kW under a net head of 400m. The blade angle at outlet is 15^{o} and the reduction in the relative velocity while passing over the blade is 5%. If the overall efficiency of the wheel is 80%, $C_v = 0.98$ and speed ratio = 0.46, then find a) The diameter of the jet b) Total flow c) The force exerted by a jet on the buckets. If the jet ratio is not to be less than 10, find the speed of the wheel for a frequency of 50 hertz/sec and the corresponding wheel diameter.	**20**	**CO5**
Q 11	A single acting reciprocating air compressor has cylinder diameter and stroke length of 200 mm and 300 mm respectively. The compressor sucks air at 1 bar and $27^{o}C$ and deliver at 8 bar while running at 100 rpm. Calculate a) Indicated power of the compressor b) Mass of air delivered by the compressor per minute c) Temperature of air delivered by the compressor The compression follows the law $pv^{1.25} = C$. Take R as 287 J/kg K. **OR** A two stage air compressor takes in 22.5 kg of air per minute at 15^{0} C and 1 bar and delivers it at 16.5 bar. At the intermediate pressure, it is cooled to initial temperature. Assuming an ideal diagram with no clearance and compression according to $pv^{1.2} = C$, determine the intermediate pressure that gives least work. Also find the heat rejected in the intercooler per minute and minimum power required to run the compressor.	**20**	**CO5**

	Take $C_{p=}$ 1 kJ/kg K and R = 287 J/kg K.		