UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program:	**B Tech / Mechatronics**	**Semester –**	**V**
Subject :	**Fluid mechanics and machinery**	**Max. Marks**	**: 100**
Course Code :	**GNEG 321**	**Duration**	**: 3 Hrs**
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Section- A

Answer all the questions. **4 x 5 = 20 M**

Q1. Classify the hydraulic turbines based on type of energy conversion and direction of flow. Also arrange them in ascending order for specific speed and runner speed. **[5]**

Q2. With neat sketch explain the governing mechanism of impulse and reaction turbine. **[5]**

Q3. Define manometric, volumetric, mechanical and overall efficiency in context of centrifugal pump. **[5]**

Q4. State why draft is tube used in reaction turbine? Enlist the different types of draft tube utilized in reaction turbine. **[5]**

Section- B

Answer all the questions. **4 x 10 = 40M**

Q5. A single jet Pelton wheel runs at 350 rpm under a head of 500 m. The jet diameter is 200 mm, its deflection inside the bucket is 165^0 and its relative velocity is reduced by 20 % due to friction. Determine the (a) water power, (b) Resultant force on the bucket. The co-efficient of velocity at nozzle is equal to 0.98 and speed ratio 0.45. **[10]**

Q6. A turbine is to operate under a head of 25 m at 180 rpm. The discharge is 10 m^3. If the overall efficiency is 90%, determine the shaft power of the turbine under a head of 20 m. **[10]**

Q7. Derive Euler's equation for work done in turbines using usual notations and neat sketch.

OR

Enlist the advantage and disadvantage of (a) Francis turbine over the Pelton wheel (b) Kaplan turbine over the Francis turbine. **[10]**

Q8. Two reservoirs with a difference in elevation of 15m are connected by the three pipes in series. The pipes are 300 m long of diameter 30 cm, 150 m long of 20 cm diameter, and 200m long of 25 cm diameter respectively. The friction factor (f) in the relation

$$h_f = \frac{flV^2}{2gD}$$

for the three pipes are respectively 0.018, 0.020 and 0.019. Further the contractions and expansion are sudden. Determine the flow rate in liter/sec. The losses coefficient for sudden contraction from diameter 30 cm to 20 cm is equal to 0.24. **[10]**

Section- C

Answer all the questions. **2 x 20 = 40M**

Q9. The following data is given for an inward flow reaction turbine:
Net head (H) = 85.4m , speed of runner (N) = 650 r.p.m., shaft power(P) = 397 KW, width of blade and diameter at inlet (B_1/D_1) = 0.1, outer diameter to inner diameter ratio = 0.5, flow ratio = 0.17, constant flow velocity and radial discharge. The overall efficiency and hydraulic efficiency are 0.85 and 0.95 respectively. Find the discharge, diameter and width at inlet and outlet of runner, velocity of whirl at inlet, inlet jet angle , and blade angle at inlet and outlet.

OR

The Kaplan turbine develops power (P) = 25000 KW at an average head(H) = 40m . Assuming a speed ratio of (K_u) = 2, flow ratio (kf) = 0.6, ratio of hub diameter (Db) to outer runner diameter (D_0) = 0.35 , overall efficiency = 0.88, calculate diameter , speed and specific speed of the turbine. **[20]**

Q 10 . (a) Derive the equation of pressure head at inlet of draft tube using suitable assumptions and neat sketch. **[12]**

(b) Francis turbine is fitted with a vertical conical shaped draft tube, with top and bottom diameters equal to 50 cm and 100 cm respectively. The tube is running full with water flowing downwards, and it has a vertical height of 10m out of which 2 m is drowned in the tailrace water. Assume friction loss of head between the top and bottom points as 0.2 times the kinetic head of draft tube exit, and the exit velocity is 2 m/s. Determine the efficiency of draft tube efficiency.

[8]