Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V • EXAMINATION – WINTER 2013

Subject Code: 151903   **Date: 04-12-2013**
Subject Name: Fluid Power Engineering
Time: 10.30 am - 01.00 pm   **Total Marks: 70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Water at the rate of rate of 400 litres per second is flowing through a **07**
diverging duct AB. The pressure head at A is 8m and its elevation above the
ground is 4m. The point B is 8m above the ground. If the frictional losses are
2m, calculate the pressure head at B and draw the energy line. The diameter
of the duct at A and B are 30cm and 60cm respectively.

(b) With usual notations derive an expression of Darcy Weis-bach equation.   **07**

Q.2 **(a)** A small ship driven by reaction jets and discharging astern is estimated to **07**
have a relative velocity of 12m/s when moving at 30km/h.
The cross-sectional area of the jets at discharge is 240cm². Find the
resistance to the motion of ship and propulsive work.
If water enters through orifices facing the direction of motion of
ship and pump is 85 % and frictional losses in the pipe are equivalent to
3.6m of water head, calculate :
    (i) Power required to drive the pump,
    (ii) Overall efficiency of propulsion.

(b) A jet of water having a velocity of 40 m/s .impinges without shock on a **07**
series of vanes moving at 12m/s. The jet is making an angle of 20° with the
direction of motion of the vane. Relative velocity at outlet is 0.9 times the
relative velocity at inlet and absolute velocity of water at exit is normal to
the direction of motion of the vane. calculate :
(a)Vane angles at inlet and outlet.
(b)Work done on the vane per kg of water.
(c)Efficiency.

OR

(b) Derive an expression for calculating efficiency for radial vane for jet striking **07**
a moving curved vane tangentially at one tip.

Q.3 **(a)** The gross available head for a pelton wheel is 600 m out of which one third **07**
is lost due to friction in the penstock which takes water to the nozzle of the
pelton wheel. The rate of flow of water through the nozzles fitted at the end
of the penstock is 2 m³/s. The angle of deflection of jet is 165°.The reduction
in relative velocity while passing through buckets as 15 percent.
    Take speed ration K_u = 0.45 and coefficient of velocity C_v = 0.978,
D/d=1/10, η_{mech}=95%, Determine.
      a) Power developed by the turbine ,
      b) Hydraulic efficiency ,
      c) The unit power , and
      d) The dimensionless specific speed.

(b) State causes of cavitation in hydraulic turbine and methods of avoiding it. **07**

OR

Q.3 **(a)** A reaction turbine and its draft tube have a vertical axis. The pressure head **07** in the spiral casing at inlet is 48 m above atmospheric pressure and the velocity of water is 6 m/s. The water flow through the tube is 2.1m³/s, and the hydraulic and overall efficiencies are 83% respectively. The top of the draft tube is 1.2 m below the center line of the spiral casing while the tail race is 3.9 m below the top of the draft tube. The diameter of the draft tube at inlet is 0.75m and that at the tail race level 1.05 m. Determine :
  (i) Total head across the turbine,
  (ii) Shaft power,
  (iii)Head lost in turbine and draft tube,
  (iv) Power lost in mechanical friction

(b) State advantages and disadvantages of Francis turbine over Pelton turbine. **04**

(c) How are hydraulic turbines classified? **03**

Q.4 **(a)** An axial flow compressor draws air at 20°C and delivers it at 50 °C. **07** Assuming 50% reaction calculate the velocity of flow if blade velocity is 100 m/s, work factor as 0.85 assume $\alpha=10°$, $\beta=40°$, calculate the number of stages.

(b) With neat sketch explain construction and working of Scroll compressor. **07**

OR

Q.4 **(a)** In a three-stage compressor air is compressed from 98 k Pa to 20 bar. **07** Calculate for 1m^3 of air per second.
  i.   Work under ideal condition for n=1.3.
  ii.   Isothermal work.
  iii. Saving in work done due to multistage.
  iv.   Isothermal efficiency.

(b) Compare reciprocating compressor and centrifugal compressor. **03**

(c) Define following terms: Power input factor, slip factor, Pressure coefficient, **04** Pre-whirl.

Q.5 **(a)** During a test on a centrifugal pump the following readings were obtained **07**
Pressure gauge reading =1.32bar
Vacuum gauge reading =300 mm of Hg
Effective height between gauges=0.45m
Power of electric motor=22 k W
Discharge of pump= 85 lts./ sec
Diameter of delivery pipe=150 mm
Diameter of suction pipe=200 mm
Determine overall efficiency of pump

(b) Write brief note on: Hydraulic intensifier OR hydraulic ram. **07**

OR

Q.5 **(a)** Write brief note on: Multi-stage Centrifugal pump. **07**

(b) Prove from the first principles that the work saved in a single–acting **07** reciprocating pump by fitting an air vessel is 84.8%.

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