

B.E. Mechanical Engineering (Model Curriculum) Semester - IV  
**PCCME203 - Fluid Machines**

P. Pages : 2

Time : Three Hours



**GUG/S/23/14063**

Max. Marks : 80

- Notes :
1. All questions carry as indicated marks.
  2. Due credit will be given to neatness and adequate dimensions.
  3. Assume suitable data wherever necessary.
  4. Diagrams and Chemical equation should be given wherever necessary.
  5. Illustrate your answers wherever necessary with the help of neat sketches.
  6. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
  7. Attempt Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10

1. a) Draw a general layout of a Hydro-Electric power Plant and mention all the essential elements of it including efficiencies of Pelton wheel. 7
- b) A jet of water having a velocity of 20m/sec strikes a curved vane, which is moving with a velocity of 10m/sec. The jet makes an angle of  $20^\circ$  to the direction of motion of vanes at inlet and leaves at an angle of  $130^\circ$  to the direction of motion of vane at outlet. Calculate 9
- i) Vane angles so that water enters and leaves without shock.
  - ii) Work done per second per unit weight of water striking

**OR**

2. a) Derive the expression for work done by a water jet when it strikes normally series of flat plates mounted on a periphery of a wheel. Also derive the condition for maximum efficiency. 8
- b) A Pelton wheel is supplied with  $5\text{m}^3/\text{sec}$  when working under a head of 256 meter. Assuming overall efficiency of 85% and coefficient of velocity for nozzle and speed ratio being 0.98 and 0.46 respectively calculate: 8
- i) Shaft power
  - ii) Diameter of the wheel and jet diameter
  - iii) No. of Buckets and its dimensions.
  - iv) Specific speed.
- Assume the turbine runs at 500 rpm.
3. a) What is a draft tube? Discuss its types and function. 8
- b) A reaction turbine works at 450 rpm. Its flow area is  $0.4\text{m}^2$ . Under a head of 120 meters. Its diameter at inlet is 120 meter and the flow area is  $0.4\text{m}^2$ . The angle made by the absolute and relative velocities at inlet are  $20^\circ$  and  $60^\circ$  respectively with the tangential velocity. The discharge at outlet of the Turbine is radial. Calculate:- 8
- i) The volume flow rate
  - ii) Power developed.
  - iii) Head at inlet.
  - iv) Hydraulic efficiency
- Assume velocity of flow to be constant

**OR**

4. a) A Kaplan turbine runner is to be designed to develop 9000kW. The net available head is 6m. If the speed ratio is 2.0 and flow ratio is 0.7, over all efficiency 87% and the diameter of boss being  $\frac{1}{3}$  of the diameter of the runner. Find the diameter of the runner, its speed and specific speed of the turbine. **8**
- b) What is cavitation? How can it be avoided at design and operational stage? **8**
5. a) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angle of the impeller at inlet and outlet are  $20^\circ$  and  $30^\circ$  respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by impeller per unit weight of water. **10**
- b) Derive an expression for the minimum speed for starting a centrifugal pump. **6**
- OR**
6. a) Derive an expression for the work done by the impeller of a Centrifugal pump on a liquid. **11**
- b) What do you understand by cavitation of the centrifugal pump? **5**
7. a) A single acting reciprocating piston pump runs at a speed of 50 rpm and delivers 0.01 m<sup>3</sup> of water per second. The diameter of the piston is 200 mm and its stroke is 400 mm. Determine:- **8**
- i) The theoretical discharge of the pump,
  - ii) The coefficient of discharge of the pump,
  - iii) The slip of the pump,
  - iv) The percentage slip of the pump.
- b) Explain with the help of Indicator diagram that work done by pump is directly proportional to area of Indicator diagram. **8**
- OR**
8. a) What do you understand by coefficient of discharge of a reciprocating pump? What is its relationship with slip? Can slip be negative? If yes how? **8**
- b) The cylinder bore diameter of single acting reciprocating pump is 150mm and its stroke is 300mm. The pump runs at 50 r.p.m. and lift water through height of 25m. The delivery pipe is 22m long and 100 mm in diameter. Find the theoretical discharge and theoretical power required to run the pump. If the actual discharge is 4.2 liters/s. Find the % slip. Also, determine the acceleration head at the beginning and middle of delivery stroke. **8**
9. a) Define similitude. Explain in brief different types of similarities applied to hydraulic machines. **8**
- b) Explain: Model testing of centrifugal pump. **8**
- OR**
10. Explain with neat sketches following water lifting devices. **16**
- i) Regenerative pumps.
  - ii) Bore hole pumps.
  - iii) Jet Pumps.
  - iv) Hydraulic rams.

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