(3 Hours)   Marks :80

Note   i. Question number 1 is compulsory.
 ii. Solve any three questions of remaining.
 iii. Assume data wherever necessary and clearly mention.
 iv. Draw neat sketches as needed.

Q1   Solve any FOUR   20
 a   What are merits of distorted models
 b   Write a note on surface profiles in open channel.
 c   Derive condition for most economical rectangular section
 d   Derive expression for unit power of turbine
 e   Write a note on hydroelectric power plant layout
 f   Write a note on multistage pumps

**Q2   a   A pipe of 300 mm diameter conveying 0.30 m^3/s of water has a right angles, bend in a   10
       horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and
       outlet of the bend are 24.525 N /cm^2 and 23.544 N/cm^2.**

 b   Show by dimensional analysis, that the power P developed by a hydraulic turbine is given   10

       by:

       $P = \rho N^3 D^5 f \left[\frac{N^2 D^2}{gH} \right]$

       Where ρ is mass density of liquid, N is rotational speed, D is the diameter of runner, H is

       working head and g is gravitational acceleration.

**Q3   a   At a particular hydroelectric solution, the available head is 60 m and it is estimated that a   10
       discharge of 30 m^3/s will be available. It is proposed to install Francis turbine of specific
       speed 215 and these are to run at 550 rpm with an overall efficiency of 85%. Make
       calculations for number of turbines and power available**

 b   Find the power required to drive a centrifugal pump which delivers 0.04 m^3/s of   10
       Water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall
       efficiency of the pump is 70 % and coefficient of friction f = 0.15 in the formula
       $h_f = (4 f L V^2/2gd)$

**Q4   a   A 25mm diameter water jet exerts a force of 470 N in the direction of flow against a flat   7
       plate which is held inclined at angle 30 degree to axis of stream. Make calculation for
       flow rate of water**

 b   In hydroelectric generating plant, there are four similar turbines of total output 220 MW.   7
       Each turbine is 90% efficient and runs at 100 rpm under head of 65m. Find flow rate of
       any one turbine

 c   Derive an expression for energy loss during   hydraulic jump   6

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Q5 a The discharge of water through a rectangular channel of width 8 m is 15 m³/s when depth   10
of flow of water is 1.2m. determine (1) specific energy of flowing water (2) Critical depth
(3) critical velocity (4) minimum specific energy

     b 1 in 20 model of stilling basin, the height of hydraulic jump in the model is observed to be   10
20 cm. What would be corresponding height of jump in prototype. If energy dissipation
in model is 0.1 KW, what would be the corresponding value in the prototype?

Q6 a Derive condition for most economical circular section for maximum velocity   5
     b Differentiate between open channel flow and pipe flow   5
     c Derive expression for force exerted by jet on stationary curved plate when jet striking at   5
centre
     d Write a note on NPSH   5

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