I D NO.

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 40 % Max Marks: 80 Max Time: 2 hrs. 11 May Friday 2018

ENDTERM FINAL EXAMINATION MAY 2018 SET A

Even Semester 2017-18 Course: **MEC 303 Turbomachinery** VI Sem. Mechanical

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Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) Scientific and Non-programmable calculators are permitted
(iv) *Write answers pointwise.* ***Lengthy answers attracts penalty.***

Part A

(6 Q x 4 M = 24 Marks)

1. Give minimum two classifications of hydraulic turbines.
2. Define slip factor. How do you reduce slip factor in Centrifugal compressor?
3. Draw pressure and velocity distribution for given figure 1 (see backside of the paper).
4. Draw inlet and outlet velocity triangles for following configurations of Axial Flow Compressor:
    a. Axial Entry
    b. Blade angle at outlet is less than 90º
5. Enlist minimum four parts of wind turbine.
6. Give minimum two sets of differences on Vertical axis wind turbine and Horizontal axis wind turbine.

Part B

(3 Q x 12 M = 36 Marks)

7. A centrifugal compressor runs at a speed of 15000 rpm and delivers 30 kg of air per second. Exit radius is 0.35 m; relative velocity at exit is 100 m/s at an exit angle of 75º. Assume axial inlet and $T_{01} = 300\ K\ and\ P_{01} = 1\ bar$. Calculate (a) the torque, (b) the power

required to drive the compressor, (c) the ideal head developed, and (d) the work done. Also, draw outlet velocity triangle.

8. In a gas power plant, gas flows through the nozzle with a velocity of 500 m/s at an angle of 22º. It exits the moving blade at a speed of 80 m/s and at an angle of 50º. The mass flow rate of gas is 54000 kg/hr. Mean rotor speed of the blade is 200 m/s. Calculate (a) blade angles, (b) power developed, and (c) the power lost in friction. Also, draw the velocity triangle. Assume that blades are equiangular.
9. In a four-stage axial flow compressor, stagnation conditions of air at entry are 1 bar and 20ºC. The stage efficiency is 90% with a compression ratio of 1.2 for each stage. Calculate (a) the stagnation pressure, and (b) temperature at the end of each stage.

Part C

(1Q x 20 M = 20 Marks)

10. Consider, a Hoover dam hydroelectric power plant (shown in figure 2) uses Multi-jet Pelton wheel operating at a head of 305 m at 600 rpm. The jet is impinging 0.595 $\frac{m^3}{s}$ of water on buckets of Pelton wheel and deflected through an angle of 160º before leaving the buckets. The power transferred to grid is 20,000 kW from generator with efficiency of 95%. The overall efficiency of Pelton wheel is 80%. The speed ratio is 0.43, the coefficient of velocity is 0.98 and blade velocity coefficient is 0.88. Draw the velocity triangle and calculate;

(a) flow angle at outlet
(b) power available at the input of generator
(c) total discharge capacity
(d) diameter of single jet
(e) number of jets required
(f) mean diameter of Pelton wheel
(g) number of buckets required
(h) width, depth and length of the buckets

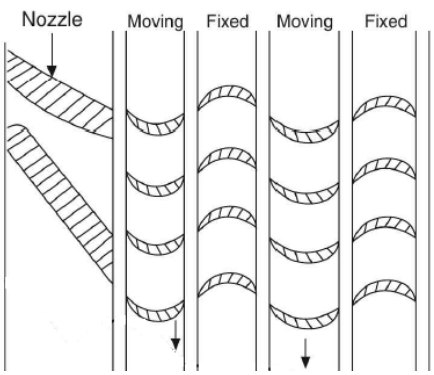

Figure 1

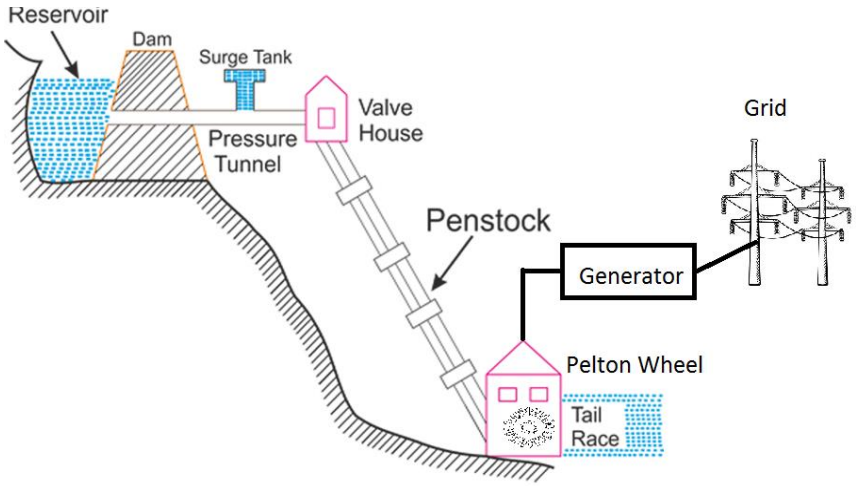

Figure 2

ID NO:	

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 20% Max Marks: 40 Max Time: 1 hr. 28 March Wednesday 2018

TEST – 2 **SET A**

Even Semester 2017-18 Course: **MEC 303 Turbomachinery** VI Sem. Mechanical

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Instruction:

(i) *Read the question properly and answer accordingly.*
(ii) *Attempting all questions are compulsory.*
(iii) *Scientific and Non-programmable calculators are permitted.*
(iv) ***Lengthy answers attracts penalty.***

Part A

(4 Q x 4 M = 16 Marks)

1. What is priming of the pump? Define degree of reaction for axial flow turbine.
2. Mention an expression of maximum utilization factor for (a) Impulse Turbine, and (b) Reaction Turbine. Enlist minimum four names of principle parts of centrifugal compressor.
3. Classify centrifugal pump according to (a) the liquid handled, and (b) the specific speed.
4. Draw inlet and exit velocity triangle for a 50% axial flow compressor.

Part B

(1 Q x 9 M = 9 Marks)

5. An inward radial flow turbine has 0.6 reaction. The blade speed at entry is 12 m/s and the radial velocity of flow is constant at 2.4 m/s. The rotor diameter at entry is twice that at exit. Find the utilization factor, angles of the blades at entry and exit assuming that there is no exit whirl velocity and no friction loss. Is utilization factor maximum?

Part C

(1Q x 15 M = 15 Marks)

6. A centrifugal pump is used to handle sewage water (density = 1400 kg/m^3) in water treatment plant. It is running at 1500 rpm against a head of 20 m. The outer vane angle of the impeller is 30^o. The velocity of flow is constant and equal to 3 m/s with discharge capacity of 0.3 m^3/s. If the manometric efficiency is 75%, determine (a) the diameter of the impeller at outlet, (b) the width of the impeller at outlet, (c) inlet vane angle, if diameter at inlet is 15 cm, (d) the power imparted by the impeller, and (e) the shaft power supplied by motor, if the mechanical efficiency is 80%. Also, draw the velocity triangle.

ID NO:	

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 20 % Max Marks: 40 Max Time: 1 hr. 20 Feb Tuesday 2018

TEST – 1

Even Semester 2017-18 Course: **MEC 303 Turbomachinery** VI Sem. Mechanical

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Instruction:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) Scientific and Non-programmable calculators are permitted.
(iv) ***Lengthy answers attracts penalty.***

Part A

(3 Q x 4 M = 12 Marks)

1. Define and write the formula for Mach number and Specific Speed of a turbine.
2. Differentiate between Positive displacement machines and turbomachines with at least four valid points.
3. Draw an inlet and outlet velocity triangle for Centrifugal Pump with following effects:
   a. Radial inlet
   b. Blade discharge angle, $\beta_2 = 26.5^0$
   c. Name the type of curved vanes/blades used for the given configuration.

Part B

(2 Q x 8 M = 16 Marks)

4. A quarter-scale turbine model is tested under a head of 10 m. The full-scale turbine is required to work under a head of 28.5 m and 415 rpm. (a) At what speed must the model be run if it develops 94kW and uses 0.96 $\frac{m^3}{s}$ at this speed? (b) What will be the power obtained from the full-scale turbine?
5. The resistance force R, to the motion of a completely submerged body depends upon the length of the body L, velocity of the flow V, mass density of the fluid ρ and kinematic viscosity of fluid ϑ. By dimensional analysis, prove that

$$R = \rho V^2 L^2 \, \emptyset\left(\frac{\vartheta}{LV}\right)$$

Part C

(1Q x 12 M = 12 Marks)

1. A skyscraper uses a high capacity centrifugal pump to pump the water at a head of 100 m. The velocity of flow is 20 m/s and is constant at inlet and outlet. The blades are radial at the tip and pump runs at 2500 RPM. The width of the blade at the tip is 50 mm. Assume radial entry. Calculate
    a. Draw velocity triangle
    b. Outer diameter of impeller
    c. Inlet diffuser angle at the impeller exit
    d. Flow rate of water
    e. Stage pressure rise (Assume compression process is isentropic)
    f. Degree of reaction