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# UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

**End Semester Examination, December 2017**

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| **Program: M.Tech./RE** | **Semester – I** |
| **Subject (Course): Steam Gas and Hydraulic Turbines** | **Max. Marks : 100** |
| **Course Code : MREQ702** | **Duration : 3 Hrs** |
| **No. of page/s: 02** | |

## Section-A

**Note: Answer all questions in Section-A.** **[5×4 = 20 M]**

1. Describe the choked flow in steam nozzles.
2. Compare the axial and radial flow gas turbines.
3. Explain the necessity of surge tanks for hydraulic turbines.
4. Why Cascade theory is necessary for performance analysis of gas turbines?
5. Explain the combustion phenomenon in gas turbines?

## Section-B

**Note: Answer all questions in Section-B.** **[4×10 = 40 M]**

6. (a) Exemplify the advantages of gas turbines over steam turbines.

   (b) Why compounding in turbines is necessary? Draw the velocity compounding diagram.
7. Derive the stagnation properties of pressure, temperature and density for steam nozzles.
8. (a) Discuss the effect of cavitation on performance of hydraulic turbines.

   (b) Explain the important role of draft tube in improvement of the performance of hydraulic turbines.

9. Explain simple gas turbine cycle. How reheating and intercooling processes would improve the performance of a gas turbine cycle? **(or)**

Explain the specific speed and efficiencies of hydraulic turbines. Draw the curve between specific speed and efficiency for different types of turbines.

## Section-C

**Note: Answer all questions in Section-C. Assume appropriate data for any missing values while solving the numerical.** **[2×20 = 40 M]**

10. Following are the specifications of a free vortex turbine blade.

Blade root diameter = 440 mm; Blade tip diameter = 740 mm; Rotor blade inlet angle at mean height = $45^o$ ; Rotor blade outlet angle at mean height = $75^o$; Nozzle outlet angle at mean height = $76^o$; Speed = 5800 rpm; Considering that the axial velocity remains constant across the rotor find the nozzle exit angle, degree of reaction and rotor blade angles at the hub and tip.

**(or)**

The head at the base of the nozzle of a Pelton wheel is 640 m. The outlet vane angle of the bucket is $15^o$. The relative velocity at the outlet is reduced by 15% due to friction along the vanes. If the discharge at outlet is without whirl find the ratio of bucket speed to the jet speed. If the jet diameter is 100 mm while the wheel diameter is 1.2 m, find the speed of the turbine in rpm, the force exerted by the jet on the wheel, the power developed and the hydraulic efficiency. Take $C_v$ =0.97

11. Steam issues from the nozzle of a simple impulse turbine with a velocity of 900 m/s. The nozzle angle is $20^o$, the mean diameter of the blades is 25 cm and the speed pf rotation is 20,000 rpm. The mass flow through the turbine nozzles and blading is 0.18 kg of steam per sec. Draw the velocity diagram and calculate tangential force on the blades, axial force on the blades, power developed by turbine wheel, efficiency of blading and inlet angles of blades for shock less inflow of steam. Assume the outlet angle of the blades is equal to the inlet angle and frictional losses are negligible.

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