No. of Printed Pages : **3 + Drawing Sheet**

BIME-013

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2013

BIME-013 : TURBO MACHINES

Time : 3 hours *Maximum Marks : 70*

*Note : Answer **any five** questions. Assume missing data suitable if any. All questions carry **equal** marks. Use of scientific calculator is **permitted**.*

1. (a) Define specific speed of a turbine and a pump. Obtain an expression for the specific speed of turbine and explain its significance. 7

   (b) The resisting force 'F' of a supersonic plane during flight can be considered as dependent upon the length of the aircraft 'L', velocity 'V', air viscosity 'μ' air density 'ρ' and bulk modulus of air 'K'. Express the functional relationship between these variables and the resisting force. 7

2. (a) Derive an expression for maximum hydraulic efficiency of pattern wheel. 7

   (b) What is cavitation ? How can it be avoided in reaction turbine ? 7

3. (a) Draw the neat sketch of francis turbine and explain its working. 7

(b) A kaplan turbine produces 30,000 kW under a head of 9.6 m, while running at 65.2 rpm. The discharge through the turbine is 350 m^3/s. The tip diameter of the runner is 7.4 m. The hub diameter is 0.432 times the tip diameter. 7

Calculate :

(i) The turbine efficiency

(ii) The specific speed of turbine

(iii) The speed ratio (based on tip diameter)

(iv) The flow ratio

4. (a) Derive an expression for the overall pressure ratio developed in centrifugal compressor. 7

(b) What is NPSH ? Explain priming in pump. 7

5. (a) Derive an equation for degree of reaction in a radial flow Turbine. 7

(b) A centrifugal pump delivers water against a head of 25 m. The radial velocity of flow is 3.5 m/s and it is constant. The flow rate of water is 0.05 m^3/s. The blades are radial at the tip and the pump runs at 1500 rpm. 7

Calculate :

(i) The diameter at the tip

(ii) The width of the blade at the tip

(iii) Inlet diffuser angle at the impeller exit

6. (a) Show that gross stage efficiency of an impulse steam turbine is the product of blade efficiency and nozzle efficiency. 7

(b) A gas turbine plant with a pressure ratio of 1 : 5 takes in air at 15° C. The maximum temperature is 600° C and develops 2200 kW. The turbine and compressor efficiencies are equal to 0.85. Taking Cp = 1 kJ/kg K and Cv = 0.714 kJ/kgK. 7

Determine :

(i) Actual over all efficiency of the turbine

(ii) Mass of air circulated by the turbine

7. Explain the following as related to steam turbine : 14

(a) Speed ratio

(b) Diagram efficiency

(c) Blade velocity coefficient

(d) Stage efficiency