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BIME-013

B.Tech. - VIEP - MECHANICAL ENGINEERING

(BTMEVI)

Term-End Examination, 2019

BIME-013 : TURBO MACHINES

Time : 3 Hours

Maximum Marks : 70

Note : Attempt any seven questions. All questions carry equal marks. Use of scientific calculator is permitted. Missing data, if any, may be suitably assumed.

1. Explain, with neat sketches, the construction and working of a Single-Stage Centrifugal Pump. [10]

2. An Agitator of diameter D rotates at a speed N in a liquid of density ρ and viscosity μ . [10]

Show that the power P required to mix the liquid is expressed by a functional form :

$$\frac{\rho}{\rho N^3 D^5} = f \left[\frac{\rho N D^2}{\mu}, \frac{N^2 D}{g} \right]$$

3. What is a Surge Tank and a Forebay ? What are their functions ? Describe with neat sketches any one type of surge tank. [10]
4. (a) How does actual gas turbine cycle differ from the Theoretical cycle ? [5]
- (b) What are the requirements of Combustion Chamber of a gas turbine ? [5]
5. What is a Centrifugal Compressor ? How does it differ from an axial flow compressor ? [10]
6. Describe in brief the phenomenon of Cavitation in turbines. How it can be avoided ? [10]
7. A Centrifugal compressor has to deliver 35 kg of air per sec. The impeller is 76 cm diameter, revolving at 11,500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4.2 : 1, estimate the probable axial width of the impeller at the impeller tip, if the radial velocity is 120 m/s. The inlet conditions are 1 bar and 47°C. [10]
8. A diesel engine contains 0.1 m³ of air at 0.98 bar and 30°C at the beginning of Compression. The compression ratio is 15 and the volume at cut-off is

0.0125 m³. Determine for the corresponding air standard cycle :

- (a) The cut-off ratio
- (b) The percentage clearance
- (c) The work done
- (d) The air standard efficiency

Take $C_p = 1.005 \text{ KJ/Kg K}$, and $\gamma = 1.4$

9. Find the required air-fuel ratio in a gas turbine whose turbine and compressor efficiencies are 85% and 80% respectively. Maximum cycle temperature is 875°C. The working fluid can be taken as air ($C_p = 1.0 \text{ KJ/Kg K}$, $\gamma = 1.4$), which enters the compressor at 1 bar and 27°C. The pressure ratio is 4. The fuel used has calorific value of 42000 KJ/Kg. There is a loss of 10% of calorific value in the combustion chamber. [10]

10. A 137 diameter jet of water issuing from a nozzle impinges on the buckets of a Pelton wheel and the jet is deflected through an angle of 165° by the buckets. The head available at the nozzle is 400m. Assuming

co-efficient of velocity as 0.97, speed ratio as 0.46 and reduction in relative velocity while passing through buckets as 15%, find :

- (a) The force exerted by the jet on buckets in tangential direction ;
- (b) The power developed.

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