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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, November 2014
(2013 Scheme)
13.306 : HYDRAULIC MACHINES AND HEAT ENGINES (E)

Time : 3 Hours Max. Marks : 100

***Instruction** : Draw sketches wherever **necessary**.*

PART – A

Answer **all** questions.

1. State Newton's law of viscosity and give examples of its applications.
2. Explain the phenomenon of surface tension with a neat sketch.
3. Briefly explain the working of a Bourdon tube pressure gauge with a neat sketch.
4. Define the terms speed ratio and jet ratio related to Pelton wheel.
5. Explain the purpose of providing scroll casing and guide vanes for a reaction turbine.
6. What is priming ? Why it is required in centrifugal pumps ?
7. Describe multistage pump with impellers in series and impellers in parallel.
8. Describe the function of air vessel with a neat sketch.
9. Explain heat balance test and draw a heat balance sheet for a diesel engine.
10. Discuss the methods to improve the thermal efficiency of an open cycle gas turbine plant.

(10×2=20 Marks)

P.T.O.

PART – B

Answer **one full** question from **each** Module.

Module – I

11. a) Derive an expression for the relation between gauge pressure inside the droplet of a liquid and the surface tension. **8**

    b) An inverted U-tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30 cm, when an oil of specific gravity 0.8 is used as gauge fluid. The vertical height of water columns in the two limbs of the inverted manometer are found to be the same and equal to 35 cm. when measured from the respective centre lines of the pipes. Determine the difference of pressure between the pipes. **12**

OR

12. a) Derive an expression for the power transmission through the pipes. Find also the condition for maximum transmission of power and corresponding efficiency of transmission. **10**

    b) A venturimeter is to be fitted to a pipe 25 cm diameter in which the maximum flow is 7200 liters per minute and the pressure head is 6 m of water. What is the minimum diameter of throat so that there is no negative head in it ? What is the quantity of water flowing in it, when a double column differential mercury gauge shows a deflection of 20 cm. ? Take C_d for venturimeter as 0.98. **10**

Module – II

13. a) Derive an expression for the hydraulic efficiency of a reaction turbine in terms of the tangential velocities of the runner at inlet and outlet, the velocities of whirl at inlet and outlet and the supply head. Take all velocities in the direction of motion of the runner as positive. **10**

    b) A Kaplan turbine develops 9000 kW under a net head of 7.5 m with an overall efficiency of the wheel as 86%. The speed ratio based on the outer diameter is 2.2 and the flow ratio is 0.66. Diameter of the boss is 0.35 times the external diameter of the wheel. Determine the diameter of the runner and the specific speed of the runner. **10**

OR

14. a) Obtain an expression for the work done per second by water on the runner of a pelton wheel. Hence derive an expression for maximum hydraulic efficiency of the pelton wheel giving the relationship between the jet speed and bucket speed. 8

b) A pelton wheel is to be designed to develop 735.5 kW at 400 rpm. It is to be supplied with water from a reservoir whose level is 250 m above the wheel, through a pipe 900 m long. The pipe line losses are to be 5% of gross head. The coefficient of friction is 0.005. The bucket speed is to be 0.46 of the jet speed and efficiency of the wheel is 85%. Calculate

i) pipeline diameter

ii) jet diameter and

iii) wheel diameter. 12

Module – III

15. a) With the help of a neat sketch, explain the operation of a centrifugal pump. 8

b) The impeller of a centrifugal pump of 30 cm inside diameter and 60 cm outside diameter is running at 1000 rpm. The water enters radially and velocity of flow through the impeller is constant at 3 m/s. The exit vane angle of the blade is 45°. Find the inlet vane angle, work done per kg of water and velocity of water in magnitude and direction at outlet. 12

OR

16. a) Derive an expression for the head loss due to friction in the delivery pipe of a reciprocating pump with and without air vessel. 10

b) The bore and stroke of a double acting reciprocating pump are 15 cm and 30 cm respectively. The suction and delivery heads are 3 m and 30 m. The pump delivers 0.62 m^3/min when running at 60 rpm. Find the power required to run the pump if the mechanical efficiency is 80%. Also find the percentage skip and coefficient of discharge. 10

Module – IV

17. a) What are various methods for finding out friction power of an IC engine ? Explain any method in detail with the help of a neat sketch. 8

b) The following details were noted in a test on a four cylinder four stroke engine. Bore and stroke of the cylinders are 100 mm and 120 mm. Speed of the engine is 1600 rpm. Fuel consumption is 0.2 kg/min. Calorific value of fuel is 44000 kJ/kg. Difference in tension on either side of the brake pulley is 40 kg and brake circumference is 300 cm. If the mechanical efficiency is 80%, calculate

i) brake thermal efficiency ii) indicated thermal efficiency

iii) mean effective pressure iv) specific fuel consumption. **12**

OR

18. a) Describe with neat sketches the working of a simple constant pressure open cycle gas turbine. How does the actual cycle differ from ideal cycle ? **10**

b) In an open cycle constant pressure gas turbine air enters the compressor at 1 bar and 300°K. The pressure of air after the compression is 4 bar. The isentropic efficiencies of compressor and turbine are 78% and 85% respectively. The air-fuel ratio is 80:1. Calculate the power output and thermal efficiency of the cycle if the flow rate of air is 2.5 kg/s. Take $C_p = 1.005$ kJ/kg and $\gamma = 1.4$ for air and $C_{pg} = 1.147$ kJ/kg-K and $\gamma = 1.33$ for gases. $R = 0.287$ kJ/kg-K. Calorific value of fuel = 42000 kJ/kg. **10**