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SUBJECT CODE = CEE024102

Roll No. of candidate

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2017

End Semester M. Tech. (Civil Engineering) Examination

1st semester

PUMPING SYSTEMS

FULL MARKS- 70

Pass Marks-21

Time-3 Hours

Questions:

PART: A

Marks

16×1=16

Q.1

- What is a pump?
- Why air vessels are fitted to a reciprocating pump?
- What are the purposes of using multistage pumps?
- Name a pump which can be used for pumping highly viscous fluid.
- What is represented by the abscissa of the Pump Characteristics Curves?
- For a centrifugal pump Head \propto (Speed)ⁿ. What is the value of n?
- What is the unit of specific speed?
- Why centrifugal pumps are popular compared to other pumps?
- What are the main components of centrifugal pumps?
- What is meant by pump operating point?
- Describe each part of this centrifugal pump designation: 2×3-10.
- How are centrifugal pumps classified?
- What is static head of a centrifugal pump?
- What is cavitation?
- What is priming?
- What is shut-off head of a pump?
- What are the hydraulic functions of impeller and casing?

PART: B

2×7=14

Q. 2

- Describe the affinity laws for centrifugal pumps.
- A two-stage centrifugal pump is required for a fire engine for a duty of 60 L/sec at a head of 75 m. If the overall efficiency is 75% and specific speed per stage about 40, find (i) the running speed in RPM and (ii) the BHP of driving engine.

PART: C

4×10=40

1. A pump lifts water from a low reservoir (W. L. = 80 m) to an elevated reservoir (W. L. = 90 m). The suction pipe is 30 m long, 300 mm diameter and the delivery pipe is 150 m long, 250 mm diameter. Both pipes are new cast iron with $e = 0.26$ mm. Suction side has a foot valve ($K = 2.5$) and a 90° elbow ($K = 0.9$) and delivery side has a gate valve ($K = 0.19$) and two 90° elbows ($K = 0.9$). The pump head-discharge data are given below. Find two points on the system head - discharge curve. Use Zigrang-Sylvester relationship for determining 'f' for the DW formula. Take v as $1.3 \text{ mm}^2/\text{s}$.

Discharge, Q (m ³ /s)	0	0.02	0.04	0.06	0.08	0.10	0.12	0.14
Head, H (m)	30.8	30.9	30.8	29.0	27.0	23.0	17.3	9.0

OR

Describe the methods for finding out pump operating points when they operate in parallel and in series.

2. Determine the available NPSH ($NPSH_A$) for a system consisting of a closed tank with a pressure of -20 kPa above water at 70°C , which is connected to a pump with a pipe of OD 48.3 mm and wall thickness 3.68 mm through a 90° elbow and a fully open globe valve. Total length of pipe is 12 m. The atmospheric pressure is 100.5 kPa. The water level in the tank is 2.5 m above the pump inlet. The flow rate is 95 L/min. What will be NPSH required ($NPSH_R$) if minimum 10% margin for $NPSH_A$ over $NPSH_R$ is called for? Use following information for solving the problem: (a) at 70°C , $\gamma_w = 9.59 \text{ kN/m}^3$; $\nu = 4.11 \times 10^{-7} \text{ m}^2/\text{sec}$; $h_{vp} = 3.25 \text{ m}$; (b) $F_T = 0.021$; $K = 30 F_T$ for 90° elbow and $340F_T$ for Globe valve; pipe roughness (e)= $4.6 \times 10^{-5} \text{ m}$.

OR

A centrifugal pump is to discharge 118 L/sec at a speed of 1450 RPM against a head of 25 m. The impeller diameter is 250 mm and its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outlet periphery of the impeller.

3. The Characteristics of a centrifugal pump operating at two different speeds are listed below.

Speed (RPM)	Discharge (gpm)	Head (m)	Efficiency (%)
1750	0	220	-
	1500	216	63
	2500	203	81
	3000	192	85
	3300	182	86
	3500	176	85
	4500	120	72
1150	0	96	-
	1000	93	65
	1500	89	77
	2000	82	83
	2200	77	84
	2500	70	83
	3000	49	71

Plot these curves and connect the best efficiency points (b.e.p.) with a dashed line. Calculate Head-Discharge values for an operating speed of 1450 RPM and plot the curve. Sketch the pump operating envelope between 60 and 120% of the b.e.p.

OR

Describe the principle and working of a reciprocating pump with a neat diagram.

3. A water pump is discharging at a rate of $0.25 \text{ m}^3/\text{sec}$. The diameters of the discharge and suction nozzles are 300 mm and 350 mm respectively. The reading on the discharge gage located 0.25 m above the centreline of the impeller is 150 kN/m^2 ; the reading on the suction gage located at the centreline of the impeller is 20 kN/m^2 . Determine (1) the total dynamic head, (2) the power input required by the pump and (3) the power input to the motor. Assume that the efficiencies of the pump and the motor are 65 and 90% respectively.

OR

List 10 major factors that should be considered when selecting a pump. What are the 10 items that must be specified after pump election?