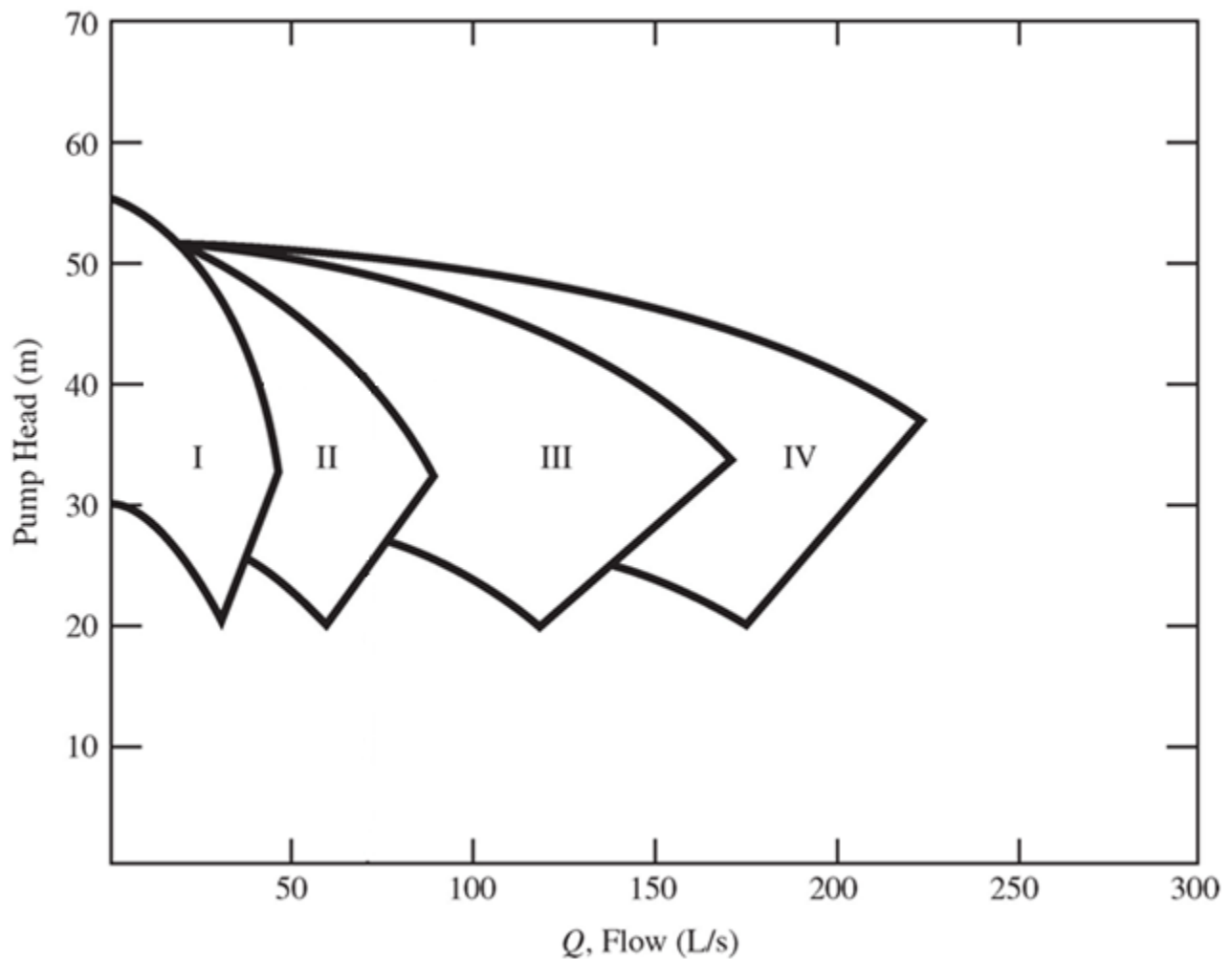


## Tutorial 4

- Select two different pumps (model and rotational speed) from Figures 5.23 and 5.24 below that are capable of supplying water (20°C) to a reservoir at a flow rate of 30 L/s. The water must be raised 20 m, and the distance between the supply and receiving reservoirs is 100 m. A ball check valve ( $k_L=70$ ) is used with 15 cm – diameter galvanized iron ( $k_s = 0.12$  mm) pipeline. The other minor losses on the pipeline include an entrance loss ( $k_L=0.5$ ) and an exit loss ( $k_L = 1.0$ ). Determine the working conditions and the pump efficiencies.

Assume:  $\nu = 1 \times 10^{-6} \text{ m}^2/\text{s}$



**Figure 5.23** Pump model selection chart (Houghtalen et al., 2010)

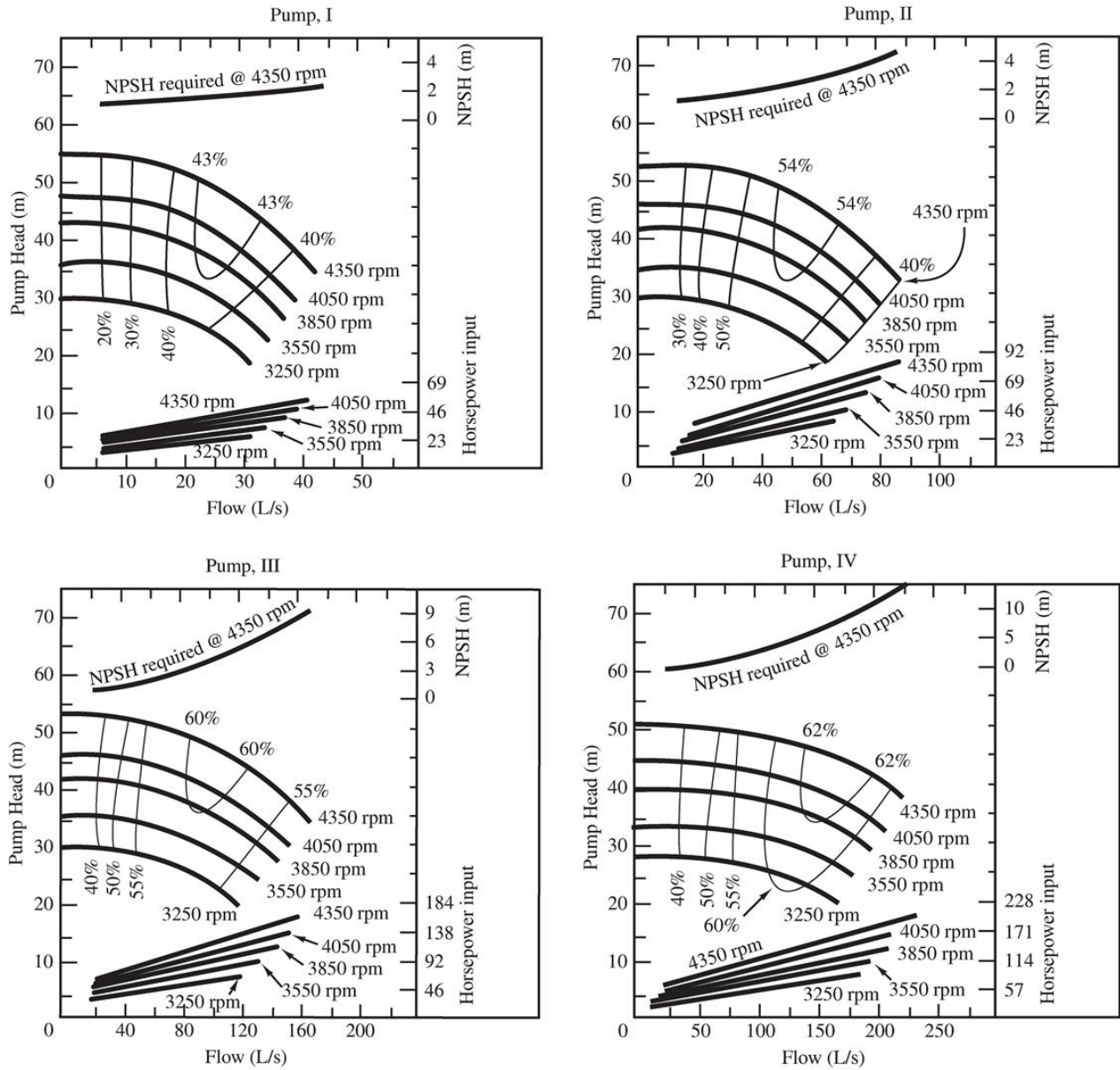
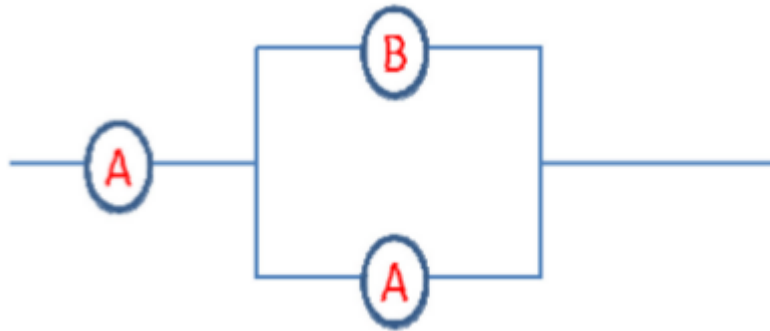


Figure 5.24 Characteristic curves for several pump models (Houghtalen et al., 2010)

2. A pump system comprising three pumps, connected as shown in the diagram below, delivers water through a 40 cm - diameter, 1000 m long pipeline from reservoir R1 to R2. The difference in water surface elevations between the two reservoirs is 60 m. The local losses on the pipeline amount to  $10 \frac{v^2}{2g}$  and the friction factor,  $\lambda = 0.02$ . Two of the pumps in the system are identical and of type A, and one is of type B. The respective pumps characteristics are provided in the tables below.
- Plot the combined pump curve ( $H_p$  vs  $Q$ )
  - Plot the system curve ( $H_p$  vs  $Q$ )
  - Find the discharge and the head in the system and define the operating conditions for each of the three pumps.



Pump A

Q (m <sup>3</sup> /s)	H <sub>R</sub> (m)	η (%)
0.00	90.72	-
0.10	90.53	-
0.20	88.81	33.09
0.30	85.56	48.69
0.40	80.78	59.79
0.45	77.81	63.69
0.50	74.46	66.50
0.60	66.61	68.90
0.70	57.23	67.11
0.80	46.32	61.21
0.90	33.87	51.31
1.00	19.89	-
1.10	0.00	-

Pump B

Q (m <sup>3</sup> /s)	H <sub>R</sub> (m)	η (%)
0.00	74.46	-
0.10	71.60	-
0.20	67.07	44.95
0.30	61.32	68.37
0.40	54.34	78.99
0.45	50.39	80.24
0.50	46.13	79.16
0.60	36.68	71.17
0.70	26.01	57.36
0.80	14.11	40.05
0.90	0.00	21.55