ME/SemIII/CBCGS/Mech Thermal/m&ATE/m-J4-3 17/05/2017

Q.P Code:13738

3 Hrs. **[Total Marks: 80]**

Note: 1. Answer any FOUR question.
2. Assume suitable additional data if necessary and draw the sketches wherever required.

Qu 1. a) Illustrate the need of optimization in Thermal process? [10]

Qu 1. b) Explain use of optimization in Energy generation Systems. [10]

Qu 2. a) What is the importance of dimensional analysis in the design of thermal analysis? [10]

Qu 2. b) What are the commonly used methods for optimization and the nature and type of equations? [10]

Qu 3. a) What do you mean by accuracy and validation? What is the important role of accuracy and validating in modelling? [10]

Qu 3. b) The flow rate Q in circular pipes is measured as a function of the diameter D and the pressure difference Δp. The data obtained for the flow rate in m^3/s are [10]

D (m) → Δp (atm) ↓	0.3	0.5	1.0	1.4
0.5	0.13	0.43	2.1	4.55
0.9	0.25	0.81	4.0	8.69
1.2	0.34	1.12	5.5	11.92
1.8	0.54	1.74	8.59	18.63

Obtain a best fit to these data, assuming a power-law dependence of Q on the two independent variables D and Δp.

Qu 4. a) What are the methods using for raising capital? [10]

Qu 4. b) In a manufacturing system, rectangular boxes of length x, height y, and width z (in meters) and open at the top, are used for storing and conveying material. The cost of material and fabrication is Rs. 9000/- per unit area in square meters, and the cost of storage varies inversely as the volume xyz, being 103 per unit volume in cubic meters. Formulate the optimization problem for minimizing the cost and obtain the optimum by using geometric programming. [10]

Qu 5. a) A refrigeration system is to be designed to maintain the temperature in a storage facility in the range of -15 to -5^0C, while the outside temperature varies from 15 to 22^0C. The total thermal load on the storage unit is given as 20 kW. Obtain an initial design for a vapour compression cooling system. [10]

Qu 5. b) How to do simplification of boundary conditions while doing modelling of thermal systems? [10]

Qu 6. a) What are the main areas for the information sought for the design of thermal systems? [10]

Qu 6. b) In a hot-rolling process, the cost C of the system is a function of the dimensionless temperature T, the thickness ratio x, and the velocity ratio y, before and after the rolls, and is given by the expression [10]

$$C = 1.5 + 5\,x^2 y + \frac{10}{T^2}$$

Subject to the constraints due to mass and energy balance given, respectively, as

$$xy = 1 \text{ and } T = \frac{5x}{y}$$

Formulate this optimization problem and apply geometric programming to determine the optimum.