PG

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS:M.TECH **SEMESTER : SECOND**

BRANCH: MECHANICAL ENGG **SESSION : SP/ 22**

SUBJECT: ME 573 DESIGN OF THERMAL SYSTEMS

TIME:TWO HOURS **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 15 questions each of 5 marks.
2. Attempt any ten questions only.

3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Steam Tables, Mollier chart, refrigeration table/ chart are allowed to the candidates in the examination hall.

Q1 Explain the role of design variables and constraints in the formation of the thermal system design problem.

Q2. Write down steps involved in a conceptual design of the thermal system.

Q3. An air- conditioning system is to be designed for a residential building. The interior of the building is to be maintained at a temperature of 22 ± 5°C. The ambient temperature can go as high as 38°C and the rate of heat dissipated in the house is given as 2 kW.The location, geometry, and dimensions of the building may be assumed. Formulate the design problem and give the problem statement.

Q4. What is an activation function in a neural network and define input layer, hidden layer and output layer.

Q5. Explain with a suitable example cross-over and mutation in a genetic algorithm.

Q6. Explain any one component of a knowledge base system.

Q7. Explain with a suitable example Hessian matrix.

Q8. Explain

(i) Conceptual design

(ii) Initial design

(iii) Workable design

(iv) Optimal design

Q9. (i) Calculate power set of A if A = $\{a_1, a_2, a_3\}$

(ii) Calculate scalar cardinality for a fuzzy set

$$A(x) = \{ (x_1, 0.1), (x_2, 0.2) , (x_3, 0.3) , (x_4, 0.4) \}$$

(iii) What is the difference between probability and membership in a fuzzy set?

Q10. Starting with $F_n = 34$ and original interval 3m, execute only two iterations using Fibonacci search algorithm for

$A = 2\pi r^2 + 2\pi rh$

$V = \pi r^2 h = 4\ m^3$

and $0.5 \leq r \leq 3.5$ m.

Q11. The temperature T of a small copper sphere cooling in air is measured as a function of time $\tau_{(s)}$ to yield the following data:

$\tau_{(s)}$	0.2	0.6	1.0	1.8	2.0	3.0	5.0	6.0	8.0
T (℃)	146	129.5	114.8	90.3	85.1	63.0	34.6	25.6	14.1

An exponential decrease in temperature is expected from lumped mass modeling. Obtain a best fit to represent these data.

Q12. Derive the model for an exchanger with the following parameters and hence sketch the response for a unit step change in input temperature and a unit step change in steam flow.

$V = 3m^3$, $F = 0.2\ m^3/s$, $\lambda = 2.3 \times 10^6$ J/kg, $\rho = 1000$ kg/m^3, $C_p = 4200$ J/degree,

$T_{i,s} = 20$ degrees, $Q_s = 10$ kg/s

The symbols have their usual meaning.

Q13. Explain system simulation with its usage.

Q14. Explain analog model or physical model.

Q15. Discuss the development of a simple mathematical model to analyze for a common heat exchanger (parallel/counter flow)

**********29-4-2022 E**********