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**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **14ME4002** | **Duration :** | **3hrs** |
| **Sub. Name :** | **APPLIED THERMAL ENGINEERING AND EXPERIMENTAL METHODS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Marks** |
| 1. | a. | Write the increase of entropy principle. | 5 |
| b. | A 50-kg block of iron casting at 500 K is thrown into a large lake that is at a temperature of 285 K. The iron block eventually reaches thermal equilibrium with the lake water. Assuming an average specific heat of 0.45 kJ/kg · K for the iron, determine i) the entropy change of the iron block, ii) the entropy change of the lake water, and iii) the entropy generated during this process. | 15 |
| (OR) | | | |
| 2. | a. | Write the decrease of exergy principle. | 5 |
| b. | A 5-kg block initially at 350°C is quenched in an insulated tank that contains 100 kg of water at 30°C. Assuming the water that vaporizes during the process condenses back in the tank and the surroundings are at 20°C and 100 kPa, determine i) the final equilibrium temperature, ii) the exergy of the combined system at the initial and the final states, and iii) the wasted work potential during this process. | 15 |
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| 3. | a. | Consider an airplane cruising at an altitude of 10 km where standard atmospheric conditions are -50˚C and 26.5 kPa at a speed of 800 km/h. Each wing of the airplane can be modeled as a 25-m x 3-m flat plate, and the friction coefficient of the wings is 0.0016. Using the momentum-heat transfer analogy, determine the heat transfer coefficient for the wings at cruising conditions. | 10 |
|  | b. | The electrically heated 0.6-m-high and 1.8-m-long windshield of a car is subjected to parallel winds at 1 atm, 0˚C, and 80 km/h. The electric power consumption is observed to be 50 W when the exposed surface temperature of the windshield is 4˚C. Disregarding radiation and heat transfer from the inner surface and using the momentum-heat transfer analogy, determine drag force the wind exerts on the windshield. | 10 |
| (OR) | | | |
| 4. | a. | Write conservation of mass, momentum and energy equation for convection heat transfer. | 5 |
|  | b. | A thin liquid film of ammonia (NH3), which has formed on the inner surface of a tube of diameter D = 10 mm and length L = 1 m, is removed by passing dry air through the tube at a flow rate of 3 x 10-4 kg/s. The tube and the air are at 25oC. What is the average mass transfer convection coefficient? | 15 |
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| 5. | a. | Discuss in detail about diaphragm and bellow gages for pressure measurement. | 10 |
|  | b. | Explain with a neat diagram of Laser Doppler Anemometer for flow measurement. | 10 |
| (OR) | | | |
| 6. | a. | Describe thermocouple compensation with a neat diagram. | 10 |
|  | b. | Write short notes on data acquisition system with a flow chart. | 10 |
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| 7. | a. | What is point of inflection and depict it graphically? | 5 |
|  | b. | In a system for providing hot water for industrial use, the heating unit has a power input of 150 kW and a thermal efficiency of 100(0.2 + 0.045T0.5), in percent, where T is the operating temperature in degrees centigrade. The rate of heat loss to the environment, in kW, is represented by the expression 0.12T1.25. Formulate the optimization problem to maximize the rate of energy supplied to the industry and obtain the optimum by using geometric programming. Also, solve the problem by minimizing the energy loss and show that the results obtained are the same as before. | 15 |
| (OR) | | | |
| 8. | a. | What are the factors that involved in the selection of a suitable material in the design of thermal system? | 5 |
|  | b. | A hot-water storage system consists of a vertical cylindrical tank with its height L to diameter D ratio given as 8, the diameter being 40 cm. The tank is made of 5-mmthick stainless steel. Hot water from a solar energy collection system is discharged into the tank at the top and withdrawn at the bottom for recirculation through the collector system. The tank loses energy to the ambient air at temperature T with a convective heat transfer coefficient h at the outer surface of the tank wall. The temperature range in the system may be taken as 20 oC to 90 oC. Develop a mathematical model for the storage tank to determine the temperature distribution in the water. Also use non-dimensionalisation to obtain the governing parameters. Then solve the steady-state problem. | 15 |
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|  | | **Compulsory:** |  |
| 9. | a. | How to characterize nano-fluids using Scanning Electron Microscope (SEM) | 10 |
|  | b. | What is the importance of Zeta Potential? | 5 |
|  | c. | Briefly discuss about particle analyzer for particle size measurement. | 5 |