Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_

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

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| **Code :** | **16ME2011** | **Duration :** | **3hrs** |
| **Sub. Name :** | **HEAT AND MASS TRANSFER** | **Max. marks :** | **100** |

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

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Derive the heat conduction equation in cylindrical coordinate system. | CO1 | 10 |
| b | Derive an expression for steady state heat conduction through a plane wall. | CO1 | 10 |
| (OR) | | | | |
| 2. | a. | A surface wall consists of 23cm of fire brick and 11.5cm of insulating brick having thermal conductivities of 0.72W/m K and 0.27W/m K respectively. Calculate the rate of heat lost per square meter when the temperature difference between inner and outer surface is 650K. | CO1 | 10 |
| b. | Find the heat loss from a rod of 3mm in diameter and infinitely long when its base is maintained at 140oC. The thermal conductivity of the material is 150 W/mK and the heat transfer co-efficient on the surface of the rod is 300 W/m2 K. The temperature of the air surrounding the rod is 15oC. | CO1 | 10 |
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| 3. | a. | A 40 X 40 cm copper slab with 5mm thick at a uniform temperature of 250oC suddenly has its surface temperature lowered at 30oC. Find the time at which the slab temperature becomes 90oC. Take ρ = 9000 kg/m3, C = 0.38 kJ/kg K, k=370 W/mK and h = 90 W/m2 K. | CO1 | 10 |
| b. | How can the transient heat conduction for a plain wall be analysed with the help of Heisler charts? | CO1 | 10 |
| (OR) | | | | |
| 4. |  | State Buckingham’s π theorem. Explain the various parameters used in forced convection. Using dimensional analysis obtain an expression for Nusselt number in terms of Reynolds and Prandtle numbers. | CO1 | 20 |
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| 5. |  | A stainless steel cylindrical rod fin of 1.2 cm diameter and 6 cm height with thermal conductivity of 25 W/mK is exposed to surrounding with a temperature of 60oC. The heat transfer coefficient is 45 W/m2K and the temperature at the base of the fin is 100oC. Determine   1. Fin efficiency 2. Temperature at the edge of the rod 3. Heat dissipation 4. Fin effectiveness   Assume fin end is insulated. | CO1 | 20 |
| (OR) | | | | |
| 6. | a. | Discuss the general arrangement of the following heat exchangers   1. Parallel flow 2. Counter flow 3. Cross flow | CO2 | 10 |
| b. | Hot exhaust gases are used in a finned-tube cross-flow heat exchanger to heat 2.5 kg/s of water from 35°C to 85°C. The gases (cpg=1.09 kJ/kg-°C) enter at 200°C and leave at 93°C. The overall heat-transfer coefficient is 180 W/m2°C. Determine area of the heat exchanger using the effectiveness-NTU method. | CO2 | 10 |
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| 7. |  | A concentric tube heat exchanger uses water, which is available at 15°C, to cool ethylene glycol from 100 to 60°C. The water and glycol flow rates are each 0.5 kg/s. Determine the maximum possible heat transfer rate and effectiveness of the exchanger. Determine which is preferred, a parallel –flow or counter flow mode of operation? | CO2 | 20 |
| (OR) | | | | |
| 8. |  | CO2 and air experiences equimolar counter diffusion in a circular tube whose length and diameter are 1m and 50mm respectively. The system is at a total pressure of 1atmosphere and a temperature of 25 oC . The ends of the tube are connected to large chambers in which the species concentration is maintained at fixed values. The partial pressure of CO2 at one ned is 190mm of Hg while the other end is 90mm of Hg. Estimate the mass transfer rate of CO2 and air through the tube. | CO3 | 20 |
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|  | | **Compulsory**: |  |  |
| 9. |  | Two large parallel plates are maintained at 600K and 900K and emissivities are 0.4 and 0.7 respectively. Determine heat transfer by radiation and also calculate the percentage reduction in heat transfer and shield temperature when another plate of emmisivity 0.05 is introduced in between them. | CO3 | 20 |