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**MANIPAL INSTITUTE OF TECHNOLOGY**
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# VI SEMESTER B.TECH (MECHANICAL ENGINEERING)
# END SEMESTER MAKEUP EXAMINATION – JUNE 2018
## SUBJECT: HEAT TRANSFER (MME 3201)
### REVISED CREDIT SYSTEM

**Time: 3 Hours** **Max. Marks: 50**

**Note:** (i) Answer all the questions
(ii) Missing data, if any, may be appropriately assumed
(iii) Draw the sketch as applicable
(iv) Assumptions made must be clearly mentioned

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| 1A | Derive an expression for steady state heat transfer through a composite plain wall and get an expression for the overall heat transfer coefficient. | 05 |
| 1B | Show that a cylindrical wall ,from the point of view of heat transfer is equivalent to a plane wall of the same thickness, same material and same temperature drop but with an area $A_m = \dfrac{A_o - A_i}{\log \dfrac{A_o}{A_i}}$ , Where $A_0$ and $A_i$ are outside and inside areas. | 05 |
| 2A | Derive an expression for temperature distribution across a plain wall with uniform heat generation in which one-dimensional horizontal heat conduction is taking place under steady state conditions. Assume the two side walls to be maintained at two different temperatures $T_{w1}$ *and* $T_{w2}$. | 05 |
| 2B | Derive an expression for temperature distribution across a fin with infinite length. | 05 |
| 3A | Differentiate between film-wise condensation and drop-wise condensation. | 04 |
| 3B | Water is heated in a tank dipping an Immersion heater in the shape of rectangular plate 200 mm x 400 mm in size. The temperature of the plate surface is maintained at 100 $^oC$. Assuming the temperature of the surrounding water is at 30 $^oC$, compute the heat loss from the plate. The 200 mm side of the plate is vertical.<br>Property of water at mean temperature is given below.<br>$\rho = 977.2\ kg/m^3,\quad k = 0.667 W/m^oC,\quad \beta = 6.24\times10^{-4}\ /^o C,$<br>$c_p = 4.186\ kJ/kg^oC,\ \mu = 41.4\times10^{-6}\ N\,s/m^2$<br>Use the correlation for average Nusselt number as $Nu = 0.13(Gr.\Pr)^{1/3}$ | 04 |

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| 3C | Using Buckingham's pi theorem derives the Nusselt number and Prandtl number expressions for a forced convection system. | 02 |
| 4A | With suitable figures and notations, derive an expression for LMTD of a parallel flow heat exchanger. | 05 |
| 4B | A heat exchanger is to heat water from $20^0$C to $60^0$C while water is flowing through tubes of 25mm outer diameter and 20mm inner diameter and 4m long. Heat is supplied by steam condensing outside the tubes at $100^0$C. The total water flow rate through all the tubes is 680 kg/min and the thermal conductivity of the tube is 325 W/m$^0$C. The inside and outside film coefficient can be taken as being 4100 W/m$^2$ $^0$C and 800 W/m$^2$ $^0$C. Estimate the total number of tubes required. | 05 |
| 5A | Two concentric spheres 200 mm and 300 mm diameters with space between them evacuated are to be used to store liquid air at -153 $^0$C in a room at 27 $^0$C. The surface of the sphere is polished with aluminum having emissivity of 0.03. If the latent heat of the liquid air is 0.21x10$^6$ J/kg, find the rate of evaporation of liquid air. | 05 |
| 5B | Derive an expression for radiation heat exchange between two parallel gray bodies using electrical analogy. | 05 |