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06ME6013 Reg. Number…….
Name……...……..

A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY
M.TECH DEGREE EXAMINATION, DECEMBER 2020
FIRST SEMESTER

Energy Management

Numerical Methods in Heat Transfer

Time : 3 Hours **Max. Marks: 60**

PART A
Answer All Questions

1. List out 2 methods for prediction of heat transfer and fluid flow processes.
2. What is the difference between a nonlinear and a quasilinear partial differential equation?
3. What is the condition for diagonal dominance of a $n \times n$ matrix?
4. Sketch the computational molecule for an explicit (1-D transient) scheme.

4 x 5 marks = 20 marks

PART B

5. With reference to a heated wall explain the numerical approach to problem solving.

OR

6. List out any 5 advantages of theoretical calculation in predicting heat transfer problems.

7. Classify the following partial differential equations:

   (a) $\frac{\partial^2 u}{\partial x^2} = \frac{1}{\alpha}\frac{\partial u}{\partial t}$

   (b) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$

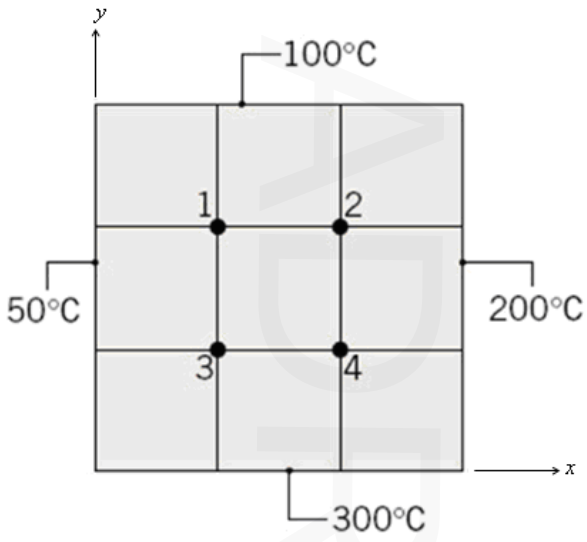
   (c) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + S = 0$

   (d) $\frac{\partial^2 u}{\partial x^2} = \frac{1}{C^2}\frac{\partial^2 u}{\partial t^2}$

OR

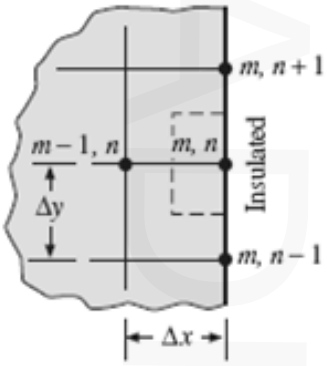
8. Obtain the first order forward difference expression for the *x* and *y* derivatives at the grid point (*i*,*j*).

9. Solve the two-dimensional steady state conduction heat equation, over the square mesh of side 3 units, with the boundary conditions as given in the following figure.



OR

10. With respect to the following figure obtain nodal equation for equal increments in x and y corresponding to the node (m, n).



11. Explain Crank-Nicolson method for solving one dimensional transient heat transfer problems.

OR

12. Use explicit method to solve for temperature distribution at 0.3 sec of a thin rod of 10 cm length using $\Delta x = 2$ cm. and $\Delta t = 0.1$sec. At time $t = 0$, the temperature of the rod is zero and the boundary conditions are fixed at $T(0) = 100^{\circ}C$ and $T(10) = 50^{\circ}C$. The material of the rod is aluminium with $\alpha = 0.835 cm^2/\text{sec}$.

4 x 10 marks = 40 marks