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

CLASS: BE **SEMESTER: VII**
BRANCH: CE/C&P **SESSION: MO/2018**

SUBJECT: CL7017 COMPUTATIONAL FLUID DYNAMICS

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Define CFD? Write the importance of CFD in Chemical Engineering. [2]
(b) List out the assumptions made while deriving the Navier-Stokes (N-S) equations. Simplify the N-S equations for square duct by CFD approach in the form of $A\phi = b$. Where A is the coefficient matrix and b is the constant matrix. [3]

Q2 (a) Assuming SI units, verify that units of each term of continuity & N-S equations are identical. [2]
(b) Show that: $y_i'' = \frac{y_{i+2} - 2y_{i+1} + y_i}{h^2} + 0\,(h)$ [3]

Q3 (a) Write a short note on equivalence theorem of Lax. [2]
(b) Write the generalized Governing equation for transport phenomena. Deduce the continuity equation, momentum equation and energy equation from the generalized Governing equation. [3]

Q4 (a) Define the following terms: Stability, Consistency, Advection and Courant number. [2]
(b) What are various errors encounter in discretization techniques? How these errors effect the solution of the problem? [3]

Q5 (a) Write short note on Gaussian elimination method and tridiagonal matrix algorithm. [2]
(b) What are the disadvantages of Jacobi method? What is the convergence criterion for Gauss-Siedel (G-S) method? [3]

Q6 (a) Why does diagonal dominance ensure convergence in G-S iterative method? [2]
(b) Describe the implicit and explicit approach for one-dimensional diffusion less and source less flow. [3]

Given:
Equation of Continuity: $\frac{\partial \rho}{\partial t} + (\nabla . \rho \boldsymbol{v}) = \mathbf{0}$
Equation of Motion for a Newtonian Fluid with Constant ρ and μ:

$$\rho \frac{D\boldsymbol{v}}{Dt} = -\nabla p + \mu \nabla^2 \boldsymbol{v} + \rho \boldsymbol{g}$$

:::: 13/09/2018 M ::::::