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



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

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| **Code : 18ME3002** |  | **Duration :** | **3hrs** |
| **Sub. Name : ADVANCED FLUID DYNAMICS** |  | **Max. marks :** | **100** |

**ANSWER ANY FIVE QUESTIONS (5 x 16 = 80 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. |  | The y component of velocity in a steady, incompressible flow field in the xy plane is . Derive the simplest expression for the x component of the velocity. | CO2 | 16 |
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| 2. | a. | Derive the Energy equation in Cartesian coordinates. | CO2 | 8 |
| b. | A velocity field is represented by the expression  ‘, where A=2 s-1, B=4 ms-1, D=5 ms-2, and the coordinates are measured in meters. Calculate the acceleration of a fluid particle located at point (x,y)=(3,2). | CO3 | 8 |
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| 3. |  | The velocity field for a two-dimensional flow is  where A=1s-2 B=2s-2, t is in seconds, and the coordinates are measured in meters. Is this a possible incompressible flow? Is the flow steady or unsteady? Show that the flow is irrotational and derive an expression for the velocity potential. | CO4 | 16 |
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| 4. | a. | A metallic sphere of Specific Gravity 7.0 falls in an oil of density 800 kg/m3. The diameter of the sphere is 8 mm and it attains a terminal velocity of 40 mm/s. Find the viscosity of the oil in poise. | CO5 | 8 |
| b. | Calculate the weight of a ball of diameter 80 mm which is just supported in a vertical air stream which is flowing at a velocity of 7 m/s. The density of air is 1.25 kg/m3 . The kinematic viscosity of air is 1.5 stokes. | CO5 | 8 |
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| 5. |  | For the velocity profile in laminar boundary layer flow as  find the thickness of the boundary layer and the shear stress 1.5 m from the leading edge of a plate. The plate is 2 m long and 1.4 m wide and is placed in water which is moving with a velocity of 200 mm/s. Find the total drag force on the plate if the dynamic viscosity of water is 0.01 poise. | CO6 | 16 |
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| 6. | a. | Derive the Bernoulli’s equation along a streamline. | CO2 | 8 |
| b. | Determine the family of stream functions  that will yield the velocity field . | CO2 | 8 |
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| 7. |  | Air flows steadily at low speed through a horizontal nozzle, discharging to atmosphere. The area at the nozzle inlet is 0.1 m2. At the nozzle exit, the area is 0.02 m2. Determine the gage pressure required at the nozzle inlet to produce an outlet speed of 50 m/s. | CO3 | 16 |
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| **COMPULSORY QUESTION (1 x 20 = 20 Marks)** | | | | |
| 8. |  | Transform the continuity equation in two-dimensions from the physical plane to the computational plane. | CO6 | 20 |