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



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – Nov/Dec – 2016**

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|  |  | **Semester :** | **2016-17 ODD** |
| **Code :** | **15AE3002** | **Duration :** | **3hrs** |
| **Sub. Name :** | **Boundary Layer Theory** | **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. | Starting from Navier-Stokes equations, derive governing equations for fully developed (no more changing along the length ) flow of incompressible fluid in a channel of height 2 h.  Assume flow symmetry about the centerline of channel.. | CO1 | 12 |
| b. | Derive the relation for velocity variation with height for the case above. | CO1 | 8 |
| (OR) | | | | |
| 2. | a. | Starting from Navier-Stokes equations, derive governing equations for creeping flow over a sphere. | CO2 | 12 |
| b. | Find the velocity for the case above. | CO2 | 8 |
| 3. |  | For a flow of incompressible fluid over a flat plate, using order of magnitude analysis show that boundary layer thickness varies with length as . | CO2 | 20 |
| (OR) | | | | |
| 4. |  | Consider the incompressible boundary layer over a flat plate without pressure gradient. Using similarity consideration, derive the Blausssius equation governing the similar velocity profile.Give the boundary conditions for governing equation. | CO2 | 12  8 |
| 5. | a. | Derive Karman Integral equation for momentum | CO1 | 20 |
| (OR) | | | | |
| 6. |  | For a velocity profile in boundary layer given by  , find the displacement thickness and momentum thickness in terms of constants a,b, c and d. Assume that there is no velocity gradient at the edge of boundary layer. | CO2 | 20 |
| 7. |  | For boundary layer velocity profile given by  where U is the velocity at the edge of boundary layer and δ is boundary layer thickness. Assume that there is no velocity gradient at the edge of boundary layer.   1. Find the all the constants using appropriate boundary conditions. 2. Find displacement thickness δ\* in terms of δ. 3. Find momentum thickness θ in terms of δ. | CO2 | 10  5  5 |
| (OR) | | | | |
| 8. |  | For boundary layer velocity profile given by  where U is the velocity at the edge of boundary layer and δ is boundary layer thickness. Assume that there is no velocity gradient at the edge of boundary layer.   1. Find the all the constants using appropriate boundary conditions 2. Using momentum integral equation for boundary layer, find the variation of boundary layer thickness along the length of body. | CO2 | 12  8 |
|  | | **Compulsory:** |  |  |
| 9. |  | Consider incompressible 2D turbulent flow over a flat plate with plate along x-axis. Consider the momentum equation along the plate. Using time averaging process, derive the averaged momentum equation along the length of the flat plate. | CO2 | 20 |

ALL THE BEST