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– 2017**

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| **Code :** | **14AE3006** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ADVANCED AERODYNAMICS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. |  | Consider the velocity field given by u = x2− 2xy.   1. Find v-component of velocity so as to satisfy incompressible flow continuity equation for 2D incompressible flow field. 2. Find Stream function for flow field. 3. Find Vorticity for the flowfield. | CO1 | 10  5  5 |
| (OR) | | | | |
| 2. |  | For two-dimensional incompressible flow in cylindrical polar coordinates (r, θ),the radial velocity is given by .   1. Find the circumferential velocity vθ 2. Find the stream function 3. Find whether flow is rotational or irrotational. | CO1 | 8  7  5 |
| 3. |  | A sink of strength is located 6m upstream of source of strength . The combination is placed in uniform velocity field along the line joining the source and sink. It is noted that at a point 5m equidistant from both source and sink, the velocity is normal to the line joining source and sink. Find the i. velocity of Uniform flow field. ii. velocity at the point mentioned above. | CO2 | 20 |
| (OR) | | | | |
| 4. |  | The steady irrotational two dimensional flow of an incompressible fluid along an inside corner has velocity components and with α ≥ 0. The boundary of semi-infinite flow field is given by the two straight lines and for x ≥ 0.     1. How many stagnation points are there in the flow field? State their coordinates. 2. Determine the equation y = f(x) of the streamline that passes throughthe point P1 ( 1,0). 3. Consider another point P2 with x = 2 on the same streamline that passesthough point P1. How much time ∆t elapses as the fluid element movesalong this streamline from P1 to P2? | CO2 | 5  6  9 |
| 5. |  | A two dimensional flow field is described by velocity components u= ax and v = - a y( a is positive constant).   1. Find the streamlines of the flow field. 2. What is the rotation ω of the flow field? 3. A dust particle with no mass is placed at time t=toon the point (xo, yo). 4. At what time tethe particle reaches point ( xe,ye) of the streamline. | CO1 | 6  5  5  4 |
| (OR) | | | | |
| 6. | a. | Find the velocity induced by the line vortex in the form of a horseshoe asshown below at the point P.  Horseshoe.jpg | CO2 | 10 |
|  | b. | Find the velocity induced by the line vortex in the form of a rectangle asshown below at its centre. | CO2 | 10 |
| 7. |  | A model to describe the inviscid flow past the ridge of a roof is obtained bysuperimposing a flow with velocity U past a circular cylinder of radius R on the flow of a potential vortex. The ridge angle α is 120o.     1. What circulation Γ of the potential must be chosen to correctly model the inviscid flow past the ridge? 2. What is the force acting on the ridge if the pressure of the flow below the ridge is p∞ and the depth of the ridge is unity? | CO2 | 12  8 |
| (OR) | | | | |
| 8. |  | Prove using Euler equations and shock relations that for Hypersonic flow, Mach number independence principle holds. | CO1 | 20 |
|  | | **Compulsory**: |  |  |
| 9. |  | Consider a sharp wedge with includedwedge angle 2θ at an angle of attack α. Using Modified Newtonian theory, determine   1. Axial Force coefficient. 2. Normal force coefficient. | CO2 | 10  10 |

ALL THE BEST