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



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **17AE2016** | **Duration :** | **3hrs** |
| **Sub. Name :** | **GAS DYNAMICS** | **Max. Marks :** | **100** |

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

**USE OF GAS TABLES PERMITTED**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. |  | Describe the performance of converging-diverging nozzle with various ratios of back pressure to supply pressure and draw the following curves  i) Pressure vs distance along the nozzle axis  ii) Exit plane pressure vs back pressure  iii) Throat pressure vs back pressure  iv) Mass flow parameter vs ratio of back pressure to supply  pressure. | CO2 | 20 |
| **(OR)** | | | | |
| 2. | a. | State the equations required to analyse.  i) Incompressible flows  ii) Compressible flows  iii) Compressible isentropic flows. | CO1 | 5 |
| b. | State the energy conservation principle and first law of thermodynamics. Derive energy equation for isentropic flows and obtain the relations connecting static and total flow variables (Temperature, Pressure and Density) | CO5 | 15 |
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| 3. |  | State the three techniques of flow visualizations and describe them in detail. | CO6 | 20 |
| **(OR)** | | | | |
| 4. |  | Derive the Governing Physical Relations for normal shock. Further derive the working formulas for normal shocks. | CO3 | 20 |
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| 5. | a. | Derive the differential equation of the velocity potential for steady three-dimensional isentropic flow and deduce the Laplace equation. | CO3 | 15 |
| b. | Derive the equation of continuity for unsteady, three- dimensional flow in Cartesian Coordinate system. | CO2 | 5 |
| **(OR)** | | | | |
| 6. |  | Derive the Rankine-Hugoniot Equations and Prandtl Relation for Oblique Shock and deduce them for Normal Shock. | CO3 | 20 |
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| 7. | a. | i) Describe the high-speed subsonic flow over aerofoil.  ii) Compare lift coefficient vs angle of attack curve of high  subsonic speed with that of incompressible flow. | CO4 | 8 |
| b. | Draw and explain the movement of shock over an aerofoil with increasing Mach number in the transonic regime. | CO4 | 12 |
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| 8. | a. | Write a note on supersonic aerofoil and illustrate the wave formation on a double delta wing in supersonic speed.  i) When the angle of attack less than half angle of the wedge  ii) When the angle of attack more than half angle of the wedge. | CO4 | 5 |
| b. | Compute the lift per unit span of a flat plate aerofoil of chord length 3 m flying at Mach 3 at an angle of attack of 5 deg. The ambient pressure is 0.5 atmosphere. | CO4 | 15 |
|  | | **Compulsory**: |  |  |
| 9. |  | The symmetrical diamond-shaped aerofoil having a chord length of 3 m shown in the figure is operating at 30 angle of attack. The flight speed is M = 3 and air pressure is 7 \* 104 Pa. (i) Compute the pressure on each surface, (ii) Calculate the lift and drag force and (iii) Repeat the problem with a 100 angle of attack. | CO4 | 20 |