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**B.Tech. AEROSPACE ENGINEERING
(BTAE)****Term-End Examination****December, 2017****BAS-015 : AERODYNAMICS - II***Time : 3 hours**Maximum Marks : 70*

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- Note :** (i) *Answer any seven questions.*
(ii) *All questions carry equal marks.*
(iii) *Use of scientific calculator is permitted.*
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1. (a) Derive the linearized velocity potential equation for compressible flow and based on the equation, derive the Prandtl-Glanert rule. **6**
- (b) A combustion chamber in a gas turbine plant receives air at 350 K, 0.55 bar and 75 m/s. The air fuel ratio is 30 and the calorific value of fuel is 42 MJ/kg. Taking $\lambda = 1.4$ and $R = 287 \text{ J/kg K}$ for the gas, determine **4**
- (i) Initial and final Mach numbers
- (ii) Final pressure, temperature and velocity of the gas

2. (a) Derive expressions for the lift and drag coefficient of a diamond aerofoil using linear theory. 4
- (b) An airplane flying at 1500 kmph at an altitude where pressure and temperature are respectively $3 \times 10^4 \text{ N/m}^2$ and -50° C . Calculate the pressure, density and temperature at the leading edge of the wing. 6
3. (a) Describe the behaviour of a swept wing of an aircraft placed in a supersonic flow. 5
- (b) Explain with suitable sketches the effect of pressure ratio on flow in a D' Laval nozzle. 5
4. Answer any four of the following questions in brief : 4x2.5=10
- (a) What is perturbation potential ?
- (b) Explain " Under - expanding " nozzle flow.
- (c) What is Rayleigh correction formula for pressure measurements in supersonic flow ?
- (d) Explain pressure deflection diagrams.
- (e) Explain Mach number spectrum.
- (f) Write Bernoulli's equation for compressible flow.
5. (a) Sketch the pressure variation along the centre line of a converging diverging nozzle for optimum expansion. What is the influence of back pressure on this variation ? 5
- (b) Explain the procedure to be followed for the design of a supersonic nozzle using method of characteristics. 5

6. (a) What is Rayleigh's correction for total pressure measurement in supersonic flows ? Why is the correction needed ? 6
- (b) Give reasons as to why shocks cannot occur in subsonic flows. 4
7. Derive an expression for choked mass flow rate through a converging diverging nozzle in terms of total pressure, total temperature and throat area. 10
8. (a) What is shock polar ? What is its use in supersonic aerodynamics ? 4
- (b) If a compression corner of angle 20° is allowed to encounter a uniform stream of supersonic flow at Mach 5, calculate the shock wave angle, pressure and Mach number behind the shock wave. 6
9. What are the flow losses suffered by a compressible flow in variable area ducts ? How does back pressure effect the losses ? Analyse. 10
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