Register Number.....

**M.E. DEGREE EXAMINATIONS: JANUARY 2009**

First Semester

**ENERGY ENGINEERING**

P07EN105 Advanced Fluid Mechanics

**Time: Three Hours** **Maximum Marks: 100**

**Answer ALL Questions:-**

(Gas Table is permitted)

**PART A (20 x 1 = 20 Marks)**

1. Boundary layer equation is

   (a) $\partial v/\partial x + \partial u/\partial y = 0$ (b) $\partial u/\partial x + \partial v/\partial y = 0$

   (c) $\partial x/\partial u + \partial y/\partial v = 0$ (d) $\partial x/\partial v + \partial y/\partial u = 0$

2. The wall skin friction co-efficient is defined as

   (a) $C_f(x) = \tau_w(x)/((1/2)\rho v^2_\alpha)$ (b) $C_f(x) = \tau_w(x)/((1/2)\rho v^3_\alpha)$

   (c) $C_f(x) = \tau_w(x)/((1/2)\rho v^4_\alpha)$ (d) $C_f(x) = \tau_w(x)/((1/2)\rho v_\alpha)$

3. Young's Modulus E =

   (a) 3G(1+1/m) (b) 3G(1+1/2m) (c) 2G(1+1/m) (d) 2G(1+1/2m)

4. Reynolds number is given by

   (a) $R_e = \rho vd/\mu$ (b) $R_e = vd\,\mu/\rho$ (c) $R_e = \rho v\,\mu/d$ (d) $R_e = \rho\,\mu\,d/v$

5. Mach number is written as

   (a) M = V/a (b) M = ρV/a (c) M = a/V (d) M = ρa/V

6. The effects of moving shock wave can be estimated by the method of

   (a) Relative quantity (b) Relative velocity

   (c) Relative mass (d) Relative Pressure

7. In case of isentropic process

   (a) the temperature is constant (b) the enthalpy is constant

   (c) the entropy is constant (d) All of the above

8. Supersonic flow expansion around a convex corner, involving a smooth, gradual change in flow properties is known as

   (a) Oblique shock wave (b) Kelvin's theorem

   (c) Hodograph expansion (d) Prandtly-Meyer expansion

9. Turbulent flow is occurring when the Reynolds number falls

   (a) below 1000 (b) between 1000 and 2000 (c) above 4000 d) between 2000 and 4000

10. The intensity of turbulence is given by

(a) $T_u$ = Sqrt of $(2/3(\bar{u}'^2 + \bar{v}'^2 + \bar{w}'^2))/U_\alpha$

(b) $T_u$ = Sqrt of $(1/3(\bar{u}'^2 + \bar{v}'^2 + \bar{w}'^2))/U_\alpha$

(c) $T_u$ = Sqrt of $(4/3(\bar{u}'^2 + \bar{v}'^2 + \bar{w}'^2))/U_\alpha$

(d) $T_u$ = Sqrt of $(1/2(\bar{u}'^2 + \bar{v}'^2 + \bar{w}'^2))/U_\alpha$

11. Couette flow is given by

(a) $T_w = \mu(U_s/S_s)$ (b) $T_w = \mu(S_s/U_s)$

(c) $T_w = (U_s/\mu S_s)$ (d) $T_w = (S_s/\mu U_s)$

12. The steady flow in pipe is f=defined as

(a) the velocity of flow is constant (b) the quantity of flow is constant

(c) the velocity of flow is constant (d) all of the above

13. Mass flow rate is found out by

(a) ρvm (b) ρvd (c) ρAV (d) all of the above

14. Venturimeter is used to measure

(a) the rate of flow (b) the velocity of flow

(c) the mass of flow (d) all of the above

15. The maximum temperature occurs at

(a) M= 1/sqrt (K) (b) M= 1/sqrt(C) (c) M= (K) (d) M= (C)

16. The space with in the Mach Cone is known as

(a) Zone of silence (b) Zone of disturbance

(c) Zone of action (d) all of the above

17. The Hugoniot equation is

(a) $e_1-e_2 = ((P_1+P_2)/2)(V_1-V_2)$ (b) $e_2-e_1 = ((P_1+P_2)/2)(V_1-V_2)$

(c) $e_2-e_1 = ((P_2-P_1)/2)(V_2-V_1)$ (d) $e_1-e_2 = ((P_2-P_1)/2)(V_1+V_2)$

18. Shock tube is a device

(a) To produce high speed flow with high temp

(b) For investigating shock phenomena

(c) To study the behavior of materials and objects when subjected to extreme conditions of pressure and temperature.

(d) All of the above

19. The waves causing isentropic expansion and compression are called

(a) Single waves (b) Supersonic waves

(c) Simple waves (d) Complex waves

20. Shock waves propagate faster than Mach waves do, and they show large gradients in

(a) Pressure (b) Temperature (c) Density (d) All of the above

**PART B (5 x 16 = 80 Marks)**

21 (a). Derive the Navier-Strokes equation for laminar incompressible flow

**(OR)**

21 (b). Write the integrated boundary layer equation over a control volume

22 (a). Derive the general potential equation for three-dimensional flow

**(OR)**

22 (b). What do you mean by subsonic flow and write the Prandtl-Glauert rule for the subsonic flow.

23 (a). Discuss in detail about the shear stress models

**(OR)**

23 (b). Explain the turbulent flow for very high Reynolds number

24 (a). Atmospheric air at pressure $1.0135 \times 10^5$ N/m$^2$ and temperature 300 K is drawn through frictionless bell-mouth entrance into a 3 m long tube having a 0.05 m diameter. The average friction co-efficient f = 0.0005, for the tube. The system is perfectly insulated.

(i) Find the maximum mass flow rate and the range of back pressures that will produce this flow.

(ii) What is the exit pressure required to produce 90% of the maximum mass flow rate, and what will be stagnation pressure and the velocity at the exit for that mass flow rate?

**(OR)**

24 (b). Explain the constant area isothermal flow with friction.

25 (a). Discuss in detail about Prandtl-Meyer Function

**(OR)**

25 (b). Derive and explain the Hugonit equation.

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