Date:17st Oct/2015

Time duration :2 hr

IITians Aerospace Team

GATE-2016

(AEROSPACE ENGINEERING)

Mock-8TH

Max Marks:-100

Instructions:-

- I. Each question of 2 marks
- II. Negative marking is 2/3 for each wrong answer
- III. Qualifying marks 35
- 1. An aircraft has drag during the stall in turning is 430 N. Load factor during turning is 1.5. Then the drag during the stall in steady-level flight will be
 - a) 645 N b) 351.09 N c) 526.64 N d) 286.66 N
- 2. A turbo fan engine has abypass ratio 5 and enthalpy rise across the fan is 33.33 KJ/kg,If the mechanical efficiency is 97%. What will be the enthalpy drop across the low pressure turbine_____
- 3. A multistage rocket is having 3 stages, with equal pay load ratio of 0.15 for each stage. Then the total pay load ratio for this rocket is
 a) 0.45
 b) 0.0033
 c) 0.05
- 4. If a rocket is having propellant ratio $\Phi = 0.8$, then the mass ratio, Λ for this rocket is a) 5 b) 0.2 c) 1.25 d) 1.6
- 5. For an incompressible fluid the kinematic viscosity is the measure of
 - a) Volume flow rate per unit length
 - b) Elasticity of the fluid
 - c) Mass flow rate per unit length
 - d) Energy flux of the fluid element
- 6. For an incompressible fluid dynamic viscosity is the measure of
 - a) Volume flow rate per unit length
 - b) Elasticity of the fluid
 - c) Mass flow rate per unit length
 - d) Energy flux of the fluid element

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7.	 What performance profiles occur at [^L_D]_{max} a) Jet max range, prop max endurance b) Both jet and prop max range c) Prop max range, jet max endurance d) Both jet and prop max endurance
8.	An aircraft of elliptic wing has lift coefficient 0.2 and lift coefficient at minimum drag condition is 0.18 and (CD)min=0.02 and aspect ratio is 5 then the total drag coefficient CD for this particular aircraft $(D) = 0.02$
9.	The gravity due to earth rotation at the equator isa) 9.77b) 6.6c) 8.77d) 9.22
10.	The degree of reaction of a reaction turbine is a) 0.5 b) 1 c) 0 d) 0.75
11.	The design lift coefficient for NACA 23012 isa) 0.3b) 0.4c) 0.2d) 0.1
12.	Which of the following statement is true. In ground effecta) lift coefficient decreasesb) power required increasesc) thrust required decreasesd) induced drag increases
13.	for a centrifugal compressor, impeller tip diameter is 1.5m and impeller speed is 4000 rpm. Themass flow rate of air is 13 kg/s and slip factor is 0.88. The power input is given by (KW)a) 1281b) 1129c) 1456d) 1392
14.	For the nose diving aircraft, the load factor will be
	a) 1 b) <1 c) 0 d) >1
15.	consider an axial flow compressor with free vortex design. Then, across a blade radius of an axial flow compressor
	a) axial velocity (Cz) is constantb) work output (W) is constantc) work output (W) is varyingd) both Cz and W is constant
16.	The absolute angle at the inlet and outlet of rotor of an axial turbine are α_2 and α_3 respectively.
	The degree of reaction of an axial turbine is 1. Choose the correct option a) $\alpha_2 > \alpha_2$ b) $\alpha_2 < \alpha_2$ c) $\alpha_2 = \alpha_2$ d) none of these
17.	In a low speed wind tunnel test, the wing is kept at an angle of attack 6 degree, at an mach number $M_{-} = 0.7$ the angle of attack seen by the wing is (in degree)
	a) 4.28 b) 8.4 c) 0.07478 d) 0.1466
18.	Choose the correct option for stream line pattern, in the case of compressible and incompressible flow a) Stream lines are more separated in incompressible flow than compressible flow

d) $\frac{dr}{d\theta} = \frac{1}{r} \frac{u_{\theta}}{u_{r}}$

- b) Stream lines are more separated in compressible flow than an incompressible flow
- c) Stream lines pattern is same in both type of flows
- d) none of the above
- 19. A flat plate is kept at an angle of attack 5 degree in a supersonic flow of $M_{\infty}=2$, the value of drag coefficient for this flat plate is
 - a) 0.01523 b) 0.2015 c) 0.01758 d) 57.73
- 20. Choose the correct statement for pressure coefficient (C_n) over a body, in an inviscid and incompressible flow
 - a) C_p changes with density of the flow
 - b) C_p changes with free stream velocity of the flow
 - c) C_p changes with body shape and orientation
 - C_p changes with density and free stream velocity of the flow d)
- 21. In a 2-d incompressible and inviscid flow, the condition of irrotationality is a) $\frac{\partial V_{\theta}}{\partial r} = r \frac{\partial V_r}{\partial \theta}$ b) $\frac{\partial V_{\theta}}{\partial r} = \frac{1}{r} \frac{\partial V_r}{\partial \theta}$ c) $\frac{1}{r^2} \frac{\partial V_{\theta}}{\partial r} = \frac{\partial V_r}{\partial \theta}$ c $c)\frac{1}{r^2}\frac{\partial V_{\theta}}{\partial r} = \frac{\partial V_{r}}{\partial \theta}$ d) $r^2 \frac{\partial V_{\theta}}{\partial r} = \frac{\partial V_{r}}{\partial \theta}$
- 22. The equation of a stream line in a 2-d flow is given by a) $\frac{dr}{d\theta} = r \frac{u_{\theta}}{u_{r}}$ b) $\frac{dr}{d\theta} = r \frac{u_{r}}{u_{\theta}}$ c) $\frac{1}{r} \frac{dr}{d\theta} = \frac{u_{r}}{u_{\theta}}$ a) $\frac{dr}{d\theta} = r \frac{u_{\theta}}{u_{r}}$

b) $\varphi = \Lambda$

- 23. In a source flow the radial velocity was measured 7 m/s, at a radial location r = 0.2 m from the origin of source. The strength of the source (Λ) is
 - b) 4.4 m2/s c) 8.8 m2/s d) 2.2 m2/sa) 2.8 m2/s
- 24. For a source flow, the stream function (φ) is given by (where \wedge , strength of the source) a) $\varphi = \frac{\Lambda}{2\pi} \ln r$ b) $\varphi = \frac{\Lambda}{2\pi} \theta$ c) $\varphi = \frac{\Lambda}{2\pi} \ln \theta$ d) $\varphi = \frac{\Lambda}{2\pi} r$
- 25. A uniform flow is superimposed on a source flow of strength \wedge , then the stagnation stream line of the resulting flow is given by c) $\varphi = \frac{\Lambda}{2}$ d) $\varphi = \frac{\Lambda}{2\pi}$

a)
$$\varphi = 0$$

- 26. A uniform flow with a velocity 10 m/s, is superimposed on a doublet flow of strength k=3, form a non-lifting flow over a circular cylinder of radius a) 0.3872 m b) 0.2185 c) 4.6 m d) 0.31
- 27. In a inviscid and incompressible flow, a sphere is generated by superimposing a 3-d doublet and a uniform flow. The pressure coefficient at a location of $\theta = 30$ degree is a) 0.625 b) 0.4375 c) 0.8125 d) 0
- 28. In a flow over a flat plate, if we are moving from x=0 to x=L, the drop in shear stress (where L is the length of the plate)
 - a) More rapid in turbulent than laminar flow
 - b) Same in both laminar and turbulent flow
 - c) More rapid in laminar than turbulent
 - d) None of the above

- 29. Choose the wrong statement for a flow over a circular cylinder
 - a) Skin friction drag is more in laminar than turbulent
 - b) Skin friction drag is less in laminar than turbulent
 - c) Pressure drag is less in turbulent than laminar
 - d) Pressure drag is less in turbulent and skin friction more in turbulent

Statement- (Q 30 & 31) Consider an untwisted wing of elliptical planform in inviscid incompressible irrotational flow at an angle of attack of 4 degrees. The wing aspect ratio is 7 and the zero lift angle of attack is -2 degree.

c) 0.44

c) 0.0118

- 30. The wing lift coefficient CL is
a) 0.660.51
- 31. The induced drag coefficient of the wing C_{D_i} is a) 0.0053 b) 0.0087

d) 0.0197

d) 0.34

32. An Unswept fixed-winged aircraft has a large roll stability if the wing is placed

- a) Low on the fuselage and has negative dihedral angle
- b) low on the fuselage and has positive dihedral angle
- c) high on the fuselage and has negative dihedral angle
- d) high on the fuselage and has positive dihedral angle
- 33. In case of an aircraft with canard configuration

a) Canard surface stalls after wing b) canard surface stalls before wing

- c) Both stalls simultaneously d) canard surface cannot stall
- 34. The mass flow rate of air through single sided centrifugal compressor is 3.2 kg/s. The ambient temperature and pressure are 298 K and 1 bar respectively. The ratio of hub diameter to eye tip diameter is 0.35 and the hub radius is 0.055m. Assuming zero swirl at the inlet. The absolute velocity at the inlet is
 - a) 10.37 m/s b) 40.24 m/s c) 5.732 m/s d) 30.55 m/s
- 35. At low speed propulsive efficiency is higher for
a) Turbojetb) turbofan (HBP)c) turbofan (LBP)d) turboprop
- 36. For turbulent flowsa) Inertia force are dominatingc) Viscous forces are dominatingd) pressure forces are dominating
- 37. Which of the following statement is correct?
 - a) Equivalent air speed is always greater than or equal to true air speed
 - b) Equivalent air speed is always lesser than or equal to true air speed
 - c) Equivalent air speed is always greater than true air speed
 - d) Equivalent air speed is always lesser than true air speed

- 38. for the cambered aerofoil having zero lift angle of attack of -2.5 degree. What will be the lift coefficient at an angle of attack of 9.5 degree in % of C_{Lmax}. The stalling angle is 13.5 degree

 a) 40%
 b) 55%
 c) 75%
 d) 60%
- 39. consider an aircraft flying at a speed of 50 m/s having weight 20kN. The wing area is 27 m2 and lift curve slope of the wing is 0.09/degree. CM at αa =0 is 0.06, tail volume ratio is 0.33, (δCM/δαa) is -0.0129 and control effectiveness is 0.06. Considering downward deflection is positive, the elevator angle required to trim the aircraft is

 a) 0.460 downward
 b) 3.490 upward
 c) 3.490 downward
 d) 0.460 upward
- 40. Service ceiling is an altitude where maximum rate of climb for jet engine aircraft is a) 0.5 m/s b) 1.5 m/s c) 2.5 m/s d) 2 m/s
- 41. If the mach no. before the shock wave is 2.5, what will be the percentage change in pressure across the shock_____
- 42. A C-D diffuser is to be used at mach 3.0. The diffuser has to use a variable throat area so as to swallow the starting shock. What percentage increase in throat area will be necessary
 - a) 104.6 % b) 204.6 % c) 304.6 % d) 404.6 %

Statement- (Q 43 & 44) Air at a stagnation temperature of 15 0c and stagnation pressure 100 kPa enters an axial compressor with an absolute velocity of 120 m/s. Inlet guide vanes direct this absolute velocity to the rotor inlet at an angle of 180 to the axial direction. The rotor turning angle is 270 and the mean blade speed is 200 m/s. The axial velocity is assumed constant through the stage.

- 43. The blade angle at the inlet of the rotor is

 a) 25.50
 (B) 38.50
 (C) 48.50
 (D) 59.50

 44. If the mass flow rate is 1 kg/s, the power required to drive the compressor is

 b) 50.5 kW
 (B) 40.5 kW
 (C) 30.5 kW
 (D) 20.5 kW
- 45. For a axial flow compressor, for better efficiency, the degree of reaction should be
 - a) High at root and low at tip of the blade
 - b) Low at root and high at tip of the blade
 - c) High at central region and low at root and tip
 - d) Equal at root and tip of the blade
- 46. If the degree of reaction at the hub and tip region is 0.4 and 0.7 respectively, then the ratio of radius of hub to tip is
 - a) 0.707 b) 0.5 c) 1.41 d) 0.3
- 47. If the degree of reaction at mean radius of a AFC (axial flow compressor)is , R_m=0.5, and the ratio of hub to mean radius is 1.6. Then the value of degree of reaction at hub will be
 a) 0.8 b) 0.6875 c)0.2 d) 0.3125

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- 48. If the degree of reaction at mean radius of a AFC (axial flow compressor)is, R_m=0.5,and hub and tip radius is 2 m and 8 m respectively. Then degree of reaction at tip will be
 a) 0.8 b) 0.6875 c) 0.2 d) 0.3125
- 49. An axial flow compressor operated at sea level, having blade height 2.5 m, mean diameter 4.5 m and axial velocity is 35 m/s.what will be the mass flow rate through the compressor (kg/sec)
 a) 1516 b) 758 c) 379 d) 3032
- 50. work done factor, in case of an axial flow compressor is
 - a) decreases with increasing number of stagesb) increases with increasing number of stagesc) unaffected by number of stagesd) decreases with decreasing number of stages

END OF THE QUESTION PAPER