Test VII

Read the following instructions carefully.

1. **There are a total of 65 questions carrying 100 marks**

2. Questions 1 to 25 will carry 1 mark each and questions 26 to 55 will carry 2 marks each

3. Questions 56 to 65 belong to General Aptitude (GA). Questions 56 to 60 will carry 1 mark each and questions 61 to 65 will carry 2 marks each.

4. Unattempted questions will carry zero marks

5. Wrong answers will carry negative marks, 0.33 marks for 1 mark questions and 0.66 marks for 2 marks questions will be deducted. There is no negative marking for questions 28 and 53

SECTION – A (Question 1 – 25) (1 marks)

Q1. An Eigen value of a square matrix is λ = 0. Then

(a) IAI ≠0 (b) A is symmetric (c) A is singular (d) A is skew-symmetric

Q2. Find the absolute maximum and minimum values of f(x,y) = 2 + 2x + 2y – x^2 –y^2 on triangular plate in the first quadrant, bounded by the lines x=0, y=0 and y = 9-x.

Q3. Effect of increasing load factor on stalling speed is

(a) Increases (b) decreases (c) remains constant (d) No effect

Q4. A lifting force produced when a rotating cylinder produces a pressure differential. This principle is known as

(a) D-Alembert Paradox (b) Magnus effect (c) Kutta-Joukowski (d) Prandtl's lifting line theory

Q5. Maximum principal stress at a point is 100MPa and maximum shear stress is 40 MPa. If a Mohr's stress circle is drawn. The radius of the circle is_________

Q6. The Blasius equation, $\frac{d^3f}{dx^3} + \frac{f}{2}\frac{d^2f}{dx^2} = 0$, is a

(a) second order non-linear ordinary differential equation (b) third order non-linear ordinary differential equation (c) third order linear ordinary differential equation (d) mixed order non-linear ordinary differential equation

Q7. The natural frequency of a spring – mass system on earth is ωn. The natural frequency of this system on the moon (g_{moon} = g_{earth}/6) is

(a) ωn (b) 0.408 ωn (c) 0.204 ωn (d) 0.167 ωn

Q8. The distance between the origin and the point nearest to it on the surface z^2 = 1 + xy is

(a) 1 (b) $\sqrt{3/2}$ (c) $\sqrt{2}$ (d) 2

Q9. For maximum thrust power, the jet velocity for an aircraft flying at 1000m/s is ________.

Q10. The relation between C_i and C_j for maximum propulsive efficiency is _______.

Q11. The pressure ratio in any one stage of a jet engine compressor is limited by

(a) Entry stagnation temperature in that stage
(b) Entry Mach number in that stage
(c) Pressure gradient induced separation in that stage
(d) Mass flow rate in that stage

Q12. Propulsion efficiency of a jet engine is

(a) Directly proportional to both the thrust power and the air mass flow rate
(b) inversely proportional to both the thrust power and the air mass flow rate
(c) Directly proportional to the thrust power and inversely proportional to the air mass flow rate
(d) inversely proportional to the thrust power and directly proportional to the air mass flow rate

Q13. NACA 12017 airfoil indicates its designed C_L as ______

Q14. An airfoil generates a lift of 80 N when operating in a free stream flow of 60m/s. If the ambient pressure and temperature are 100KPa and 290 K respectively (R = 287 J/Kg K), the circulation on the airfoil in m^2/ sec is ________.

Q15. Given that $\ddot{x} + 3x = 0$, and x(0) = 1, $\dot{x}(0) = 0$, the value of is x(1) ____.

Q16. The transverse shear stress acting in a beam of rectangular cross-section, subjected to a transverse shear load, is

(a) Variable with maximum at the bottom of the beam
(b) Variable with maximum at the top of the beam
(c) Uniform
(d) Variable with maximum at the neutral axis

Q17. A rod of Length L and diameter D is subjected to a tensile load P. Which of the following is sufficient to calculate the resulting change in diameter?

(a) Young's modulus (b) Shear modulus (c) Poisson's ratio (d) Both Young's modulus and shear modulus

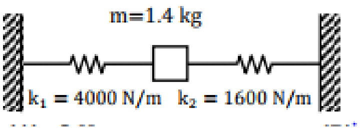
Q18. For a continuity equation given by $\vec{\nabla}.\vec{V} = 0$ to be valid, where $\vec{V}$ is the velocity vector, which one of the following is a necessary condition?

(a) steady flow (b) irrotational flow (c) Inviscid flow (d) incompressible flow

Q19. A solid circular shaft of diameter 100 mm is subjected to an axial stress of 50 MPa. It is further subjected to a torque of 10 KN- m. The maximum principal stress experienced on the shaft is closest to

(a) 41 MPa (b) 82 MPa (c) 164 MPa (d) 204 MPa

Q20. The natural frequency of the spring mass system shown in the figure is closest to



(a) 8 Hz (b) 10 Hz (c) 12 Hz (d) 14 Hz

Q21. The effect of tail wind on the endurance of the aircraft is (a) increases (b) decreases (c) remains constant (d) first decreases and then increases

Q22. The lift coefficient for minimum ground run for an aircraft with drag polar 0.024 + $0.04C_L^2$ is ______.

Q23. For a level flight at cruise altitude, C_D = 0.018 with drag coefficient at zero lift $C_{D,O}$ = 0.015. For a 30^0 climb at the same altitude and speed, C_D = ____ * 10^{-3}.

Q24. For longitudinal stable airplane, static margin is-

(a) zero (b) positive (c) negative (d) not related

Q25. A flying wing will require-

(a) $x_{cg}>x_{ac}$ (b) $x_{cg}<x_{ac}$ (c) $x_{cg}=x_{ac}$ (d) neutral stability

SECTION – B (Question 25 – 55) (2marks)

Q26. One of the Eigenvectors of the matrix A = $\begin{bmatrix} 2 & 2 \\ 1 & 3 \end{bmatrix}$ is

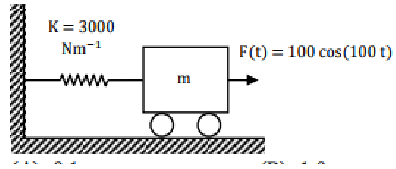
(a) { 2 −1 } (b) { 2 1 } (c) { 4 1 } (d) { 1 −1 }

Q27. In a channel section with vertical web, flanges are 10mm * 2mm and web 18mm*2mm, the distance of its shear centre from centre of web is _____________

Q28. The Laplace transform of a function f(t) is $1/s^2(s+1)$. The function f(t) is

(a) $t - 1 + e^{-t}$ (b) $t + 1 + e^{-t}$ (c) $-1 + e^{-t}$ (d) $2t + e^{t}$

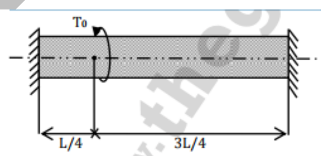
Q29. A mass m attached to a spring is subjected to a harmonic force as shown in figure. The amplitude of the forced motion is observed to be 50 mm. The value of m (in kg) is _____________.



Q30. . You are asked to evaluate assorted fluid flows for their suitability in a given laboratory application. The following three flow choices, expressed in terms of the two-dimensional velocity fields in the x-y plane, are made available. P. u = 2y, v = -3x; Q. u = 3xy, v = 0; R. u = 2x, v = 2y. Which flows(s) should be recommended when the application requires the flow to be incompressible and irrotational?

(a) P and R (b) Q (c) Q and R (d) R

Q31. A solid shaft of diameter, d and length L is fixed at both the ends. A torque, T0 is applied at a distance, L/4 from the left end as shown in the figure given below.



The maximum shear stress in the shaft is

(a) $\frac{16T_0}{\pi d^3}$ (b) $\frac{12T_0}{\pi d^3}$ (c) $\frac{8T_0}{\pi d^3}$ (d) $\frac{4T_0}{\pi d^3}$

Q32. If the centre of gravity of an airplane is moved forward towards the nose of the airplane, the C_{Lmax} value for which the airplane can be trimmed (C_m = 0) will

(a) Decrease (b) increase (c) remain same (d) depend upon rudder deflection

Q33. If the contribution of only the horizontal tail of an airplane was considered for estimating $\frac{dC_m}{d\alpha}$, and if the tail moment arm "l" was doubled, then how many times the original value would the new $\frac{dC_m}{d\alpha}$ become?

(a) Two times (b) three times (c) 1.414 times (d) 1.732 times

Q34. If horizontal tail area is increased while the elevator to horizontal tail area ratio is kept same, then

(a) Both longitudinal static stability and elevator control power will increase.
(b) Only longitudinal static stability will increase
(c) Only elevator control power will increase
(d) Neither stability nor control power changes

Q35. An aircraft weighing 160000 N has a wing area of 42 m^2. The thrust power available from the engine is 2.25 MW. The maximum Rate of climb at sea-level is_________ Drag polar equation is 0.014 + $0.05C_L^2$.

Q36. At an altitude of 1000m, an airplane flying with 200m/s, the pilot is forced to take a level turn of 5g to avoid collision. The distance covered for reversing the direction of flight is ______. Take wing loading as 200 Kg/m^2.

Q37. A glider weigningn5000N has elliptic wing of 10m^2. It is required to maintain a glide angle of 3^0 at a forward speed of 50m/s. Assuming C_{D0} = 0.015, the aspect ratio of the glider wing is __________.

Q38. A glider flying a level flight develops a Phugoid motion through a thermal disturbance whose damping is very small. The speed varies between 18.33m/s to 20.12m/s. The vertical amplitude (h) is _________.

Q39. If the stagnation temperature T_0 at compressor inlet is increased 1.44 times and stagnation pressure P_o is decreased to 0.6 times its value, then by what factor should the mass flow rate be decreased in the compressor to achieve the same pressure ratio _______.

Q40. For turbine, the relationship between polytropic efficiency and overall efficiency?

(a) $\eta_P = \eta_0$ (b) $\eta_P > \eta_0$ (c) $\eta_P < \eta_0$ (d) None of these

Q41. The combustion efficiency of an aircraft

(a) Decreases with the altitude (b) remain constant (c) increases with altitude (d) can't say

Q42. Pressure inside the duct is 1.0 bar in which air is flowing with velocity 300m/s and temperature 290K. Take ϒ = 1.4 and R = 287 J/Kg K. The total temperature and total pressure is________.

Q43. A turbojet engine is flying at M = 0.85 at an altitude where T = 216.6K. Cross-sectional area of diffuser at the entry is 0.5m^2; air-fuel ratio is 60. Pressure, temperature and velocity at exit are 47700 Pa, 1000K, 660m/s respectively. The propulsive and overall efficiency is_____.

Q44. Total pressure throughout the engine length i.e. in compressor, combustion chamber and nozzle –

(a) Increases then decreases then increases
(b) Decreases then remains constant then increases
(c) Increases then remains constant then decreases
(d) Decreases then remains constant then increases

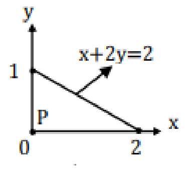
Q45. The induced drag of an airplane weighing 2270 Kg and span of 15.25m flying at 145Km/hr at sea level is __ (in Kg)

Q46. The position of the centre of pressure and aerodynamic centre of an aerofoil of chord length 1m, given that C_L and C_D at an incidence of 8^0 are 0.4 and 0.0112 respectively and C_M about quarter chord point is -0.1 is __.

Q47. The air speed indicator fitted to a particular aeroplane has no instrument errors and is calibrated assuming incompressible flow in standard conditions. While flying at sea-level in the I.S.A., the indicated air speed is 950 Km/hr. The true sir speed is ______ (Km/hr).

Q48. An aeroplane wings have a loading of 20 Kg/m^2. The wing has 20 m^2 area. If half of the lift is due to the decrease of pressure on the top surface. The actual pressure on the top surface of the wing at sea level is _______.

Q49. Consider the shaded triangular region P shown in the figure. What is $\iint_P xydxdy$?

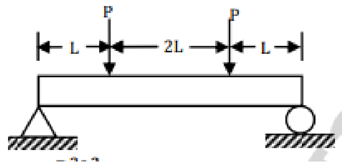


(a) 1⁄6 (b) 2⁄9 (c) 7⁄16 (d) 1

Q50. For what value of a, if any, will the following system of equations in x, y and z have a solution 2x + 3y = 4 x + y + z = 4 x + 2y − z = a

(a) Any real number (b) 0 (c) 1 (d) There is no such value

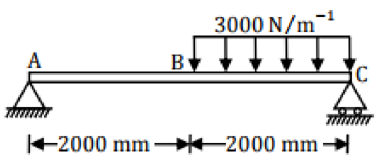
Q51. The strain energy stored in the beam with flexural rigidity EI and loaded as shown in the figure is



(a) $\frac{P^2L^3}{3EI}$ (b) $\frac{2P^2L^3}{3EI}$ (c) $\frac{4P^2L^3}{3EI}$ (d) $\frac{8P^2L^3}{3EI}$

Common data question 52 and 53

A massless beam has a loading pattern as shown in the figure. The beam is of rectangular cross – section with a width of 30 mm and height of 100 mm



52. The maximum bending moment occurs at

(a) Location B (b) 2675 mm to the right of A (c) 2500 mm to the right of A (d) 3225 mm to the right of A

Q53. The maximum magnitude of bending stress (in MPa) is given by

(a) 60.0 (b) 67.5 (c) 200.0 (d) 225.0

Common data question 54 and 55

An airplane designer wants to keep longitudinal static stability Margin(SM) within 5% to 15% of mean aerodynamic chord. A wind tunnel test of the model showed that for $X_{C.G.}$ = 0.3, $\frac{dC_m}{dC_L}$ = -0.1. Note that the distance from the wing leading edge to the centre of the gravity has been non-dimensionalized by dividing it with mean aerodynamic chord c.

Q54. The most forward location of the airplane centre of gravity permitted to fulfil the designers' requirement on longitudinal static stability margin is

(a) 0.35c (b) 0.25c (c) 0.15c (d) 0.52c

Q55. The most aft location of the airplane centre of gravity permitted to fulfil the designers' requirement on longitudinal static stability margin is

(a) 0.35c (b) 0.25c (c) 0.15c (d) 0.52c

Q. 56 – Q. 60 carry one mark each.

Q56. Which of the following options is closest in meaning to the word Circuitous?

(a) cyclic (b) Indirect (c) confusing (d) crooked

Q57. The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair. Unemployed: Worker

(a) fallow: land (b) unaware: sleeper (c) wit: jester (d) renovated: house

Q58. Choose the most appropriate word from the options given below to complete the following sentence: If we manage to ____________ our natural resource, we would leave a better planet for our children.

(a) uphold (b) restrain (c) cherish (d) conserve

Q59. Choose the most appropriate word from the options given below to the complete the following sentence: His rather casual remarks on ___________ his lack of seriousness about the politics subject.

(a) masked (b) belied (c) betrayed (d) suppressed

Q60. 25 persons are in a room. 15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is:

(a) 2 (b) 17 (c) 13 (d) 3

Q. 61 - Q. 65 carry two marks each.

Q61. Hari (H), Gita (G), Irfan (I) and Saira (S) are siblings (i.e. brothers and sisters). All were born on 1st January. The age difference between any two successive siblings (that is born one after another) is less than 3 years. Given the following facts: a. Hari's age + Gita's age > Irfan's age + Saira's age. b. The age difference between Gita and Saira is 1 year. However Gita is not the oldest and Saira is not the youngest. c. There are no twins. In what order were they born (oldest first)?

(a) HSIG (b) SGHI (c) IGSH (d) IHSG

Q62. 5 skilled workers can build a wall in 20 days: 8 semi-skilled workers can build a wall in 25 days; 10 unskilled workers can build a wall in 30 days. If a team has 2 skilled, 6 semi- skilled and 5 unskilled workers, how long will it take to build the wall?

(a) 20 days (b) 18 days (c) 16 days (d) 15 days

Q63. Modern warfare has changed from large scale clashes of armies to suppression of civilian populations. Chemical agents that do their work silently appear to be suited to such warfare; and regretfully, there exist people in military establishments who think that chemical agents are useful tools for their cause. Which of the following statements best sums up the meaning of the above passage?

(a) Modern warfare has resulted in civil strife.
(b) Chemical agents are useful in modern warfare.
(c) Use of chemical agents in warfare would be undesirable.
(d) People in military establishments like to use chemical agents in war

Q64. Given digits 2,2,3,3,3,4,4,4,4 how many distinct 4 digit numbers greater than 3000 can be formed?

(a) 50 (b) 51 (c) 52 (d) 54

Q65. If 137 + 276 = 435 how much is 731 + 672?

(a) 534 (b) 1403 (c) 1623 (d) 1513