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AI24BTEC11026 - pendem nitesh sri satya

- 1) The directional derivative of the function $f(x, y) = \frac{x^2 + xy^2}{\sqrt{5}}$ in the direction $\vec{a} = 2\hat{i} - 4\hat{j}$ at $(x, y) = (1, 1)$ is
 - a) $-\frac{1}{\sqrt{5}}$
 - b) $-\frac{2}{\sqrt{5}}$
 - c) 0
 - d) $-\frac{1}{5}$
- 2) The value of $\int_4^5 \frac{x+2}{x^2+4x-21} dx$ is
 - a) $\ln \sqrt{\frac{24}{11}}$
 - b) $\ln \sqrt{\frac{12}{11}}$
 - c) $\ln \sqrt{2}$
 - d) $\ln(\frac{12}{11})$
- 3) At $x = 0$ the function $y = |x|$ is
 - a) continuous but not differentiable
 - b) continuous and differentiable
 - c) not continuous but differentiable
 - d) not continuous and not differentiable
- 4) one of the eigenvectors of the matrix

$$A = \begin{pmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ -1 & 0 & 1 \end{pmatrix}$$
 is $v = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$
 The corresponding eigenvalue is _____.
- 5) which one of the following is the most stable configuration of an airplane in roll?
 - a) Sweep back, anhedral and low wing
 - b) Sweep forward, dihedral and low wing
 - c) Sweep forward, anhedral and high wing
 - d) Sweep back, dihedral and high wing
- 6) which one of the following flight instruments is used on an aircraft to determine its attitude in flight?
 - a) Vertical speed indicator
 - b) Altimeter
 - c) Artificial Horizon
 - d) Turn-bank indicator
- 7) A supersonic airplane is expected to fly at both subsonic and supersonic speeds during its whole flight course. which one of the following statements is TRUE?
 - a) Airplane will experience less stability in pitch at supersonic speeds than at subsonic speeds

- b) Airplane will feel no change in pitch stability
 c) Airplane will experience more stability in pitch at supersonic speeds than at subsonic speeds
 d) pitch stability cannot be inferred from the information given
- 8) which one of the following is favorable for an airplane operation?
 a) Tail wind in cruise and head wind in landing
 b) Tail wind both in cruise and landing
 c) head wind both in cruise and landing
 d) Head wind in cruise and tail wind in landing
- 9) which one of the following is TRUE with respect to phugoid mode of an aircraft?
 a) Frequency is directly proportional to flight speed
 b) Frequency is inversely proportional to flight speed
 c) Frequency is directly proportional to the square root of flight speed
 d) Frequency is inversely proportional to the square root of flight speed
- 10) the x and y velocity components of a two dimensional flow field are, $u = \frac{cy}{x^2+y^2}$, $v = \frac{cx}{x^2+y^2}$ where c is a constant. The streamlines are a family of
 a) hyperbolas
 b) parabolas
 c) ellipses
 d) circles
- 11) which one of the following statements is NOT TRUE for a supersonic flow?
 a) over a gradual expansion, entropy remains constant
 b) over a gradual expansion corner, entropy can increase
 c) over a gradual compression, entropy can remain constant
 d) over a sharp compression corner, entropy increases
- 12) consider a compressible flow where an elemental volume of the fluid is $\delta\rho$, moving with velocity \vec{V} . which one of the following expressions is TRUE?
 a) $\nabla \cdot \vec{V} = \frac{1}{\delta\rho} \frac{D\delta\rho}{Dt}$
 b) $\nabla \cdot (\nabla \times \vec{V}) = \frac{1}{\delta\rho} \frac{D\delta\rho}{Dt}$
 c) $\nabla \cdot \frac{D\vec{V}}{Dt} = \frac{1}{\delta\rho} \frac{D\delta\rho}{Dt}$
 d) $\vec{V} \cdot (\nabla \times \vec{V}) = \frac{1}{\delta\rho} \frac{D\delta\rho}{Dt}$
- 13) consider a thin flat plate airfoil at a small angle α to an oncoming supersonic stream of air. Assuming the flow to be inviscid, $\frac{C_d}{c_1^2}$ is
 a) zero
 b) independent of α
 c) proportional to α
 d) proportional to α^2