

# GATE Questions 2

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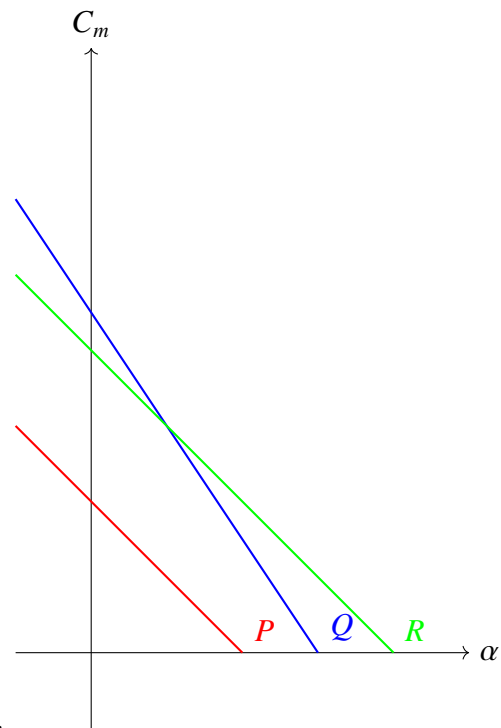
- 1) In a 3-D orthotropic material, the number of elastic constants in linear stress-strain relationship is
- a) 3                                      b) 5                                      c) 9                                      d) 21
- 2) The compatibility conditions in theory of elasticity ensure that
- a) there is compatibility between various direct and shear stress  
b) relationships between stresses and strains are consistent with constitutive relations  
c) displacements are single-valued and continuous  
d) stresses satisfy bi-harmonic equation
- 3) In a spring-mass-damper single degree of freedom system, the mass is 2kg and the undamped natural frequency is 20Hz. The critical damping constant of the system is
- a)  $160\pi N - s/m$                       b)  $80\pi N - s/m$                       c)  $1N - s/m$                       d)  $0N - s/m$
- 4) Which of the following quantities remains constant for a satellite in an elliptical orbit around the earth ?
- a) Kinetic energy  
b) Product of speed and radial distance from the centre of the earth.  
c) Rate of area swept by the radial vector from the centre of the orbit.  
d) Rate of area by the radial vector from the centre of the earth.
- 5) A planet is observed to be at its slowest when it is at a distance  $r_1$  from the sun and its fastest when it is at a distance  $r_2$  from the sun. The eccentricity  $e$  of the planet's orbit is given by
- a)  $e = \frac{r_1}{r_2}$                                       b)  $e = \frac{r_1 - r_2}{r_1 + r_2}$                                       c)  $e = \frac{r_2}{r_1}$                                       d)  $e = \frac{r_1 + r_2}{r_1 - r_2}$
- 6) The function  $f(x, y, z) = \frac{1}{2}x^2y^2z^2$  satisfies
- a)  $\text{grad } f = 0$                                       b)  $\text{div}(\text{grad } f) = 0$                                       c)  $\text{curl}(\text{grad } f) = 0$                                       d)  $\text{grad}(\text{div}(\text{grad } f)) = 0$
- 7) Which of the following is true for all choices of vectors  $\mathbf{p}, \mathbf{q}, \mathbf{r}$  ?
- a)  $\mathbf{p} \times \mathbf{q} + \mathbf{q} \times \mathbf{r} + \mathbf{p} \times \mathbf{r} = 0$   
b)  $(\mathbf{p} \cdot \mathbf{q})\mathbf{r} + (\mathbf{q} \cdot \mathbf{r})\mathbf{p} + (\mathbf{p} \cdot \mathbf{r})\mathbf{q} = 0$   
c)  $\mathbf{p} \cdot (\mathbf{q} \times \mathbf{r}) + \mathbf{q} \cdot (\mathbf{r} \times \mathbf{p}) + \mathbf{r} \cdot (\mathbf{p} \times \mathbf{q}) = 0$   
d)  $\mathbf{p} \times (\mathbf{q} \times \mathbf{r}) + \mathbf{q} \times (\mathbf{r} \times \mathbf{p}) + \mathbf{r} \times (\mathbf{p} \times \mathbf{q}) = 0$
- 8) The value of the line integral  $\frac{1}{2\pi} \int (x dy - y dx)$  taken anti-clockwise along a circle of unit radius is
- a) 0.5                                      b) 1                                      c) 2                                      d)  $\pi$
- 9) Which of the following is a solution of  $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$  ?
- a)  $e^{-x} + xe^{-x}$                                       b)  $e^x + xe^x$                                       c)  $e^x + e^{-x}$                                       d)  $e^{-x} + xe^x$
- 10) Suppose the non-constant functions  $F(x)$  and  $G(t)$  satisfy  $\frac{d^2F}{dx^2} + p^2F = 0$ ,  $\frac{dG}{dt} + c^2p^2G = 0$ , where  $p$  and  $c$  are constants. Then the function  $u(x, t) = F(x)G(t)$  definitely satisfies
- a)  $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$                                       c)  $\nabla^2 u = 0$   
b)  $\frac{\partial u}{\partial x} = c^2 \frac{\partial^2 u}{\partial x^2}$                                       d)  $\frac{\partial^2 u}{\partial t^2} + c^2 u^2 = 0$
- 11) The following set of equations

$$\begin{pmatrix} 1 & 1 & 2 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}$$

has

- a) no solution
- b) a unique solution
- c) two solutions
- d) infinite solutions

- 12) The function  $f(x) = x^2 - 5x + 6$
- a) has its maximum value at  $x=2.0$
  - b) has its maximum value value at  $x=2.5$
  - c) is increasing on the interval  $(2.0, 2.5)$
  - d) is increasing on the interval  $(2.5, 3.0)$
- 13) Let  $Y(s)$  denote the Laplace Transform  $L(y(t))$  of the function  $y(t) = \cosh(at)\sin(at)$ . Then
- a)  $L\left(\frac{dy}{dt}\right) = \frac{dY}{ds}, L(ty(t)) = sY(s)$
  - b)  $L\left(\frac{dy}{dt}\right) = sY(s), L(ty(t)) = -\frac{dY}{ds}$
  - c)  $L\left(\frac{dy}{dt}\right) = \frac{dY}{ds}, L(ty(t)) = Y(s-1)$
  - d)  $L\left(\frac{dy}{dt}\right) = \frac{dY}{ds}, L(ty(t)) = e^{as}Y(s)$
- 14) The velocity required for a spacecraft to escape earth's gravitational field depends on
- a) the mass of the spacecraft
  - b) the distance between earth's centre and the spacecraft
  - c) the earth's rotational speed about its own axis
  - d) the earth's orbital speed
- 15) Which of the following statements is TRUE as the altitude increases in the stratosphere of the International Standard Atmosphere ?
- a) Temperature increases and the dynamic viscosity decreases
  - b) Temperature increases and pressure increases
  - c) Temperature decreases and sound speed increases
  - d) Temperature decreases and density decreases
- 16) Which of the following statement is TRUE ?
- a) Wing dihedral reduces roll stability while a low wing increases roll stability
  - b) Wing dihedral increases roll stability while a low wing increases roll stability
  - c) Wing dihedral, as well as long wing reduces roll stability
  - d) Wing dihedral, as well as long wing increases roll staility.
- 17) The figure below shows the variation of  $C_m$  versus  $\alpha$  for an aircraft for three combinations of elevator deflections and locationsof centre of gravity. In the figure, lines P and Q are parallel, while lines Q



and R have the same intercept on the  $C_m$  axis.  
following is true ?

Which of the

- Lines P and Q correspond to the same centre of gravity location.
- Lines Q and R correspond to the same centre of gravity location.
- Lines P and R correspond to the same elevator deflection.
- Lines P and R correspond to the same centre of gravity location.