2016-XE-'14-26'

EE24BTECH11050 - Pothuri Rahul

4) Which of the following is a quasi-linear partial differential equation?
   a) $\frac{\partial^2 u}{\partial t^2} + u^2 = 0$
   b) $\left(\frac{\partial u}{\partial t}\right)^2 + \frac{\partial u}{\partial x} = 0$
   c) $\left(\frac{\partial u}{\partial t}\right)^2 - \left(\frac{\partial u}{\partial x}\right)^2 = 0$
   d) $\left(\frac{\partial u}{\partial t}\right)^4 - \left(\frac{\partial u}{\partial x}\right)^3 = 0$
5) Let $P(x)$ and $Q(x)$ be the polynomials of degree 5, generated by Lagrange and Newton interpolation methods respectively, both passing through given six distinct points on the $xy-plane$. Which of the following is correct?
   a) $P(x) \equiv Q(x)$
   b) $P(x) - Q(x)$ is a polynomial of degree 1
   c) $P(x) - Q(x)$ is a polynomial of degree 2
   d) $P(x) - Q(x)$ is a polynomial of degree 3
6) The Laurent series of $f(x) = 1/\left(z^3 - z^4\right)$ with center at $z = 0$ in the region $|z| > 1$ is

   a) $\sum\limits_{n=0}^{\infty} z^{n-3}$ b) $-\sum\limits_{n=0}^{\infty} \frac{1}{z^{n+4}}$ c) $\sum\limits_{n=0}^{\infty} z^n$ d) $\sum\limits_{n=0}^{\infty} \frac{1}{z^n}$

7) The value of the surface integral $\iint \mathbf{F}.nds$ over the sphere Γ given by $x^2+y^2+z^2 = 1$ where $\mathbf{F} = 4x\hat{i} - z\hat{k}$, and n denotes the outward unit normal, is

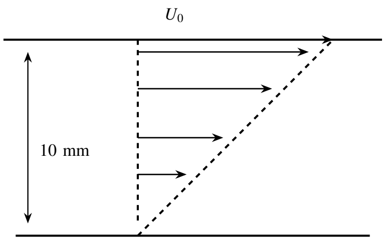
   a) π b) 2π c) 3π d) 4π

   Q.8 - Q.11 carry two marks each
8) A diagnostic test for a certain disease is 90% accurate. That is, the probability of a person having (respectively, not having) the disease tested positive (respectively, negative) is 0.9. Fifty percent of the population has the disease. What is the probability that a randomly chosen person has the disease given that the person tested negative?
9) Let $M = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$. Which of the following is correct?
   a) Rank of M is 1 and M is not diagonalizable
   b) Rank of M is 2 and M is diagonalizable
   c) 1 is the only eigenvalue and M is not diagonalizable
   d) 1 is the only eigenvalue and M is diagonalizable
10) Let $f(x) = 2x^3 - 3x^2 + 69, -5 \leq x \leq 5$. Find the point at which f attains the global maximum.
11) Calculate $\int\limits_{c_1} \mathbf{F}.dr - \int\limits_{c_2} \mathbf{F}.dr$, where $c_1 : \mathbf{r}\left(t, t^2\right) and c_1 : \mathbf{r}\left(t, \sqrt{t}\right)$, t varying from 0 to 1 and $\mathbf{F} = xy\hat{j}$.

B.Fluid Mechanics

Q.1-Q.9 carry one mark each.

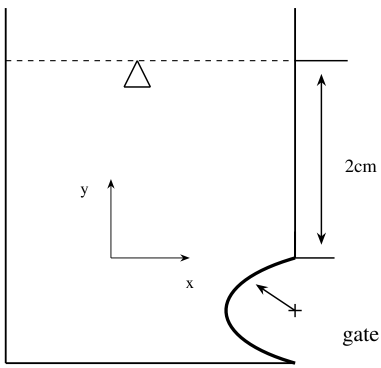
1) In the parallel-plate configuration shown, steady-flow of an incompressible Newtonian fluid is established by moving the top plate with a constant speed, $U_0 = 1m/s$. If the force required on the top plate to support this motion is 0.5 per unit area (in m_2) of the plate then the viscosity of the fluid between the plates is ___________ $N - s/m^2$



2) For a newly designed vehicle by some students, volume of fuel consumed per unit distance travelled ($q_f in m^3/m$) depends upon the vicosity (μ) and density (ρ) of the fuel and, speed (U) and size (L) of the vehicle as
$q_f = c\frac{\rho U^2 L}{\mu^3}$
where C is a constant. The dimensions of the constant C are

a) $M^0L^0T^0$ b) $M^2L^{-1}T^{-1}$ c) $M^2L^{-5}T^{-1}$ d) $M^{-2}L^1T^1$

3) A semicircular gate of radius $1m$ is placed at the bottom of a water reservoir as shown in the figure below. The hydrostatic force per unit width of the cylindrical gate in y-direction is ___________ kN. The gravitational acceleration, $g = 9.8m/s^2$ and density of the water = $1000kg/m^3$.



4) Velocity vector in m/s for a 2-D flow is given in Cartesian coordinate (x, y) as $\bar{V} = \left(\frac{x^2}{4}\hat{i} - \frac{xy}{2}\hat{j}\right)$. Symbols bear usual meaning. At a point in the flow, the x-component

and y-component of the acceleration vector are given as $1m/s^2$ and $-0.5m/s^2$, respectively. The velocity magnitude at that points is ___________ m/s.

5) If $\phi(x,y)$ is velocity potential and $\psi(x,y)$ is stream function for a 2-D, steady, incompressible and irrotational flow, which of the followings is correct?

a) $\left(\frac{dy}{dx}\right)_{\phi=const} = -\frac{1}{\left(\frac{dy}{dx}_{\psi=const}\right)}$

b) $\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} = 0$

c) $\left(\frac{dy}{dx}\right)_{\phi=const} = \frac{1}{\left(\frac{dy}{dx}_{\psi=const}\right)}$

d) $\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} = 0$