

# Mechanical Engineering-2007

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- 1) In orthogonal turning of a low carbon steel bar of diameter 150 mm with uncoated carbide tool, the cutting velocity is 90 m/min. The feed is  $0.24 \frac{\text{mm}}{\text{rev}}$  and the depth of cut is 2 mm. The chip thickness obtained is 0.48 mm. If the orthogonal rake angle is zero and the principal cutting edge angle is  $90^\circ$ , the shear angle in degree is
- a) 20.56                      b) 26.56                      c) 30.56                      d) 36.56
- 2) Which type of motor is NOT used in axis or spindle drives of CNC machine tools?
- a) induction motor                      c) stepper motor  
b) de servo motor                      d) linear servo motor
- 3) Volume of a cube of side '  $l$  ' and volume of a sphere of radius '  $r$  ' are equal. Both the cube and the sphere are solid and of same material. They are being cast. The ratio of the solidification time of the cube to the same of the sphere is
- a)  $\left(\frac{4\pi}{6}\right)^3 \left(\frac{r}{l}\right)^6$                       b)  $\left(\frac{4\pi}{6}\right) \left(\frac{r}{l}\right)^2$                       c)  $\left(\frac{4\pi}{6}\right)^2 \left(\frac{r}{l}\right)^3$                       d)  $\left(\frac{4\pi}{6}\right)^2 \left(\frac{r}{l}\right)^4$
- 4) If  $y = x + \sqrt{x + \sqrt{x + \sqrt{x + \dots \infty}}}$ , then  $y(2) =$
- a) 4 or 1                      b) 4 only                      c) 1 only                      d) undefined
- 5) The area of a triangle formed by the tips of vectors  $\vec{a}$ ,  $\vec{b}$  and  $\vec{c}$  is
- a)  $\frac{1}{2} \left| \left( (\vec{a} - \vec{b}) \cdot (\vec{a} - \vec{c}) \right) \right|$                       c)  $\frac{1}{2} \left| \vec{a} \times \vec{b} \times \vec{c} \right|$   
b)  $\frac{1}{2} \left| (\vec{a} - \vec{b}) \times (\vec{a} - \vec{c}) \right|$                       d)  $\frac{1}{2} \left| \vec{a} \times \vec{b} \cdot \vec{c} \right|$
- 6) The solution of  $\frac{dy}{dx} = y^2$  with initial value  $y(0) = 1$  is bounded in the interval
- a)  $-\infty \leq x \leq \infty$                       b)  $-\infty \leq x \leq 1$                       c)  $x < 1, x > 1$                       d)  $-2 \leq x \leq 2$
- 7) If  $F(s)$  is the Laplace transform of function  $f(t)$ , then Laplace transform of  $\int_0^t f(\tau) d\tau$  is
- a)  $\frac{1}{s} F(s)$                       b)  $\frac{1}{s} F(s) - f(0)$                       c)  $sF(s) - f(0)$                       d)  $\int F(s) ds$
- 8) A calculator has accuracy up to 8 digits after decimal place. The value of  $\int_0^{2\pi} \sin x dx$  when evaluated using this calculator by trapezoidal method with 8 equal intervals, to 5 significant digits is

- a) 0.00000      b) 1.0000      c) 0.00500      d) 0.00025

9) Let  $X$  and  $Y$  be two independent random variables. Which one of the relations between expectation ( $E$ ), variance ( $\text{Var}$ ) and covariance ( $\text{Cov}$ ) given below is FALSE?

- a)  $E(XY) = E(X)E(Y)$       c)  $\text{Var}(X + Y) = \text{Var}(X) + \text{Var}(Y)$   
 b)  $\text{Cov}(X, Y) = 0$       d)  $E(X^2Y^2) = (E(X))^2(E(Y))^2$

10)  $\lim_{x \rightarrow 0} \frac{e^x - 1 + x + \frac{x^2}{2}}{x^3} =$

- a) 0      b)  $\frac{1}{6}$       c)  $\frac{1}{3}$       d) 1

11) The number of linearly independent eigenvectors of  $\begin{pmatrix} 2 & 1 \\ 0 & 2 \end{pmatrix}$  is

- a) 0      b) 1      c) 2      d) infinite

12) The inlet angle of runner blades of a Francis turbine is  $90^\circ$ . The blades are so shaped that the tangential component of velocity at blade outlet is zero. The flow velocity remains constant throughout the blade passage and is equal to half of the blade velocity at runner inlet. The blade efficiency of the runner is

- a) 25%      b) 50%      c) 80%      d) 89%

13) The temperature distribution within the thermal boundary layer over a heated isothermal flat plate is given by  $\frac{T - T_w}{T_\infty - T_w} = \frac{3}{2}\left(\frac{y}{\delta_t}\right) - \frac{1}{2}\left(\frac{y}{\delta_t}\right)^3$ , where  $T_w$  and  $T_\infty$  are the temperatures of plate and free stream respectively, and  $y$  is the normal distance measured from the plate. The local Nusselt number based on the thermal boundary layer thickness  $\delta_t$  is given by

- a) 1.33      b) 1.50      c) 2.0      d) 4.64

14) In a counterflow heat exchanger, hot fluid enters at  $60^\circ\text{C}$  and cold fluid leaves at  $30^\circ\text{C}$ . Mass flow rate of the hot fluid is  $1 \frac{\text{kg}}{\text{s}}$  and that of the cold fluid is  $2 \frac{\text{kg}}{\text{s}}$ . Specific heat of the hot fluid is  $10 \frac{\text{kJ}}{\text{kgK}}$  and that of the cold fluid is  $5 \frac{\text{kJ}}{\text{kgK}}$ . The Log Mean Temperature for the heat exchanger in  $^\circ\text{C}$  is

- a) 15      b) 30      c) 35      d) 45

15) The average heat transfer coefficient on a thin hot vertical plate suspended in still air can be determined from observations of the change in plate temperature with time as it cools. Assume the plate temperature to be uniform at any instant of time and radiation heat exchange with the surroundings negligible. The ambient temperature is  $25^\circ\text{C}$  the plate has a total surface area of  $0.1\text{m}^2$  and a mass of  $4 \text{ kg}$ . The specific heat of the plate material is  $2.5 \frac{\text{kJ}}{\text{kgK}}$ . The convective heat transfer coefficient in  $\frac{\text{W}}{\text{m}^2\text{K}}$  at the instant when the plate temperature is  $225^\circ\text{C}$  and the change in plate temperature with time  $\frac{dT}{dt} = -0.02 \frac{\text{K}}{\text{s}}$ , is

- a) 200                      b) 20                      c) 15                      d) 10

16) A model of a hydraulic turbine is tested at a head of  $\frac{1}{4}^{th}$  of that under which the full scale turbine works. The diameter of the model is half of that of the full scale turbine. If  $N$  is the RPM of the full scale turbine, then the RPM of the model will be

- a)  $\frac{N}{4}$                       b)  $\frac{N}{2}$                       c)  $N$                       d)  $2N$

17) The stroke and bore of a four stroke spark ignition engine are 250 mm and 200 mm respectively. The clearance volume is  $0.001 \text{ m}^3$ . If the specific heat ratio  $\gamma = 1.4$ , the air-standard cycle efficiency of the engine is

- a) 46.40%                      b) 56.10%                      c) 58.20%                      d) 62.80%