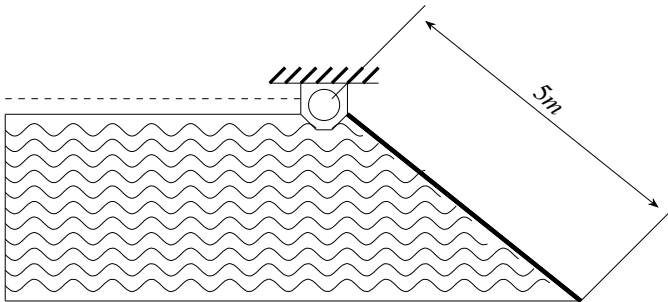


# Assignment 2

EE24BTECH11049  
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- 1) A bar is subjected to fluctuating tensile load from  $20kN$  to  $100kN$ . The material has yield strength of  $240MPa$  and endurance limit in reversed bending is  $160MPa$ . According to the Soderberg principle, the area of cross-section in  $mm^2$  of the bar for a factor of safety of 2 is (2007-ME)
  - a) 400
  - b) 600
  - c) 750
  - d) 1000
- 2) A simply supported beam of length  $L$  is subjected to a varying distributed load  $\sin \frac{3\pi x}{L} Nm^{-1}$ , where the distance  $x$  is measured from the left support. The magnitude of the vertical reaction force in  $N$  at the left support is (2007-ME)
  - a) Zero
  - b)  $\frac{L}{3\pi}$
  - c)  $\frac{L}{\pi}$
  - d)  $\frac{2L}{\pi}$
- 3) Two large diffuse gray parallel plates, separated by a small distance, have surface temperatures of  $400K$  and  $300K$ . If the emissivities of the surfaces are 0.8 and the Stefan-Boltzmann constant is  $5.67 \times 10^{-8} \frac{W}{m^2 K^4}$ , the net radiation heat exchange rate in  $\frac{kW}{m^2}$  between the two plates is (2007-ME)
  - a) 0.66
  - b) 0.79
  - c) 0.99
  - d) 3.96
- 4) A hinged gate of length  $5m$ , inclined at  $30^\circ$  with the horizontal and with water mass on its left, is shown in the figure below. Density of water is  $1000 \frac{kg}{m^3}$ . The minimum mass of the gate in kg per unit width (perpendicular to the plane of paper), required to keep it closed is



(2007-ME)

- a) 5000                      b) 6600                      c) 7546                      d) 9623

5) The pressure, temperature and velocity of air flowing in a pipe are  $5\text{bar}$ ,  $500\text{K}$  and  $50\frac{\text{m}}{\text{s}}$  respectively. The specific heats of air at constant pressure and at constant volume are  $1.005\frac{\text{KJ}}{\text{kgK}}$  and  $0.718\frac{\text{KJ}}{\text{kgK}}$  respectively. Neglect potential energy. If the pressure and temperature of the surroundings are  $1\text{bar}$  and  $300\text{K}$ , respectively, the available energy in  $\frac{\text{kJ}}{\text{kg}}$  of the air stream is (2007-ME)

- a) 170                      b) 187                      c) 191                      d) 213

6) The probability that a student knows the correct answer to a multiple choice question is  $\frac{2}{3}$ . If the student does not know the answer, then the student guesses the answer. The probability of the guessed answer being correct is  $\frac{1}{4}$ . Given that the student has answered the question correctly, the conditional probability that the student knows the correct answer is (2007-ME)

- a)  $\frac{2}{3}$                       b)  $\frac{3}{4}$                       c)  $\frac{5}{6}$                       d)  $\frac{8}{9}$

7) The solution of the differential equation

$$\frac{d^2u}{dx^2} - k\frac{du}{dx} = 0$$

where  $k$  is a constant, subjected to the boundary conditions  $u(0) = 0$  and  $u(L) = U$ , is (2007-ME)

- a)  $u = U\frac{x}{L}$                       c)  $u = U\left(\frac{1 - e^{-kx}}{1 - e^{-kL}}\right)$   
 b)  $u = U\left(\frac{1 - e^{kx}}{1 - e^{kL}}\right)$                       d)  $u = U\left(\frac{1 + e^{kx}}{1 + e^{kL}}\right)$

8) The value of the definite integral

$$\int_1^e \sqrt{x} \ln(x) dx$$

is (2007-ME)

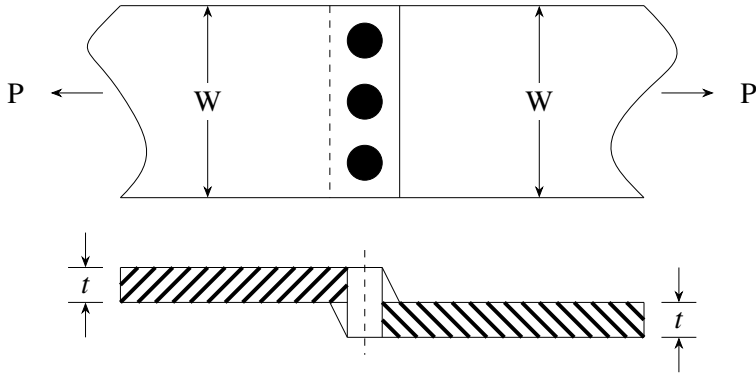
- a)  $\frac{4}{9}\sqrt{e^3} + \frac{2}{9}$                       b)  $\frac{2}{9}\sqrt{e^3} - \frac{4}{9}$                       c)  $\frac{2}{9}\sqrt{e^3} + \frac{4}{9}$                       d)  $\frac{4}{9}\sqrt{e^3} - \frac{2}{9}$

## 1 COMMON DATA QUESTIONS

### 1.1 Common Data for Questions 48 & 49:

9 10

A single riveted lap joint of two similar plates as shown in the figure below has the following geometrical and material details.



width of the plate  $w = 200\text{mm}$ , thickness of the plate  $t = 5\text{mm}$ , number of rivets  $n = 3$ , diameter of the rivet  $d_r = 10\text{mm}$ , diameter of the rivet hole  $d_h = 11\text{mm}$ , allowable tensile stress of the plate  $\sigma_p = 200\text{MPa}$ , allowable shear stress of the rivet  $\sigma_s = 100\text{MPa}$  and allowable bearing stress of the rivet  $\sigma_c = 150\text{MPa}$ .

- 9) If the rivets are to be designed to avoid crushing failure, the maximum permissible load  $P$  in  $\text{kN}$  is (2007-ME)
- a) 7.50                      b) 15.00                      c) 22.50                      d) 30.00
- 10) If the plates are to be designed to avoid tearing failure, the maximum permissible load  $P$  in  $\text{kN}$  is (2007-ME)
- a) 83                          b) 125                          c) 167                          d) 501

### 1.2 Common Data for Questions 50 & 51:

11 12

Water (specific heat,  $c_p = 4.18 \frac{\text{kJ}}{\text{kgK}}$ ) enters a pipe at a rate of  $0.01 \frac{\text{kg}}{\text{s}}$  and a temperature of  $20^\circ\text{C}$ . The pipe, of diameter  $50\text{mm}$  and length  $3\text{m}$ , is subjected to a wall heat flux  $q''$  in  $\frac{\text{W}}{\text{m}^2}$

- 11) If  $q''_w = 2500x$ , where  $x$  is in  $\text{m}$  and in the direction of flow ( $x = 0$  at the inlet), the bulk mean temperature of the water leaving the pipe in  $^\circ\text{C}$  is (2007-ME)
- a) 42                          b) 62                          c) 74                          d) 104
- 12) If  $q''_w = 5000$  and the convection heat transfer coefficient at the pipe outlet is  $1000 \frac{\text{W}}{\text{m}^2\text{K}}$ , the temperature in  $^\circ\text{C}$  at the inner surface of the pipe at the outlet is (2007-ME)

a) 71

b) 76

c) 79

d) 81

## 2 LINKED ANSWER QUESTIONS

### 2.1 Statement for Linked Answer Questions 52 & 53:

13

In orthogonal turning of a bar of  $100\text{mm}$  diameter with a feed of  $0.25\frac{\text{mm}}{\text{rev}}$ , depth of cut of  $4\text{mm}$  and cutting velocity of  $90\frac{\text{m}}{\text{min}}$ , it is observed that the main (tangential) cutting force is perpendicular to the friction force acting at the chip-tool interface. The main (tangential) cutting force is  $1500\text{N}$ .

13) The orthogonal rake angle of the cutting tool in *degree* is (2007-ME)

a) zero

b) 3.58

c) 5

d) 7.16