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

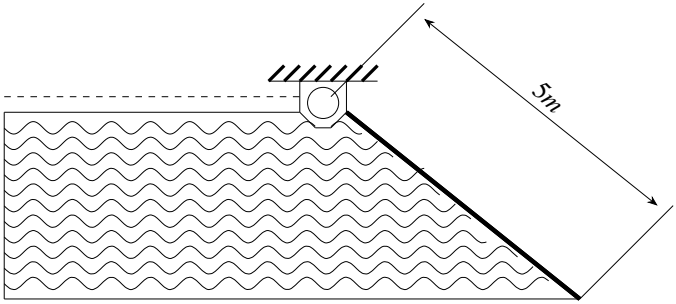
2) A simply supported beam of length L is subjected to a varying distributed load $\sin\frac{3\pi x}{L} Nm^{-1}$, where the distance x is measured from the left support. The magnitude of the vertical reaction force in N at the left support is (2007-ME)

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 $5.67 \times 10^{-8} \frac{W}{m^2K^4}$, 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° 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 $5bar$, $500K$ and $50\frac{m}{s}$ respectively. The specific heats of air at constant pressure and at constant volume are $1.005\frac{KJ}{kgK}$ and $0.718\frac{KJ}{kgK}$ respectively. Neglect potential energy. If the pressure and temperature of the surroundings are $1bar$ and $300K$, respectively, the available energy in $\frac{kJ}{kg}$ 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) $u = U\frac{x}{L}$

b) $u = U\left(\frac{1 - e^{kx}}{1 - e^{kL}}\right)$

c) $u = U\left(\frac{1 - e^{-kx}}{1 - e^{-kL}}\right)$

d) $u = U\left(\frac{1 + e^{kx}}{1 + e^{kL}}\right)$

8) The value of the definite integral

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

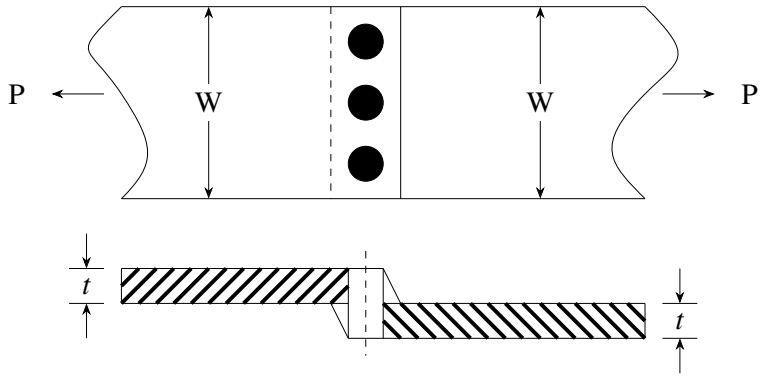
is (2007-ME)

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

9) If the rivets are to be designed to avoid crushing failure, the maximum permissible load P in 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 kN is (2007-ME)

a) 83 b) 125 c) 167 d) 501

1.2 Common Data for Questions 50 & 51: 11 12

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

11) If$q''_W = 2500x$, where x is in m and in the direction of flow ($x = 0$ at the inlet), the bulk mean temperature of the water leaving the pipe in $^{\circ}C$ 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 $1000\frac{W}{m^2K}$, the temperature in $^{\circ}C$ 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*mm* diameter with a feed of $0.25\frac{mm}{rev}$, depth of cut of 4*mm* and cutting velocity of $90\frac{m}{min}$, 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*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