# 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

    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

    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

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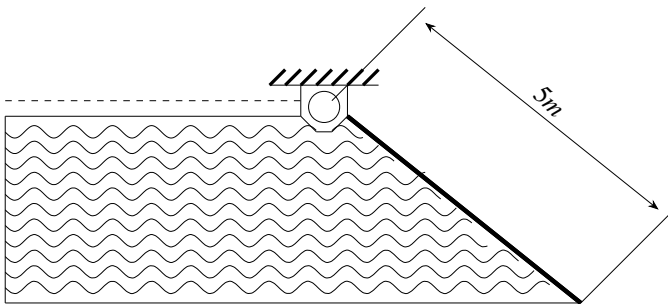
a) 5000   b) 6600   c) 7546   d) 9623

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

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

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

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

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

8) The value of the definite integral

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

is

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:

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 $\sigma_c = 150MPa$.
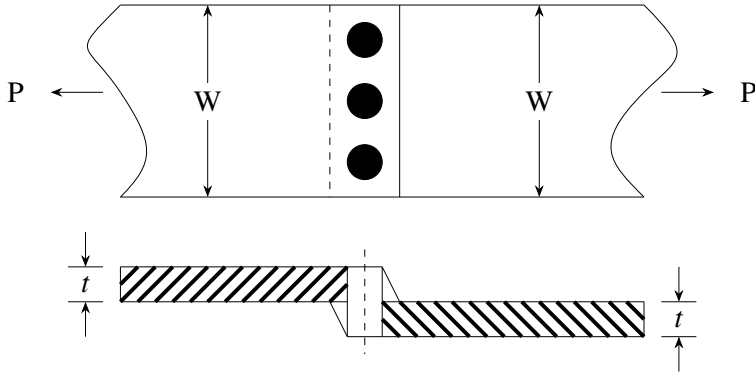
9) If the rivets are to be designed to avoid crushing failure, the maximum permissible load P in kN is

    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

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

1.2 Common Data for Questions 50 & 51:

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 $20°C$. 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 $°C$ is

    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 $°C$ at the inner surface of the pipe at the outlet is

    a) 71   b) 76   c) 79   d) 81

2 Linked Answer Questions

2.1 Statement for Linked Answer Questions 52 & 53:

In orthogonal turning of a bar of $100mm$ diameter with a feed of $0.25\frac{mm}{rev}$, depth of cut of $4mm$ 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 1500N.

13) The orthogonal rake angle of the cutting tool in *degree* is

    a) zero   b) 3.58   c) 5   d) 7.16