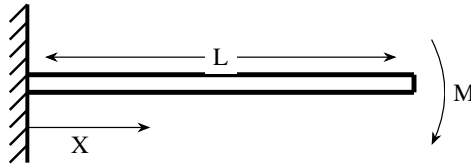# Assignment 4

EE24BTECH11049

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1 ME, SET-1

1.1 MCQ - Carry ONE mark each

1) A cantilever beam of length L and flexural rigidity, EI, is subjected to an end momen, M, as shown in the figure. The deflection of the beam at $x = \frac{L}{2}$ is

(2021 MA)

   a) $\frac{ML^2}{2EI}$ b) $\frac{ML^2}{4EI}$ c) $\frac{ML^2}{8EI}$ d) $\frac{ML^2}{16EI}$

2) A prismatic bar $PQRST$ is subjected to axial loads as shown in the figure. The segments having maximum and minimum axial stresses, respectively, are
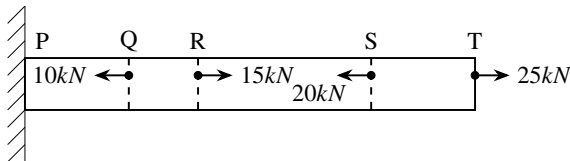
(2021 MA)

a) QR and PQ c) QR and RS

b) ST and PQ d) ST and RS

3) Sheer stress distribution on the cross-section of the coil wire in a helical compression spring is shown in the figure. This sheer stress distribution resprents
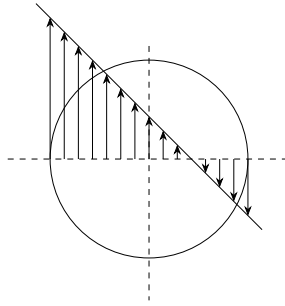
a) direct sheer stress in the coil wire cross-section
b) torsional shear stress in the coil wire cross-section
c) combined direct shear and torsional shear stress in th coil wire crosstion
d) combined direct shear and torsional shear along with the effect of stress concentration at inside edge of the coil wire cross-section

1.2 Numerical Type - Carry ONE mark each

1) Robot Ltd. wishes to maintain enough safety stock during the lead time period between starting a new production run and its completion such that he probability of satisfying the customer demand during the lead time period is 95%. The lead time period in 5 days and daily customer demand can be assumed to follow the Gaussian (normal) distribution with mean 50 units and a standard deviation of 10 units. Using $\phi^{-1}(0.95) = 1.64$, where ϕ respresents the cummulative distribution function of the standard normal random variable, the amount of safety stock that must be maintained by Robot Ltd. to achieve this demand fulfillment probability for the lead time period _____ (round off to decimal places).

2) A pressure measurement device fitted on the surface of a submarine, located at a depth H below the surface of an ocean, reads an absolute pressure of $4.2MPa$. The density of a sea water is $1050\frac{kg}{m^3}$, the atmospheric pressure is $101kPa$ and the acceleration due to gravity is $9.8\frac{m}{s^2}$. The depth H _____ m (round off to nearest integer).

3) Consider fully developed, steady state incompressible laminar flow of a viscous fluid between two large parallel horizontal plates. The bottom plate is fixed and the top plate moves with velocity of $U = 4\frac{m}{s}$. Separation between plates is $5mm$. There is no pressure gradient in the direction of $1.25 \times 10^{-4}\frac{m^2}{s}$. The average shear stress in the fluid is _____ Pa (round off to nearest integer).

4) A rigid insulated tank is initially evacuated. It is connected through a value to a supply line that carries air at a constant pressure and temperature of $250kPa$ and $400K$ respectively. Now the valve is opened and air is allowed to flow into the tank until the pressure inside the tank reaches to $250kPa$ at which point valve is closed. Assume that the air beaves as a perfect gas with constant properties.

$\left(c_p = 1.005\frac{kJ}{(kg-K)}, c_v = 0.718\frac{kJ}{(kg-K)}, R = 0.287\frac{kJ}{(kg-K)}\right).$Final temperature of the air inside the tank is _____ K (round off to one decimal places)
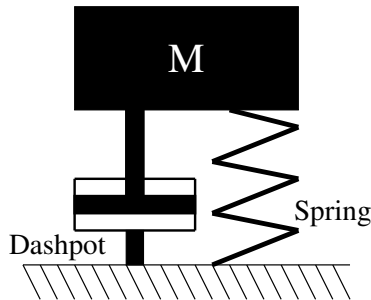
<div align="right">(2021 MA)</div>

5) The figure shows an arrangement of a heavy propeller shaft in a ship. The combiined polar mass moment of inertia of the propeller and the shaft is $100kg - m^2$. The propeller rotates at $\omega = 12\frac{rad}{s}$. The waves acting on the ship hull induces a rolling motion as shown in the figure with an angular velocity of $5\frac{rad}{s}$. The gyroscopic moment generated on the shaft due to the motion described is _____ $N - m$. (round off to the nearest integer)

Side view   End view
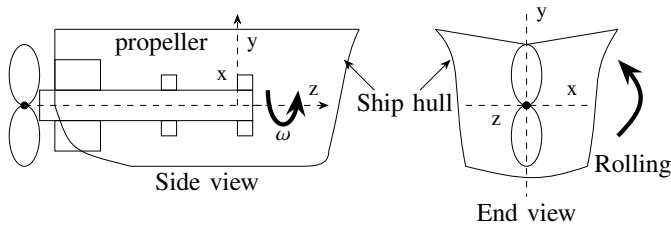
<div align="right">(2021 MA)</div>

6) Consider a single degreeof freedom system comprising a mass M supported on a spring and a dashpot as swn in the figure.

If the amplitude of the free vibration response reduces from 8 mm to 1.5 mm in 3 cycles, the damping ratio of the system is _____ (round off to three decimal places)

<div align="right">(2021 MA)</div>

7) Consider a vector p in 2-dimensional space. Let it direction (counter-clockwise angle with the positive x-axis) be θ. Let p be an eigen vector of a 2×2 matrix A with corresponding eigen value $\lambda, \lambda > 0$. If we denote the magnitude of a vector v by $\|v\|$, identify the VALID statement regarding p', where $p' = Ap$.

<div align="right">(2021 MA)</div>

a) Direction of $p' = \lambda\theta, \|p'\| = \|p\|$

Job	A	B	C	D	E	F	G	H
Turning(minutes)	2	4	8	9	7	6	5	10
Grinding(minutes)	6	1	3	7	9	5	2	4

b) Direction of $p' = \theta, \|p'\| = \lambda \|p\|$
c) Direction of $p' = \lambda\theta, \|p'\| = \lambda \|p\|$
d) Direction of $p' = \theta, \|p'\| = \frac{\|p\|}{\lambda}$

8) Let C respresent the unit circle centerted at origin in the complex plane, and complex variable, $z = x + \iota y$. The value of the contour integral

$$\oint_c \frac{\cosh 3z}{2z}$$

(where integration is taken counter clockwise) is

(2021 MA)

a) 0   b) 2   c) $\pi\iota$ d) $2\pi\iota$

9) A set of jobs A,x' B, C, D, E, F, G, H arrive at time $t = 0$ for processing on turning and griding machines. Each job needs to be processed in sequence first on the turning machine and second on the grinding must occur immediately after turning. The processing times of the jobs are given below. If the makespan is to be minimized, then the optimal sequence in which these jobs must be processed on the turning and grinding machines is

(2021 MA)

a) A-E-D-F-H-C-G-B   c) G-E-D-F-H-C-A-B
b) A-D-E-F-H-C-G-B   d) B-G-C-H-F-D-E-A

10) The fundamental thermodynamic relation for a rubber band is given by $dU = TdS + \tau dL$, where T is the absolute temperature, S is the entropy, τ is the tension in the rubber band, and L is the length of the rubber band. Which one of the following relationsis CORRECT:

(2021 MA)

a) $\tau = \left(\frac{\partial U}{\partial S}\right)_L$ b) $\left(\frac{\partial T}{\partial L}\right)_S = \left(\frac{\partial \tau}{\partial S}\right)_L$ c) $\left(\frac{\partial T}{\partial S}\right)_L = \left(\frac{\partial \tau}{\partial L}\right)_S$ d) $T = \left(\frac{\partial U}{\partial S}\right)_\tau$