ASSIGNMENT-5
GATE ME-2019

EE24BTECH11019 - DWARAK A

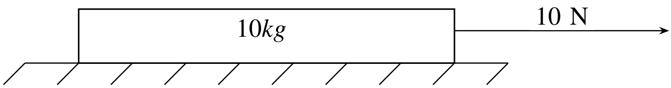
Q.1 to Q.25 carry one mark each.

1) The table presents the demand of a product. By simple three-months moving average method, the demand-forecast of the product for the month of September is

Month	Demand
January	450
February	440
March	460
April	510
May	520
June	495
July	475
August	560

   a) 490
   b) 510
   c) 530
   d) 536.67

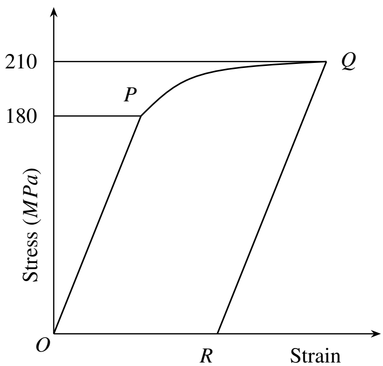
2) Evaluation of $\int_{2}^{4} x^3 dx$ using a 2-equal-segment trapezoidal rule gives a value of ______
3) A block of mass $10kg$ rests on a horizontal floor. The acceleration due to gravity is $9.81m/s^2$. The coefficient of static friction between the floor and the block is 0.2. A horizontal force of $10N$ is applied on the block as shown in the figure. The magnitude of force of friction (in N) on the block is ______



4) A cylindrical rod of diameter $10mm$ and length $1.0m$ is fixed at one end. The other end is twisted by an angle of $10°$ by applying a torque. If the maximum shear strain in the rod is $p \times 10^{-3}$, then p is equal to _____ (round off to two decimal places).
5) A solid cube of side $1m$ is kept at a room temperature of $32°C$. The coefficient of linear thermal expansion of the cube material is $1 \times 10^{-5}/^{\circ}C$ and the bulk modulus is

$200GPa$. If the cube is constrained all around and heated uniformly to $42°C$, then the magnitude of volumetric (mean) stress (in MPa) induced due to heating is ______

6) During a high cycle fatigue test, a metallic specimen is subjected to cyclic loading with a mean stress of $+140MPa$, and a minimum stress of $-70MPa$. The R-ratio (minimum stress to maximum stress) for this cyclic loading is ______ (round off to one decimal place).
7) Water flows through a pipe with a velocity given by $\mathbf{V} = \left(\frac{4}{t} + x + y\right)\hat{j} m/s$, where $\hat{j}$ is the unit vector in the y direction, $t (> 0)$ is in seconds, and x and y are in meters. The magnitude of total acceleration at the point $(x, y) = (1, 1)$ a $t = 2s$ is ______ m/s^2
8) Air of mass $1kg$, initially at $300K$ and $10\,bar$, is allowed to expand isothermally till it reaches a pressure of $1\,bar$. Assuming air as an ideal gas with gas constant of $0.287kJ/kgK$, the change in entropy of air (in $kJ/kg.K$, round off to two decimal places) is ______
9) Consider the stress-strain curve for an ideal elastic-plastic strain hardening metal as shown in the figure. The metal was loaded in uniaxial tension starting from **O**. Upon loading, the stress-strain curve passes through initial yield point at **P**, and then strain hardens to point **Q**, where the loading was stopped. From point **Q**, the specimen was unloaded to point **R**, where the stress is zero. If the same specimen is reloaded in tension from point **R**, the value of stress at which the material yields again is ______ MPa



Q.26 to Q.55 carry one mark each.

10) The set of equations

$$x + y + z = 1$$

$$ax - ay + 3z = 5$$

$$5x - 3y + az = 6$$

has infinite solutions if $a =$

a) -3

b) 3
c) 4
d) −4

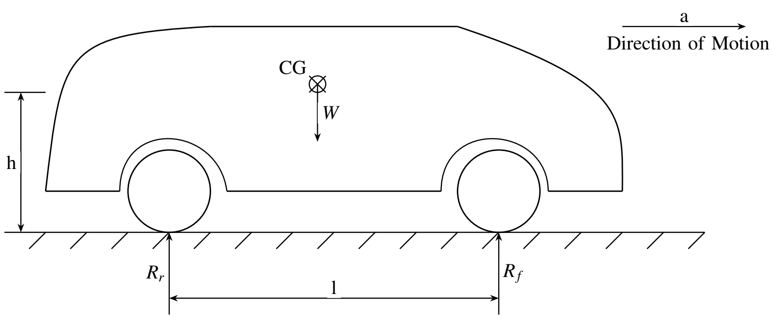
11) A harmonic function is analytic if it satisfies the Laplace equation.
If $u(x,y) = 2x^2 - 2y^2 + 4xy$ is a harmonic function, then its conjugate harmonic function $v(x,y)$ is

a) $4xy - 2x^2 + 2y^2 +$ constant
b) $4y^2 - 4xy +$ constant
c) $2x^2 - 2y^2 + xy +$ constant
d) $-4xy + 2y^2 - 2x^2 +$ constant

12) The variable x takes a value between 0 and 10 with uniform probability distribution. The variable y takes a value between 0 and 20 with uniform probability distribution. The probability of the sum of variables $(x + y)$ being greater than 20 is

a) 0
b) 0.25
c) 0.33
d) 0.50

13) A car having weight W is moving in the direction as shown in the figure. The center of gravity (CG) of the car is located at height h from the ground, midway between the front and rear wheels. The distance between the front and rear wheels is l. The acceleration of the car is a, and acceleration due to gravity is g. The reactions on the front wheels (R_f) and rear wheels (R_r) are given by



a) $R_f = R_r = \frac{W}{2} - \frac{W}{g}\left(\frac{h}{l}\right)a$
b) $R_f = \frac{W}{2} + \frac{W}{g}\left(\frac{h}{l}\right)a; R_r = \frac{W}{2} - \frac{W}{g}\left(\frac{h}{l}\right)a$
c) $R_f = \frac{W}{2} - \frac{W}{g}\left(\frac{h}{l}\right)a; R_r = \frac{W}{2} + \frac{W}{g}\left(\frac{h}{l}\right)a$
d) $R_f = R_r = \frac{W}{2} + \frac{W}{g}\left(\frac{h}{l}\right)a$