

5852

Q.P. code: 10095305

FE Sem - I R-19 scheme All

[2 Hours]

[Total Marks: 60]

N.B.:

- (1) Question No. 1 is compulsory.
- (2) Attempt any three questions from Q. 2 to Q. 6
- (3) Assume suitable data wherever required.
- (4) Figures to the right indicate marks.

- Q. 1 Attempt any five [15]
- a) Draw the following planes  
(101), (121), (113)
  - b) In Newton's Rings reflected light of wavelength  $5 \times 10^{-7}$  cm. The diameter of the 10<sup>th</sup> dark ring is 0.5 cm. Calculate radius of curvature R.
  - c) What is de Broglie wavelength of an electron which has been accelerated from rest through a p.d. of 100 V?
  - d) Explain construction of Liquid Crystal Display.
  - e) Explain Meissner effect with application.
  - f) What is the significance of wave function?
  - g) Explain why an excessively thin film appears black in the reflected light.
- Q. 2
- a) Explain the concept of holes as majority carriers in the p-type semiconductors. Calculate electron and hole concentration in intrinsic silicon at room temperature if its electrical conductivity is  $4 \times 10^{-4} (\Omega\text{-m})^{-1}$ .  
Take  $\mu_n = 0.14 \text{ m}^2 \text{ v}^{-1}$  and  $\mu_p = 0.04 \text{ m}^2 \text{ v}^{-1}$  [3+5]
  - b) Derive the condition for maxima and minima due to interference of light-reflected from a thin film of uniform thickness. [7]
- Q. 3
- a) Derive one dimensional time dependent Schrodinger equation for matter waves. [8]
  - b) Explain the Principle, construction and working of LED. [7]
- Q. 4
- a) Explain analysis of crystal structure using Bragg's X-ray spectrometer. [5]
  - b) What are the properties of matter waves [5]
  - c) Find the thickness of the soap film which appear yellow ( $\lambda = 5896 \text{ \AA}$ ) in reflection when it is illuminated by white light at an angle of  $45^\circ$ .  
(Given R.I. of the film is 1.33) [5]
- Q. 5
- a) What are high  $T_c$  superconductors? Explain their Principle characteristics, advantages, disadvantages and applications. [5]
  - b) Derive an expression for the interplanar spacing for (hkl) planes in a cubic crystal. [5]
  - c) In a semiconductor with  $R_{H1} = 145 \text{ cc/c}$  having width of 2 cm and thickness 0.2 cm with a magnetic induction of 2T along the smaller dimension, a current of 150 mA is passing. Calculate current density and Hall voltage [5]
- d) Q. 6
- a) What is mesomorphic state of matter? Explain with a neat diagram the cholesteric state [5]
  - b) Distinguish between type-I and type-II supercapacitors [5]
  - c) White light is incident at an angle of  $45^\circ$  on a soap film  $4 \times 10^{-5}$  cm thick. Find the wavelength of light in visible spectrum which will be absent in the reflected light.  
( $\mu = 1.2$ ) [5]

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## FE Sem I All Branches R-19 C scheme

Time: 2 hours

Maximum marks: 60

NB:

1) Question No.1 is Compulsory

2) Attempt any Three questions from the remaining Five questions

3) Figures to the right indicate full marks

- Q.1 Attempt any five of the following: (15)
- Compare temporary and permanent hardness (any 3 points).
  - Why  $H_2O$  is liquid and  $H_2S$  is a gas. Justify.
  - Comment on glass transition temperature ( $T_g$ ).
  - Give difference between bonding and antibonding orbitals.
  - Identify how many phase/s are present in each of the following systems:
    - Mixture of  $N_2$ ,  $H_2$  and  $O_2$
    - Mixture of rhombic and monoclinic Sulphur
    - Ethanol and water
  - Explain drawbacks of Kekule's Benzene structure.
  - Calculate COD of 25 ml of waste water sample in ppm which was refluxed with 10 ml of  $K_2Cr_2O_7$  and after refluxing the excess unreacted dichromate required 6.5 ml of 0.1N FAS solution. A blank of 25 ml of distilled water on refluxing with 10 ml of  $K_2Cr_2O_7$  solution required 27 ml of 0.1N FAS solution.
- Q.2) a) Apply Gibb's phase rule to one-component (Water) system. (6)
- b) Explain reverse osmosis with the help of principle, process, and diagram. Also give its advantages. (5)
- c) Discuss the roles of plasticizer and lubricant in compounding of plastics. (4)
- Q.3) a) Draw the Molecular Orbital diagram of CO molecule. Give its electronic configuration. Calculate its bond order and identify its magnetic behaviour. (6)
- b) What is hydrogen bonding? Explain its types with examples. (5)
- c) Calculate number average molecular weight of polymer which has 5 molecules of molecular weight of 10000, 3 molecules of molecular weight 30000 and 2 molecules of molecular weight 60000. (4)

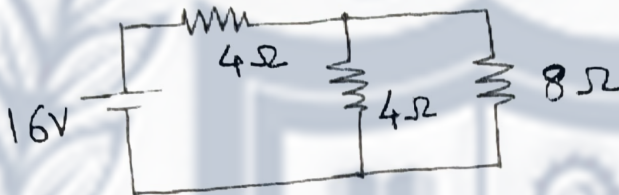
- Q.4) a) Explain Gibbs phase rule with its mathematical expression. Give its limitations and advantages. (6)
- b) Comment on structure and bonding of pyrrole. (5)
- c) Explain p-doped and n-doped conducting polymers with appropriate examples. (4)
- Q.5) a) Define fabrication of plastics. Explain injection moulding process with neatly labelled diagram. Give its any two advantages. (6)
- b) Distinguish between orbit and orbital (any three points). Explain the shapes of p-orbitals with their diagrams. (5)
- c) Give equations explaining EDTA titration. (4)  
 Standard hard water sample contained 1 mg of pure  $\text{CaCO}_3$  per ml. 50 ml of Standard hard water sample consumed 20 ml of EDTA solution. 50 ml of hard water sample required 30 ml of EDTA solution. Calculate total hardness of water in ppm.
- Q.6) a) Explain the ion-exchange method for softening of water giving the following details: Principle, diagram, process, and Reactions. (6)
- b) i) Define: Phase and Component. (2)
- ii) An alloy of tin and lead contains 73% tin. Find the mass of eutectic in 1 kg of solid alloy, if the eutectic contains 64% of tin. (3)
- c) i) Draw Molecular Orbital diagram of  $\text{O}_2$  molecule. (2)
- ii) Give synthesis of Kevlar. (2)



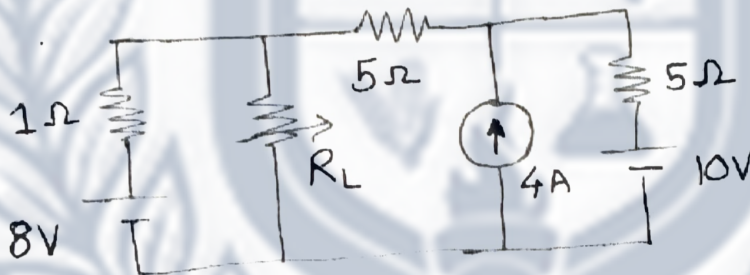
- Q4 a) Derive relationship between line and phase quantities in a three-phase star connected circuit. (10)
- b) A balanced three phase delta connected load of 200KVA at 0.7pf lag. A voltage of 440V, 50Hz is applied to a circuit. Find circuit constant, active and reactive powers. Also find line and phase current. (10)

- Q5 a) Derive an emf equation of single-phase transformer. (5)
- b) Explain the working principle of three phase induction machine. (5)
- c) A resistor & capacitor are connected in series with a variable inductor. When the circuit is connected to a 230V, 50Hz supply, maximum current drawn by varying the inductor is 2A. The voltage across capacitor is then 500V. Calculate resistance and capacitance of the circuit. (10)

- Q6 a) Compare series resonance and parallel resonance. (5)
- b) Find current in  $8\ \Omega$  by Thevenin's theorem. (5)



- c) Find value of  $R_L$  for maximum power transfer and find maximum power transferred. (10)



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SIGCE

## FE Sem-I All branch R-19 scheme

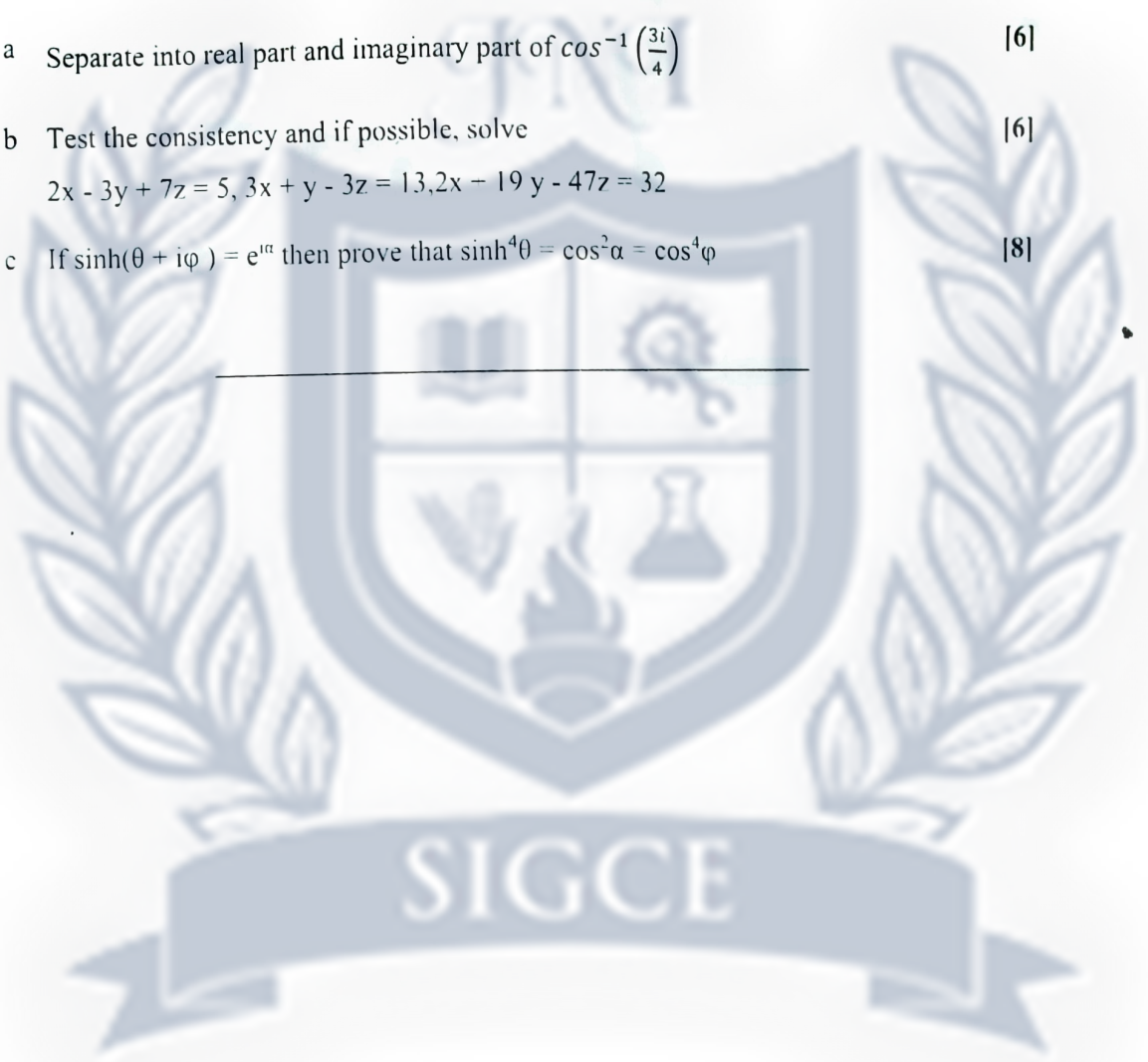
Time: 3 Hours

Marks: 80

- N.B. : (1) Question No 1 is Compulsory.  
 (2) Attempt any three questions out of the remaining five.  
 (3) All questions carry equal marks.

- 1 a Evaluate  $\left[ \frac{1 + \sin \alpha + i \cos \alpha}{1 + \sin \alpha - i \cos \alpha} \right]^n$  [5]
- b Expand  $x^5 - x^4 + x^3 - x^2 + x - 1$  in powers of  $(x-2)$  by using Taylor's series [5]
- c Show that the matrix  $A = \begin{bmatrix} \alpha + i\gamma & -\beta + i\delta \\ \beta + i\delta & \alpha - i\gamma \end{bmatrix}$  is unitary [5]  
 if  $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = 1$ .
- d If  $u = x^2 \tan^{-1} \left( \frac{y}{x} \right) - y^2 \tan^{-1} \left( \frac{x}{y} \right)$  then show that  $\frac{\partial^2 u}{\partial x \partial y} = \frac{x^2 - y^2}{x^2 + y^2}$  [5]
- 2 a By using De Moivre's Theorem expand  $\sin^4 \theta \cos^3 \theta$  [6]
- b If  $z = \tan(y - ax) + (y - ax)^{\frac{3}{2}}$  show that  $\frac{\partial^2 z}{\partial x^2} = a^2 \frac{\partial^2 z}{\partial y^2}$  [6]
- c Find the two non-singular matrices P & Q such that PAQ is in normal form [8]  
 where  $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & -1 \\ 3 & 1 & 1 \end{bmatrix}$
- 3 a Show that  $\tan 7\theta = \frac{7 \tan \theta - 35 \tan^3 \theta + 21 \tan^5 \theta - \tan^7 \theta}{1 - 21 \tan^2 \theta + 35 \tan^4 \theta - 7 \tan^6 \theta}$ . [6]
- b Expand  $\log(1+x)$  by using Maclaurin's series [6]
- c If  $y = e^{\tan^{-1} x}$  then prove that [8]  
 $(1 + x^2)y_{n+2} + [2(n+1)x - 1]y_{n+1} + n(n+1)y_n = 0$
- 4 a Find an approximate root of the equation  $e^{-x} - \sin x = 0$  by using Newton Raphson method. [6]
- b Solve the equation for real values of x; [6]  
 $17 \cosh x + 18 \sinh x = 1$ .
- c Find all the stationary points of the function  $x^3 + 3xy^2 - 15x^2 - 15y^2 - 72x$ . [8]  
 Examine whether function is maximum or minimum at those points.

- 5 a Find  $n^{\text{th}}$  derivative of  $\frac{x^3}{(x+1)(x-2)}$  [6]
- b Solve the following equations by Gauss-Siedel Method [6]  
 $27x + 6y - z = 85$ ,  $6x + 15y + 2z = 72$ ,  $x + y + 54z = 110$  (Take three iterations).
- c Solve  $x^5 = 1 + i$  and find the continued product of the roots. [8]
- 6 a Separate into real part and imaginary part of  $\cos^{-1}\left(\frac{3i}{4}\right)$  [6]
- b Test the consistency and if possible, solve [6]  
 $2x - 3y + 7z = 5$ ,  $3x + y - 3z = 13$ ,  $2x - 19y - 47z = 32$
- c If  $\sinh(\theta + i\phi) = e^{i\alpha}$  then prove that  $\sinh^4\theta = \cos^2\alpha = \cos^4\phi$  [8]



FE sem I All Branches R-19 Cscheme

3 Hours

Total Marks: 80

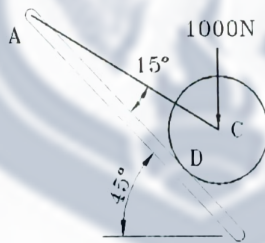
- Question-1 is compulsory.
- Answer any three from remaining five questions.
- Assume any suitable data wherever required, but justify the same. Assumptions made should be clearly stated.
- Illustrate answers with sketches, wherever required.

1. Answer any four

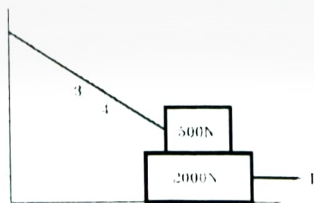
a. Find the forces  $P$  &  $Q$ , such that the resultant of the given system is zero. [05]



b. A roller of weight  $W = 1000\text{ N}$  rests on a smooth inclined plane. It is kept from rolling down the plane by a string  $AC$ . Find the tension in the spring and the reaction at the point of contact  $D$ . [05]

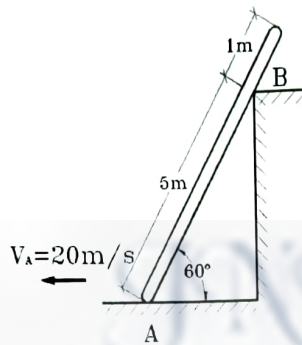


c. A block weighing  $500\text{ N}$  is resting on another block of  $2000\text{ N}$  weight. The upper block is tied to a vertical wall by a wire. Determine the horizontal force  $P$  required to pull the lower block. The coefficient of friction between all surfaces of contact is  $0.3$ . [05]

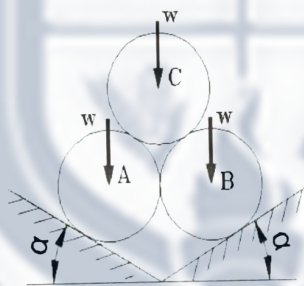


d. A sprinter in a  $100\text{-m}$  race accelerates uniformly for the first  $35\text{ m}$  and then runs with constant velocity. If the sprinter's time for the first  $35\text{ m}$  is  $5.4\text{ sec}$ , determine his time for the race. [05]

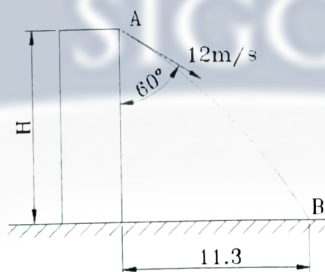
- e. The velocity of the point A on the rod is 20 m/s at the instant shown in figure. Locate ICR and determine velocity of the point B on the rod. [05]



- f. A car travelling at a speed of 90 k/hr suddenly applies brakes and comes to stop after skidding 68 m. Determine, [05]
- Time needs to stop the car
  - Coefficient of friction between the tyre and the road
- 2a. Three identical right circular cylinders A, B & C, each of weight W, are arranged on smooth inclined surfaces as shown in the figure. Determine the least value of  $\alpha$  that will prevent the arrangement from collapsing. [06]

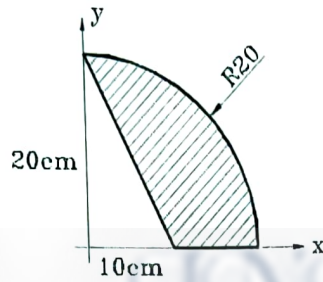


- b. A ball thrown with speed of 12 m/s at an angle of  $60^\circ$  with a building strikes the ground 11.3 m horizontally from the foot of the building as shown. Determine the height of the building. [08]

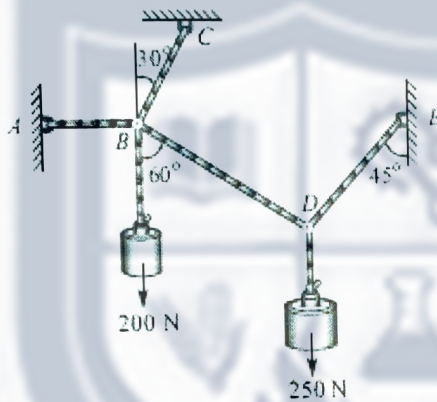


- c. Three perfectly elastic balls A, B and C of masses 2 kg, 4 kg and 8 kg move along a line with velocities 4 m/s, 1 m/s and 0.75 m/s, respectively. If the ball-A strikes the ball-B, which in turn strikes the ball-C, determine the velocities of the three balls after the impacts. [06]

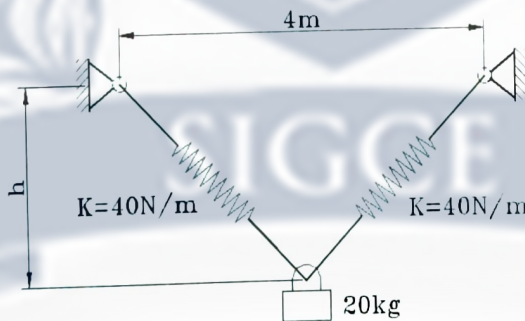
- 3a. Determine the centroid of the shaded area with respect to the given x and y axes. [08]  
All dimensions are in cm.



- b. A system of connected flexible cables shown in the figure is supporting two vertical forces 200 N and 250 N at points B and D. Determine the forces in various segments of the cable. [05]



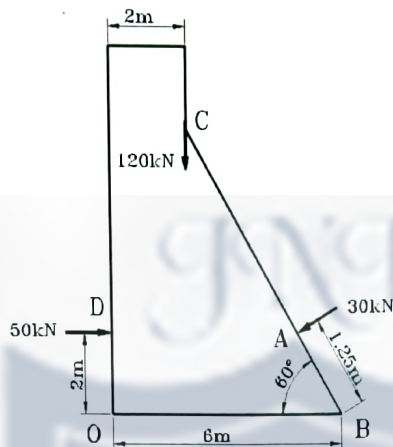
- c. A cylinder has mass 20 kg and is released from rest, when  $h=0$ . Determine the speed [07] when  $h=3$  m. The springs have unstretched lengths of 2 m.



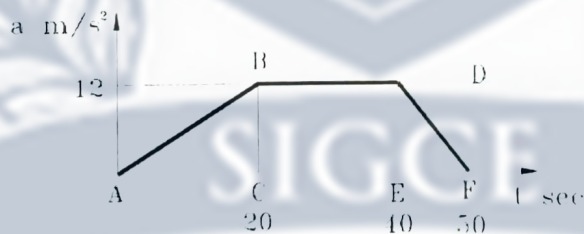
- 4a. Determine the reactions of all supports of the given beam. [08]



- b. The forces acting on 1 m length of a dam are shown in figure. Determine the [07]  
resultant force acting on the dam. Calculate the point of intersection of the resultant  
with the base.

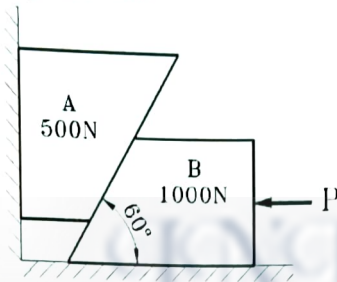


- c. A car travels along a depression in a road, the equation of depression being [05]  
 $x^2 = 200y$ . The speed of the car is constant equal to 72 km/h. Find the acceleration,  
when the car is at the deepest point in the depression. What is the radius of curvature  
at the depression at this point?
- 5a. The lines of actions of three concurrent forces at the origin 'O' passing through [07]  
points A (1, 2, 4), B (3, 0, -3) and C (2, -2, 4) are having magnitudes  $F_A = 40$  N,  
 $F_B = 10$  N and  $F_C = 30$  N, respectively. Find the magnitude and direction of their  
resultant.
- b. Figure below shows a plot of  $a-t$  curve for a particle moving along a straight line. [08]  
Draw  $v-t$  and  $s-t$  curves and determine the speed and distance covered by the particle  
after 50 sec. Also, find the maximum speed attained by the particle.

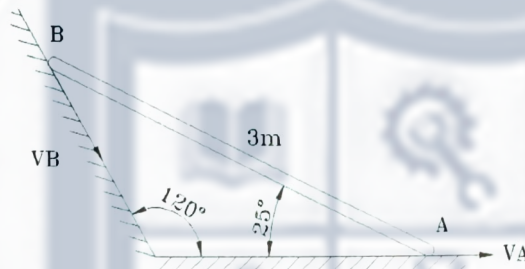


- c. Acceleration of a particle moving along a straight line is represented by the relation [05]  
 $a = t^3 - 2t^2 + 7$ . At  $t = 1$  second, velocity of the particle is 3.58 m/s and  
displacement is 9.39 m. Determine the velocity and displacement at  $t = 2$  seconds.

- 6a. Assuming the values for  $\mu$  as 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks, find the minimum value of the horizontal force  $P$  applied to the lower block that will hold the system in equilibrium. [08]



- b. A 3 m long bar AB slides down the plane. The velocity of the end A is 3.6 m/s. [06]  
Using velocity diagram, determine the angular velocity of the rod AB and the velocity of the end B.



- c. Determine the weight  $W$  required to be attached to 150 N block to bring the system to stop in 5 seconds, if at any stage 500 N is moving down at 3 m/s. Assume pulley to be frictionless and massless. [06]

