PhD Admissions – Sample Question Paper

Department of Mechanical and Aerospace Engineering
Indian Institute of Technology Hyderabad
(1.5 hours)

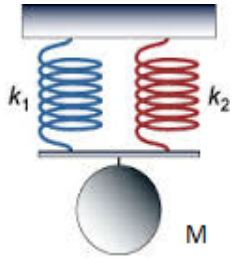
Instructions:

1. Questions 1 to 4 are compulsory. You may choose any two amongst questions 5 to 10.
2. Each question carries 10 marks. The paper is for 60 marks.
3. Clearly explain all the steps involved including illustrations where necessary.

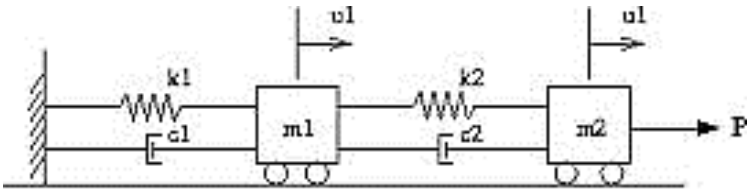
Question-1: Find the inverse Laplace Transformation of $\frac{s^2+s+1}{(s+1)^2(s-1)}$?

Question-2: Find the solution of differential equation $x\frac{dy(x)}{dx} = 4x^2 - 2y(x)$ subjected to the initial condition $y(1) = 2$.

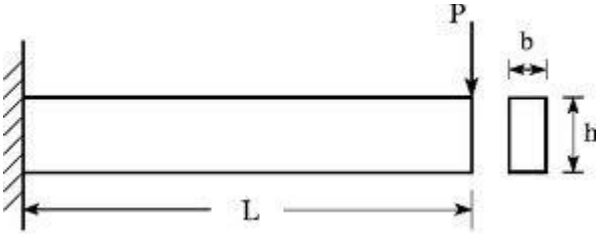
Question - 3: For the spring-mass system shown, given k1=10KN/m, k2=2*k1, M=1000Kg, find the (a) deflection of the mass M. Assume g is 10 m/s^2 acting downwards. If the system then starts accelerating upwards with an acceleration of a= 10 m/s^2 (b) what will be the maximum deflection and (c) the frequency of the subsequent oscillations?



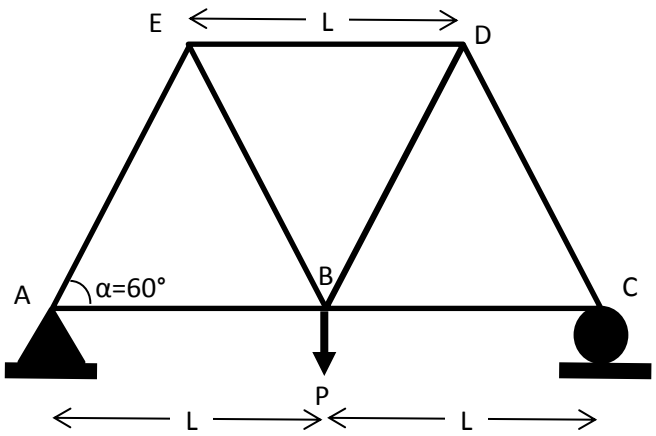
Question-4: Derive the equation of motion of the mechanical system shown below



Question-5: Draw the Shear force and Bending Moment Curve for the following beam, Given E=200GPa, b=100, h=200mm, L=4m, P=10KN.



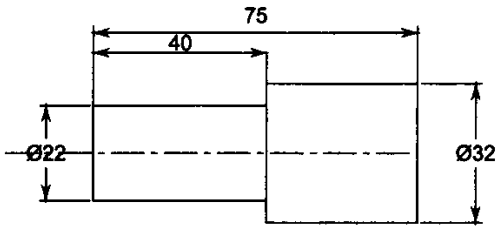
Question-6: Find the Forces in the all the truss member as shown below, given P=10KN.



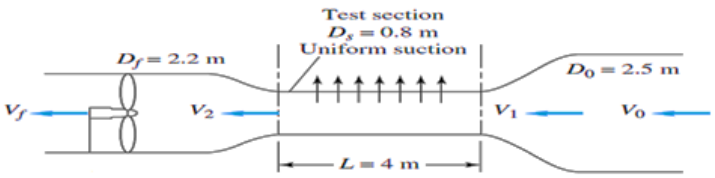
Question-7: During machining experiments using certain combination of tool and work-piece materials, cutting length and maximum flank wear at three different cutting speeds are found as given in the table below. If allowable 'maximum flank wear' is 0.5mm, develop tool life equation and estimate tool life at cutting speed of 250 m/min.

	VB_{bmax} in mm		
Cutting Length in m	100 m/min	200 m/min	300 m/min
0	0.0	0.0	0.0
300	0.2	0.2	0.2
600	0.3	0.3	0.4
900	0.4	0.4	0.5
1200	0.5	0.6	0.6
1500	0.6	0.7	0.8

Question-8: A component as shown in figure is to be machined from a stock of 40 mm in diameter and 75 mm long. Calculate the machining time if cutting speed, feed rate and depth of cut are 30 m/min, 0.30 mm/rev, and 2mm respectively. The available spindle speeds are 70, 110, 176,280,440,700 and 1100 RPM.



Question-9: In some wind tunnels the test section is perforated to suck out fluid and provide a thin viscous boundary layer. The test section wall in Fig. 1 contains 1200 holes of 5 mm diameter each per square meter of wall area. The suction velocity through each hole is Vs = 8 m/s and the test section entrance velocity is V1 = 35 m/s. Assuming incompressible steady flow of air at 200C, compute (a) V0, and (b) V2 in m/s



Question-10: The hot combustion gases of a furnace are separated from the ambient air and its surroundings which are at 25°C by a brick wall 0.15 m thick. The brick has a thermal conductivity of 1.2 W/m K and a surface emissivity of 0.8. Under steady state conditions an outer surface temperature of 100°C is measured. Free convective heat transfer to the air adjoining the surface is characterized by a convective heat transfer coefficient of 20 W/m^2 K. Stefan-Boltzmann constant is 5.67 × 10-8. What is the brick inner surface temperature?