Question Bank for 2022-2023 Fall Semeter

University of Salahaddin / College of Engineering

Engineering Analysis

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1- A tank initially contains **50** gallons of brine, with **30** lb of salt in solution. A brine of 1/6 pounds of salt per gallon of water is added to the tank at the rate of **3** gallons per minute. The mixture in the tank is kept uniform by stirring. Brine runs out (drained) from the tank at the same rate.

Find;

a) The amount of salt in the tank at any time t?

b) Time of overflow?

c) Amount of salt at overflow?

2- A boiling solution (100^{o} C) is set in room of temp (20^{o} C), after 5 min the solution cooled to (60^{o} C).

When will the temp. of the solution be (22^{o} C).

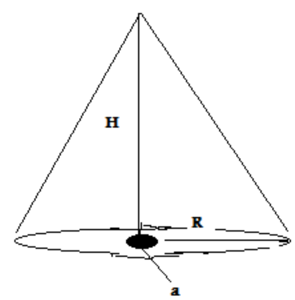
3- A tank contains 8 L (liters) of water in which is dissolved 32 g (grams) of chemical. A solution containing 2 g/L of the chemical flows into the tank at a rate of 4 L/min, and the well-stirred mixture flows out at a rate of 2 L/min.

a- Determine the amount of chemical in the tank after 20 minutes.

b- What is the concentration of chemical in the tank at that time?

4- A cold juice initially at 35° F warms up to 40° F in 3 min while sitting in a room of temperature 70° F. How warm will the juice be if left out for 20 min?

5- Suppose we have an inverted conical tank with height H and radius R, suppose fluid is flowing through a hole in the bottom with cross sectional area a with velocity given by $V(t) = k\,[2\,g\,h(t)]^{1/2}$; where h(t) is the height of fluid in the tank.
Find the time required to empty the tank.



6- Find the lateral displacement of a hinged-hinged column (or hinged-hinged beam) of length (L) subjected to an axial load (P) and a uniform lateral distributed load (W) .

7- Find the Buckling of a hinged-hinged column

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9- Solve; $L\left(5e^{-3t}\sinh 2t\right)$

10- So $L\left[2e^{3t}(4\cos 2t - 5\sin 2t)\right]$

11- Sc $L\left[3e^{-2t}(\sinh 2t - 2\cosh 2t)\right]$

12- Use the Laplace transform of the **Second** derivative to derive:

$$\boxed{L(\sin at) = \frac{a}{s^2 + a^2}}$$

13- Use the Laplace transform of the **Second** derivative to derive:

$$\boxed{L(\sinh at) = \frac{a}{s^2 - a^2}}$$

14- Use the Laplace transform of the **Second** derivative to derive:

$$\boxed{L(\cosh at) = \frac{s}{s^2 - a^2}}$$

15- Use the Laplace transform of the Second derivative to determine the Laplace of:

$$L\ \{t \cdot \cos \quad \omega\, t\}$$

16- Solve; $\mathcal{L}^{-1}\left\{\dfrac{4s-3}{s^2-4s-5}\right\}$

17- Solve; $L^{-1}\left\{\dfrac{2(s+1)}{s^2+2s+10}\right\}$

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18- Solve; $L^{-1}\left\{\dfrac{7s+13}{s(s^2+4s+13)}\right\}$

19- Determine the following inverse Laplace transforms

$$\mathcal{L}^{-1}\frac{(s+3)}{s(s-1)(s+2)}$$

20- Determine the following inverse Laplace transforms

$$\mathcal{L}^{-1}\frac{(s-1)}{s^2+2s-8}$$

21- Determine the following inverse Laplace transforms

$$\mathcal{L}^{-1}\frac{3s+7}{s^2-2s+5}$$

22- Determine the following inverse Laplace transforms

$$\mathcal{L}^{-1}\frac{e^{-7s}}{(s+3)^3}.$$

23- Use Laplace transforms to solve the differential equation

$$\frac{d^2y}{dx^2}+6\frac{dy}{dx}+13y=0\ ,\ \textit{given that when}\ \ x=0,\ y=3\ \ \textit{and}\ \ \frac{dy}{dx}=7.$$

24- Use Laplace transforms to solve the differential equation

$$\frac{d^2y}{dx^2}-7\frac{dy}{dx}+10y=e^{2x}+20,\ \textit{given that when}\ \ x=0,\ y=0\ \ \textit{and}\ \ \frac{dy}{dx}=-\frac{1}{3}.$$

25- Use Laplace transforms to solve the differential equation

$$\frac{d^2y}{dx^2}+16y=10\cos 4x\quad ,\ \textit{given that when}\ \ y(0)=3\quad \textit{and}\quad y'(0)=4$$

26- Use the convolution of the Laplace transforms to solve the differential equation:

$$\frac{dy}{dx}-ay=e^{ct},\ \text{ at }\ y(0)=0$$

27- Find the inverse of the Laplace transform using Convolution theorem for function:

$$H(s) = \frac{2s}{(s^2+1)^2}$$

28- Use the convolution of the Laplace transforms to solve the differential equation:

$$\boldsymbol{y'' + 2y' + 2y = sin\ \alpha t} \qquad \boldsymbol{y(0) = 0}$$

$$\boldsymbol{y'(0) = 0}$$

29- Apply convolution theorem to evaluate:

$$L^{-1}\left\{\frac{1}{s^2(s-1)}\right\}$$

30- Apply convolution theorem to evaluate:

$$L^{-1}\left\{\frac{s}{(s^2+4)^2}\right\}$$

31- Apply convolution theorem to evaluate:

$$L^{-1}\left\{\frac{1}{s(s^2+4)^1}\right\}$$

32- Apply convolution theorem to evaluate:

$$L^{-1}\left\{\frac{1}{(s+a)(s+b)}\right\}$$

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