Question Bank for 2022-2023 Spring Semester

University of Salahaddin / College of Engineering

Engineering Analysis

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1- Solve the DE $xy=(1-x^2)\frac{dy}{dx}$; given $y=1$ when $x=0$

2- Solve $xy^3 dy = (x^4 + y^4)dx$

3- Solve $x.dy - y.dx = 0$

4- Solve $\sinh(x).\sinh(y) + \cosh(x).\cosh(y).y' = 0$

5- Solve $\cos(x+y) + (3y^2 + 2y + \cos(x+y)).y' = 0$

6- Solve $(\cos \omega x + \omega.\sin \omega x)dx + e^x dy = 0$

7- Solve $\left[cosx \cdot \tan y + \cos(x+y)\right]dx + \left[sinx \cdot \sec^2 y + \cos(x+y)\right]dy = 0$

8- Solve $2xy.y' = x^2 + y^2$

9- Solve $(1 + y^2 \sin 2x)dx - 2y\cos^2 x\, dy = 0$

10- Solve $y' + 2.\sin 2x.y = 2e^{\cos 2x}$

11- Solve $y' = 6(y - 2.5)\tanh(1.5x)$

12- Solve $y'.\cos^2 x + 3y = 1$

13- Solve $y' + 2y = 4\cos 2x$

14- Solve $y' + y = y^3$

15- Solve $y' = 5.7y - 6.5y^2$

16- 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 the amount of salt in the tank at any time t?

17- A tank initially contains **60** gallons of brine, with **20** lb of salt in solution. A brine of 1/10 pounds of salt per gallon of water is added to the tank at the rate of **5** gallons per minute. The mixture in the tank is kept uniform by stirring. Brine runs out (drained) from the tank at the rate **2** gallons per minute.

Find;

a) The amount of salt in the tank at any time t?
b) Time of overflow?
c) Amount of salt at overflow?

18- 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).

19- In winter season, the daytime temperature in a particular building is maintained at 70^{o}F. The heating shut off at 10 P.M. and turned on at 6 A.M.

On a certain day the temperature inside the building at 2 A.M. was found to be 65^{o}F.

The outside temperature was 50ºF at 10 P.M. and had dropped to 40ºF by 6 A.M.

What was the temp. inside the building when the heat turned on at 6 A.M.

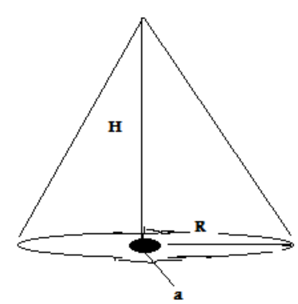
20- A tank contains 8 L (liters) of water in which is dissolved 32 g (grams) of chemical. A solution containing 2 g/L of the chemical flows into the tank at a rate of 4 L/min, and the well-stirred mixture flows out at a rate of 2 L/min.

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?

21- 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?

22- 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.

23- 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) .

24- Find the Buckling of a hinged-hinged column

25- 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).

26- Solve $y'' - y' - 12 = 0$

27- Solve $y'' + 5y' + 4y = 0$

28- Solve $y'' - 5y' = 0$

29- Solve $y'' - 9y = 0$

30- Solve $4y'' + y = 0$

31- Solve $y'' + y = 0$

32- Solve $4y'' + y' = 0$

33- Solve $y'' + y' + y = 0$

34- A spring with a mass 2kg has natural length 0.5m. A force of 25.6 N is required to maintain it stretched to a length of 0.7m. If the spring is stretched to a length of 0.7m and then released with **initial** velocity zero, find the position of the mass at any time t.

35- Solve the differential equation:

$$y'' + 3y' + 2y = x^2 \text{............}(1)$$

36- Solve the differential equation:

$$y'' + 9y = e^{-4x} \text{..........}(1)$$

37- Solve the differential equation:

$$y'' - 4y' - 5y = \cos(2x)$$

38- Solve the differential equation:

$$y'' - y = e^x$$

39- Solve the differential equation:

$$y'' - 6y' + 9y = 6e^{3x}$$

40- Solve the differential equation:

$$y'' + y' + y = x^2 + e^x$$

41- Solve the differentail equ:

$$y'' - 2y' - 3y = e^{2t} + 3t^2 + 4t - 5 + 5\cos(2t)$$

42- Solve the differentail equ:

$$y'' + 9y = -4x\sin(3x)$$

43- *Write down the form of the particular solution to:*

$$\boxed{y'' + y' + y = G(t)}$$

For the following G(t)'s:

$$G(t) = 16e^{7t} \cdot \sin(10t)$$

$$G(t) = (9t^2 - 103t)\cos t$$

44- Write down the form of the particular solution to the following G(t):

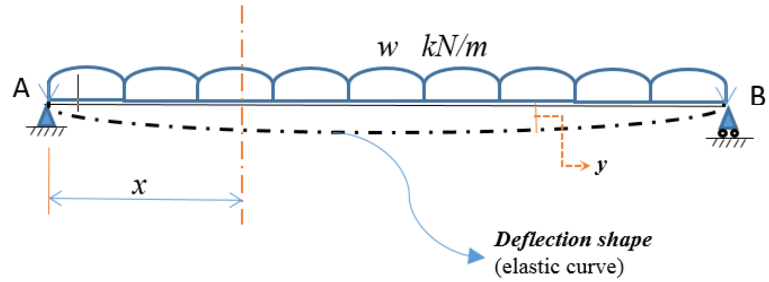
$$\boxed{y'' + y' + y = G(t)}$$

$$G(t) = e^{-2t}(3 - 5t)\cos 9t$$

$$G(t) = 4\cos(6t) - 9\sin(6t)$$

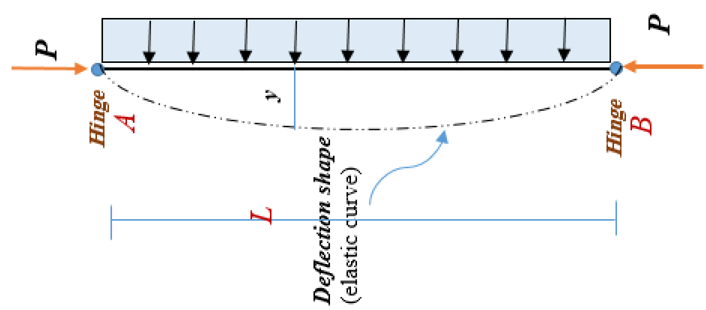
$$G(t) = -2\sin t + \sin(14t) - 5\cos(14t)$$

45- *Find the maximum deflection of simply supported beam subjected to uniform distributed load:*

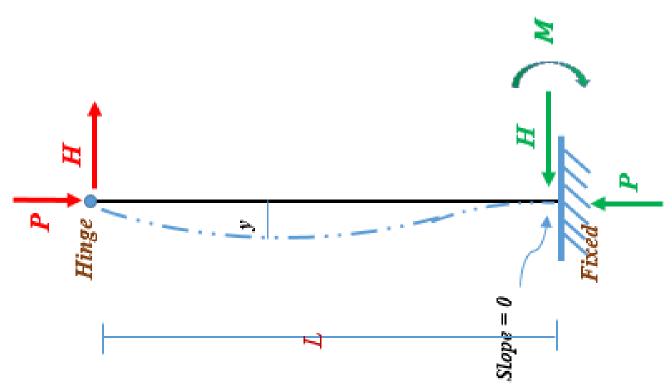


46- *Buckling of the hinged-hinged columns*

47- *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) .*



48- *Buckling of the fixed-hinged columns*



49- Solve; $L\,(5e^{-3t}\sinh 2t)$

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

51- Solve;

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

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

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

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

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

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

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

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

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

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

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

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

59- Determine the following inverse Laplace transforms

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

60- Determine the following inverse Laplace transforms

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

61- Determine the following inverse Laplace transforms

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

62- Determine the following inverse Laplace transforms

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

63- Use Laplace transforms to solve the differential equation

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

64- Use Laplace transforms to solve the differential equation

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

65- Use Laplace transforms to solve the differential equation

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

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

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

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

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

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

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

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

69- Apply convolution theorem to evaluate:

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

70- Apply convolution theorem to evaluate:

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

71- Apply convolution theorem to evaluate:

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

72- Apply convolution theorem to evaluate:

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

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