## Question 1/14 (3 p.)

Find an expression for the Euler−Cauchy equation whose general solution is given by

$$y = C_1 x^4 + C_2 \cdot \ln(x) x^4 + x \cdot \ln(x) + \frac{2x}{3}$$

- ○ $x^2 y'' - 7xy' + 16y = 9x\ln(x) + \frac{3x}{2}$
- ○ $x^2 y'' - 7xy' + 16y = \frac{3x}{2} + x\ln(x)$
- ○ $x^2 y'' - 7xy' + 16y = 9x\ln(x)$
- ○ $x^2 y'' - 7xy' + 16y = x\ln(x)$

## Question 2/14 (3 p.)

The solution to the ODE $y'' = \sin(x) + \cos(x)$

- $y = -\sin(x) - \cos(x) + C_1 x + C_2$
- $y = \sin(x) + \cos(x) + C_1 x + C_2$
- $y = -\sin(x) + \cos(x) + C_1 x + C_2$
- $y = -\sin(x) + \cos(x) + C_1 x$
- $y = -\sin(x) - \cos(x) + C_1$

## Question 4/14 (3 p.)

Let $F(s) = -\frac{s}{(s+2)(s+3)}$, find the inverse Laplace transform $f(t)$.

- ○ $f(t) = -2e^{-2t} + 3e^{-3\cdot t}$
- ○ $f(t) = 2e^{-3t} - 3e^{-2\cdot t}$
- ○ $f(t) = -2e^{-3t} + 3e^{-2\cdot t}$
- ○ $f(t) = 2e^{-2t} - 3e^{-3\cdot t}$
- ○ $f(t) = (2e^{-3t} - 3e^{-2\cdot t})u(t)$

## Question 5/14 (3 p.)

Which of the following are solutions to $2y^{(4)} + 11y^{(3)} + 18y'' + 4y' - 8y = 0$ ?
Hint: Select all that apply.

- [ ] $te^{-2t}$
- [ ] $te^{-2t}\ln(t)$
- [ ] $e^{\frac{t}{2}}$
- [ ] $e^{-2t}$

**Question 6/14** (3 p.)

Let $f(t) = \dfrac{\cos(\sqrt{2}\,t) - \cos(\sqrt{3}\,t)}{te^{t}}$ , then Laplace transform F(s) is given by

- ○ $F(s) = \ln\left(\sqrt{1 + \dfrac{1}{s^2 + 3}}\right)$
- ◉ $F(s) = \ln\left(\sqrt{4 + \dfrac{1}{s^2 + 2s + 3}}\right)$
- ○ $F(s) = \ln\left(\sqrt{1 + \dfrac{1}{s^2 + 2s + 4}}\right)$
- ○ $F(s) = \ln\left(\sqrt{3 + \dfrac{1}{s^2 + 2s + 4}}\right)$
- ○ $F(s) = \ln\left(\sqrt{1 + \dfrac{1}{s^2 + 2s + 3}}\right)$

## Question 8/14 (3 p.)

Which of the following are Eigenvectors of the Matrix A below?

$$\mathbf{A} = \begin{pmatrix} 5 & 0 & 0 \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{pmatrix}$$

Hint: Select all that apply

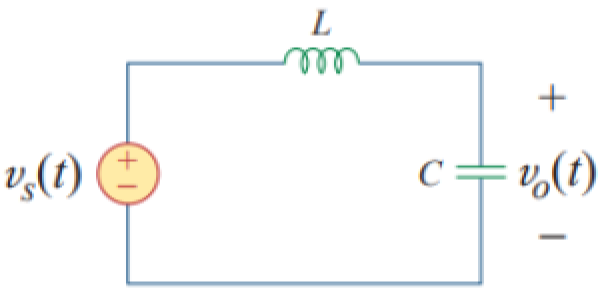
- [ ] $\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$



- [ ] $\begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$

## Question 9/14 (3 p.)

Find an expression for $v_o(t)$ when $v_s(t) = \delta(t-\pi)$, where $v_o(0) = v'_o(0) = 0$.






- $v_o(t) = \frac{1}{\sqrt{LC}}\sin\left(\frac{t}{\sqrt{LC}}\right)u(t-\pi)$
- $v_o(t) = \frac{1}{\sqrt{LC}}\sin\left(\frac{t-\pi}{\sqrt{LC}}\right)u(t-\pi)$
- $v_o(t) = \frac{1}{\sqrt{\pi LC}}\sin\left(\frac{t-\pi}{\sqrt{LC}}\right)u(t-\pi)$
- $v_o(t) = \frac{1}{\sqrt{LC}}\sin\left(\frac{t-\pi}{\sqrt{LC}}\right)u(t)$
- $v_o(t) = \frac{\pi}{\sqrt{LC}}\sin\left(\frac{t-\pi}{\sqrt{LC}}\right)u(t-\pi)$

## Question 12/14 (3 p.)

Find the solution to the ODE $ty' + 2y = t^2 - t + 1$

- $y = \frac{t^2}{4} - \frac{t}{3} + \frac{1}{2} + \frac{Ct^2}{2}$
- $y = \frac{t^2}{4} - \frac{t}{3} + \frac{1}{2} + \frac{C}{t^2}$
- $y = \frac{t^2}{4} - \frac{t}{3} + \frac{C}{2} + \frac{1}{t^2}$
- $y = \frac{t^2}{4} - \frac{t}{3} + \frac{1}{2} + \frac{C}{t^3}$
- $y = \frac{t^2}{4} - \frac{t}{3} + \frac{1}{2} + Ct^2$

## Question 13/14 (2 p.)

Which of the following are NOT true about any nonsingular matrix?
Hint: select all that apply.

- [ ] It is a square matrix
- [ ] Its determinant is non-zero
- [ ] Its inverse can be only evaluated using Gauss-Jordan method
- [ ] It has an inverse
- [ ] It is a rectangular matrix

## Question 14/14 (3 p.)

Let

$$M = \begin{bmatrix} a & r & 0 \\ b & c & 0 \\ d & e & k \end{bmatrix}$$

Then |M| is given by



- $k(a \cdot r - b \cdot c)$
- $a \cdot k \cdot r$
- $c(a \cdot k - b \cdot r)$
- $k(a \cdot c - b \cdot r)$
- $k(a \cdot b - c \cdot r)$