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1. The equation is given as

$$2\cos y \, dx - \sin x \, dy = 0$$

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- (1) Find the integrating factor of the equation. (10%)
(2) Find the general solution of the equation. (5%)

2. Obtain the general solutions of the following problem. (15%)

$$x^2 y'' - 4xy' + 6y = -7x^4$$

3. For the partial differential equation

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} ; u(0, t) = u(2, t) = 0, u(x, 0) = 1.$$

Find the solution. (20%)

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4. (1) Please prove the $L[f'(t)] = sF(s) - f(0)$ (5%)

(2) $f(t) = \sin^2 t$. Find the $L[f(t)]$ (10%) (Note: $L[\]$ Laplace transform symbol)

5. Solve the initial problem. (15%)

$$y'' + 2y' + y = e^{-x} ; y(0) = -1, y'(0) = 1$$

Find the particular solution.

6. For the matrix A

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

- (1) Find the eigenvalues and the corresponding eigenvectors of A. (10%)
(2) Find two nonsingular matrices P and Q such that PAQ is a diagonal matrix. (10%)

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