

科目：工程數學甲 適用：電機所電子組

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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編號：431

Engineering Mathematics

1. (10%) Solve  $4y'' + 4y' + 17y = 0, y(0) = -1, y'(0) = 2$ .
2. (10%) Solve  $x \frac{dy}{dx} - 4y = x^6 e^x$ .
3. (10%) The function  $y_1 = x^2$  is a solution of  $x^2 y'' - 3xy' + 4y = 0$ . Find the general solution of the differential equation on the interval  $(0, \infty)$ .

4. (10%) Solve  $X' = \begin{bmatrix} 2 & 1 & 6 \\ 0 & 2 & 5 \\ 0 & 0 & 2 \end{bmatrix} X$ .

5. (20%) The numerical method defined by the formula  $y_{n+1} = y_n + h \frac{f(x_n, y_n) + f(x_{n+1}, y_{n+1}^*)}{2}$ , where  $y_{n+1}^* = y_n + hf(x_n, y_n)$  is the improved Euler's method. Use the improved Euler's method with  $h=0.1$  to obtain the approximate value of  $y(1.5)$  for the solution of the initial-value problem (IVP)  $y' = 2xy, y(1) = 1$ .

6. The R-C series circuit with  $R=50$  ohms,  $C=20m$  farads, and voltage source  $v_s(t) = 100$  volts. At  $t=0$ , the current and voltage are zero.

(a) (10%) Find the s-domain expression for the current. (hint: using Laplace transform)

(b) (10%) Find the time-domain expression for the output voltage in C ( $v_c$ ).

7. In Problem 6, the voltage source is changed to  $v_s(t) = 10e^{-2t}u(t)$  volts.

(a) (10%) Find the circuit transfer function  $H(\omega)$ .

(b) (10%) Find the output voltage in C ( $V_c(\omega)$ ).