Week 04 Participation Assignment (1 of 2)

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1 Part 1

One of the most important steps on solving higher order linear differential equation with constant coefficients is to identify the characteristic/auxiliary polynomial. Then from the roots (single roots, repeated roots or complex roots), we can determine the solution to the homogeneous equation.

For this exercise, we would like to practice on the relation between the roots and the solutions (not only from the roots to the solution, but also from the solution/function to the roots):

1.1 1)

$$\begin{aligned} r_1 &= -1 \\ r_2 &= 5 \\ p(r) &= (r - r_1)(r - r_2) \\ &= (r - (-1))(r - 5) \\ p(r) &= r^2 - 4x - 5 \end{aligned}$$

$$\boxed{p(r) = r^2 - 4x - 5}$$

1.2 2)

$$\begin{aligned} r_1 &= -1 \\ r_2 &= -1 \\ p(r) &= (r - r_1)(r - r_2) \\ &= (r + 1)(r + 1) \\ p(r) &= r^2 + 2r + 1 \end{aligned}$$

$$\boxed{p(r) = r^2 + 2r + 1}$$

1.3 3)

$$\begin{aligned}
r_1 &= 4 \\
r_2 &= -4 \\
p(r) &= (r - r_1)(r - r_2) \\
&= (r - 4)(r - (-4)) \\
p(r) &= r^2 + 16
\end{aligned}$$

$$\boxed{p(r) = r^2 + 16}$$

1.4 4)

$$\begin{aligned}
r_1 &= -3 - 2i \\
r_2 &= -3 + 2i \\
p(r) &= (r - r_1)(r - r_2) \\
&= (r - (-3 - 2i))(r - (-3 + 2i)) \\
p(r) &= r^2 + 6r + 13
\end{aligned}$$

$$\boxed{p(r) = r^2 + 6r + 13}$$

1.5 5)

$$\begin{aligned}
r_1 &= -3 \\
r_2 &= -3 \\
r_3 &= -3 \\
p(r) &= (r - r_1)(r - r_2)(r - r_3) \\
&= (r - (-3))(r - (-3))(r - (-3)) \\
p(r) &= r^3 + 9r^2 + 27r + 27
\end{aligned}$$

$$\boxed{p(r) = r^3 + 9r^2 + 27r + 27}$$

1.6 6)

$$\begin{aligned}
r_1 &= \pm 1 \\
r_2 &= \pm 1 \\
p(r) &= (r - r_1)(r - r_2) \\
&= (r - (-1))^2 (r - 1)^2 \\
p(r) &= r^4 + 2r^2 + 1
\end{aligned}$$

$$\boxed{p(r) = r^4 + 2r^2 + 1}$$

1.7 7)

$$
\begin{aligned}
r_1 &= -5 \pm 4i \\
r_2 &= -5 \pm 4i \\
p(r) &= (r - r_1)(r - r_2) \\
&= (r - (-5 + 4i))^2 (r - (-5 - 4i))^2 \\
p(r) &= r^4 + 20r^3 + 182r^2 + 820r + 168
\end{aligned}
$$

$$
\boxed{p(r) = r^4 + 20r^3 + 182r^2 + 820r + 168}
$$