

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
Ramapuram Campus

FACULTY OF ENGINEERING AND TECHNOLOGY

Department of Mathematics

Odd Semester 2022 – 2023

Innovative Teaching Methods

21MAB101T – Calculus and Linear Algebra

Pedagogy 5 – Heuristic Learning

The Greek word '**Heuristic**' means '**I find**' or '**I discover**'. In **Heuristic Learning Method**, the teacher becomes an observer and emphasis students to solve problems independently.

LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS

General form $a_0 \frac{d^n y}{dx^n} + a_1 \frac{d^{n-1} y}{dx^{n-1}} + a_2 \frac{d^{n-2} y}{dx^{n-2}} + \dots + a_n y = f(x)$

Let $D = \frac{d}{dx}$, $D^2 = \frac{d^2}{dx^2}$, ... and so on.

$(a_0 D^n + a_1 D^{n-1} + a_2 D^{n-2} + \dots + a_n)y = f(x)$. (i.e.) $\phi(D)y = f(x)$

The general or complete solution consists of two parts namely

(i) Complementary Function (C.F.) and (ii) Particular Integral (P.I.).

To find Auxiliary Equation (A.E.)

Put $D = m$ in the given equation and then equate to zero.

To find C.F.

S. No.	Roots of A.E.	C.F.
1	If the roots are real and different $m_1, m_2 (m_1 \neq m_2)$	$Ae^{m_1 x} + B e^{m_2 x}$
2	If two roots are equal and real $m_1 = m_2 = m(\text{say})$	$(Ax + B)e^{mx}$
3	If three roots are equal and real $m_1 = m_2 = m_3 = m(\text{say})$	$(Ax^2 + Bx + C)e^{mx}$
4	If the roots are complex $\alpha \pm i \beta$	$e^{\alpha x} (A \cos \beta x + B \sin \beta x)$

To find P.I.

S.No.	$f(x)$	P.I.
1	e^{ax}	$D \rightarrow a$
2	$\sin ax, \cos ax$	$D^2 \rightarrow -a^2$
3	x^n	Use Binomial expansion and then operate on x^n
4	$e^{ax} f(x)$	Take e^{ax} outside and $D \rightarrow D + a$

High Level Problems

1. Solve $(D^2 - 4D + 3)y = e^x \cos 2x$.
2. Solve $(D^2 - 1)y = x^2 \cos x$
3. Solve $(D^2 + 4)y = 2 \cos x \cos 3x$.

Staff incharge**HOD / Mathematics**