

<u>2.3.2</u>

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- 1. Smart Classrooms
- > Teachers use ICT enabled tools for effective teaching-learning process.







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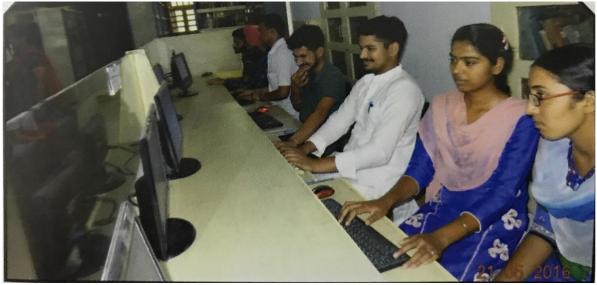






#### 2. <u>E-library</u>









#### 3. Computer labs







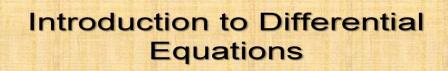






4. Course PPTs by the Teachers

#### **DEPARTMENT OF MATHEMATICS**



Dr. Payal Singla

Department of Mathematics Guru Nanak College Killianwali payalsingla86@gmail.com

#### ordinary differential equations

#### **Definition**:

A differential equation is an equation containing an unknown function and its derivatives.

Examples:

1.  $\frac{dy}{dx} = 2x + 3$ 2.  $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + ay = 0$ 3.  $\frac{d^3 y}{dx^3} + \left(\frac{dy}{dx}\right)^4 + 6y = 3$ 

**y** is dependent variable and **x** is independent variable, and these are ordinary differential equations





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#### **Partial Differential Equation**

Examples:

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

*u* is dependent variable and *x* and *y* are independent variables, and is partial differential equation.

2. 
$$\frac{\partial^4 u}{\partial x^4} + \frac{\partial^4 u}{\partial t^4} = 0$$
  
3. 
$$\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2} - \frac{\partial u}{\partial t}$$

1.

u is dependent variable and x and t are independent variables

#### Order of Differential Equation

The **order** of the differential equation is order of the highest derivative in the differential equation.

**Differential Equation** 

#### ORDER

1

2

3

 $\frac{dy}{dx} = 2x + 3$  $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 9y = 0$ 

$$\frac{d^3 y}{dx^3} + \left(\frac{dy}{dx}\right)^4 + 6y = 3$$





#### **Degree of Differential Equation**

The degree of a differential equation is power of the highest order derivative term in the differential equation.

**Differential Equation** 

a

Degree

1

1

3

$\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + ay = 0$	
$\frac{d^3 y}{dx^3} + \left(\frac{dy}{dx}\right)^4 + 6y = 3$	
$\left(\frac{d^2 y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^5 + 3 = 0$	

**Linear Differential Equation** 

A differential equation is linear, if

1. dependent variable and its derivatives are of degree one,

2. coefficients of a term does not depend upon dependent variable.

**Example:** 1.  $\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 9y = 0.$ 

is linear.

Example: 2.

$$\frac{d^3 y}{dx^3} \left( \left( \frac{dy}{dx} \right)^4 \right) + 6 y = 3$$

is non - linear because in 2<sup>nd</sup> term is not of degree one.





Example: 3.

 $x^2$ 

$$\frac{d^2 y}{dx^2} + y \frac{dy}{dx} = x^3$$

is non - linear because in 2<sup>nd</sup> term coefficient depends on y.

Example: 4.

$$\frac{dy}{dx} = \sin y$$

is non - linear because  $\sin y = y - \frac{y^3}{3!} + -$  is non - linear

#### 1st - order differential equation

1. Derivative form:

$$a_1(x)\frac{dy}{dx} + a_0(x)y = g(x)$$

2. Differential form:

$$(1+x)dy - ydx = 0$$

3. General form:

4

$$\frac{dy}{dx} = f(x, y)$$
 or  $f(x, y, \frac{dy}{dx}) = 0.$ 

**Differential Equation Chapter 1** 

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# First Order Ordinary Differential equation

$f(x,y,rac{dy}{dx})=O.$
$\frac{dy}{dx} = f(x, y)$
$\frac{du}{M}(x,y)dx + N(x,y)dy = 0$
$a_1(x)rac{dy}{dx}+a_0(x)y=g(x)\ a_1(x)y+a_0(x)y=g(x)$
$\frac{dy}{dx} + P(x)y = Q(x)$
ax

Derivative form Differential form Standard form Standard form First order linear differential equation form

Differential Equation Chapter 1

9

#### Second order Ordinary Differential Equation

$$\begin{aligned} f(x, y, \frac{dy}{dx}, \frac{d^2y}{dx^2}) &= O. \\ \frac{d^2y}{dx^2} &= f(x, y, \frac{dy}{dx}) \\ a_2(x)\frac{d^2y}{dx^2} + a_1(x)\frac{dy}{dx} + a_0(x)y &= g(x) \\ a_2(x)y' + a_1(x)y' + a_0(x)y &= g(x) \end{aligned}$$

Differential Equation Chapter 1

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# nth – order linear differential equation

1. nth - order linear differential equation with constant coefficients.

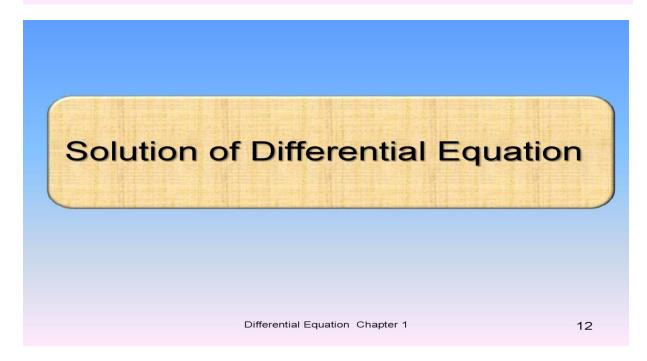
$$a_n \frac{d^n y}{dx^n} + a_{n-1} \frac{d^{n-1} y}{dx^{n-1}} + \dots + a_2 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_0 y = g(x)$$

2. nth – order linear differential equation with variable coefficients

$$a_n(x)\frac{dy}{dx} + a_{n-1}(x)\frac{d^{n-1}y}{dx^n} + \dots + a_2(x)\frac{d^2y}{dx^2} + a_1(x)\frac{dy}{dx} + a_0(x)y = g(x)$$

Differential Equation Chapter 1

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Examples

y=3x+c , is solution of the 1<sup>st</sup> order differential equation  $\frac{dy}{dx} = 3 c_1$  is arbitrary constant. As is solution of the differential equation for every value of c<sub>1</sub>, hence it is known as general solution.

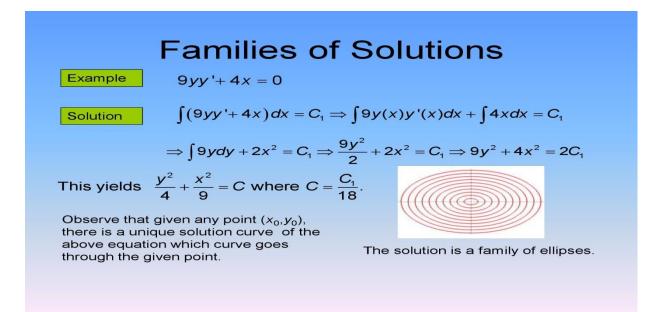
Examples

 $y' = \sin(x) \Rightarrow y = -\cos(x) + C$ 

 $y'' = 6x + e^x \Rightarrow y' = 3x^2 + e^x + C_1 \Rightarrow y = x^3 + e^x + C_1x + C_2$ 

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Observe that the set of solutions to the above 1<sup>st</sup> order equation has 1 parameter, while the solutions to the above 2<sup>nd</sup> order equation depend on two parameters.







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### Origin of Differential Equations Solution

#### 1. Geometric Origin

1. For the family of straight lines

$$y = c_1 x + c_2$$
 the differential equation is

$$\frac{d^2 y}{dx^2} = 0$$

2. For the family of curves

A. 
$$y = ce^{\frac{x^2}{2}}$$
 the differential equation is

$$B_{.} \quad y = c_1 e^{2x} + c_2 e^{-3x}$$

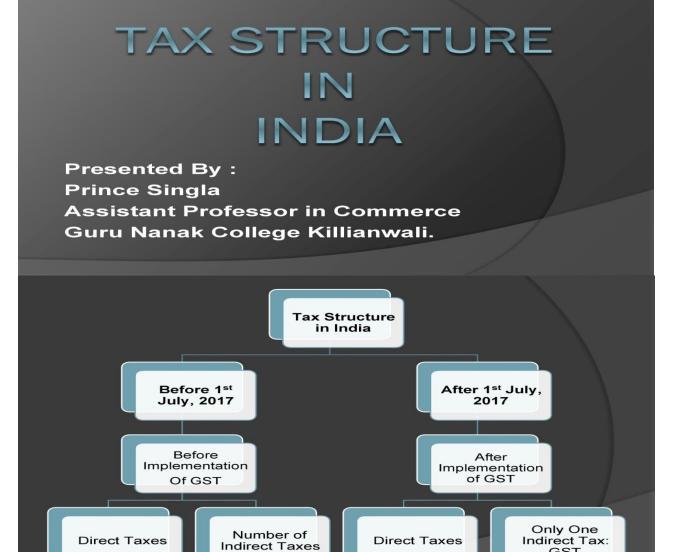
the differential equation is

$$\frac{dy}{dx} = xy$$

$$\frac{d^2 y}{dx^2} + \frac{dy}{dx} - 6y = 0$$
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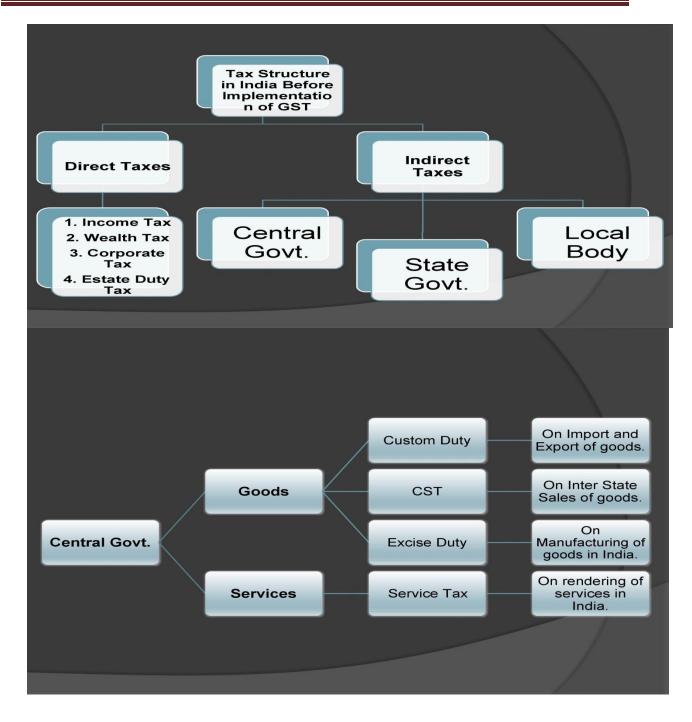


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GST



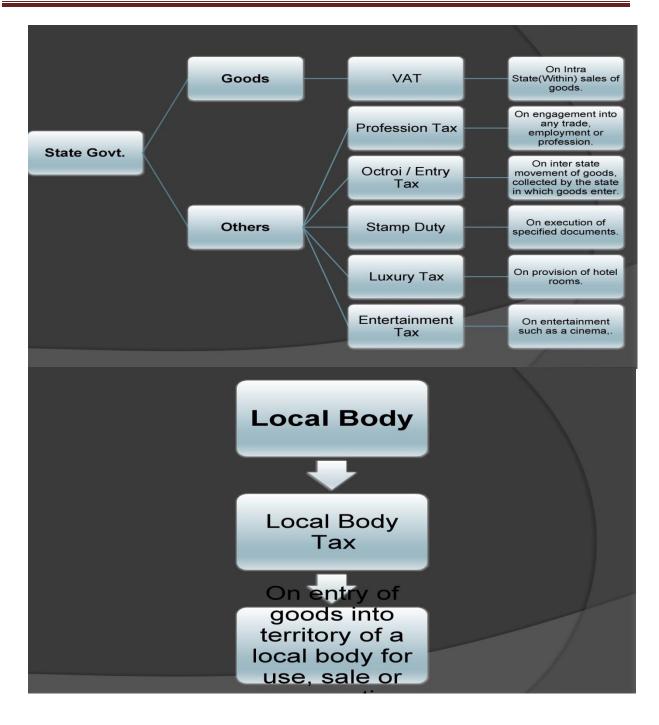






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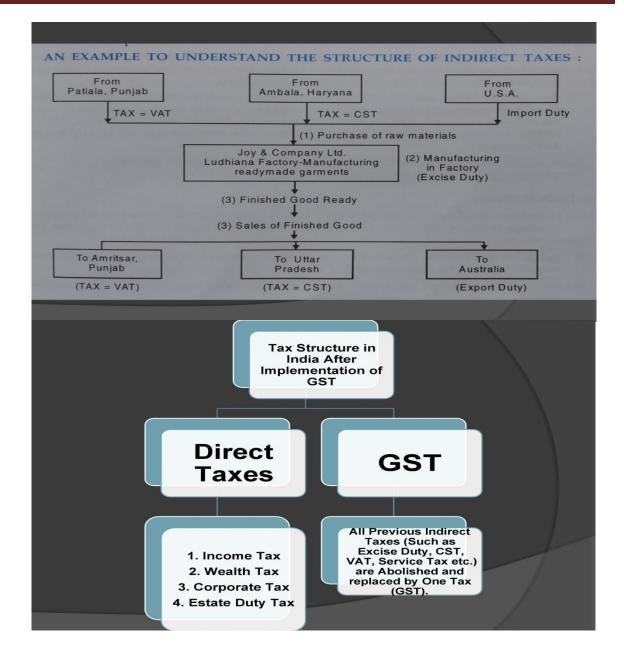




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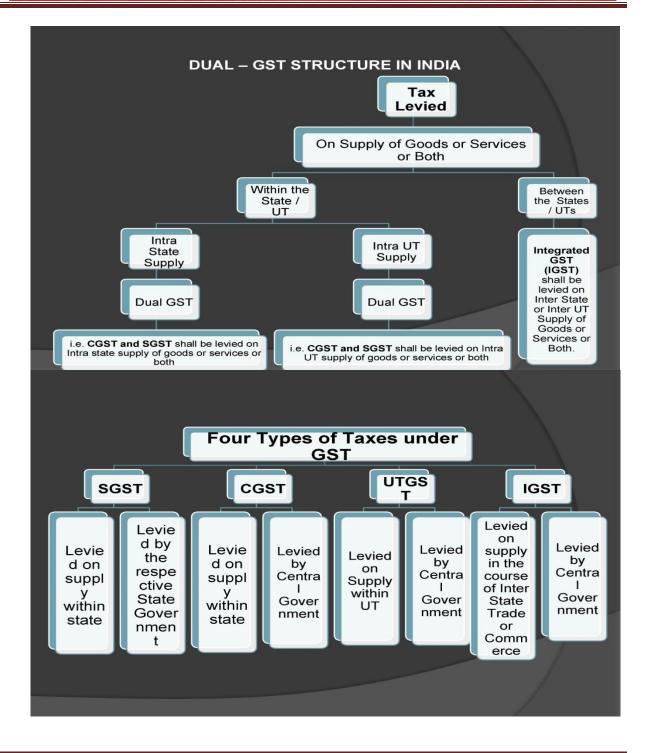
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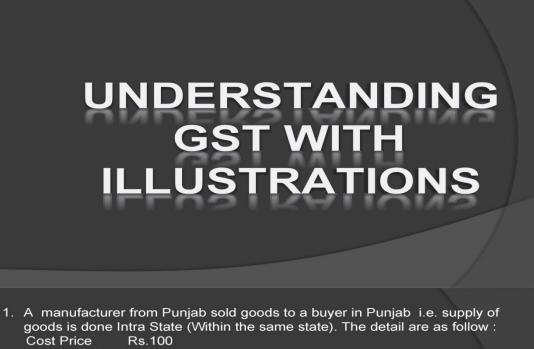












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Profit Margin Rs.10 Excise Duty @ 12.5% and VAT @ 12.5%

Solution. As per the previous Indirect Tax System :

Particular	Rs.
Cost Price of Manufacturer	100
Add: Profit Margin	10
	110
Add: Excise Duty @ 12.5% of 110 (Levied on Manufacturing)	13.75
	123.75
Add: VAT @ 12.5% of 123.75 (Levied on Sale within Punjab)	15.47
Total S.P.	139.22





As Per GST Regime	
Under the GST Regime, on Intra state s shall be levied i.e. CGST and SGST. No	
Supplier (Inter	s goods State oply)
Particular	Rs.
Cost Price of Manufacturer	100
Add: Profit Margin	10
	110
Add: 10% CGST of 110	11
Add: 10% SGST of 110 (Both CGST and SGST are levied on the base	11
price, which avoids double taxation)	
	132





Difference between previous system & GST regime:

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(a) No Cascading effect under GST- under the previous Indirect Tax System, VAT is levied on price which includes Excise Duty. This leads to double taxation. This is removed under GST, both CGST and SGST are levied on base price of 110. (b) S.P is less under GST. (c)Total tax paid under GST is less (22 in comparison to 29.22 under present system (13.75 + 15.47 = 29.22)).





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#### 5. Student Learning through ICT Enabled Tools







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#### 6. <u>ICT usage by the Teachers</u>







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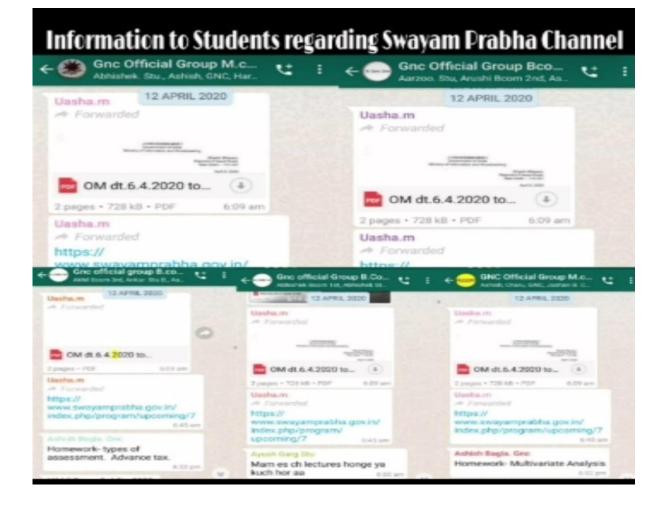
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# Online Lectures through YouTube Channel.

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	Hire Purchase System 1 month ago - 54 vie		Hire Purchase Trading Account 1 month ago - 17 view		4 weeks ago - 22 vie Hire Purchase System
and	Underwriting of Shares and Debentures 1 month ago - 23 vik		Hire Purchase Trading Account 1 month ago - 14 viev	2 250	4 weeks ago - 12 vie Hire Purchase System
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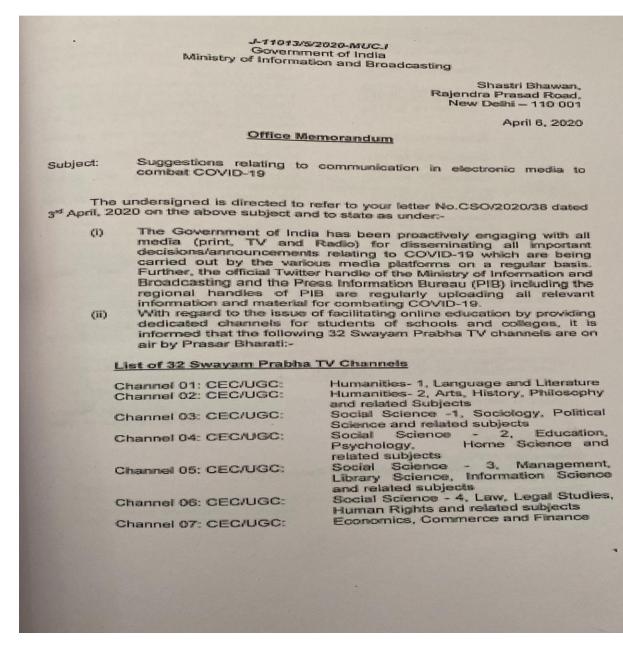


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• Supplementary online learning material







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Mathematics Physical sciences. Channel 08: CEC/UGC: Physics, Chemistry and related Subjects Life Sciences, Botany, Zoology, Bio, Subjects Channel 09: CEC/UGC: Science and related Applied Sciences, Allied Physical and Applied Sciences and related subjact Applied Sciences and related subjects Chemical Sciences and related subjects Channel 10: CEC/UGC: Chemical Engineering, Chemistry and Channel 11: NPTEL: Civil Engineering and related subjects Channel 12: NPTEL: Computer Science and Engineering Channel 13: NPTEL: Electrical engineering, Electronics and Channel 14: NPTEL: Engineering Communication related subjects and Channel 15: NPTEL: Engineering Sciences and general subjects for engineering Channel 16: NPTEL: Humanities, Social Sciences and Management Mechanical Engineering and related Channel 17: NPTEL: subjects Mathematics, Physics, Metallurgy and Channel 18: NPTEL: related subjects Channel 19: IIT PAL: Biology Channel 20: IIT PAL: Chemistry Channel 21: IIT PAL: Mathematics Channel 22: IIT PAL: Physics Channel 23: IGNOU: Liberal Arts and Humanities Channel 24: IGNOU: Agriculture, Vocational and Allied Sciences Channel 25: IGNOU: Culture Channel 26: IGNOU: State Open Universities' programs Channel 27: NIOS: Secondary School Education Higher Secondary School Education Channel 28: NIOS: Channel 29: QEEE: QEEE 1 (Live classes in Engineering and Technology) Channel 30: NPTEL: Mathematics Channel 31: NCERT: School and Teacher Education Channel 32: IGNOU and NIOS: Teacher Education (Shailesh Gautam) Under Secretary to the Govt of India

Government of Puniab (Kind attn.: Shri Karan A Singh, Chief Secretary) Punjab Secretariat, Chandigarh - 160 001





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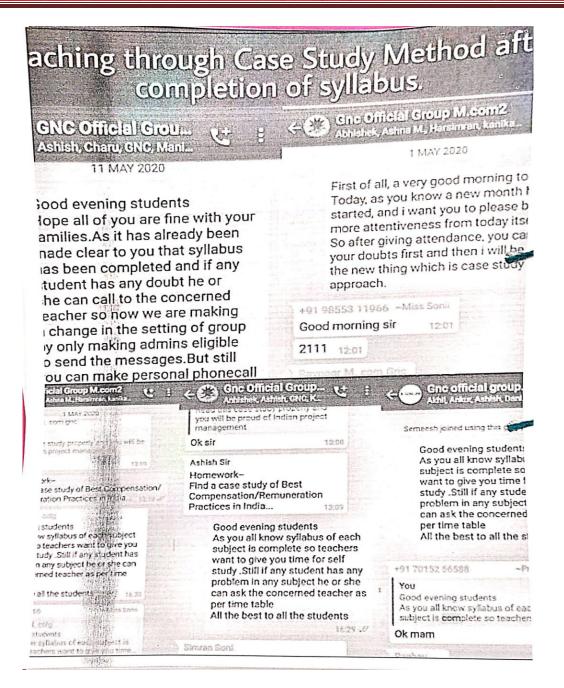
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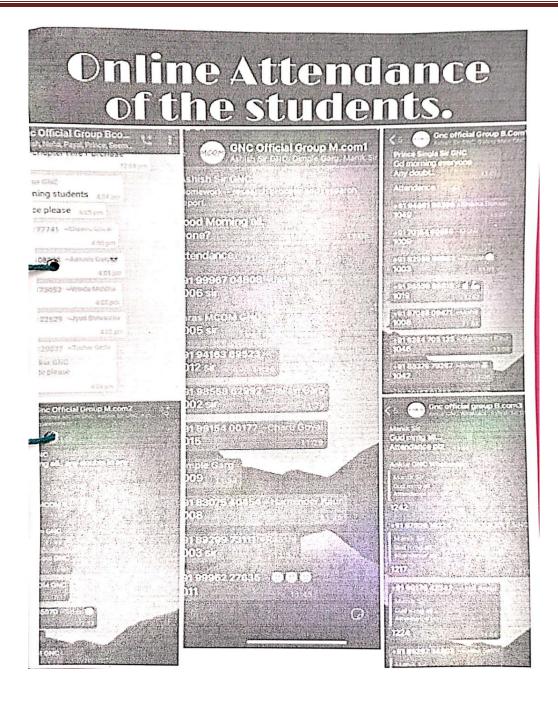






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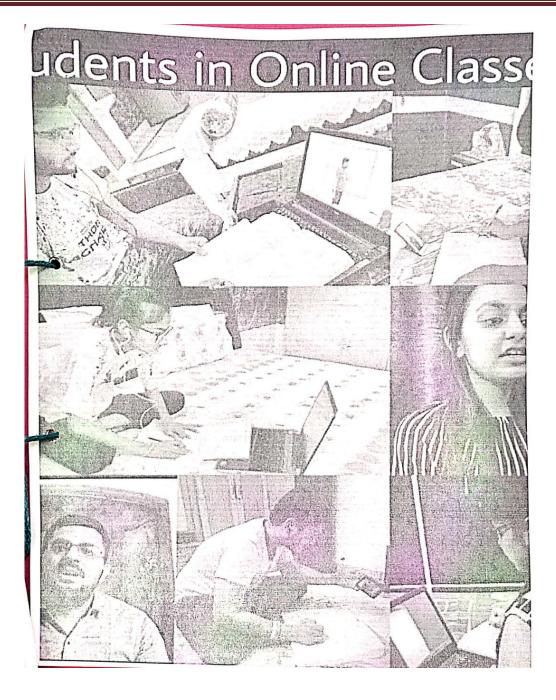






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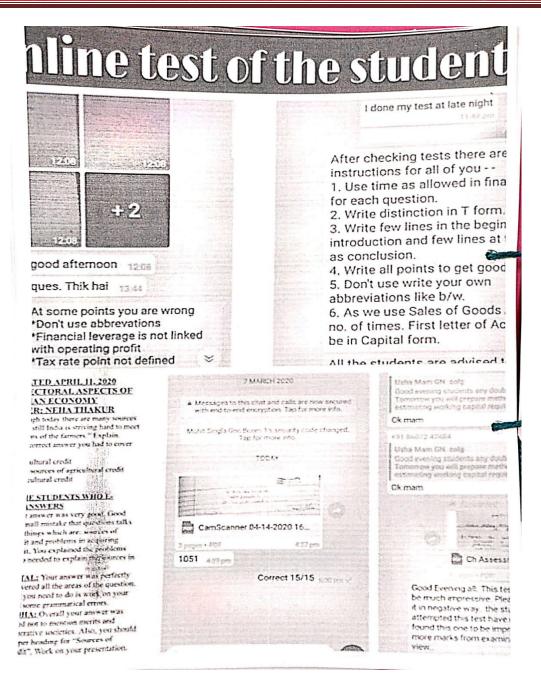






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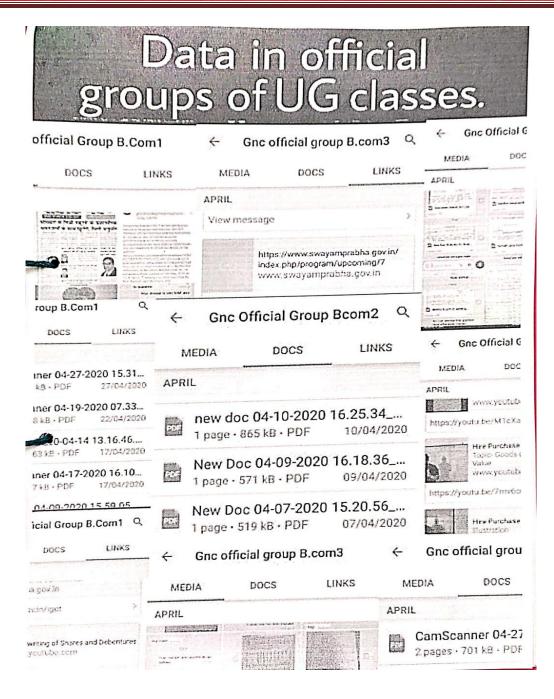






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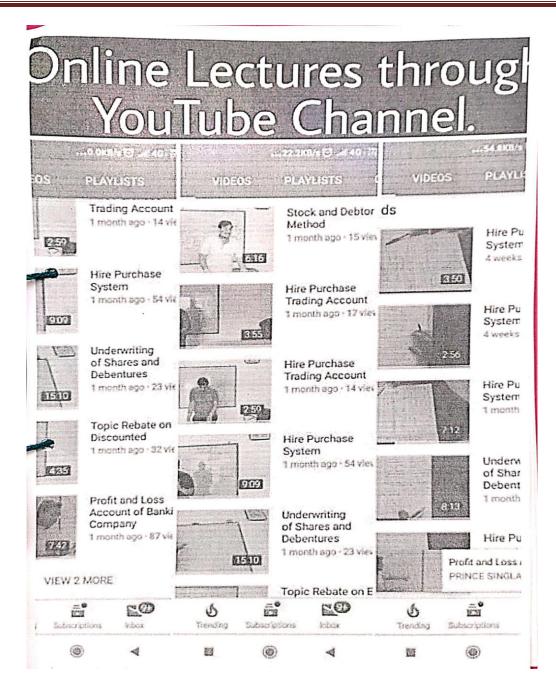






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