KBTCOE

MARATHA VIDYA PRASARAK SAMAJ'S
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COLLEGE OF ENGINEERING
Permanently Affiliated to Savitribai Phule Pune University Vide Letter No: CA/1542
& Approved by AICTE New Delhi Vide Letter No: 740-89-32 (E) ET/98
AISHE Code - C-41622

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# Department of Mechanical Engineering

## Innovative Teaching Method - Report

| | |
|---|---|
| Academic Year –2020-21 | Class -SE |
| Semester–II | Date:05/7/2021 |
| CO:CO1,CO2,CO3,CO4,CO5,CO6 | PO:PO1, PO2, PO8, PO12 |

1. **Title of Innovation method/activity: Mind map** by using Google Classroom

2. Link shared to the students:

   https://classroom.google.com/u/0/w/Mjk0NDE3OTA3MDM2/tc/MzY4OTE5MzA2ODcw

3. Name of Faculty: Ms.S.D.Marathe

4. Course :Engineering Mathematics-III (207002)

5. Objective of Method

   a. Clear the concept.

   b. It helps students to think individually.

c. More involvement of students.

## 6. Topic Covered through Activity

**Engineering Mathematics-III**

## 7. Description of method with Benefits(8 –10lines)

### Description of method

Monitor and support students for performing Activity:

By using this method we are able to check the concept understood by the students. Also students get engaged and show their creativity while preparing Mind Map. Students are able to revise the topic very easily.

### Benefits of method

- It helps students to think individually about a topic and clear their concept.
- It helps students to develop their creativity.
- It helps students to understand the concepts and revise the topic.
- Students know the application which increase the interest of students in Mathematics

## 8. Roles and Responsibilities

- **Teacher**
  - Elaborate regarding activity.
  - Encourage students to prepare Mind Map and upload it on Google Classroom.
  - Provide the study material on Topic .
  - Remain available during the completion of the task.
  - Prepare assessment methodology.

- **Student**
  - Go through the concept of the topic.
  - Understand the concept and show their creativity independently while preparing the Mind Map and upload the PDF on or before the given time.
  - Actively participate in Mind Map activity and contribute their knowledge regarding the topic covered.

**9. Assessment Tools :Maximum Marks 25**

| | | | |
|---|---|---|---|
| Involvement , Understanding and performance | 10 | 7 | 4 |
| | Excellent | Good | poor |
| | All topics are covered with correct procedure and application. | some topics are covered with correct procedure and application | Few topics are covered with some error in procedure and application is missing |
| | | | |
| Presentation and Organization | 10 | 7 | 4 |
| | Excellent | Good | poor |
| | Neatness is Good and with creativity | Neatness is OK and with less creativity | less Neatness and with no creativity or file of other student is uploaded |
| | | | |
| Timely submission | 5 | 3 | 0 |
| | Excellent | Good | poor |
| | submitted within deadline | late Submitted | not submitted |

**10. Evaluation sheet of attendee: Separate sheet attached.**

| Roll No | Name of the Student | Involvement , Understanding & Performance (10) | Presentation Organization (10) | Timely Submission (5) | Total (25) |
|---|---|---|---|---|---|
| 2 | Ahirrao Ganesh Umesh | 6 | 7 | 5 | 18 |
| 5 | Bachhav Siddhant Sunil | 7 | 7 | 5 | 19 |
| 7 | Baviskar Tejas Santosh | 6 | 7 | 5 | 18 |
| 10 | Bodke Sushant Rajendra | 6 | 7 | 3 | 16 |
| 11 | Borade swapnil tukaram | 6 | 7 | 3 | 16 |
| 12 | Boraste Samarth Bhagwat | 6 | 7 | 5 | 18 |

| | | | | | |
|---|---|---|---|---|---|
| 15 | Chavan Rushikesh Manoj | 7 | 10 | 5 | 22 |
| 16 | Derle Ankush Santosh | 6 | 6 | 3 | 15 |
| 17 | Deshmukh Shashank Vinod | 7 | 7 | 3 | 17 |
| 18 | Dhondge_Gaurav_Pushparao | 9 | 8 | 5 | 22 |
| 19 | Dugaje_Rohit_Ramesh | 7 | 7 | 5 | 19 |
| 20 | Gadakh Sakshi Vishwas | 10 | 7 | 3 | 20 |
| 21 | Gadakh Vishwajeet Rajendra | 4 | 4 | 3 | 11 |
| 22 | GAIKWAD ONKAR HEMANT | 10 | 7 | 5 | 22 |
| 26 | Jadhav Prathamesh Dinesh | 9 | 10 | 5 | 24 |
| 27 | Jadhav Umesh Shriram | 4 | 4 | 5 | 13 |
| 28 | Kadam Amey Appasaheb | 9 | 10 | 5 | 24 |
| 29 | Kapadnis neha rajendra | 9 | 10 | 5 | 24 |
| 30 | KAPURE YASH DEEPAK | 9 | 9 | 3 | 21 |
| 31 | Kelkar lokesh dnyaneshwar | 7 | 4 | 5 | 16 |
| 32 | Khairnar Rutuj Sanjay | 7 | 4 | 5 | 16 |
| 33 | Khairnar Yashodeep Arun | 4 | 4 | 5 | 13 |
| 35 | Khole Vishal Ramnath | 4 | 4 | 3 | 11 |
| 36 | Kirtiwar Vaibhav Ashok | 4 | 4 | 3 | 11 |
| 37 | Kothawade Gaurav Murlidhar | 4 | 4 | 3 | 11 |
| 38 | kothawade pushkar rajendra | 4 | 4 | 5 | 13 |
| 39 | Kotkar Abhishek Sharad | 4 | 4 | 3 | 11 |
| 40 | Kushare Vaibhav Dnyaneshwar | 9 | 9 | 5 | 23 |
| 41 | LABHADE YUVRAJ RAMCHANDRA | 10 | 9 | 5 | 24 |
| 42 | Lahane Aniket Kailas | 7 | 6 | 5 | 18 |
| 43 | Lawand Aniket Subhash | 10 | 7 | 5 | 22 |
| 44 | Mahale Jay Rajendra | 7 | 6 | 5 | 18 |
| 46 | Bachhav Kunal Devidas | 7 | 7 | 3 | 17 |
| 47 | Bahiram Shubham Motilal | 7 | 7 | 3 | 17 |
| 49 | Ghayal Aniket Arun | 4 | 4 | 3 | 11 |
| 52 | Jadhav Mukta Mahendra | 10 | 9 | 5 | 24 |
| 55 | Khairnar Aniket Sanjay | 7 | 7 | 3 | 17 |
| 58 | Minesh Mahesh Chaure | 10 | 8 | 5 | 23 |
| 59 | Jadhav Shubham pandit | 8 | 9 | 5 | 22 |
| 60 | Sonawane Piyush Rajendra | 10 | 9 | 3 | 22 |
| 62 | Kardile Yash Ashok | 10 | 9 | 5 | 24 |
| 63 | Jadhav Girish Pravin | 7 | 7 | 3 | 17 |
| 64 | Bhandare Suraj santosh | 6 | 6 | 3 | 15 |

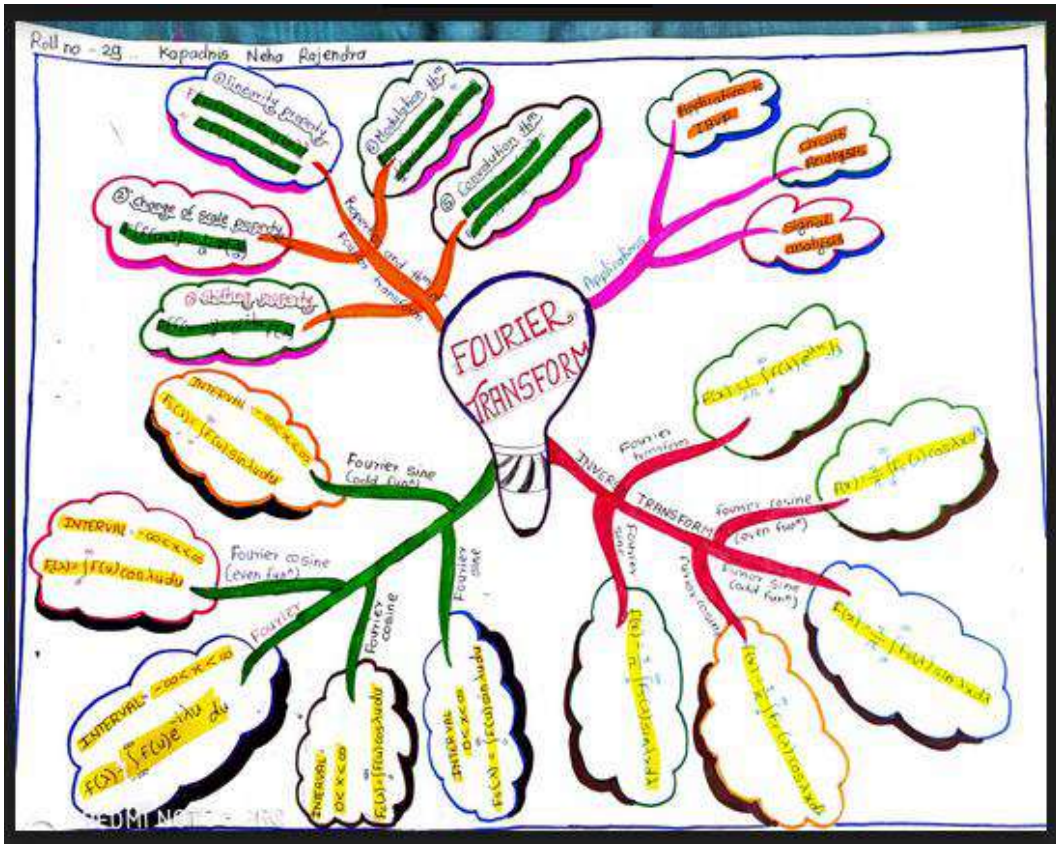
|  |  |  |  |  |  |
|---|---|---|---|---|---|
| 65 | Holkar Shraddha Sudhir | 7 | 7 | 3 | 17 |
| 66 | Ahirrao komal Mahendra | 10 | 9 | 3 | 22 |
| 67 | Khaire pranali Keshav | 9 | 10 | 5 | 24 |
| 68 | Kamble Manav Satish | 9 | 10 | 5 | 24 |
| 69 | Gujarathi Anand Anil | 9 | 9 | 5 | 23 |
| 71 | Deshmukh Atharva Abhay | 10 | 8 | 3 | 21 |
| 73 | Giri Ajinkya Devidas | 10 | 7 | 5 | 22 |
| 75 | Bundelkhandi Nishant Pravin | 10 | 10 | 5 | 25 |
| 78 | Sonaskar Sarthak Santosh | 6 | 6 | 5 | 17 |
| 170 | Atre Mrunali Sonaji | 9 | 9 | 5 | 23 |
| 171 | Shinde monali ramdas | 9 | 9 | 5 | 23 |
| 173 | Borgude Pratiksha Ashok | 8 | 7 | 5 | 20 |
| 174 | Shelar Aditya Sanjay | 10 | 9 | 5 | 24 |
| 176 | Dhatrak Jayesh Sanjay | 8 | 7 | 5 | 20 |
| 177 | Patil Gayatri Chunilal | 10 | 9 | 5 | 24 |
| 178 | Gonde Devika Dipak | 4 | 4 | 3 | 11 |
| 179 | Tupe Aniket Balasaheb | 8 | 7 | 5 | 20 |

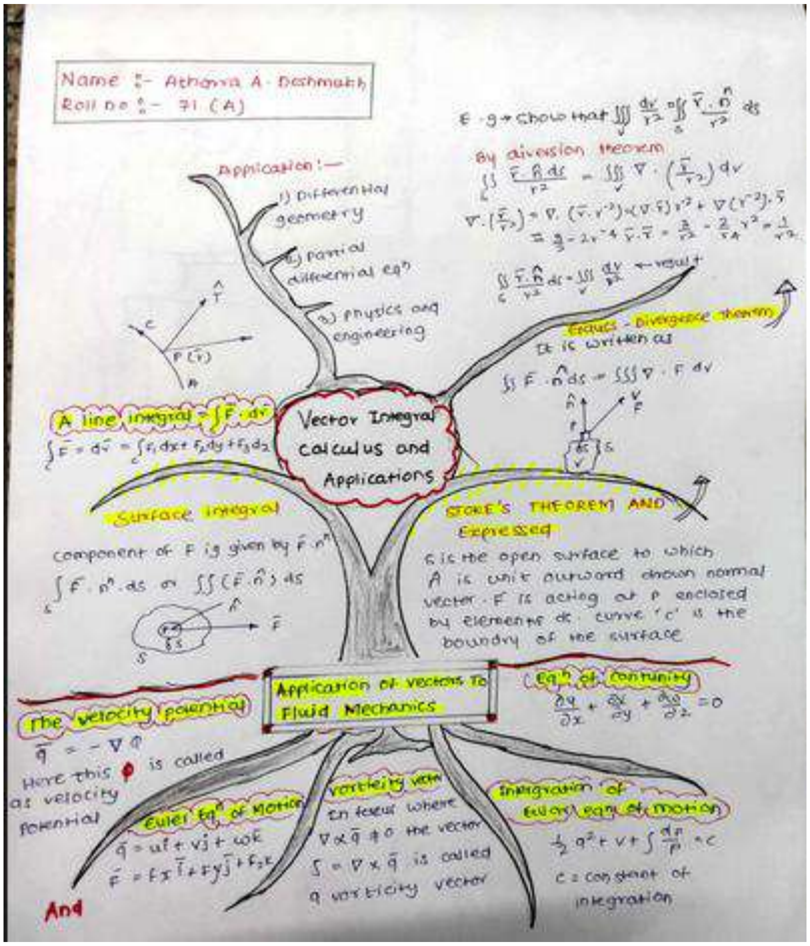
## 11. Impact Analysis

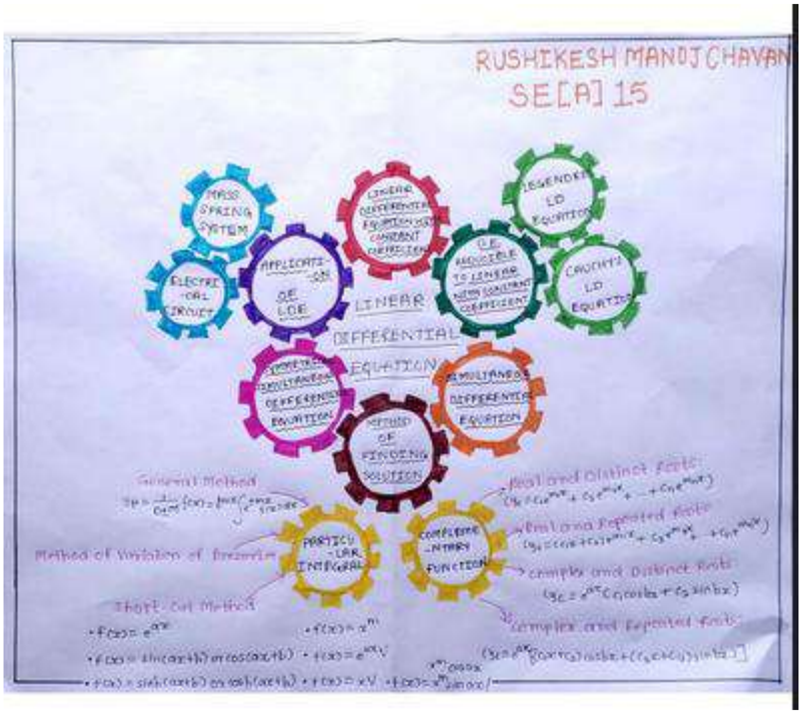
| **Sr. No.** | 3-High/Excellent | 2-Moderate /Average | 1-Slight/Poor |
|---|---|---|---|
| 1. Did you understand and cover the objective of the activity? | 76.5 % | 21.6% | 2% |
| 2. Do you find that methodology is helpful to cover the content beyond syllabus? | 70.6% | 27.5% | 2% |
| 3.Does this help you increase your knowledge of the topic? | 70.6% | 29.4% | - |
| 4. Does the content covered are relevant and will be helpful as a Life-long learning? | 64.7% | 33.3% | 2% |
| 5. Do you want to conduct | 78.4% | 19.6% | 2% |

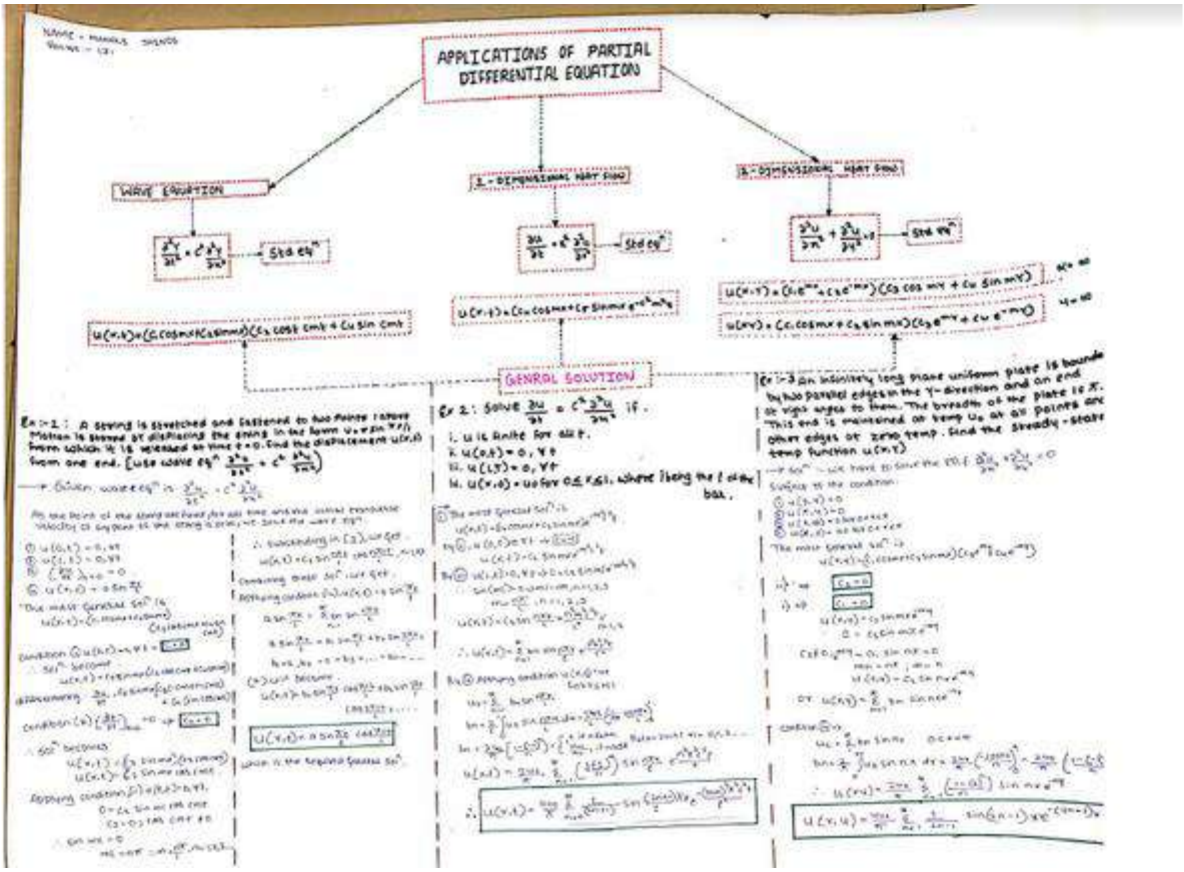
|  |  |  |  |
|---|---|---|---|
| such an activity again? |  |  |  |

## 12. Activity Picture




Name :- Atharva A. Deshmukh
Roll no :- 71 (A)
Application :—
1) Differential geometry
2) Partial differential eqn
3) Physics and engineering
E.g → Show that ∭ dv/r² = ∬ r̄.n̂/r² ds
By divergence theorem
→ result
Gauss - Divergence theorem
It is written as
∬ F.n̂ ds = ∭ ∇.F dv
A line integral = ∫F.dr
Vector Integral calculus and Applications
Surface integral
component of F is given by F.n̂
∫F.n̂ ds or ∬(F.n̂) ds
STOKE'S THEOREM AND Expressed
S is the open surface to which n̂ is unit outward drawn normal vector. F is acting at P enclosed by element ds. curve 'c' is the boundry of the surface
Application of vectors to Fluid Mechanics
Eqn of continuity
The velocity potential
q̄ = −∇φ
Here this φ is called as velocity potential
Euler Eqn of Motion
q̄ = ui + vj + wk
vorticity vector
In fluid where ∇×q̄ ≠ 0 the vector ζ = ∇×q̄ is called q vorticity vector
Integration of Euler eqn of motion
½ q² + V + ∫ dp/ρ = c
c = constant of integration
And


RUSHIKESH MANOJ CHAVAN
SE[A] 15
MASS SPRING SYSTEM
ELECTRICAL CIRCUIT
APPLICATION OF LDE
LINEAR DIFFERENTIAL EQUATION WITH CONSTANT COEFFICIENT
LEGENDRE LD EQUATION
LE REDUCIBLE TO LINEAR WITH CONSTANT COEFFICIENT
CAUCHY'S LD EQUATION
LINEAR DIFFERENTIAL EQUATION
SYMMETRICAL SIMULTANEOUS DIFFERENTIAL EQUATION
SIMULTANEOUS DIFFERENTIAL EQUATION
METHOD OF FINDING SOLUTION
General Method
PARTICULAR INTEGRAL
COMPLEMENTARY FUNCTION
Method of Variation of Parameter
Short cut Method
Real and Distinct Roots
Real and Repeated Roots
complex and Distinct Roots
complex and Repeated Roots



NAME - MANAS SHINDE
ROLL NO - 131

# APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION

**WAVE EQUATION**

$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ — Std eqⁿ

$u(x,t) = (C_1 \cos mx + C_2 \sin mx)(C_3 \cos cmt + C_4 \sin cmt)$

**1 - DIMENSIONAL HEAT FLOW**

$\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ — Std eqⁿ

$u(x,t) = (C_4 \cos mx + C_5 \sin mx) e^{-c^2 m^2 t}$

**2 - DIMENSIONAL HEAT FLOW**

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

$u(x,y) = (C_1 e^{mx} + C_2 e^{-mx})(C_3 \cos my + C_4 \sin my)$ — $x \to \infty$

$u(x,y) = (C_1 \cos mx + C_2 \sin mx)(C_3 e^{my} + C_4 e^{-my})$ — $y \to \infty$

**GENRAL SOLUTION**

Ex :- 1 : A string is stretched and fastened to two points l apart. Motion is started by displacing the string in the form $u = a \sin \frac{\pi x}{l}$ from which it is released at time $t = 0$. Find the displacement $u(x,t)$ from one end. [use wave eqⁿ $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$]

→ Given wave eqⁿ is $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$

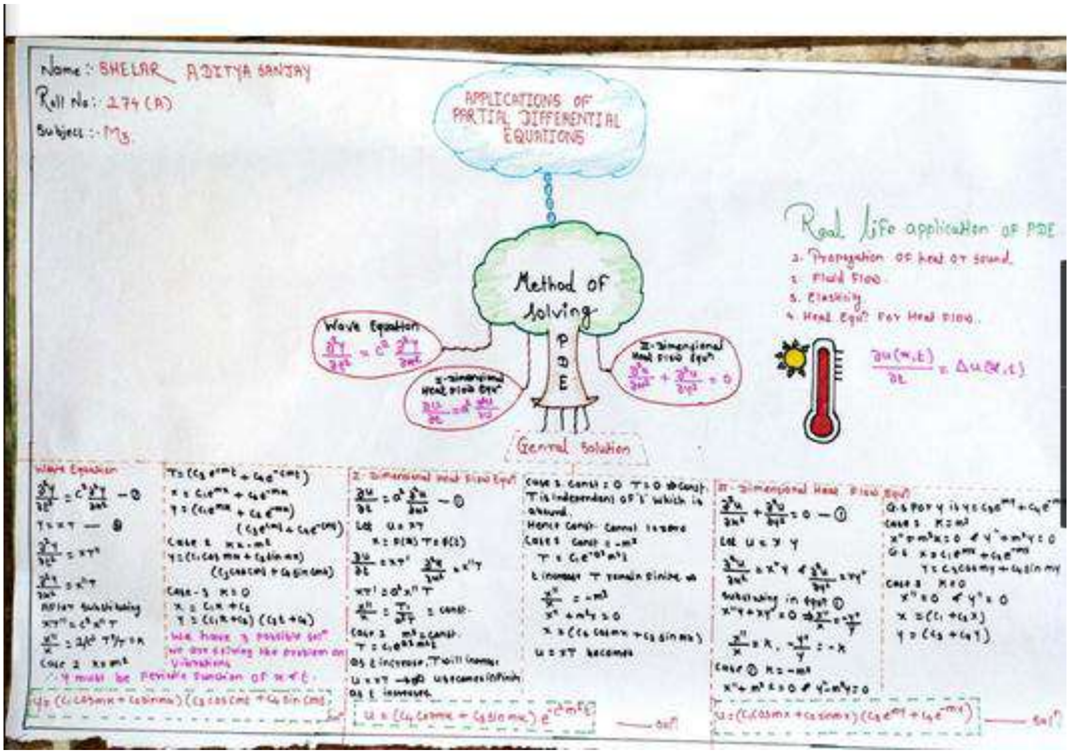
$\boxed{u(x,t) = a \sin \frac{\pi x}{l} \cos \frac{\pi c t}{l}}$

which is the required general solⁿ.

Ex 2 : Solve $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ if.

i. u is finite for all t.
ii. $u(0,t) = 0, \forall t$
iii. $u(l,t) = 0, \forall t$
iv. $u(x,0) = u_0$ for $0 \le x \le l$, where l being the l of the bar.

Ex :- 3 An infinitely long plane uniform plate is bounded by two parallel edges in the y - direction and an end at right angles to them. The breadth of the plate is π. This end is maintained at temp $u_0$ at all points and other edges at zero temp. Find the steady - state temp function $u(x,y)$



Name :- BHELAR ADITYA SANJAY
Roll No :- 274 (A)
Subject :- M3.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Method of Solving
PDE

Wave Equation
$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$

1-Dimensional Heat Flow Equ^n
$\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$

II-Dimensional Heat Flow Equ^n
$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$

Real life application of PDE
1. Propagation of heat or sound.
2. Fluid Flow.
3. Elasticity.
4. Heat Equ^n For Heat Flow.

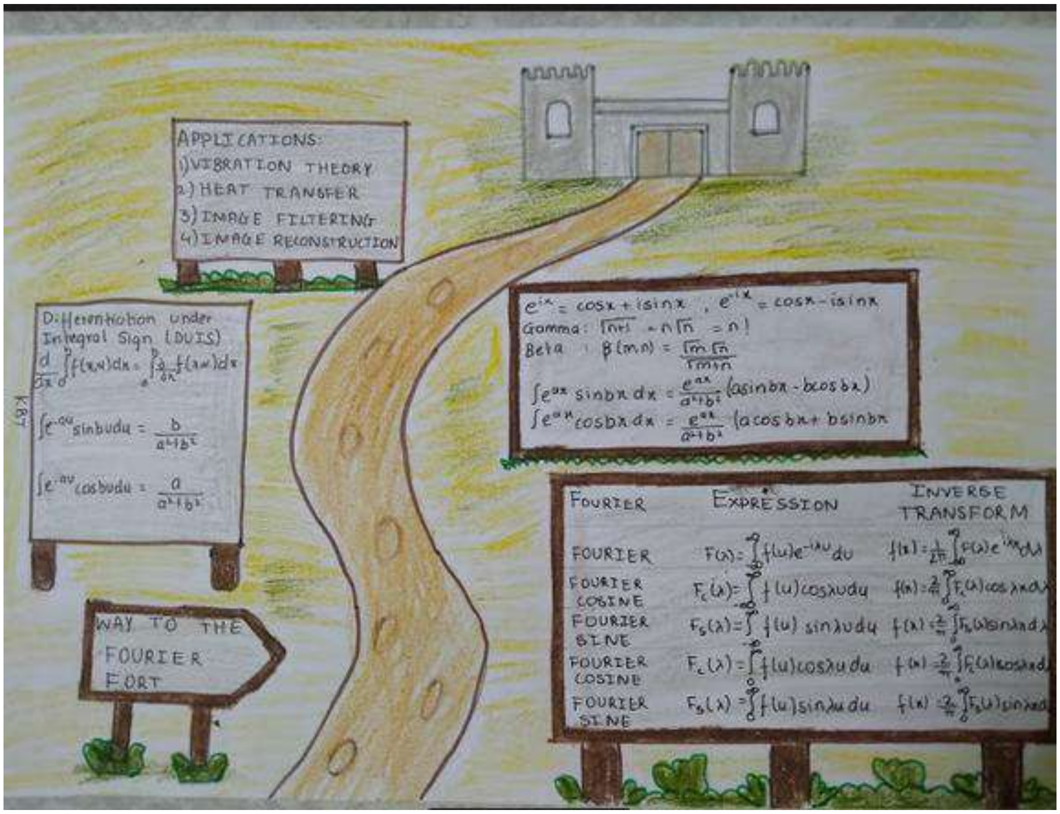
$\frac{\partial u(x,t)}{\partial t} = \Delta u(x,t)$

General Solution

Wave Equation
$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ — ①
$y = XT$ — ②
$\frac{\partial^2 y}{\partial t^2} = XT''$
$\frac{\partial^2 y}{\partial x^2} = X''T$
After substituting
$XT'' = c^2 X''T$
$\frac{X''}{X} = \frac{1}{c^2}\frac{T''}{T} = k$
Case 1 $k = m^2$
$T = (c_3 e^{cmt} + c_4 e^{-cmt})$
$X = c_1 e^{mx} + c_2 e^{-mx}$
$y = (c_1 e^{mx} + c_2 e^{-mx})(c_3 e^{cmt} + c_4 e^{-cmt})$
Case 2 $k = -m^2$
$y = (c_1 \cos mx + c_2 \sin mx)(c_3 \cos cmt + c_4 \sin cmt)$
Case-3 $k = 0$
$X = c_1 x + c_2$
$y = (c_1 x + c_2)(c_3 t + c_4)$
We have 3 possible sol^n; we are solving the problem on vibrations
∴ y must be periodic function of x & t.
$y = (c_1 \cos mx + c_2 \sin mx)(c_3 \cos cmt + c_4 \sin cmt)$ — Sol^n

1-Dimensional Heat Flow Equ^n
$\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ — ①
Let $u = XT$
$X = f(x)$ $T = f(t)$
$\frac{\partial u}{\partial t} = XT'$ $\frac{\partial^2 u}{\partial x^2} = X''T$
$XT' = c^2 X''T$
$\frac{X''}{X} = \frac{T'}{c^2 T}$ = const.
Case 1 $m^2$ = const.
$T = c_1 e^{c^2 m^2 t}$
as t increase, T will increase
$u = XT \to \infty$ u becomes infinite as t increase.
Case 2 const = 0 T = 0 ∴ const. T is independent of t which is absurd.
Hence const. cannot be zero
Case 3 const $= -m^2$
$T = c_1 e^{-c^2 m^2 t}$
t increase T remain finite as
$\frac{X''}{X} = -m^2$
$X'' + m^2 X = 0$
$X = (c_2 \cos mx + c_3 \sin mx)$
$u = XT$ becomes
$u = (c_2 \cos mx + c_3 \sin mx)\, e^{-c^2 m^2 t}$ — Sol^n

II-Dimensional Heat Flow Equ^n
$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ — ①
Let $u = XY$
$\frac{\partial^2 u}{\partial x^2} = X''Y$ & $\frac{\partial^2 u}{\partial y^2} = XY''$
Substituting in eqn ①
$X''Y + XY'' = 0 \Rightarrow \frac{X''}{X} = -\frac{Y''}{Y}$
$\frac{X''}{X} = k, \; -\frac{Y''}{Y} = -k$
Case ① $k = -m^2$
$X'' + m^2 X = 0$ & $Y'' - m^2 Y = 0$
G.S for y is $Y = c_3 e^{my} + c_4 e^{-my}$
Case 2 $k = m^2$
$X'' - m^2 X = 0$ & $Y'' + m^2 Y = 0$
G.S $X = c_1 e^{mx} + c_2 e^{-mx}$
$Y = c_3 \cos my + c_4 \sin my$
Case 3 $k = 0$
$X'' = 0$ & $Y'' = 0$
$X = (c_1 + c_2 x)$
$Y = (c_3 + c_4 y)$
$u = (c_1 \cos mx + c_2 \sin mx)(c_3 e^{my} + c_4 e^{-my})$ — Sol^n



APPLICATIONS:
1) VIBRATION THEORY
2) HEAT TRANSFER
3) IMAGE FILTERING
4) IMAGE RECONSTRUCTION

Differentiation under Integral Sign (DUIS)

$\frac{d}{d\alpha}\int_a^b f(x,\alpha)dx = \int_a^b \frac{\partial}{\partial \alpha} f(x,\alpha)dx$

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$\int e^{-au}\sin bu\,du = \frac{b}{a^2+b^2}$

$\int e^{-au}\cos bu\,du = \frac{a}{a^2+b^2}$

WAY TO THE FOURIER FORT

$e^{ix} = \cos x + i\sin x$ , $e^{-ix} = \cos x - i\sin x$

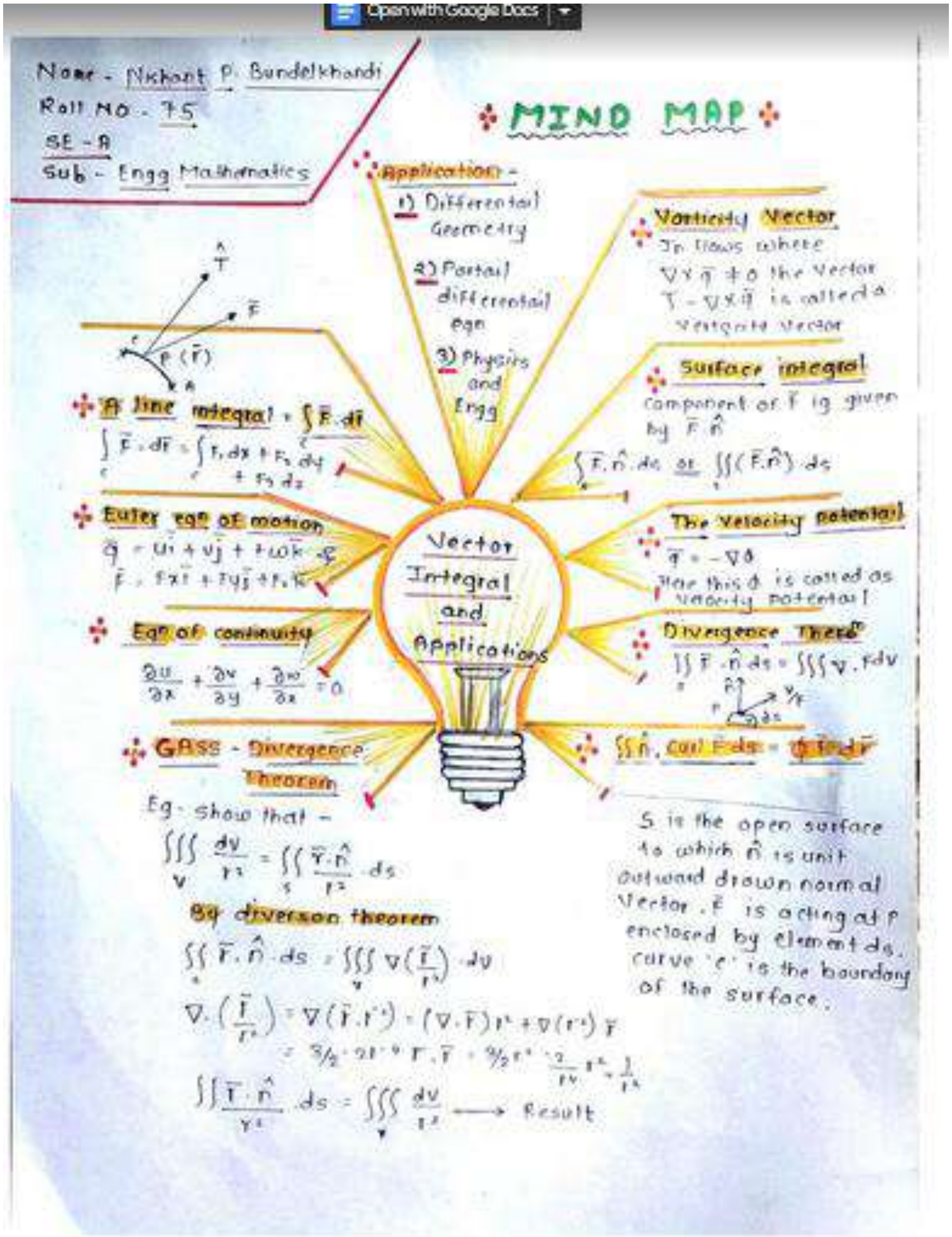
Gamma : $\Gamma(n+1) = n\Gamma(n) = n!$

Beta : $\beta(m,n) = \frac{\Gamma m\,\Gamma n}{\Gamma(m+n)}$

$\int e^{ax}\sin bx\,dx = \frac{e^{ax}}{a^2+b^2}(a\sin bx - b\cos bx)$

$\int e^{ax}\cos bx\,dx = \frac{e^{ax}}{a^2+b^2}(a\cos bx + b\sin bx$

| FOURIER | EXPRESSION | INVERSE TRANSFORM |
|---|---|---|
| FOURIER | $F(\lambda) = \int_{-\infty}^{\infty} f(u)e^{-i\lambda u}du$ | $f(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F(\lambda)e^{i\lambda x}d\lambda$ |
| FOURIER COSINE | $F_c(\lambda) = \int_{-\infty}^{\infty} f(u)\cos\lambda u\,du$ | $f(x) = \frac{2}{\pi}\int_0^{\infty} F_c(\lambda)\cos\lambda x\,d\lambda$ |
| FOURIER SINE | $F_s(\lambda) = \int_{-\infty}^{\infty} f(u)\sin\lambda u\,du$ | $f(x) = \frac{2}{\pi}\int_0^{\infty} F_s(\lambda)\sin\lambda x\,d\lambda$ |
| FOURIER COSINE | $F_c(\lambda) = \int_0^{\infty} f(u)\cos\lambda u\,du$ | $f(x) = \frac{2}{\pi}\int_0^{\infty} F_c(\lambda)\cos\lambda x\,d$ |
| FOURIER SINE | $F_s(\lambda) = \int_0^{\infty} f(u)\sin\lambda u\,du$ | $f(x) = \frac{2}{\pi}\int_0^{\infty} F_s(\lambda)\sin\lambda x\,d$ |



Name - Nikhant P. Bundelkhandi
Roll NO - 75
SE - A
Sub - Engg Mathematics

# ✣ MIND MAP ✣

**Vector Integral and Applications**

**Application -**
1) Differential Geometry
2) Partial differential eqn
3) Physics and Engg

**Vorticity Vector**
In flows where $\nabla \times \bar{q} \neq 0$ the vector $\bar{\zeta} = \nabla \times \bar{q}$ is called a vorticity vector

**Surface integral**
component of $\bar{F}$ is given by $\bar{F}\cdot\hat{n}$

$\int_S \bar{F}\cdot\hat{n}\,ds$ or $\iint_S (\bar{F}\cdot\hat{n})\,ds$

**The Velocity potential**
$\bar{q} = -\nabla\phi$
Here this $\phi$ is called as velocity potential

**Divergence Theorem**
$\iint_S \bar{F}\cdot\hat{n}\,ds = \iiint_V \nabla\cdot\bar{F}\,dv$

**$\iint_S \hat{n}\cdot \text{curl}\,\bar{F}\,ds = \oint_C \bar{F}\cdot d\bar{r}$**

S is the open surface to which $\hat{n}$ is unit outward drawn normal vector. $\bar{F}$ is acting at P enclosed by element ds. curve 'c' is the boundary of the surface.

**A line integral** = $\int_C \bar{F}\cdot d\bar{r}$

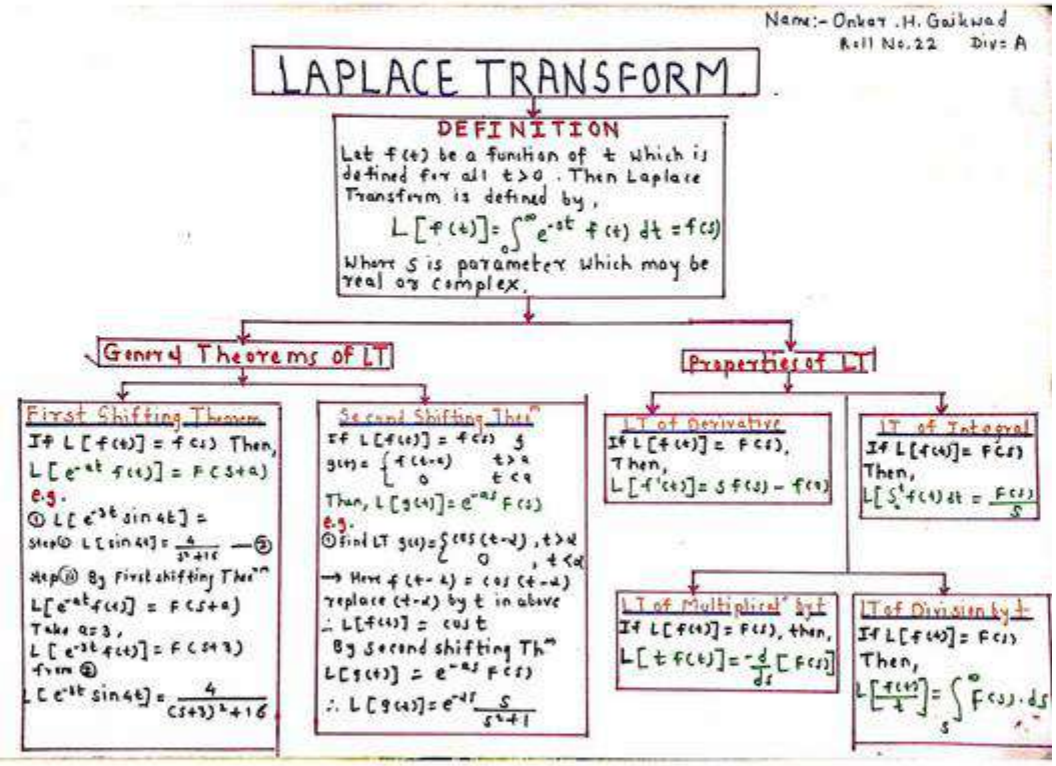
$\int_C \bar{F}\cdot d\bar{r} = \int_C F_1\,dx + F_2\,dy + F_3\,dz$

**Euler eqn of motion**
$\bar{q} = u\bar{i} + v\bar{j} + w\bar{k}$ &
$\bar{F} = F_1\bar{i} + F_2\bar{j} + F_3\bar{k}$

**Eqn of continuity**
$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

**GASS - Divergence Theorem**
Eg. Show that -
$$\iiint_V \frac{dv}{r^2} = \iint_S \frac{\bar{r}\cdot\hat{n}}{r^2}\,ds$$

**By diversion theorem**
$$\iint_S \bar{r}\cdot\hat{n}\,ds = \iiint_V \nabla\left(\frac{\bar{r}}{r^2}\right)dv$$
$$\nabla\cdot\left(\frac{\bar{r}}{r^2}\right) = \nabla(\bar{r}\cdot r^{-2}) = (\nabla\cdot\bar{r})r^{-2} + \nabla(r^{-2})\,\bar{r}$$
$$= 3/r^2 - 2r^{-4}\,\bar{r}\cdot\bar{r} = 3/r^2 - \frac{2}{r^4}r^2 = \frac{1}{r^2}$$
$$\iint_S \frac{\bar{r}\cdot\hat{n}}{r^2}\,ds = \iiint_V \frac{dv}{r^2} \longrightarrow \text{Result}$$



Name:- Onkar .H. Gaikwad
Roll No. 22 Div: A

# LAPLACE TRANSFORM

## DEFINITION

Let f(t) be a function of t which is defined for all t > 0. Then Laplace Transform is defined by,

$$L[f(t)] = \int_0^\infty e^{-st} f(t)\, dt = f(s)$$

Where s is parameter which may be real or complex.

## General Theorems of LT

### First Shifting Theorem

If $L[f(t)] = f(s)$ Then,

$L[e^{-at} f(t)] = F(s+a)$

e.g.

① $L[e^{-3t} \sin 4t] =$

Step① $L[\sin 4t] = \frac{4}{s^2+16}$ — ②

Step② By First shifting Theo<sup></sup>

$L[e^{-at} f(t)] = F(s+a)$

Take a = 3,

$L[e^{-3t} f(t)] = F(s+3)$

from ②

$L[e^{-3t} \sin 4t] = \frac{4}{(s+3)^2+16}$

### Second Shifting Theo

If $L[f(t)] = f(s)$ &

$g(t) = \begin{cases} f(t-a) & t > a \\ 0 & t < a \end{cases}$

Then, $L[g(t)] = e^{-as} F(s)$

e.g.

① Find LT $g(t) = \begin{cases} \cos(t-\alpha), & t > \alpha \\ 0, & t < \alpha \end{cases}$

→ Here $f(t-\alpha) = \cos(t-\alpha)$

replace $(t-\alpha)$ by t in above

$\therefore L[f(t)] = \cos t$

By second shifting Th<sup></sup>

$L[g(t)] = e^{-as} F(s)$

$\therefore L[g(t)] = e^{-\alpha s} \frac{s}{s^2+1}$

## Properties of LT

### LT of Derivative

If $L[f(t)] = F(s)$,

Then,

$L[f'(t)] = sF(s) - f(0)$

### LT of Integral

If $L[f(t)] = F(s)$

Then,

$L[\int_0^t f(t)\, dt = \frac{F(s)}{s}$

### LT of Multiplication by t

If $L[f(t)] = F(s)$, then,

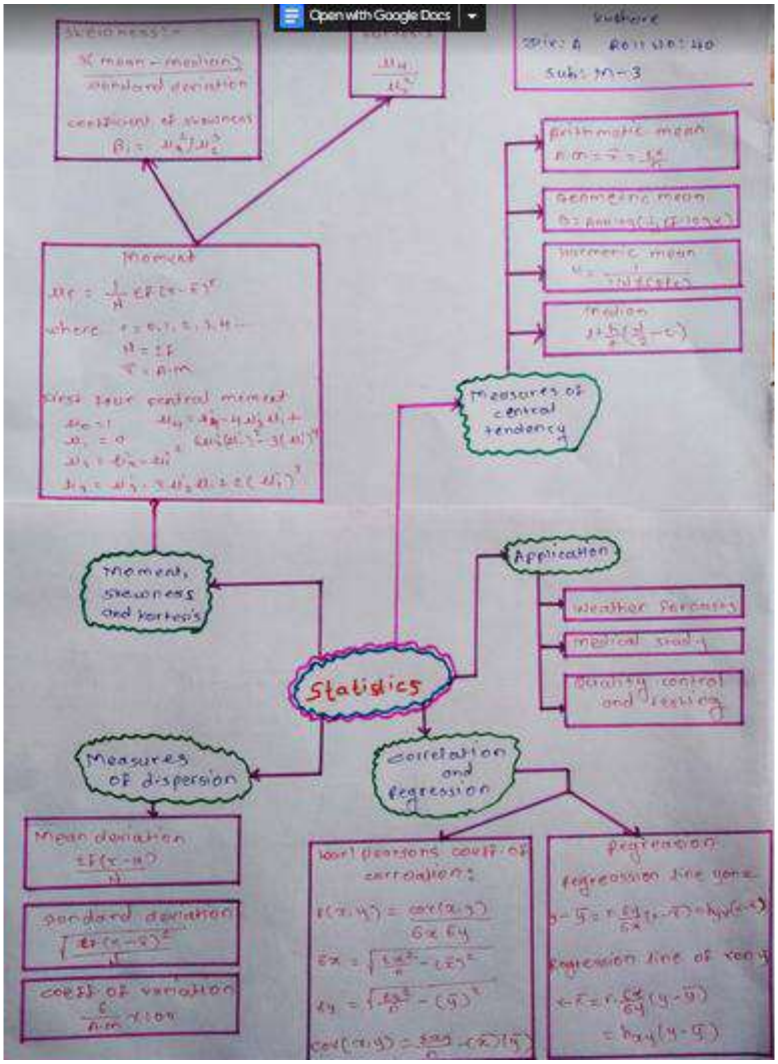
$L[t\, f(t)] = \frac{-d}{ds}[F(s)]$

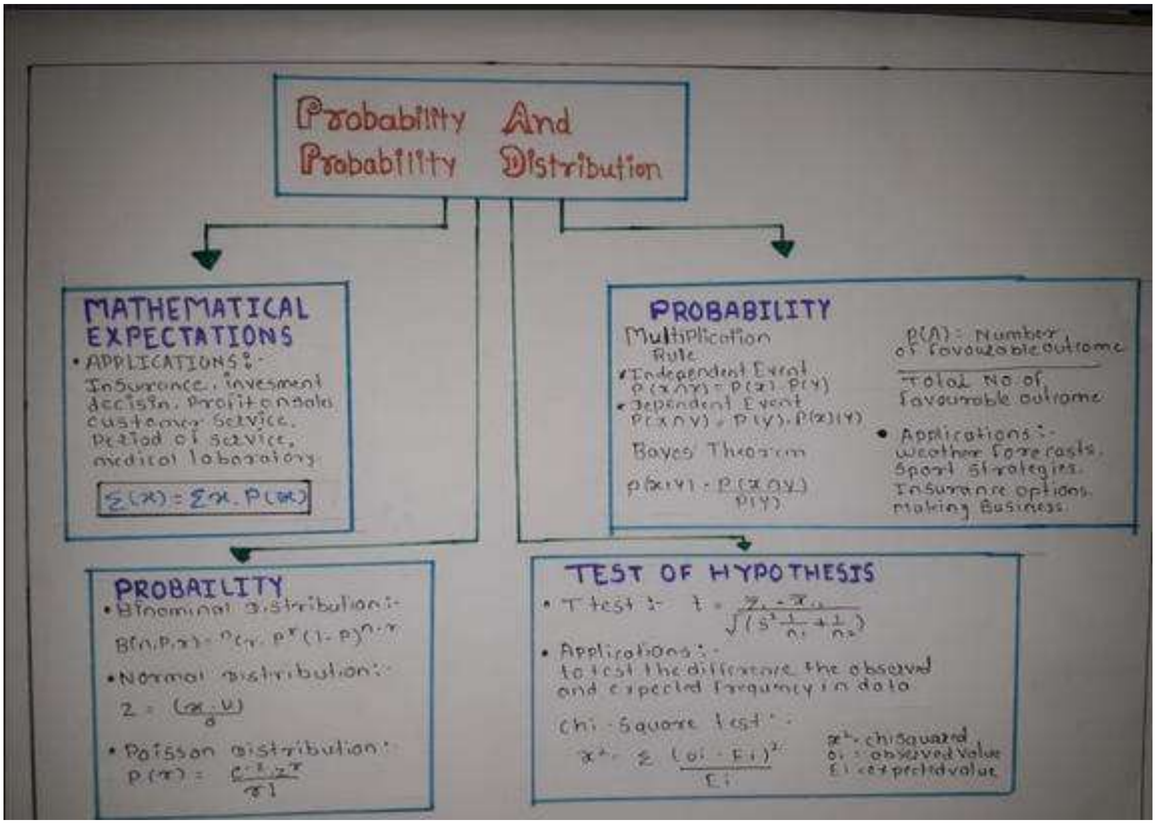
### LT of Division by t

If $L[f(t)] = F(s)$

Then,

$L\left[\frac{f(t)}{t}\right] = \int_s^\infty F(s) \cdot ds$


Open with Google Docs
Skewness :-
3( mean - median)
standard deviation
coefficient of skewness
Div: A Roll No: 40
Sub: M-3
Arithmetic mean
Geometric mean
Harmonic mean
Median
Moment
where r = 0, 1, 2, 3, 4 ...
first four central moment
Measures of central tendency
Moment, skewness and kurtosis
Application
Weather forecasting
medical study
Quality control and testing
Statistics
Measures of dispersion
correlation and regression
Mean deviation
standard deviation
coeff of variation
Karl pearsons coeff. of correlation :
Regression
regression line y on x
Regression line of x on y



Probability And Probability Distribution

MATHEMATICAL EXPECTATIONS

- APPLICATIONS:- Insurance, invesment decisin, Profit on sale, customer service, period of service, medical laboratory

$E(x) = \sum x . P(x)$

PROBABILITY

Multiplication Rule

- Independent Event $P(x \cap y) = P(x) . P(y)$
- Dependent Event $P(x \cap y) = P(y) . P(x|y)$

Bayes' Theorem

$P(x|y) = \frac{P(x \cap y)}{P(y)}$

$P(A) = \frac{\text{Number of favourable outcome}}{\text{Total No of favourable outcome}}$

- Applications:- weather forecasts, Sport strategies, Insurance options, making Business

PROBAILITY

- Binominal distribution:- $B(n,p,x) = {}^nC_x . p^x (1-p)^{n-x}$
- Normal distribution:- $z = \frac{(x-\mu)}{\sigma}$
- Poisson distribution: $P(x) = \frac{e^{-\lambda} \lambda^x}{x!}$

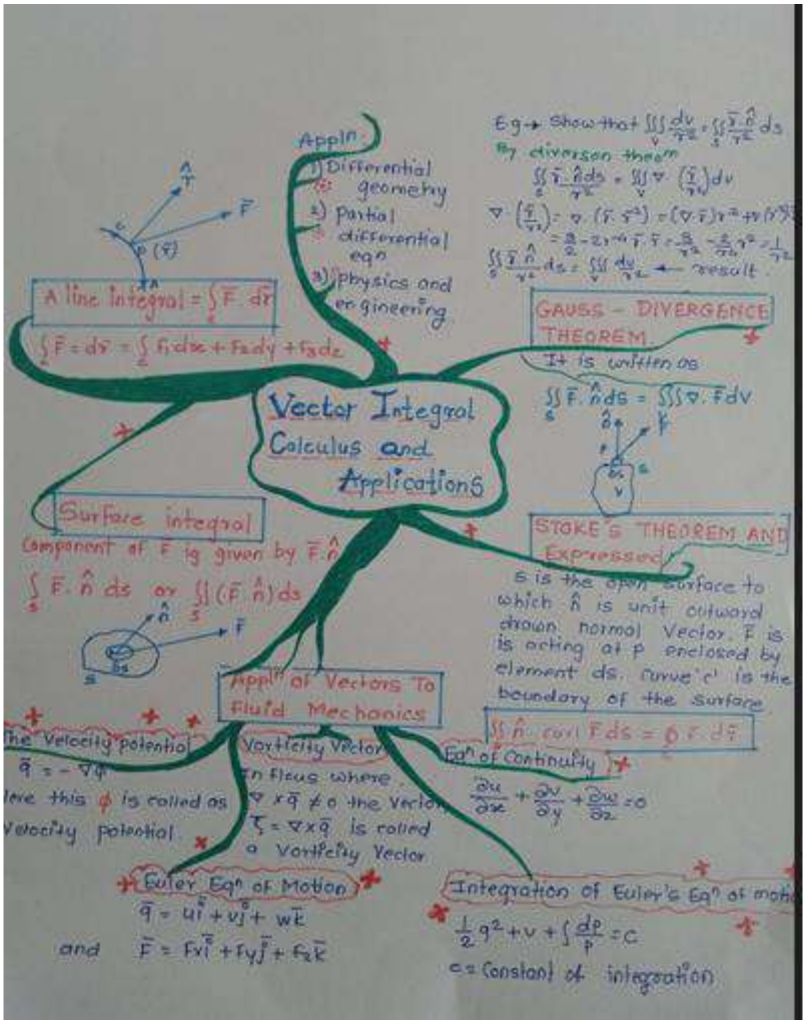
TEST OF HYPOTHESIS

- T test:- $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(s^2 \frac{1}{n_1} + \frac{1}{n_2})}}$
- Applications:- to test the difference the observed and expected frequency in data

Chi-Square test:-

$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$

$\chi^2$ = chi squared
$O_i$ = observed value
$E_i$ = expected value



Vector Integral Calculus and Applications

Applⁿ
1) Differential geometry
2) Partial differential eqⁿ
3) physics and engineering

Eg → Show that $\iiint_V \frac{dv}{r^2} = \iint_S \frac{\bar{r}\cdot\hat{n}}{r^2}\,ds$

By diversion theoᵐ

$$\iint_S \frac{\bar{r}\cdot\hat{n}\,ds}{r^2} = \iiint_V \nabla\cdot\left(\frac{\bar{r}}{r^2}\right)dv$$

$$\nabla\cdot\left(\frac{\bar{r}}{r^2}\right) = \nabla\cdot(\bar{r}\,r^{-2}) = (\nabla\cdot\bar{r})r^{-2} + \bar{r}\,\nabla(r^{-2})$$

$$= \frac{3}{r^2} - 2r^{-4}\,\bar{r}\cdot\bar{r} = \frac{3}{r^2} - \frac{2}{r^4}r^2 = \frac{1}{r^2}$$

$$\iint_S \frac{\bar{r}\cdot\hat{n}}{r^2}\,ds = \iiint_V \frac{dv}{r^2} \leftarrow \text{result}$$

GAUSS - DIVERGENCE THEOREM.

It is written as

$$\iint_S \bar{F}\cdot\hat{n}\,ds = \iiint_V \nabla\cdot\bar{F}\,dv$$

A line Integral $= \int_C \bar{F}\cdot d\bar{r}$

$$\int_C \bar{F}\cdot d\bar{r} = \int_C F_1\,dx + F_2\,dy + F_3\,dz$$

Surface integral

Component of $\bar{F}$ is given by $\bar{F}\cdot\hat{n}$

$$\int_S \bar{F}\cdot\hat{n}\,ds \text{ or } \iint_S (\bar{F}\cdot\hat{n})\,ds$$

STOKE'S THEOREM AND Expressed

S is the open surface to which $\hat{n}$ is unit outward drawn normal Vector. $\bar{F}$ is is acting at P enclosed by element ds. curve 'c' is the boundary of the surface

$$\iint_S \hat{n}\cdot \text{curl}\,\bar{F}\,ds = \oint_C \bar{F}\cdot d\bar{r}$$

Applⁿ of Vectors To Fluid Mechanics

The Velocity potential

$\bar{q} = -\nabla\phi$

Here this $\phi$ is called as Velocity potential.

Vorticity Vector

In flows where $\nabla\times\bar{q} \neq 0$ the Vector $\zeta = \nabla\times\bar{q}$ is called a Vorticity Vector

Eqⁿ of Continuity

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

Euler Eqⁿ of Motion

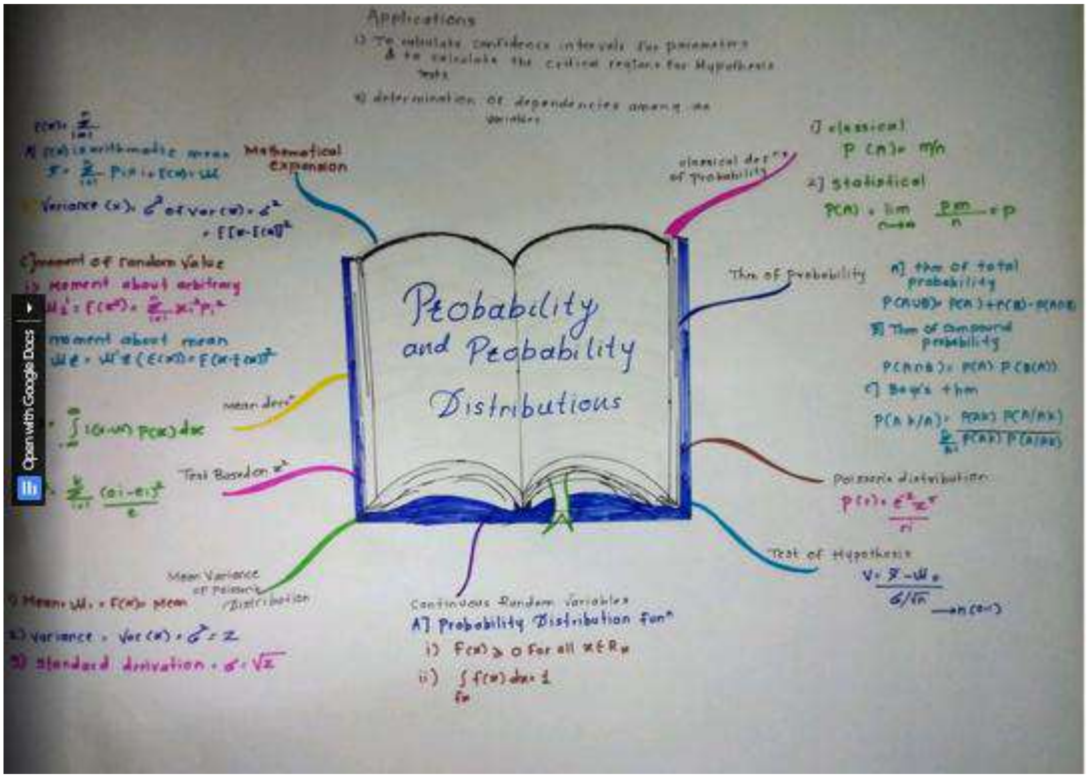
$\bar{q} = u\bar{i} + v\bar{j} + w\bar{k}$

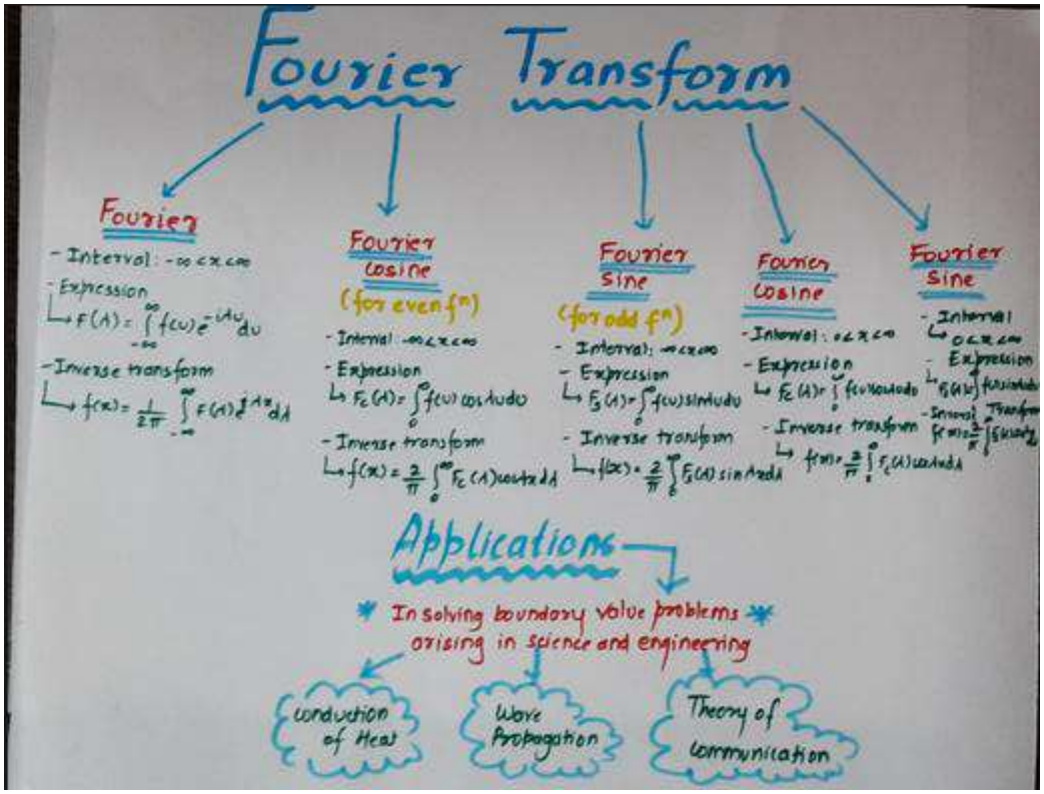
and $\bar{F} = F_x\bar{i} + F_y\bar{j} + F_z\bar{k}$

Integration of Euler's Eqⁿ of moti

$$\frac{1}{2}q^2 + v + \int\frac{dp}{\rho} = c$$

c = Constant of integration


Probability
and Probability
Distributions
Applications
1) To calculate confidence intervals for parameters & to calculate the critical regions for Hypothesis tests
2) determination of dependencies among the variables
Mathematical expansion
Variance (x) = σ² or Var(x) = σ² = E[x − E(x)]²
moment of random value
moment about arbitrary
moment about mean
Mean dev^n
Test Based on χ²
Mean Variance of Poisson's Distribution
1) Mean = μ₁ = E(x) = mean
2) Variance = Var(x) = σ² = λ
3) Standard deviation = σ = √λ
Continuous Random Variables
A] Probability Distribution fun^n
i) f(x) ≥ 0 for all x ∈ R
ii) ∫ f(x) dx = 1
classical def^n of Probability
1] classical
P(A) = m/n
2] statistical
P(A) = lim m/n = p
Thm of Probability
A] thm of total probability
P(A∪B) = P(A) + P(B) − P(A∩B)
B] Thm of compound probability
P(A∩B) = P(A) P(B/A)
C] Baye's thm
Poisson's distribution
Test of Hypothesis
Open with Google Docs



# Fourier Transform

**Fourier**

- Interval: $-\infty < x < \infty$
- Expression
  ↳ $F(\lambda) = \int_{-\infty}^{\infty} f(u) e^{-i\lambda u} du$
- Inverse transform
  ↳ $f(x) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\lambda) e^{i\lambda x} d\lambda$

**Fourier Cosine**

(for even $f^n$)

- Interval $-\infty < x < \infty$
- Expression
  ↳ $F_c(\lambda) = \int_0^{\infty} f(u) \cos \lambda u \, du$
- Inverse transform
  ↳ $f(x) = \frac{2}{\pi} \int_0^{\infty} F_c(\lambda) \cos \lambda x \, d\lambda$

**Fourier Sine**

(for odd $f^n$)

- Interval: $-\infty < x < \infty$
- Expression
  ↳ $F_s(\lambda) = \int_0^{\infty} f(u) \sin \lambda u \, du$
- Inverse transform
  ↳ $f(x) = \frac{2}{\pi} \int_0^{\infty} F_s(\lambda) \sin \lambda x \, d\lambda$

**Fourier Cosine**

- Interval: $0 < x < \infty$
- Expression
  ↳ $F_c(\lambda) = \int_0^{\infty} f(u) \cos \lambda u \, du$
- Inverse transform
  ↳ $f(x) = \frac{2}{\pi} \int_0^{\infty} F_c(\lambda) \cos \lambda x \, d\lambda$

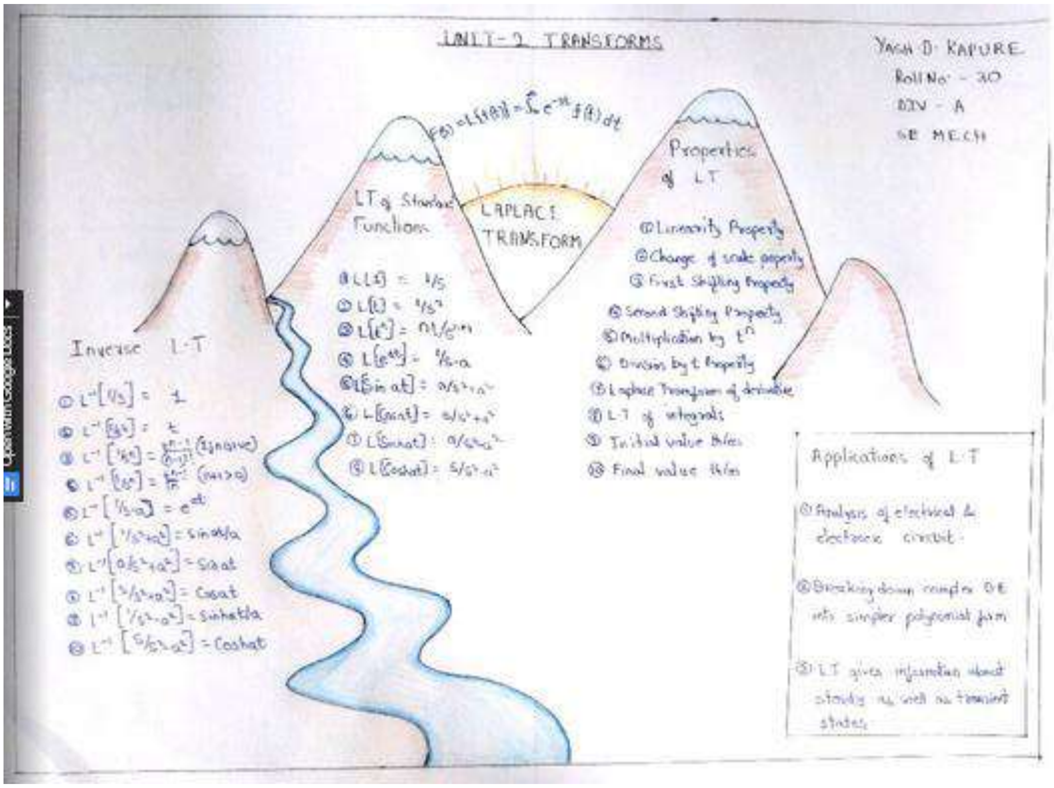
**Fourier Sine**

- Interval
  ↳ $0 < x < \infty$
- Expression
  ↳ $F_s(\lambda) = \int f(u) \sin \lambda u$
- Inversal Transform
  $f(x) = \frac{2}{\pi} \int F_s(\lambda) \sin \lambda x$

## Applications

* In solving boundary value problems arising in science and engineering *

- Conduction of Heat
- Wave Propagation
- Theory of communication



UNIT-2 TRANSFORMS

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Roll No - 30
DIV - A
SE MECH

$F(s) = L\{f(t)\} = \int_0^\infty e^{-st} f(t)\,dt$

LAPLACE TRANSFORM

LT of Standard Functions

① $L[1] = 1/s$
② $L[t] = 1/s^2$
③ $L[t^n] = n!/s^{n+1}$
④ $L[e^{at}] = 1/s-a$
⑤ $L[\sin at] = a/s^2+a^2$
⑥ $L[\cos at] = s/s^2+a^2$
⑦ $L[\sinh at] = a/s^2-a^2$
⑧ $L[\cosh at] = s/s^2-a^2$

Properties of LT

① Linearity Property
② Change of scale property
③ First Shifting Property
④ Second Shifting Property
⑤ Multiplication by $t^n$
⑥ Division by t Property
⑦ Laplace Transform of derivative
⑧ L.T of integrals
⑨ Initial value th/m
⑩ Final value th/m

Inverse L.T

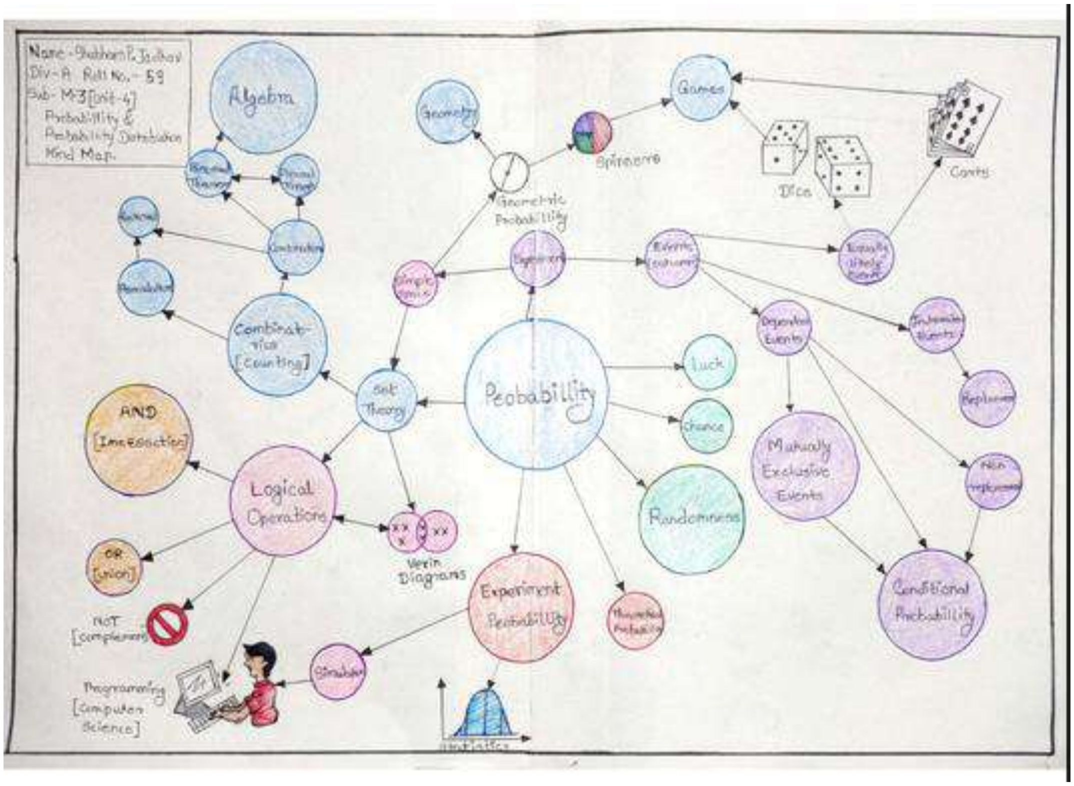
① $L^{-1}[1/s] = 1$
② $L^{-1}[1/s^2] = t$
③ $L^{-1}[1/s^n] = \frac{t^{n-1}}{(n-1)!}$ (n is +ve)
④ $L^{-1}[1/s^n] = \frac{t^{n-1}}{\Gamma n}$ (n+1>0)
⑤ $L^{-1}[1/s-a] = e^{at}$
⑥ $L^{-1}[1/s^2+a^2] = \sin at/a$
⑦ $L^{-1}[a/s^2+a^2] = \sin at$
⑧ $L^{-1}[s/s^2+a^2] = \cos at$
⑨ $L^{-1}[1/s^2-a^2] = \sinh at/a$
⑩ $L^{-1}[s/s^2-a^2] = \cosh at$

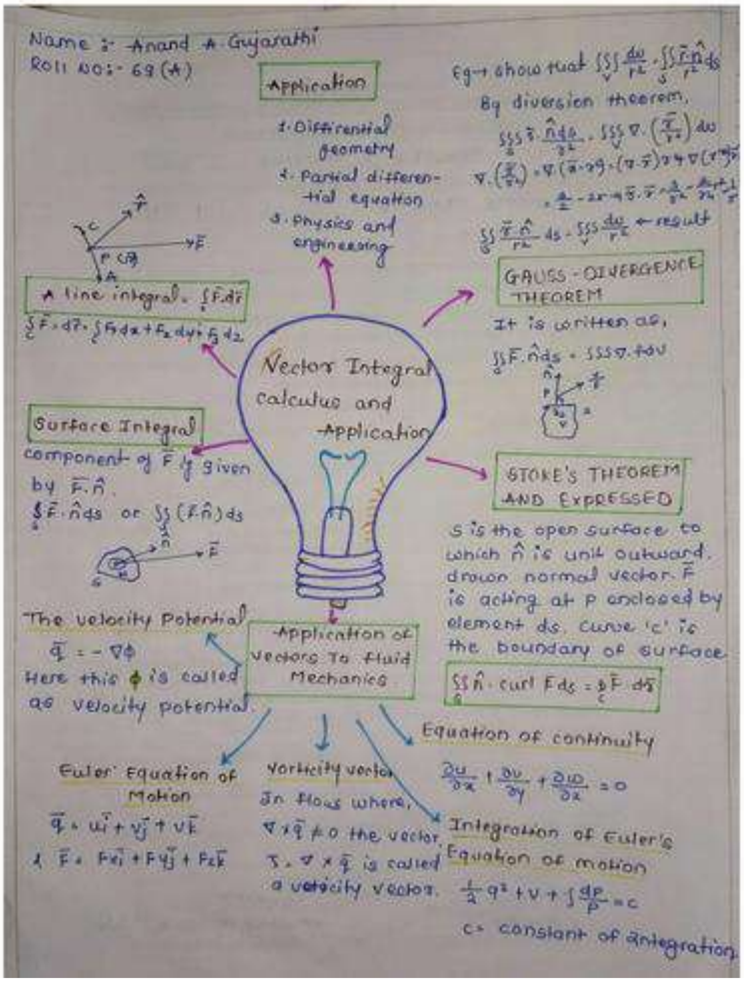
Applications of L.T

① Analysis of electrical & electronic circuit.

② Breaking down complex DE into simpler polynomial form

③ L.T gives information about steady as well as transient states.


Name - Shubham P. Jadhav
Div - A  Roll No. - 59
Sub - M-3 [Unit-4]
Probability & Probability Distribution Mind Map.
Algebra
Binomial Theorem
Pascal's Triangle
Factorial
Combinations
Permutation
Combinatorics [Counting]
Geometry
Geometric Probability
Spinners
Games
Dice
Cards
Simple Space
Experiment
Events Outcomes
Equally likely Events
Dependent Events
Independent Events
Replacement
Non replacement
Mutually Exclusive Events
Conditional Probability
Set Theory
Probability
Luck
Chance
Randomness
AND [Intersection]
Logical Operations
OR [Union]
NOT [complement]
Venn Diagrams
Experiment Probability
Theoretical Probability
Simulation
Programming [Computer Science]
Statistics



Name :- Anand A. Gujarathi
Roll No:- 69 (A)

Vector Integral calculus and Application

**Application**

1. Diffirential geometry
2. Partial differential equation
3. Physics and engineering

Eg→ show that $\iiint_V \frac{dv}{r^2} = \iint_S \frac{\bar{r}\cdot\hat{n}}{r^2} ds$

By diversion theorem,

$\iint_S \bar{r}\cdot\frac{\hat{n}\,ds}{r^2} = \iiint_V \nabla\cdot\left(\frac{\bar{r}}{r^2}\right) dv$

$\nabla\cdot\left(\frac{\bar{r}}{r^2}\right) = \nabla\cdot(\bar{r}\,r^{-2}) = (\nabla\cdot\bar{r})r^{-2} + \nabla(r^{-2})\cdot\bar{r}$

$= \frac{3}{r^2} - 2r^{-4}\bar{r}\cdot\bar{r} = \frac{3}{r^2} - \frac{2}{r^2} = \frac{1}{r^2}$

$\iint_S \frac{\bar{r}\cdot\hat{n}}{r^2} ds = \iiint_V \frac{dv}{r^2}$ ← result

**GAUSS - DIVERGENCE THEOREM**

It is written as,

$\iint_S F\cdot\hat{n}\,ds = \iiint \nabla\cdot F\,dV$

**A line integral = $\int_C \bar{F}\cdot d\bar{r}$**

$\int_C \bar{F}\cdot d\bar{r} = \int_C F_1 dx + F_2 dy + F_3 dz$

**Surface Integral**

component of $\bar{F}$ is given by $\bar{F}\cdot\hat{n}$.

$\oint_S \bar{F}\cdot\hat{n}\,ds$ or $\iint_S (\bar{F}\cdot\hat{n})\,ds$

**STOKE'S THEOREM AND EXPRESSED**

S is the open surface to which $\hat{n}$ is unit outward drawn normal vector. $\bar{F}$ is acting at P enclosed by element ds. Curve 'c' is the boundary of surface.

$\iint_S \hat{n}\cdot \text{curl}\,F\,ds = \oint_C \bar{F}\cdot d\bar{r}$

**Application of vectors To Fluid Mechanics**

The velocity Potential

$\bar{q} = -\nabla\phi$

Here this $\phi$ is called as velocity potential.

Euler Equation of Motion

$\bar{q} = u\bar{i} + v\bar{j} + v\bar{k}$

& $\bar{F} = Fx\bar{i} + Fy\bar{j} + Fz\bar{k}$

Vorticity vector

In flow where,

$\nabla\times\bar{q} \neq 0$ the vector, $\bar{\zeta} = \nabla\times\bar{q}$ is called a velocity vector.

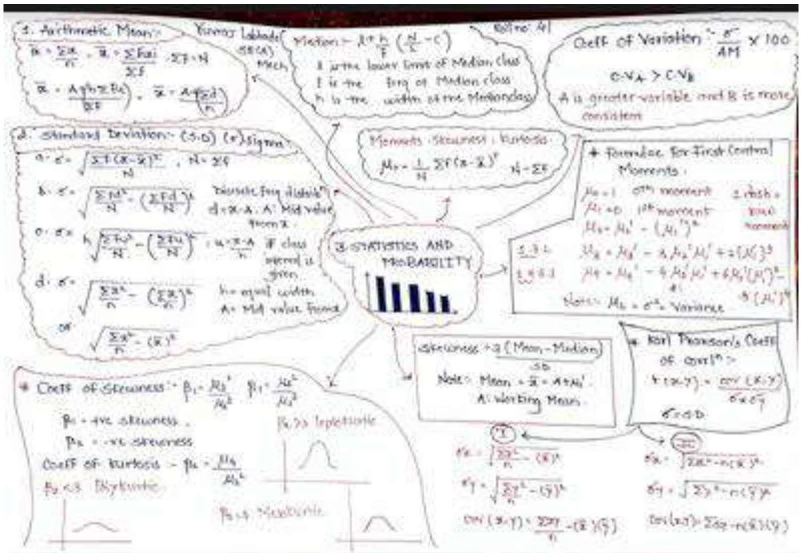
Equation of continuity

$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$

Integration of Euler's Equation of motion

$\frac{1}{2}q^2 + V + \int\frac{dp}{\rho} = c$

c = constant of integration.



1. Arithmetic Mean:-

$\bar{x} = \frac{\sum x}{n}$, $\bar{x} = \frac{\sum f x_i}{\sum f}$, $\sum f = N$

$\bar{x} = A + \frac{h \sum f u}{\sum f}$, $\bar{x} = A + \frac{\sum f d}{n}$

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Mech

Roll no: 41

Median = $l + \frac{h}{f}\left(\frac{N}{2} - c\right)$

l is the lower limit of Median class
f is the freq of Median class
h is the width of the Median class

Coeff of Variation := $\frac{\sigma}{AM} \times 100$

$C.V_A > C.V_B$

A is greater variable and B is more consistent

2. Standard Deviation:- (S.D) (σ) Sigma:

a. $\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{N}}$, $N = \sum f$

b. $\sigma = \sqrt{\frac{\sum f d^2}{N} - \left(\frac{\sum f d}{N}\right)^2}$ Discrete freq distribⁿ, d = x − A, A: Mid value from x

c. $\sigma = h\sqrt{\frac{\sum f u^2}{N} - \left(\frac{\sum f u}{N}\right)^2}$, $u = \frac{x-A}{h}$ if class interval is given

d. $\sigma = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}$ h = equal width, A = Mid value from x

or $\sqrt{\frac{\sum x^2}{n} - (\bar{x})^2}$

Moments : Skewness : Kurtosis

$\mu_r = \frac{1}{N}\sum f(x-\bar{x})^r$, $N = \sum f$

3. STATISTICS AND PROBABILITY

* Formulae for First Central Moments:

$\mu_0 = 1$ 0th moment
$\mu_1 = 0$ 1st moment
1 dash = raw moment
$\mu_2 = \mu_2' - (\mu_1')^2$
$\mu_3 = \mu_3' - 3\mu_2'\mu_1' + 2(\mu_1')^3$
$\mu_4 = \mu_4' - 4\mu_3'\mu_1' + 6\mu_2'(\mu_1')^2 - 3(\mu_1')^4$

Note:- $\mu_2 = \sigma^2 =$ Variance

Skewness = $\frac{3(\text{Mean} - \text{Median})}{S.D}$

Note:- Mean $= \bar{x} = A + \mu_1'$
A: Working Mean

* Karl Pearson's Coeff of corrlⁿ:-

$r(x,y) = \frac{cov(x,y)}{\sigma_x \sigma_y}$

σ = S.D

* Coeff of Skewness:- $\beta_1 = \frac{\mu_3^2}{\mu_2^3}$ $\beta_1 = \frac{\mu_2^2}{\mu_3^2}$

β1 = +ve skewness
β2 = −ve skewness

Coeff of kurtosis − $\beta_2 = \frac{\mu_4}{\mu_2^2}$

β2 < 3 Platykurtic

β2 > 3 leptokurtic

β2 = 3 Mesokurtic

(I)

$\sigma_x = \sqrt{\frac{\sum x^2}{n} - (\bar{x})^2}$

$\sigma_y = \sqrt{\frac{\sum y^2}{n} - (\bar{y})^2}$

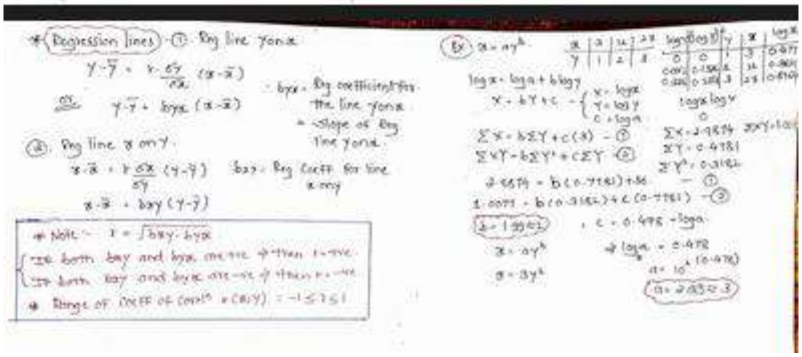
$cov(x,y) = \frac{\sum xy}{n} - (\bar{x})(\bar{y})$

(II)

$\sigma_x = \sqrt{\sum x^2 - n(\bar{x})^2}$

$\sigma_y = \sqrt{\sum y^2 - n(\bar{y})^2}$

$cov(x,y) = \sum xy - n(\bar{x})(\bar{y})$



* Regression lines - ① Reg line y on x

$y - \bar{y} = r\frac{\sigma_y}{\sigma_x}(x - \bar{x})$

or $y - \bar{y} = b_{yx}(x - \bar{x})$

$b_{yx}$ = Reg coefficient for the line y on x = slope of Reg line y on x.

② Reg line x on y.

$x - \bar{x} = r\frac{\sigma_x}{\sigma_y}(y - \bar{y})$

$b_{xy}$ = Reg coeff for line x on y

$x - \bar{x} = b_{xy}(y - \bar{y})$

* Note:- $r = \sqrt{b_{xy} \cdot b_{yx}}$

If both bxy and byx are +ve then r = +ve.
If both bxy and byx are −ve then r = −ve

* Range of Coeff of corrlⁿ r(x,y) = $-1 \le r \le 1$

Ex $x = ay^b$

| x | 3 | 12 | 24 |
|---|---|---|---|
| y | 1 | 2 | 3 |

| log y | (log y)² | y | x | log x |
|---|---|---|---|---|
| 0 | 0 | 1 | 3 | 0.477 |
| 0.301 | [illegible] | 2 | 12 | [illegible] |
| 0.4771 | [illegible] | 3 | 24 | [illegible] |

log x log y
0

$\log x = \log a + b \log y$

$X = bY + c$ — $\begin{cases} X = \log x \\ Y = \log y \\ c = \log a \end{cases}$

$\sum X = b\sum Y + c(3)$ — ①

$\sum XY = b\sum Y^2 + c\sum Y$ — ②

$\sum X = 2.9374$ $\sum XY = 1.0$

$\sum Y = 0.7781$

$\sum Y^2 = 0.3182$

$2.9374 = b(0.7781) + 3c$ — ①

$1.0079 = b(0.3182) + c(0.7781)$ — ②

$\boxed{b = 1.99 \approx 2}$, $c = 0.478 = \log a$

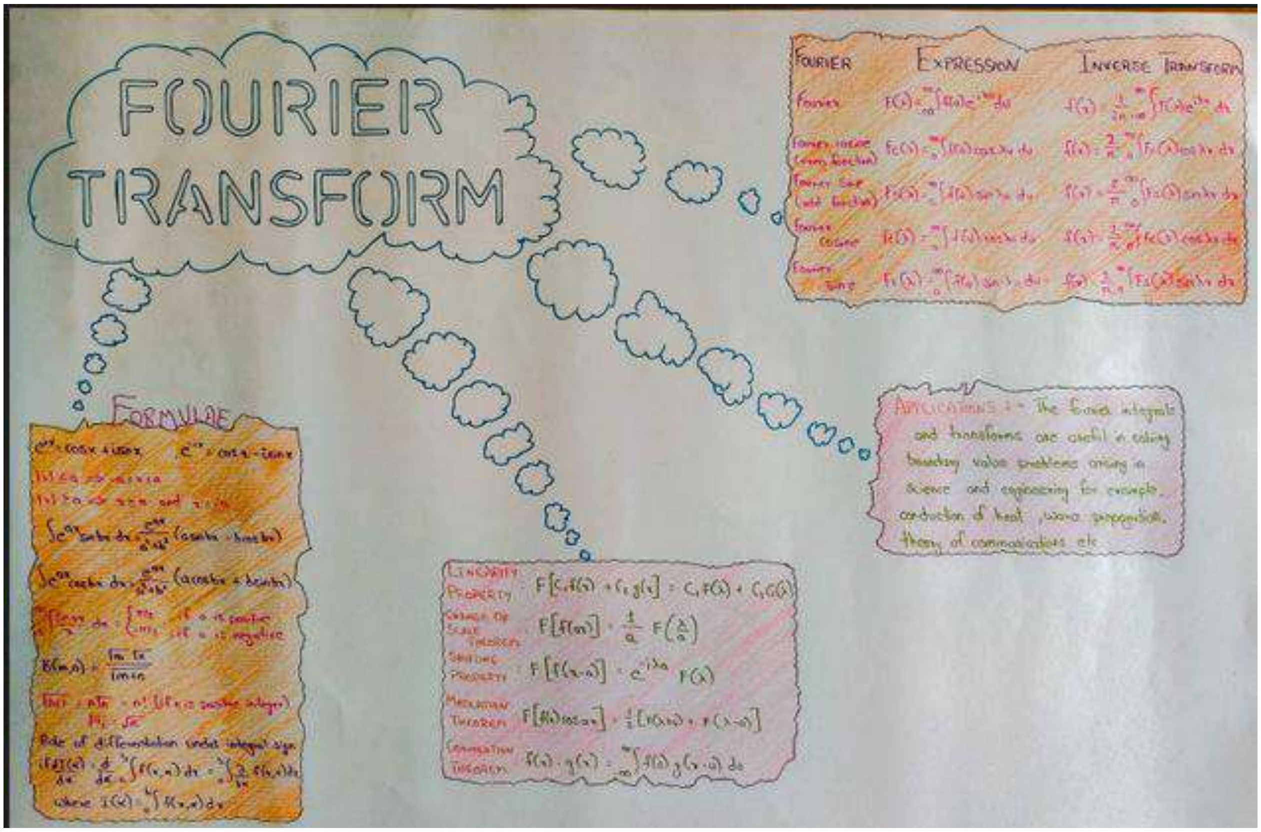
$x = ay^b$

$x = 3y^2$

$\therefore \log a = 0.478$

$a = 10^{(0.478)}$

$\boxed{a = [illegible] \approx 3}$



APPLICATIONS :- The Fourier integrals and transforms are useful in solving boundary value problems arising in science and engineering for example, conduction of heat, wave propagation, theory of communications etc

**13. For review and critique contact: e-mail address of faculty and HOD**

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| | | |
|---|---|---|
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| Subject Incharge | Module Coordinator | HOD |