	Date / 120
	<b>&amp;</b> Data
	LAA:
1-	Unit 1:
	Consistency, rank & Solutions:
	rank (A) = rank (Alb) = 8 : consistent 1/00 sol=
	rank(A) = rank (Alb) = n=r consistent 1 solution
	[rank(A) = rank (Alb) = r <n]: &="" consistent="" sol<="" th=""></n]:>
	rank(A) + rank(A1b) : inconsistent × sol=
•	Gaussian Elimination:
	· Find echelon form & check for conditions & find sol
	conditions & find sol-
- New Marie	→ Break down of elimina: pivots become zero  ⇒ Try to switch hows I then solve
	> Try to switch lows of then solve
	Γl. μ. Malaina
	Flementary Matrices:
8	Eg, = 1007 -x : multiplier
	- <del>2</del> 10
	[ 0 0 1 ]
1	I have a second of the second of the
	Triangular factorisation:
	-> LU 1:-
ı	L: All transformations to gether
	$\begin{array}{c c} \hline (x: R_2 \rightarrow R_2 - 2R_1) \\ \hline (1) & \Rightarrow & & & & & & & & & & & & & & & & & $
	LZ = b
	L. J. Gaiven
	using E solve for 2
1	Then equate Ux = Z & John for n now

	Date / /20
	> LDU:-
	Square matrix.
	L: from E -> lower triungular reatrice.  D: diagonal elements as plots
	D: diagonal elements as plots
	U: ethelon form but make pirots/
p 16.1 -	diags. = 1
- 1 A	In case of zero valued pivols,
	• Exchange yous
	· multiply by the RHS by Por
	P is the corresponding beginnetation matrix
	P is the corresponding prenutation matrix  PT = PT & P P DEN Then. Then matrices
11 S 12 S 11	possible
	PA: A but with
	Prows exchanged.
4	Gauss Tordano Methods
In its	
	$(A;I) \longrightarrow (I:A^{-1})$
	· find echekon form
	· Convert the upper triangle to O to torn
	a diagonal matrix
	· Finally make diagonals one by dividing
	lach gow.
Į.	
	( by the .

1 40 -
LAA: Unita:
Speacial Solutions:-
· Find echelon form, swap gows if needed. · Find pivot variables, free variables
· find pivot variables free variables
Find value of pov. in terms of free rais.
Find value of pov. in terms of free rars.  Ex: if: 2: +v = y, z, t = fv. (f.v)
then, $x = -y - 2z - t$ $\begin{bmatrix} -y - 2z - t \\ y \\ t \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + t \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$
-y-2z-t y +z +t/
7 ( )
p.v: the vass. corresponding to columns that have a spirot.
have a spirot.
1.v: the vais. that correspond to the cols.
Independence of vectors:  -> Vectors are independent if "null space" zero vector"
→ Vectors are independent if mull epace
= zero vector"
-> pivot exists in every whem
-> pivot exists in every column  : rank (A) = n
24f0xxx*
O Columns of invertible square matrix: always
and a man and a male of the country
Amxn if m <n (rows="" <="" always<="" columns):="" td=""></n>
Rasi
Basis:  O Dimension of the victor space: No. of basis victors
vectors
II-

rank multiple Date / 120
more Date
dim (c(4)) +
7 TWITCHIOCHUM
Matrix: Aman dinu (((a)) = m
1) C(A): W. Space  -> subspace of RM -> combina = f col S of
$\Rightarrow \text{rand}(A) = \dim(C(A))$
-> basis: columns having pivots.
- Dasis : Williams
2) C(AT): row space
2) C(A'): row space  -> subspace of IRM -> combina of rows of A  -> subspace of IRM -> combina of rows of A  -> trank (AT): dim(C(AT))
-> transfi rank (AT) = dim (C(AT))
-> basis is set of your having pivots.
3) N(A); null epace
-> subspace of Rh
> A.x = 0 all sol-s of this
→ if rank (A) = k then din (NCA) = n-k
NULLITY
4) N(AT): left wall space
$-1 A^{T} x = 0 - subspace of R^{t}$
-1 dim (N(A+)) = M-k
- 1 linear comb. of rows that gives o
Tryerse:  Right inverse: ( = AT(AAT)
Right inverse: C = A'(AA') (Steen horizontal matrix)
Left inverse: B = (ATA) AT
(verticle recativix)

	g th	***
LAA:-	i /	The state of the s
Wuit 3		
- Court		£ .
0 111		17 - A
Rotation:	7 40	tate by 0 anticlockwise.
Q = C	-5 \ 18	tate by & anti clackwise.
S	<u> </u>	
		1 grad
Biojection:-	onto a 0.	line)
Ce	s <sup>2</sup>	-singular -non-invertible (IPI=0)
Pn = P		TON (HAST TIPE
- T D		
PIZI	, , , , , , , , , , , , , , , , , , ,	Fr. 1
Color Stone	12.14 ANN -	5 5 n 41
Keffection:	long a .	L'A = 11401
H = 2P -	· I	- n
141=0-12	; no	n singular, in vertible.
H <sup>2n</sup> = I		i) > - i
(200)	Just of the sail	· 1 · 0
Rule of lines	vilu:	
- T (C) 1-111	= CT(x)	) + # d 7(4)
7 Possamus	04.80.40	) + de d 7(y)
Vegerves	by craw	C= TOY (0) 1
(C)		
Polynomial sp	au:	,2 13
Pn = co Basis: [1	+9t+ c	+ c3t3 + cntn
Basis: 1	+ + 2+	(14) A (4) .
din = n+1		
- 14	*_	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Differentia?	Y	Integration:
The Day	D	$P_{\gamma\gamma} \rightarrow P_{\gamma\gamma\gamma}$
(n) II	<u> </u>	C(A): subspace of
C(A) = all o	Pn	of Pn+1
N(A) = P.	(ID space	
	Constants)	) N(A) : Z/Ó
II A L WA A		ing to All The United In Co.

	d(m(v) + d(w(u)) = n
Osthogonal Complements: V & W	arandal -
Osthonosmal: Ilall: 1 Schworz inequality: 1076/4/10	120
Schwarz inconstitut lath = lath	11 Noll
Summy Mayarang	1 A o Find Ax-6
Comment	o find norm.
P2 - 6 A - 0 0 2 0	odiff wit each rate in
0 003	n o solve the a's
A <sub>n×n+1</sub> ; ; ;	OR OATAX = ATB
	o And multiply &
intg. matrix: 000	find the values of
P2 - P3 B= 100	Jr.
0 Y2 O	Puoj: P=Ax=b
0 0 /3	do in the col.
distriction of the second of t	space of A.
Parly and withre.	
The of lines D	roduct) (a,b)
Outhogonal vectors:    atb = 0 (inner p)    l'all = ata	415-1 V H
a   = a a	A
	7 <a,b> = 088</a,b>
<a, b="">&gt; &gt; 0 : nout</a,>	
< 0 : obtuse	1 (000)
= 0: orthogona	
	(11)
Orthogonal Subspaces de	mcv/sk
SETEV => din(s	() + dhu (T) < n
$\frac{S  \mathcal{E}_1  T  \mathcal{E}_{V} \Rightarrow  \text{dim}(s)}{x  es}  y  eT =  \chi  T_{y} =  c$	)
	the same of the sa
CLAT) & N(A): orthogona	l in R"
CLAT) & NLAT): orthogona CLA) & NLAT); ii in	R M
	14 a gad y
Perojections:	P' = P
$p = a\hat{\lambda} = a \cdot a^{\dagger}b = a$	$(a^{T}a)^{T}a^{T}b$
a <sup>t</sup> a L	P: proj. Matrix
C(P): line through a , rl	
Least Square Fit: 2 = at	<u>b</u>
$  E  ^2 =   Ax-b  ^2$	Ta ATAX=ATB
Gove.	normal ear

LAA:
Unit 4:
Outhogonal Matrex: - Matrix w/ Orthogonal" Columns (B)
Columns (Q)
m >> n ; Orthogonal if m=n
$Q^TQ = I$ (square or sect. matrix)
QT = Q-1 (ij square matrix)
(dength preserved)
$Q^{T}Q = I$ (square or sect. matrix) $Q^{T} = Q^{-1}$ (if square matrix) $  Qx   =   x  $ (dingth preserved) $(Qx)^{T}(Qy) = x^{T}y$ ( $< x, y > & angles preserved$ )
A CANAGE CHARLAND TO STOLE
$\frac{q_1^T b = \lambda_1 q_1^T q_1}{\lambda_1 = q_1^T b} = q_1^T b$
a Ta is it is it is
The state of the s
nn = an b : purjection of b onto an
$\chi = Q^T b$
1 2 2 4 b 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
GS Puocess:- ASSEN
2 2 2 2 N 1
91=a q2 = B; B=b-(q1b)q1
93 (C) ; C= C-(9,18) 9, -(9,28) 9,2
Q = [q, q, q,]
is written a Mariam in the Minister of The His
Q'R Factorisation:
Man Rux = 91 a and and and and and and and and and a
upto T 2 0 92 6 92 C
am an

	Least Squares for inconsistent systems:
	Suplace A by QR $\Rightarrow$ $Rx = Q^Tb$ $R = Q^TA$ Us given  Gind  from A.
, A.	R = Q *A
1-1-1-1	is given can given
	from A.
	Eigen Values & vectors:
	· For a vector > value unique
	a freeze to the state of the st
Taxa at at	$o \not\in \lambda(A) = \lambda(A^{-1})$
va k	
rectorsin	· A of idempotent matrix (ie A=A=AM): 0 or 1
Jor A & A	o $\ell\lambda(A) = \lambda(A^{-1})$ = o $\lambda(A^{2}) = \lambda^{2}(A) \Rightarrow \lambda(A^{n}) = \lambda^{n}(A)$ o $\lambda$ of idempotent matrix (ie $A = A^{2} = A^{n}$ ): 0 or 1 o $Tr(A) = \sum \lambda_{i}$
	) / die as loi valor untre ) = diag: a1 :
	2 (and by Trianguar Maring) =
V1187	· λ (diag. or triangular matrix) = diag. of #  · λ (orthogonal matrix) => χ is also an eigen value
	Diagonalisa":
	AS = SA
	$A = S \wedge S^{-1} / \Lambda = S^{-1} A S$
CH	> An = Sn S -1 ; An o as m - on if / ni/ < 1
Theren	S: matrix of eigen vectors
Jor hard	1: diagonal matrix with is as elements
big	de 2. must be uneque only then matrix
/	A is diagonalisable
	20+
OR ell	equation in 2 suplace 2 with A
for AT	$Ex: \lambda^3 - 7\lambda^2 + 15\lambda - 9 = 0$
3	$A^3 - 7A^2 + 15A - 9I = 0$
1	9I = -A 8 + 7A 2 + 15A
	9A = -A2 + 7A + 15 I
28 -	can calc. manually.

LAA:- Unit 5 Symmetric Matrica.
T C T -1
$A = SAS^{T} = QAQ^{-1} = QAQ^{T} (; Q^{T} = Q^{T})$ $A = SAS^{T} = QAQ^{-1} = QAQ^{T} (; Q^{T} = Q^{T})$ $A = SAS^{T} = QAQ^{T} = QAQ^{T} (; Q^{T} = Q^{T})$
A is soquer
Dan dels Standers
Positive definiteness:
odl proto >0
e del det. l'det. of sub matrices >0 always.
odu 2 >0
Sum of square terms: $a > 0$ $0 \times^{T}A \times > 0$ $ac - b^{2} > 0$
$\frac{\alpha}{\alpha}$
A=LDLT (LDU)  A=RTR  Cholisky Decomposi R=VDLT  A=RART  R=VDLT
A=LDLT (LDU) A=RTR
S Cholisky Decomposition R = VD LT
$A = Q \wedge Q^{T}$ $R = VD L$
$R = \sqrt{\Lambda} Q^T$
Find U, find L& LT, find D
Find U, find L& LT, find D  Find LTx & (LTx) T
$L^{T} \times L^{T} \times L^{T$
( ) D (L N)
local constant
SVD:- (oxthonormal)  A=U5V <sup>T</sup> U&V: orthogonal
MAN MAN MAN TOXIN
2: diag. wy
-> Start from highest eigen value. Veigen values
> horizontal x ventral singular
• then find & s vectors
if A: horizontal then matrix from rectors is
U (should be normalised)
Then find S : same dim. as A
Then nee find V (Vi = ATU; ) after norma
There has $0 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + $
Then for last $V_i \rightarrow \begin{bmatrix} V_1 \\ -V_2 \end{bmatrix} \begin{bmatrix} 3 \\ 3 \end{bmatrix} - \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

The second secon	[-v,-] -> converto echelon 4 then
- Andrews	[-V_1 -] -> converto echelon 4 then [-V_2 -] solve normally to get x, y, 2
V	Finally, V= [-v, -] = [-v]
	- V2 -
	Finally. V= [-V_1-]
	if A is vertical matrix
	ve get V from eigen rectors & hence "V" so we find Ug uring
	so we dind Us using
W	
	U; = AVi $\sqrt{\lambda}$ ;  asthogonality &  The one of the $\lambda$ is 0 then we use GS  process to calc. the seet of Uz 2 Uz
Deg 40	57; asthogonality 4
//	If one of the h is 0 then we use GS
93-1	process to calc. He seit of uz 2 43
No. 1	- 7
ANEUS.	If A is square nothing them A = Q 100
	a chief it A is socitive delicite To
t	o Check if A is positive definite.
it A:	The base 5
3910001110	: UDUT USE hornat  — US A values. Procedure.
	Coursiance makes:
Larrent	· find mean (w): add all matrices divide by N
V.	OB = Sub. M from all vectors. combined
i eath.	· And BT
- 1 ARX	0 S = 1 B.B
12 Hagyinti i	- A BAN ALL
,	From SVD: - U & V give fundamental spaces.
	first will be and a school !
	CLA): FIRST COLUMNA & U
	C(AT): Ar column of V
7 7 2 1 V	N(A): VM-r 1 of U
	N(A): lest n-r " of V
	V