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TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

F. Y. B. Tech. (Applied Mathematics-I)

Mathematics Practical Using Scilab

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Section-I (Solve using Scilab)

About the Work Book

Objectives of this book

This workbook is intended to be used by F. Y. B. Tech. students for the Applied Mathematics-I Practical course.

The objectives of this book are

1. To define the scope of the course.
2. Bringing uniformity in the way course is conducted.
3. Continuous assessment of the students.
4. Providing ready references for students while working in the lab.

Instructions:

For Applied mathematics-1, the theory examination is of 50 marks and 50 marks are based on continuous assessment (Attendance, test performance, tutorials, group activity, journal etc.).

Advisory Committee:

Prof. (Dr.) M. Y. Gokhale,

Prof. (Dr.) Nita Kankane (Chairman, Bord of Studies – Mathematics)

Prof. Ramaa Sandu.

Co-ordinator:

Prof. (Dr.) Prashant P. Malavadkar

Members:

Board of Study (Mathematics) members

1.) Some basic Mathematical Operations: (Addition, subtraction, multiplication and division.)

```
-->2+2
 ans  =    4.
-->2-2
 ans  =    0.
-->2*2
 ans  =   4.
-->2/2
 ans  =   1.
```

2.) Vector operations:

```
-->A=[1 2 3];

-->B=[4 5 6];

-->A+B
 ans  = 5.    7.    9.
-->A-B
 ans  = 3.  - 3.  - 3.
-->A*B
!--error 10
Inconsistent multiplication.
-->A.*B                          (--- Component wise Multiplication)
 ans  = 4.    10.    18.
-->A./B                          (--- Component wise division)
 ans  = 0.25    0.4    0.5
```

3) Matrix Operations:

```
-->A=[1 2;3 4]

        A =      1.    2.

                 3.    4.

-->B=[3 1;2 4]

         B =   3.    1.

                 2.    4.

-->A+B

        ans =   4.    3.

                 5.    8.

-->A-B

        ans =   - 2.    1.

                  1.    0.

-->A*B

        ans =   7.     9.

                 17.    19.

-->A/B                                  (--- Multiplication by B inverse)

        ans =   0.     0.5

                 0.4    0.9

-->det(A)

        ans  = - 2.

-->inv(A)

        ans  = - 2.     1.

                 1.5  - 0.5

-->trace(A)

         ans  = 5.

-->diag(A)                              (--- Diagonal elements in the Matrix)

        ans =   1.

                 4.
```

```
-->A(1,2)                    (--- accessing element a12 from A)

        ans  =    2.

 -->A(2,2)                   (--- accessing element a22 from A)

        ans  =    4.

-->A(2, :)                   (--- accessing R2 i.e. row-2 from A)

        ans  =    3.    4.

 -->A(: , 2)                 (--- accessing C2 i.e. coloumn-2 from A)

        ans  =    2.

                  4.

->size(A)                    (--- Dimension of A)

        ans  =    2.    2.

 -->length(A)                (--- No. of elements in A)

        ans  =    4.
```

4) Polynomial operations:

```
        -->x=poly(0,"x")             (--- Defining variable x)
`
                x  =   x
        -->v=[1 2 3];                (--- coefficient vector )
        -->p=poly(v,"x",["coeff"])   (--- defining polynomial)


                p  =                  2
                          1 + 2x + 3x
        -->u=[4 5 6];


        -->q=poly(u,"x",["coeff"])
                q  =
                                      2
                          4 + 5x + 6x
```

```
-->p*q
        ans  =
                                    2      3      4
                4 + 13x + 28x + 27x + 18x
-->p+q
        ans  =
                                  2
                5 + 7x + 9x
-->p-q
         ans  =
                                  2
                - 3 - 3x - 3x
-->p/q
        ans  =
                2
         1 + 2x + 3x
        -----------
                2
         4 + 5x + 6x

-->[Q]   =      pdiv(p,q)
        Q  =    0.5

-->[R,Q] =      pdiv(p,q)
        Q  =    0.5
        R  =    - 1 - 0.5x
```

```
-->roots(p)

 ans  =


 - 0.3333333 + 0.4714045i

 - 0.3333333 - 0.4714045i
```

```
-->[L]=lcm([p,q])                    (--- LCM of two polynomials)

 L  =

                    2     3       4

  4 + 13x + 28x + 27x + 18x
```

```
-->[G]=gcd([p,q])                    (--- g.c.d. of two polynomials)

 G  =      1
```

```
-->[l]=lcm([x^2+x,x+1])

 l  =

                    2

           x + x
```

```
-->[g]=gcd([x^2+x,x+1])

 g  =      1 + x
```

Computing with Scilab Part-II

a) Solving system of linear equations: i)Gaussian- Jordan Elimination

Q.1) Solve the following systems of equations.

x - 3y = -7

2x + 5y = 15

Solution :

```
-->A=[1 -3;2 5];
-->B=[-7;15];
-->rank([A B])
 ans  =  2.
-->rref([A B])
 ans  =  1.   0.   0.9090909
         0.   1.   2.6363636
```

Thus the solution is x = 0.91 and y = 2.64

ii) By Matrix inversion method

Q.1) Solve the following systems of equations.

x - 3y = -7

2x + 5y = 15

Solution :

```
-->A=[1 -3;2 5];
-->B=[-7;15];
--> det(A) = 11
-->[E]=inv(A);
 -->E*B
 ans  =  0.9090909
         2.6363636
```

Thus the solution is x = 0.91 and y = 2.64.

iii) Using Scilab fuction :

Q.1) Solve the following systems of equations.

x - 3y = -7

2x + 5y = 15

Solution :

```
-->A=[1 -3;2 5];
-->B=[-7;15];
-->A\B
 ans  =  0.9090909
         2.6363636
```

OR

```
-->linsolve(A,-B)
 ans  =  0.9090909
         2.6363636
```

Thus the solution is x = 0.91 and y = 2.64

b) Eigen values and Eigenvectors, Characteristic Poly and Diagonalization:

Q1) Find the eigen values and eigen vectors for Matrix A = 2. 7.
1. - 2.

Solution :

```
-->A=[2 7;1 -2]
 A  =   2.   7.
        1.  - 2.
 -->x=poly(0,'x')
  x  =  x
-->p=det(x*eye(2,2)-A)                    --- (Characteristic Polynomial)
 p  =              2
```

```
                    - 11 + x
```

-->roots(p)

ans = 3.3166248 --- (**Eigen values**)

- 3.3166248

Using spec function:

-->[v, e]=**spec**(A)

e =

3.3166248 0 --- (**Eigen values**)

0 - 3.3166248

v =

0.9827671 - 0.7963471 --- (**Eigen vectors**)

0.1848479 0.6048398

Diagonalization:

-->p=inv(v)

p = 0.8155659 1.0737943

- 0.2492489 1.3251629

-->p*A*v

ans = 3.3166248 4.441D-16

0 - 3.3166248

-->clean(p*s*v) --- (**Diagonal Matrix**)

ans = 3.3166248 0

0 - 3.3166248
1

Using bdiag function:

-->bdiag(A)

ans = 3.3166248 0.

0. - 3.3166248

Assignment-1

Q1.) Find Determinants and Inverse of the following matrices using **scilab** functions. Also justify the error if any.

i)

A = 1. 2. 3.
4. 3. 1.
5. 2. 4.

ii) D = 1. 2. 7.
8. 3. 1.

Q2.) Find rank by finding Reduced row echelon form of the following matrices using matrix row operations.

i)

A = 1. 2. 3.
4. 3. 1.
5. 2. 4.

ii) B = 8. 6. 3.
7. 3. 5.

Q3.) Examine for linear dependence/ independence.

i) $x_1 = (1, 2, -1, 0)$, $x_2 = (1, 3, 1, 2)$, $x_3 = (4, 2, 1, 0)$, $x_4 = (6, 1, 0, 1)$

ii) $x_1 = (1, -1, 1)$, $x_2 = (2, 1, 1)$, $x_3 = (3, 0, 2)$

Assignment-2

Q1.) Solve the following systems of linear equations.

i) $x + y=-2, y + z=1, x + z=1$

ii) $x + y + z=4, x – y + 2z =3, 2x + 3y - z=6$

iii) $x +3y –z + 8w=13, x + y + z+ 6w =13, 3x + y + z +11w=25, 4x - 2y=6$

iv) $x + y + z=3 , 2x – y + 3z=1, 4x + y+ 5z=2, 3x -2y +z=4$

Q.2) Find the Characteristic polynomial, Eigen values and eigenvectors of the following matrices.

i) $A = \begin{matrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 2 \\ 0 & 1 & 2 & 3 \\ 1 & 2 & 3 & 4 \end{matrix}$

ii) $D = \begin{matrix} 3 & 1 & 3 \\ 3 & 4 & 0 \\ 1 & 4 & 2 \end{matrix}$

iii) $E = \begin{matrix} 2 & 0 & 3 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{matrix}$

iv) $F = \begin{matrix} 1 & 0 & 3 \\ 1 & 2 & 1 \\ 0 & 0 & 2 \end{matrix}$