

***LABORATORY
MANUAL
FOR
MATHEMATICS
PRACTICALS
(WITH FOSS TOOLS)
FOR 4TH SEMESTER B.Sc.***

CONTENT

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LIST OF PROGRAMS

Lab 1: Write a program to check whether the given subgroup $H=[1,-1]$ of a group $G=[1,-1,i,-i]$ is Normal Subgroup of group G . (Scilab Program)

Lab 2: Write a program to find the Laplace Transform of $\cos(mt)$, e^{mt}

Lab 3: Write a program to find the Inverse Laplace Transform of $s/(s+4)^2$

Lab 4: Write a program to solve ODE using Laplace Transformation

$$\frac{dy}{dx} - 5y - e^{5x} = 0, \quad y(0)=2$$

Lab 5: Plot the graph for the following periodic function $f(x)=\sin(x)$ in $[-2\pi, 2\pi]$

Lab 6: Write a program to find the Fourier Series for $f(x)=x^2$ in $[-\pi, \pi]$

**Lab 7: Write a program to find the Half range Sine Series for $f(x)=x^2$ in $[0, \pi]$
Half range Cosine Series for $f(x)=a \sin(x)$ in $[0, \pi]$**

**Lab 8: Write a program to find the Extreme Value of the function
 $f(x,y)=x^3+y^3-3x-12y+20$**

Lab 9: Write a program to find the complementary function and Particular Integral of the given DE-1

Lab 10: Write a program to find the complementary function and Particular Integral of the given DE-2

Lab 11: Write a program to illustrate homomorphism and isomorphism of groups.

Lab 12: Revision

Lab 13: Preparatory Exam

NOTE:

In each lab one program has to be executed and relevant problems have to be solved manually.

Lab 1

- a. Write a program to check whether the given subgroup $H=[1,-1]$ of a group $G=[1,-1,i,-i]$ is Normal Subgroup of group G . (Scilab Program)
-

```
clear;
G=[1,-1,sqrt(-1),-sqrt(-1)];
H=[1,-1];
eg=1;
flag=0;
for j=1:4
    ig(j)=eg/G(j);
end
//mprintf("Inverse elements of G are:\n");
//disp(ig);
for k=1:2
    for m=1:4
        if G(m)*H(k)*ig(m)==H(1)|G(m)*H(k)*ig(m)==H(2) then
            flag=1;
        else
            flag=0;
        end
    end
end
if flag==1 then
    mprintf("H is a Normal subgroup\n");
else
    mprintf("H is not a Normal subgroup\n");
end
```

Output

H is a Normal Subgroup

Definition:

- b. *the above problem Manually.*

Verify

Lab 2

a. Write a program to find the Laplace Transform of $\cos(mt)$, $e^{(mt)}$

- `e(cos(m*t),t,s);` *laplac*
 - `laplace(exp(m*t),t,s);` *l:*
-

Output

- $s/(s^2 + m^2)$ $s/(s^2$
 - $1/(s - m)$ $1/(s-$
-

b. Solve the following problems manually **Solve**

- i.** $\cos(5t)$ **Cos(5t)**

***Cos(3t)**
- ii.** $t^2 e^{-3t}$ **t^2*e^**

(-3t)
- iii.** $t^3 + 3t$ **t^3+3t**

^2-6t+8
- iv.** $\frac{\sin^2 t}{t}$ **$\frac{\sin^2 t}{t}$**

Lab 3

a. Write a program to find the Inverse Laplace Transform of $s/(s+4)^2$

```
ilt(s/(s+4)^2,s,t);
```

Output

```
%e^(-4*t)-4*t*e^(-4*t)
```

b. the following problems manually

Solve

i.

$$\frac{s - \alpha}{(s - \alpha)^2 - b^2}$$

ii.

$$\frac{2s - 1}{s^2 + 8}$$

iii.

$$\frac{s^2}{(s - \alpha)^2}$$

iv.

$$\frac{1}{s(s + 1)(s + 2)}$$

Lab 4

a. Write a program to solve ODE using Laplace Transformation

$$\frac{dy}{dx} - 5y - e^{5x} = 0, \quad y(0)=2$$

```
l:laplace(diff(y(x),x)-5*y(x)-exp(5*x),x,s);
```

Output:

```
"Is "s-5" positive, negative, or zero?" positive;
```

```
-----  
s1:linsolve(l,[laplace(y(x),x,s)]);
```

```
s2:ev(s1,y(0):2);
```

```
s3:partfrac(s2,s);
```

```
ilt(rhs(first(s3)),s,x);
```

OUTPUT

```
s*laplace(y(x),x,s)-5*laplace(y(x),x,s)-1/(s-5)-y(0)
```

```
[laplace(y(x),x,s)=(y(0)*s-5*y(0)+1)/(s^2-10*s+25)]
```

```
[laplace(y(x),x,s)=(2*s-9)/(s^2-10*s+25)]
```

$$[\text{laplace}(y(x),x,s)=2/(s-5)+1/(s-5)^2]$$

$$x*\%e^{5*x}+2*\%e^{5*x}$$

Note: Alternate Method

- eqn:diff(y(x),x)-5*y(x)-exp(5*x)=0;
 - atvalue(y(x),x=0,2);
 - desolve([eqn],[y(x)]);
-

b.

Solve

the following problems manually

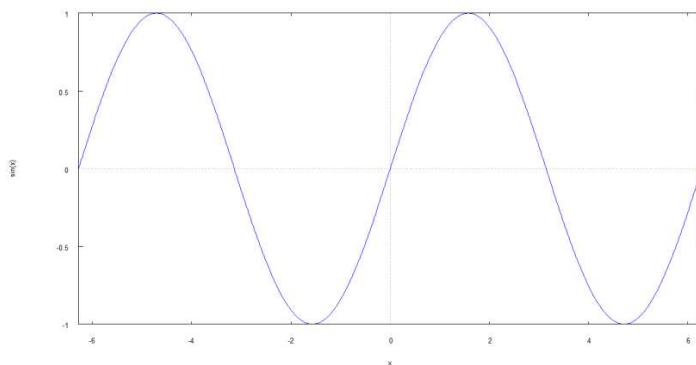
i. $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = e^{-t}\sin(t)$, $y(0)=0$, $y'(0)=1$

Lab 5

a. Plot the graph for the following periodic function $f(x) = \sin(x)$ in $[-2\pi, 2\pi]$

$$\text{plot2d}(\sin(x), [x, -2*\%pi, 2*\%pi]);$$

Output



b. Plot the graph for the following periodic functions

i. $f(x) = \sin(x)$ in $[-2\pi, 2\pi]$

ii. $f(x) = \sin(x) * \cos(x)$ in $[-2\pi, 2\pi]$

- iii. $f(x)=\cos(x)$ in $[-8,8]$
- iv. $f(x)=\tan(x)$ in $[-1,1]$

Lab 6

- a. Write a program to find the Fourier Series for $f(x)=x^2$ in $[-\pi,\pi]$
-

```
load(fourie)$
clist : fourier(x^2,x,%pi)$
print("-----")$
foursimp(clist)$
print("-----")$
f1:fourexpend(clist,x,%pi, inf);
```

Output

```
a[0]=%pi^2/3
a[n]=(2*((%pi^2*sin(%pi*n))/n-(2*sin(%pi*n))/n^3+(2*%pi*cos(%pi*n))/n^2))/%pi
b[n]=0
-----
a[0]=%pi^2/3
```

$$a[n]=(4*(-1)^n)/n^2$$

$$b[n]=0$$

$$4*(\text{sum}(((-1)^n * \cos(n*x))/n^2, n, 1, \text{inf})) + \pi^2/3$$

Note: Alternate Method

`totalfourier(x^2,x,%pi);`

b.

Solve

the following problems manually

i.

$f(x)=x-$

x^2 in $[-1,1]$

ii.

$f(x)=x^2$

$/4$ in $[-\pi,\pi]$

Lab 7

a. *Write a program to find the Half range Sine Series for $f(x)=x^2$ in $[0,\pi]$*

`load(fourie)$`

`c:foursin(x^2, x, %pi)$`

`foursimp(c)$`

`fourexpend(c,x,%pi, inf);`

Output

$b[n]=(2*((2*\pi*\sin(\pi*n))/n^2-(\pi^2*\cos(\pi*n))/n+(2*\cos(\pi*n))/n^3-2/n^3))/\pi$

$b[n]=-(2*(\pi^2*n^2*(-1)^n-2*(-1)^{n+2})))/(\pi*n^3)$

$(2*\text{sum}((-\pi^2*(-1)^n)/n+(2*(-1)^n)/n^3-2/n^3)*\sin(n*x), n, 1, \text{inf}))/\pi$

Half range Cosine Series for $f(x)=a \sin(x)$ in $[0,\pi]$

`load(fourie)$`

```
c:fourcos(a*sin(x),x,%pi)$
foursimp(c)$
fourexpend(c,x,%pi, inf);
```

Output

```
a[0]=(2*a)/%pi
a[n]=(2*((a*cos(%pi*n))/(2*n+2)-(a*cos(%pi*n))/(2*n-2)+a/(2*n+2)-a/(2*n-2)))/%pi
a[0]=(2*a)/%pi
(2*sum(((a*(-1)^n)/(2*n+2)-(a*(-1)^n)/(2*n-2)+a/(2*n+2)-a/(2*n-2))*cos(n*x),n,1,inf))/%pi+(2*a)/%pi
```

- | | |
|--|---|
| <p>b.</p> <p><i>the following problems manually</i></p> <p>i.</p> <p>series of $f(x)=x^2$ in $[0,\pi]$</p> <p>ii.</p> <p>series of $f(x)=a \sin(x)$ in $[0,\pi]$</p> | <p><i>Solve</i></p> <p><i>Sine</i></p> <p><i>Cosine</i></p> |
|--|---|

Lab 8

a. Write a program to find the Extreme Value of the function
 $f(x,y) = x^3 + y^3 - 3x - 12y + 20$

```
f:x^3+y^3-3*x-12*y+20;
fx:diff(f,x);
fy:diff(f,y);
soln:solve([fx,fy],[x,y]);
/*-----*/
a:diff(fx,x);
b:diff(fy,y);
c:diff(fx,y);
m:0$
/*-----*/
for i:1 thru length(soln) do (
a1[i]:ev(a,soln[i]),
b1[i]:ev(b,soln[i]),
```

```

c1[i]:ev(c,soln[i]))$
/*-----*/
for j:1 thru length(soln) step 1 do(
if (((a1[j]*b1[j])-c1[j]^2)>0 and a1[j]<0) then (m:1, f1[j]:ev(f,soln[j]))
elseif ((a1[j]*b1[j])-c1[j]^2)>0 and a1[j]>0) then (m:2, f1[j]:ev(f,soln[j]))
elseif ((a1[j]*b1[j])-c1[j]^2)<0) then m:3
elseif ((a1[j]*b1[j])-c1[j]^2)=0) then m:4,
if m=1 then print(" Function has maximum value at",soln[j], " and maximum value is",f1[j])
elseif m=2 then print(" Function has minimum value at",soln[j], " and minimum value is",f1[j])
elseif m=3 then print(" Function has neither maximum value nor minimum at",soln[j])
elseif m=4 then print(" Further analysis required"))$

```

Output

```

y^3-12*y+x^3-3*x+20
3*x^2-3
3*y^2-12
[[x=1,y=-2],[x=-1,y=-2],[x=1,y=2],[x=-1,y=2]]
6*x
6*y
0
Function has neither maximum value nor minimum at [x=1,y=-2]
Function has maximum value at [x=-1,y=-2] and maximum value is 38
Function has minimum value at [x=1,y=2] and minimum value is 2
Function has neither maximum value nor minimum at [x=-1,y=2]

```

- b. *the following problems manually*
- i. $x^3*y^2(1-x-y)$

Solve

$f(x,y)=x$

Lab 9

- a. *Write a program to solve DE $(D^3-3D^2+4D-2)y=e^x$*

```

kill(all)$
rhs:exp(x)$
a:1$
p:m^3-3*m^2+4*m-2$
n:solve(p,m)$
denom:ev(p,m:a)$

while denom=0 do(
denom:diff(p,m),
p:denom,
denom:ev(denom,m:a),

```

```

rhs:x*rhs)$

pi:(1/denom)*rhs$
disp("Roots of AE:",n)$
print("pi=",pi)$
print("y=cf+pi")$

```

Output

```

Roots of AE:
[m=1-%i,m=%i+1,m=1]
pi=x*%e^x
y=cf+pi

```

b.

Solve

the following problems manually

$(D^2-2D+1)y=e^x$

NOTE: Complementary function and Particular Integral has to be written manually.

Model Question Paper-1 for the IV Semester Practical Examination

I. Answer any 2 Questions

10x2=20 Marks

1. Write a program, execute and solve manually

Ex: Verify Normality of a Subgroup $[1,-1]$ of the group $[1,-1,i,-i]$

2. Write a program, execute and solve manually

Ex: Find Fourier Series for the function $f(x)=x^2$ in $[-\pi,\pi]$

3. Write a program, execute and solve manually

Ex: Find the extreme values of the function $f(x)=x^3+y^3-3x-12y+20$

II. Record – 5 Marks

III. Viva – 5 Marks

IV. Problem Solving Book – 5 Marks

Model Question Paper-2 for the IV Semester Practical Examination

I. Answer any 2 Questions

10x2=20 Marks

1. Write a program, execute and solve manually

Ex: Verify Normality of a Subgroup $[1,-1]$ of the group $[1,-1,i,-i]$

2. Write a program, execute and solve manually

Ex: Find Inverse Laplace Transform of the function $f(s) = \frac{2s - 1}{s^2 + 8}$

3. Write a program, execute and solve manually

Ex: Solve $(D^3 - 3D^2 + 4D - 2)y = e^x$

II. Record – 5 Marks

III. Viva – 5 Marks

IV. Problem Solving Book – 5 Marks

Model Question Paper-3 for the IV Semester Practical Examination

I. Answer any 2 Questions

10x2=20 Marks

1. Write a program, execute and solve manually

Ex: Find the extreme values of the function $f(x) = x^3 + y^3 - 3x - 12y + 20$

2. Write a program, execute and solve manually

Ex: Find Laplace Transform of the function $f(t)=\cos(5t)*\cos(3t)$

3. Write a program, execute and solve manually

Ex: Solve $(D^3-3D^2+4D-2)y=e^x$

II. Record – 5 Marks

III. Viva – 5 Marks

IV. Problem Solving Book – 5 Marks