SEMESTER V

16PHU514A **CLASSICAL MECHANICS (PRACTICAL)** **L T P C**
- - 4 2

Any 8 experiments

1. To determine the coupling coefficient of coupled pendulums.
2. To determine the coupling coefficient of coupled oscillators.
3. To determine the coupling and damping coefficient of damped coupled oscillator.
4. To study population models e.g. exponential growth and decay, logistic growth, species competition, predator-prey dynamics, simple genetic circuits.
5. To study rate equations for chemical reactions e.g. auto catalysis, bistability.
6. To study examples from game theory.
7. Computational visualization of trajectories in the Sinai Billiard.
8. Computational visualization of trajectories Electron motion in mesoscopic conductors as a chaotic billiard problem.
9. Computational visualization of fractal formations of Deterministic fractal.
10. Computational visualization of fractal formations of self-similar fractal.
11. Computational visualization of fractal formations of Fractals in nature – trees, coastlines, earthquakes.
12. Computational Flow visualization - streamlines, pathlines, Streaklines.

Reference Books

1. Nonlinear Dynamics and Chaos, Steven H. Strogatz, Levant Books, Kolkata, 2007
2. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.
3. An Introduction to Fluid Dynamics, G.K.Batchelor, Cambridge Univ. Press, 2002
4. Fluid Mechanics, 2nd Edn, L.D.Landau & E.M. Lifshitz, Pergamon Press, Oxford, 1987
5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
6. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
7. Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub., ISBN: 978-6133459274

CALCULATION OF DISTANCE TRAVELLED IN GIVEN TIME , TIME TAKEN TO REACH A PARTICULAR VELOCITY AND DISTANCE COVERED TO REACH A PARTICULAR VELOCITY

Aim:

To write a sci program for calculation of distance travelled in given time. Time taken to reach a particle velocity and distance covered to reach a particular velocity.

Program:

```
clc ;
clear ;
u =2.5;
t =2;
v =7.5;
a =.5;
x=(u*t) +((1/2) *a*t*t);
t1 =(v-u)/a;
x1 =((v*v) -(u*u)) /(2* a);
disp (x,'distance (inm) travelled by the particle in the first two seconds is');
disp (t1 ,'time (ins) taken by particle to reach 7.5 m/s velocity is');
disp (x1 , ' distance (inm) covered by particle to reach 7.5 m/s velocity is');
```

Output:

--->disp (x,'distance (inm) travelled by the particle in the first two seconds is'); distance (inm) travelled by the particle in the first two seconds is

6.

-->disp (t1 ,'time (ins) taken by particle to reach 7.5 m/s velocity is'); time (ins) taken by particle to reach 7.5 m/s velocity is

10.

-->disp (x1 , ' distance (inm) covered by particle to reach 7.5 m/s velocity is'); distance (inm) covered by particle to reach 7.5 m/s velocity is

50.

Result:

Distance travelled in given time. Time taken to reach a particle velocity and distance covered to reach a particular velocity is calculated using sci program.

CALCULATION OF POSITION OF PARTICLE

Aim:

Write a sci program for calculation of position of particle.

Program:

```
clc ;
clear ;

m =.01
Fx =10
Fy =5
ux =0
uy =0
t=5
ax=Fx/m;
x=( ux*t) +((1/2) *ax*t*t);
ay=Fy/m;
y=( uy*t) +((1/2) *ay*t*t);
printf ( 'at t=5s position of the particle is (i%3.2f+j%3.2f)m' ,x,y)
```

Output:

at t=5s position of the particle is(i12500.00+j6250.00)m

Result:

Position of particle is calculated using sci program.

CALCULATION OF VALUES OF CO-EFFICIENT OF STATIC AND KINEMATIC FRICTION

Aim:

Write a sci program for calculation of values of co-efficient of static and kinematic friction.

Program:

```
clc;
clear;

M =2.5
F =15
g =10
x =10
t=5
mus =F/(M*g)
a =(2* x)/(t*t)
muk =(F -(M*a))/(M*g)

printf ('the coefficient of static friction between the block and the surface is%3.2f', mus)
printf ('nn the coefficient of kinetic friction between the block and the surface is%3.2f' ,muk)
```

Output:

-->printf ('the coefficient of static friction between the block and the surface is%3.2f', mus) the coefficient of static friction between the block and the surface is 0.60

-->printf ('nn the coefficient of kinetic friction between the block and the surface is%3.2f' muk)

nn the coefficient of kinetic friction between the block and the surface is 0.52

Result:

Values of co-efficient of static and kinematic friction is calculated using sci program.

CALCULATION OF VALUE OF RADIAL AND TANGENTIAL ACCELERATION

Aim:

Write a sci program for calculation of value of radial and tangential acceleration.

Program:

```
clc;
clear;
t=3
r =20*10^ -2
function v1=f(t1)
v1 =2* t1
endfunction
v=f(t)
ar =(v*v)/r
at= derivative (f,t)
printf ('the value of radial acceleration is%dm/s^2',at)
printf ('nn the value of tangential acceleration is/s^2',at)
```

Output:

-->printf ('the value of radial acceleration is%dm/s^2',ar)

the value of radial acceleration is 180m/s^2

-->printf ('nn the value of tangential acceleration is%dm/s^2',at)

nn the value of tangential acceleration is 2m/s^2

Result:

Value of radial and tangential acceleration is calculated using sci program.

CALCULATION OF WORK DONE BY FORCE OF GRAVITY

Aim:

Write a sci program for calculation of work done by force of gravity.

Program:

```
clc;
clear;

m =20*10^ -3
u =10
g =9.8

h=(u*u) /(2* g)
W=-m*g*h
printf('the work done by force by gravity is %3.1fJ',W)
```

Output:

```
-->printf ('the work done by force by gravity is %3.1fJ',W)

the work done by force by gravity is -1.0J
```

Result:

Work done by force of gravity is calculated using sci program.

CALCULATION OF WORK DONE BY GIVEN FORCE

Aim:

Write a sci program for calculation of work done by given force.

Program:

```
clc;
clear;

function F=f(x)
F =(10+(.50* x))
endfunction
x1 =0
x2 =2
W= integrate ( 'f' ,'x' ,x1 ,x2)

printf ( ' the work done by the given force for the given displacement is%dJ',W
```

Output:

```
-->printf ( ' the work done by the given force for the given displacement is%dJ',W)
 the work done by the given force for the given displacement is 21J
```

Result:

Work done by given force is calculated using sci program.

CALCULATION OF ACCLERATION OF CENTRE OF MASS

Aim:

Write a sci program for calculation of acceleration of centre of mass.

Program:

```
clc;
clear;

M =2.5
F1 =6
F2 =5
F3 =6
F4 =4
theta1 =0
theta2 =37
theta3 =53
theta4 =60

Fx =(- F1* cosd ( theta1 ))+( F2* cosd ( theta2 ))+( F3* cosd (theta3 ))+( F4* cosd ( theta4 ))
Fy =( F1* sind ( theta1 ))+( F2* sind ( theta2 ))+(- F3* sind (theta3 ))+( F4* sind ( theta4 ))
F= sqrt (( Fx*Fx)+( Fy*Fy))
theta = atand (Fy/Fx)
acm =F/M
printf ('the acceleration of the centre of mass is%3.1fm/s^2 and is in the direction of ther esultant force',acm)
```

Output:

--->printf ('the acceleration of the centre of mass is%3.1fm/s^2 and is in the direction of the resultant force', acm)

the acceleration of the centre of mass is1.6m/s^2 and is in the direction of the resultant force

Result:

Acceleration of centre of mass is calculated using sci program.

CALCULATION OF FRICTIONAL CHANGE IN KINETIC ENERGY

Aim:

Write a sci program for calculation of frictional change in kinetic energy.

Program:

```
clc;
clear;

vb =20
v1 =30
M=1
v =(1/ M) *(( M*vb *2) -(M*v1))
deltake =(M*v1*v1 /(2*2) )+(M*v*v /(2*2) ) -(M*vb*vb /2)
fdeltake = deltake /(M*vb*vb /2)

printf ( ' the fractional change in the kinetic energy is %3.2f' ,fdeltake )
```

Output:

```
->printf ( ' the fractional change in the kinetic energy is%3.2f' ,fdeltake )

 the fractional change in the kinetic energy is 0.25
```

Result:

Frictional change in kinetic energy is calculated using sci program.