MATHLAB(MSc 2017-18)

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Part-A: Mathematica

01.(a) Integration using Simpson 3/8 rules

```
------------------------------------------------------------------------

f[x_]:=Exp[x*x];

a=0;

b=1;

ev=N[Integrate[f[x],{x,a,b}]];

n=12;

h=(b-a)/n;

s=f[a]+f[b];

For[i=1,i<n,i++,If[Mod[i,3]==0,s=s+2*f[a+i*h],s=s+3*f[a+i*h]]];

mh=N[(3*h/8)*s];

Print["---------------- Result ----------------"];

Print["Actual Value = ",ev]

Print["Using Simpson's 3/8 =",mh]

Print["Error = ",ev-mh]
```

01.(b) Integration using Weddles's rules

```
f[x_]:= 1/(1+x*x);
 a = 0;
 b = 6;
 n = 12;
 h = (b-a)/n;
 ev = N[Integrate[f[x],{x,a,b}]];

 y = {f[0]};
 For[i=1,i< 13, i++ , AppendTo[y,f[a+i*h]]]

 w = (3*h/10)*(  (Part[y,1]+Part[y,13])
              +5*(  Part[y,2]
          +Part[y,6]
          +Part[y,8]
          +Part[y,12])
              + 2*Part[y,7]
              +(Part[y,3]
            +  Part[y,5]
            +Part[y,9]
            +Part[y,11])
               + 6*(Part[y,4]
            +Part[y,10]));

 Print["-------- Output ----------"]
 Print["Actual Value = ",ev];
 Print["Using Weddles's Rule = ", N[w]];
 Print["Error = ", ev-w]
```

02.(i) Solving Initial Value problems.

$$\text{DSolve}[\{y''[x] - 7 * y'[x] + 10 * y[x] == 0, y[0] == 1, y'[0] == 3\}, y[x], x]$$

02.(ii)

$$\text{DSolve}[\{y''[x] + 4 * y[x] == 2 * \text{Sin}[2 * x], y[0] == 0, y'[0] == 0\}, y[x], x]$$

02.(iii)

```
f=(x*x-y[x]*y[x]) -x*y[x] *y'[x]
DSolve[{f==0, y[1]==1},y[x],x]
```

03.(a) Solving System of linear equations.(Gauss Jacobi)

```
----------------------------------------------------------------------
Print["Using Gauss Jacobi"];
xx = (85-6*y+z)/27;
yy = (72-6*x-28z)/15;
zz =  (110-x-y)/54;

xs = 0.001;
ys = 0.002;
zs = 0.003;

For[i=1,i<16,i++,{
aa = (85-6*ys+zs)/27;
bb = (72-6*xs-2*zs)/15;
cc =  (110-xs-ys)/54;
Print[i,"   ","  ",N[xs],"  ",N[ys],"  ",N[zs]] ;
xs = aa;
ys  = bb;
zs   = cc;
}];
Print["Actual Result"];
Solve[{27*x+6*y-z==85, 6*x+15*y+2*z==72,x+y+54*z==110},{x,y,z}] //N
----------------------------------------------------------------------
```

3.(b) Solve system of linear equation using matrix

```
----------------------------------------------------------------------
Print["Actual Solution"];
Solve[{x+2y+3z ==-4, 2x+4y+5z==-7,3x+5y+6z==-10},{x,y,z}]
A ={{1,2,3},{2,4,5},{3,5,6}};
B = {-4,-7,-10} ;
Print["Solution using Matrix Inversion"];
X = Inverse[A].B
----------------------------------------------------------------------
```

3.(c) Solve System of Linear equation using Gauss Jordan Method

```
----------------------------------------------------------------
Print["Actual Solution"];
Solve[{x+2y+z ==8, 2x+3y+4z==20,4x+3y+2z==16},{x,y,z}]
A = {{1,2,1,8},{2,3,4,20},{4,3,2,16}};
Print["Reduced Matrix"];
RowReduce[A] //MatrixForm
Print["Result using Jordan Elimination method"];
RowReduce[A][[All,4]] // MatrixForm
```

04.(a) Complex Analysis – Testing Analytic function

```
-----------------------------------------------------------------
u[x_,y_]=x*x*x+x*y*y;
v[x_,y_]=y*y*y+x*x*y;

ux=D[u[x,y],x];
uy=D[u[x,y],y];
vx=D[v[x,y],x];
vy=D[v[x,y],y];

If[ux===vy&&vx===-uy,Print[u[x,y]+Iv[x,y],"is
Analytic"],Print["w=",u[x,y],"+",I*v[x,y],"is not Analytic"]];

-----------------------------------------------------------------------
```

04.(b) Harmonic Function Testing

```
-----------------------------------------------------------------------
f[x_,y_]= (1/2)*Log[x*x+y*y];

fx  = D[f[x,y],x];
fxx= D[fx,x];
fy  = D[f[x,y],y];
fyy =D[fy,y];
If[Simplify[fxx+fyy] === 0 , Print["Harmonic"],Print["Not
Harmonic"]];
fx = D[f[x,y],x] /. {x-> z , y-> 0};
 fy   = D[f[x,y],y] /. {x-> z , y-> 0};
m = Integrate[fx-I*fy,z];
v = Im[m /. z-> x+I*y] //ComplexExpand
-----------------------------------------------------------------------
```

5.(a) Application of newton's Law of Cooling

```
-----------------------------------------------------------------
diff = (T-20);
k =- Integrate[1/diff, {T,70,40}]/Integrate[1,{t,0,3}];
E1 = Integrate[1/diff,{T,70,T}];
E2 = -k*Integrate[1,{t,0,6}];
s= Solve[E1 == E2 , T];
Print["Required temperature = ",  s[[All,1,2]] ," Fahrenheit "];
-----------------------------------------------------------------
```

5.(b) Solving ODE with NDSolve and DSolve

```
-----------------------------------------------------------------
E1 = DSolve[{y'[x]==1+0.5*y[x]*y[x], y[0]==1},y[x],x];
s1[x_] = E1[[1,1,2]];
E2 = NDSolve[{y'[x]==1+0.5*y[x]*y[x], y[0]==1},y[x],{x,0,1}];
s2[x_]= E2[[1,1,2]];
data = Table[{x,s1[x],s2[x]},{x,0,1,.1}];
TableForm[data,TableHeadings->{None,{"x","Analytic","Numerical"}}]
Plot[{s1[x],s2[x]},{x,0,1}]
-----------------------------------------------------------------
```

Part-B Fortran

08. Find real root of the equation $x^3 - 2x - 5 = 0$ using Bisection method

Solution:

```
---------------------------------------------------------------


        f(x) = x*x*x - 2.0*x -5.0
        print*,"Enter the value of a and b : "
10      read(5,*) a,b
        f1 = f(a)
        r  = f(b)
        if( r*f1 .GE. 0.0) goto 10
        print*,"   N              A              B"
        n = 1
        q = 0.1e-4
20      c = (a+b)/2
        g = f(c)
        if( g .EQ. 0.0) then
          b = c
        else
          a  = c
          f1 = g
        end if

        if(abs(b-a) .LT. q) goto 35
        write(6,30) n,a,b
30      format(3x , i2 , 2x , 2f15.6)
        n = n+1
        goto 20
35      c=(a+b)/2
        write(6,50) c
50      format(3x, "The root is x =" , f15.6)
        end


---------------------------------------------------------------
Sample Input: 2  3
---------------------------------------------------------------
```

10. Find the value of $\int_a^b e^{\frac{x}{2}} dx$ using Trapezoidal rules

Solution:

```
---------------------------------------------------------------

        integer i
        real h, sum , x , f , a , b
        print*,"Enter the value of a and b"
        read*, a , b
        n = 60
        h = (b-a)/real(n)
        sum = 0.5*(f(a)+f(b))
        do i = 1 , n-1
           x = a+i*h
           sum = sum + f(x)
        enddo
        sum = h*sum
        print*,"Value of the Integration = ", sum
        end

        function f(x)
        f = exp(x/2.0)
        return
        end function

---------------------------------------------------------------
Sample Input: 1  2
---------------------------------------------------------------
```

12. Integration using simpson 3/8 rules

Solution:

```
---------------------------------------------------------------
        real function f(x)
        real x
        f = 1.0 - exp(-x/2.0)
        return
        end function

        real y(7)
        real a,b,sum,n,init
        print*,"Enter lower and upper limit: "
        read*,a,b
        init = a
        n = 6.0
        h = (b-a)/n

        do i=1,7
           y(i) = f(init)
           init = init + h
        enddo
        sum = h/3.0*((y(1)+y(7)) + 4*(y(2)+y(4)+y(6)) +    2*(y(3)+y(5)))
        print*,"Value of the Integration = ",sum
        end


---------------------------------------------------------------
Sample Input: 1 2
---------------------------------------------------------------
```

15. Determining binomial coefficient nCr using function sub program

Solution:

```
----------------------------------------------------------------
        integer n,r
  22    print*,"Enter the value of n and r"
        read*,n,r
        if(n .LE. r) then
           print*,"n must be greater than r"
           goto 22
        endif
        nr = n-r
        ib = ifact(n)/(ifact(r)*ifact(nr))
        print*,"value of nCr = ",ib
        end

        function ifact(k)
         isum = 1;
         do i = 1,k
            isum = isum * i
         enddo
         ifact = isum
        return
        end
```

```
----------------------------------------------------------------
Sample Input: 5 2
----------------------------------------------------------------
```

16. Matrix Multiplication C=AB Where order of A = 3x4 and B = 4x5

Solution:

```
-----------------------------------------------------------------

        integer p
        parameter(m=3,n=4,p=5)
        dimension a(m,n), b(n,p) , c(m,p)

        print*,"Enter the Matrix A: "
        read*, ((a(i,j), j=1,n), i=1,m)
        print*,"Enter the Matrix B: "
        read*, ((b(i,j), j=1,p), i=1,n)

        do i=1,m
           do j=1,p
             sum = 0.0
             do k=1,n
                sum = sum + a(i,k)*b(k,j)
                c(i,j) = sum
             enddo
           enddo
        enddo

        print*," Product of A and B Matrix"
        print 30, ((c(i,j),j=1,p),i=1,m)
   30   format(2x3(2x,F8.2))
        end
-----------------------------------------------------------------
Sample Input: Matrix A: 1 2 3 2 1 3 5 3 1 4 2 3
              Matrix B: 2 1 3 5 8 6 5 4 2 1 4 5 6 7 3 4 5 6 3 4
-----------------------------------------------------------------
```

END