THIAGARAJAR COLLEGE OF ENGINEERING

(A Govt. Aided Autonomous institution affiliated to Anna University)

Madurai – 625 015

DEPARTMENT OF MATHEMATICS

22MA110 – Calculus for Engineers

MATLAB MANUAL

Common to all I Year B.E/B.Tech Students

[ACADEMIC YEAR: 2023 – 2024]

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MATLAB MANUAL

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1	Limit of a function
2	Derivatives of Functions
3	Partial Derivatives with two or three variables
4	Definite and Indefinite Integrals
5	Area and Volume
6	Double Integrals
7	Triple Integrals

Limit of a function

Aim : To find the limit of the following using MATLAB.

$(i)\ \lim_{x\to 3^+} \frac{2x}{x-3}$ $(ii)\ \lim_{x\to 3^-} \frac{2x}{x-3}$

$(iii)\ \lim_{x\to -2} \frac{x^3+2x^2-1}{5-3x}$ $(iv)\ \lim_{x\to \pi} \frac{\sin x}{2+\cos(x)}$

Main Commands: syms – to assign variables
limit – to find the limit

Source Code

(i)
```
>> syms x
>> f = 2*x/(x-3);
>> limit(f,x,3,'right')
```

(ii)
```
>> syms x
>> f = 2*x/(x-3);
>> limit(f,x,3,'left')
```

(iii)
```
>> syms x
>> f = (x^3+2*x^2-1)/(5-3*x);
>> limit(f,x,-2)
```

(iv
```
>> syms x
>> f = (sin(x))/(2+cos(x));
>> limit(f,x,pi)
```

Output (i) ans = ∞ (ii) ans = $-\infty$

(iii) ans = $\frac{-1}{11}$ (iv) ans = 0

Derivatives of Functions

Aim To compute the derivatives of the following polynomials and functions.
Find the first order derivative of the following functions, using MATLAB.

$(i)\ y = \frac{x^2+x-2}{x^3+6}$ $(ii)\ g = x^2 \sin x$

Main Commands diff- differentiate the given function
simplify Fraction – simplify symbolic rational expressions

Source Code

(i)
```
>> syms x
>> y=(x^2+x-2)/(x^3+6)
>> diff(y,x)
>> simplifyFraction(ans)
```

(ii)
```
>> syms x
>> g=x^2*sin(x)
>> diff(g,x)
```

Output (i) (- x^4 - 2*x^3 + 6*x^2 + 12*x + 6)/(x^3 + 6)^2 (ii) x^2*cos(x) + 2*x*sin(x)

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Partial Derivatives with two or three variables

Aim : To calculate the partial derivatives of the given function using MATLAB. using MATLAB. (i) Find the second order partial derivatives of $f(x, y) = x^3 + x^2 y^3 - 2y^2$ (ii) Calculate f_{xxyz}, if $f(x, y, z) = \sin(3x + yz)$.

Main Commands syms– to assign the variables
diff – to find the derivative

Source Code

(i)
```
>> syms x y
>> f = x^3 + (x^2)*(y^3) – 2*y^2
>> fx= diff(f,x)
>> fxx=diff(diff(f,x),x)
>> fy=diff(f,y)
>> fyy=diff(diff(f,y),y)
>> fxy=diff(diff(f,x),y)
>> fyx=diff(diff(f,y),x)
```

(ii)
```
>> syms x y z
>> f = sin(3*x+y*z)
>> fx=diff(f,x)
>> fxx=diff(diff(f,x),x)
>> fxxy=diff(diff(diff(f,x),x),y)
>> fxxyz=diff(diff(diff(diff(f,x),x),y),z)
```

Output (i) fxx = 2*y^3 + 6*x, fyy = 6*x^2*y – 4 and fxy = fyx = 6*x*y^2
(ii) fxxyz = 9*y*z*sin(3*x + y*z) - 9*cos(3*x + y*z)

Definite and Indefinite Integrals

Aim : To evaluate definite and indefinite integrals using MATLAB.
Evaluate the following integrals.

$$(i)\ \int_0^1 \sqrt{1-x^2}\,dx \qquad (ii)\ \int_0^1 (4+3x^2)dx$$

$$(iii)\ \int (10x^4 - 2\sec^2 x)dx \qquad (iv)\ \int_1^9 \frac{2t^2 + t^2\sqrt{t} - 1}{t^2}\,dx$$

Main Commands int – used to find the integration
disp- used to display

Source Code

(i)
```
>> syms x
>> f=sqrt(1-x^2);
>> int(f,x,0,1)
```

(ii)
```
>> syms x
>> f=4+3*x^2;
>> int(f,x,0,1)
```

(iii)
```
>> syms x
>> f=10*x-2*sec(x)^2;
>> int(f,x)
```

(iv)
```
>> syms x
>> f=(2*t^2+t^2*t^(1/2)-1)/t^2
>> int(f,x,1,9)
```

Output (i) ans = pi/4 (ii) ans = 5 (iii) ans = 5*x^2 – 2*tan(x) (iv) ans = 292/9

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Area and Volume

Aim :To calculate the area and volume of the given surface using MATLAB.

(i) The arc of the parabola $y = x^2$ from (1,1) to (2,4) is rotated about the y-axis. Find the area of the resulting surface. (ii) Find the volume of the solid obtained by rotating the region bounded by $y = x^3, y = 8$ and $x = 0$ about the *y-axis.*

Main Commands int – used to find the integration

Source Code **(i)**

```
>> syms x
>> y= x^2;
>> Dy=diff(y,x);
>> S=2*pi*x*sqrt(1+Dy^2);
>> area =int(S,x,1,2)
```

(ii)

```
>> syms y
>> A= pi*y^(2/3);
>> volume =int(A,y,0,8)
```

Output area = -(pi*(5*5^(1/2) - 17*17^(1/2)))/6

volume = (96*pi)/5

Conclusion Found the area and volume of a given surface

Double Integrals

Aim To evaluate the double integral in Cartesian coordinates and area as double integrals, using MATLAB.

(i) Evaluate $\int_0^1 \int_0^2 xy(x^3 + y^4)dxdy$. (ii) Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy(x + y)dxdy$.

(iii) Find the area bounded by the parabolas $y^2 = 4ax$ and $x^2 = 4ay$.

Main Commands syms – used to assign variables
int – to find the integration

Source Code **(i)**

```
>> syms x y
>> f = x*y*(x^3+y^4);
>> int(int(f,x,0,2), y,0,1)
```

(ii)

```
>> syms x y
>> f = x*y*(x+y);
>> int(int(f,y,x,sqrt(x)), x,0,1)
```

(iii)

```
>> syms x y a
>> pretty(int(int(1,y,(x^2)/(4*a),2*sqrt(a*x)),x,0,(4*a)))
```

Output **(i) ans = 53/15 (ii) ans = 3/56 (iii) ans = (16*a^2)/3**

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Triple Integrals

Aim : To evaluate the triple integrals in Cartesian coordinates and volume as triple integrals, using MATLAB.

(i) Evaluate $\int_0^3\int_0^1\int_0^2 xyz(x^2+y)dxdydz$. (ii) Evaluate $\int_0^2\int_0^1\int_0^3 xy(x+y+z)dzdydx$.

(iii) Find the volume of the sphere $x^2+y^2+z^2=16$.

Main Commands syms – used to assign variables, int – to find the integration

Source Code

(i)

```
>> syms x y z
>> f = x*y*z*(x^2+y);
>>int(int(int(f,x,0,2), y,0,1),z,0,3)
```

(ii)

```
>>syms x y z
>> f = x*y*(x+y+z);
>> int(int(int(f,z,0,3), y,0,1),x,0,2)
```

(iii)

```
>> syms x y
>>int(int(int(8,z,0,sqrt(16-x^2-y^2)),y,0,sqrt(16-x^2)),x,0,4)
```

Output (i) ans = 12 (ii) ans = 21/2 (iii) ans = (256*pi)/3

Conclusion Triple integrals in Cartesian coordinates and volume as triple integrals are evaluated.

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