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King Abdulaziz University – Physics Department - The 2nd Semester of 1429 H.

Computational Physics 393 – **Lab # 5**

Question 1 (8 Marks)

Use Maple to verify the following functional identities.

a) $cos(x) = \frac{e^{(ix)} + e^{(-ix)}}{2}$

b) $cos(ix) = cosh(x)$

Question 2 (8 Marks)

a) Make a 3D plot of the real and imaginary parts of the function $z = r^5 e^{(i5\theta)}$ between $r = -3 \to 3$ and $\theta = -3 \to 3$.

b) Then plot the real and imaginary parts of function in 2D.

Question 3 (16 Marks)

If $A = \begin{pmatrix} 1 & 8 & 2 \\ 2 & -7 & 6 \\ 3 & 4 & -5 \end{pmatrix}$, $B = \begin{pmatrix} -2 & 5 & -4 \\ 3 & -1 & 9 \\ 7 & 1 & 0 \end{pmatrix}$, $C = \begin{pmatrix} 3 & 5 & 2 \\ -3 & 1 & 4 \\ 0 & 9 & 7 \end{pmatrix}$,

a) Calculate $E=B+A-2C$.

b) Calculate F= C.B

c) Calculate the inverse of F.

d) show that $\det(BAB^{-1}) = \det(A)$

e) show that $(A^T)^{-1} = (A^{-1})^T$

Lab # 5

Question 1 (8 Marks)

(a)

```
> restart;
```

Let us named the *RHS* term F, then

```
> F:=(exp(I*x)+exp(-I*x))/2;
```

$$F := \frac{1}{2}\, e^{I x} + \frac{1}{2}\, e^{-I x}$$

Using Maple's command **evalc**, we find that F equals ;

```
> evalc(F);
```

$$\cos(x)$$

Hence; *RHS=LHS.*

(b)

```
> restart;
```

Let us named the *LHS* term G, then

```
> G:=cos(I*x);
```

$$G := \cosh(x)$$

Using Maple's command **evalc**, we find that G equals ;

```
> evalc(G);
```

$$\cosh(x)$$

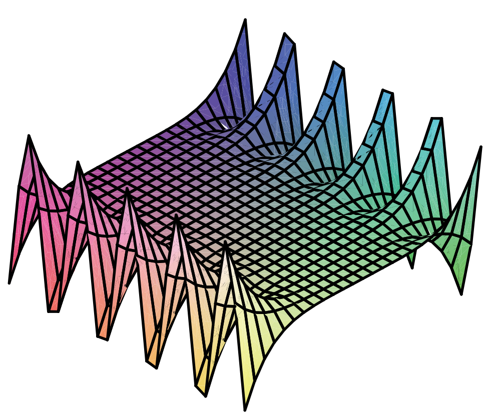
Hence; *RHS=LHS.*

Question 2 (8 Marks)

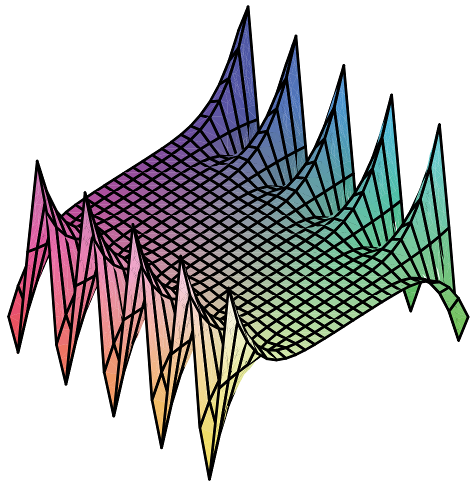
```
> restart;
> z:=r^5*exp(I*5*theta);
```

$$z := r^5\, e^{5 I \theta}$$

```
> plot3d(Re(z),r=-3..3,theta=-3..3);
```

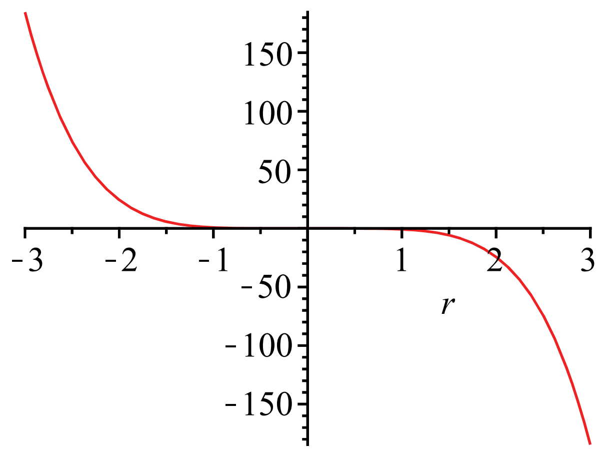


```
> plot3d(Im(z),r=-3..3,theta=-3..3);
```



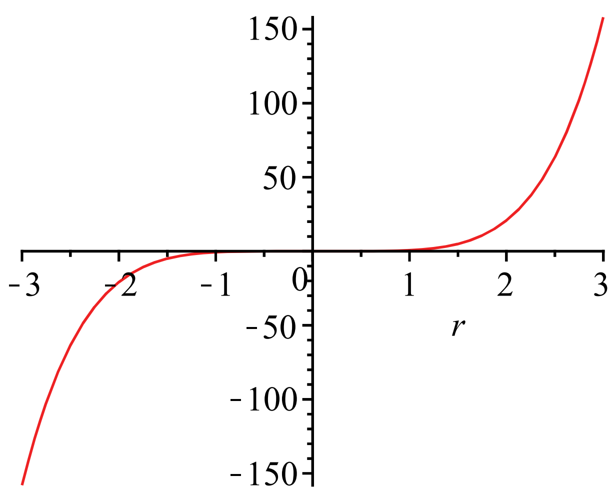
> $\theta := 3; plot(\Re(z), r=-3..3);$

$$\theta := 3$$



> $\theta := 3; plot(\Im(z), r=-3..3);$

$$\theta := 3$$



Question 3 **(16 Marks)**

```
> restart;with(LinearAlgebra):
> A:=Matrix([[1,8,2],[2,-7,6],[3,4,-5]]);
```

$$A := \begin{bmatrix} 1 & 8 & 2 \\ 2 & -7 & 6 \\ 3 & 4 & -5 \end{bmatrix}$$

```
> B:=Matrix([[-2,5,-4],[3,-1,9],[7,1,0]]);
```

$$B := \begin{bmatrix} -2 & 5 & -4 \\ 3 & -1 & 9 \\ 7 & 1 & 0 \end{bmatrix}$$

```
> C:=Matrix([[3,5,2],[-3,1,4],[0,9,7]]);
```

$$C := \begin{bmatrix} 3 & 5 & 2 \\ -3 & 1 & 4 \\ 0 & 9 & 7 \end{bmatrix}$$

(a)

```
> E:=B+A-2*C;
```

$$E := \begin{bmatrix} -7 & 3 & -6 \\ 11 & -10 & 7 \\ 10 & -13 & -19 \end{bmatrix}$$

Or;

```
> E:=Add(B,A)-2*C;
```

$$E := \begin{bmatrix} -7 & 3 & -6 \\ 11 & -10 & 7 \\ 10 & -13 & -19 \end{bmatrix}$$

(b)

```
> F:=C.B;
```

$$F := \begin{bmatrix} 23 & 12 & 33 \\ 37 & -12 & 21 \\ 76 & -2 & 81 \end{bmatrix}$$

Or;

```
> F:=Multiply(C,B);
```

$$F := \begin{bmatrix} 23 & 12 & 33 \\ 37 & -12 & 21 \\ 76 & -2 & 81 \end{bmatrix}$$

(c)

```
> Fin:=1/F;
```

$$Fin := \begin{bmatrix} \frac{155}{1758} & \frac{173}{1758} & -\frac{18}{293} \\ \frac{467}{3516} & \frac{215}{3516} & -\frac{41}{586} \\ -\frac{419}{5274} & -\frac{479}{5274} & \frac{20}{293} \end{bmatrix}$$

```
> Fin:=MatrixInverse(F);
```

$$Fin := \begin{bmatrix} \frac{155}{1758} & \frac{173}{1758} & -\frac{18}{293} \\ \frac{467}{3516} & \frac{215}{3516} & -\frac{41}{586} \\ -\frac{419}{5274} & -\frac{479}{5274} & \frac{20}{293} \end{bmatrix}$$

(d)

```
> Determinant(B.A.(1/B)) ;
```

$$293$$

```
> Determinant(A);
```

$$293$$

Then ; $det(BAB^{-1}) = det(A)$

(e)

```
> 1/Transpose(A);
```

$$\begin{bmatrix} \frac{11}{293} & \frac{28}{293} & \frac{29}{293} \\ \frac{48}{293} & -\frac{11}{293} & \frac{20}{293} \\ \frac{62}{293} & -\frac{2}{293} & -\frac{23}{293} \end{bmatrix}$$

```
> Transpose(1/A);
```

$$\begin{bmatrix} \frac{11}{293} & \frac{28}{293} & \frac{29}{293} \\ \frac{48}{293} & -\frac{11}{293} & \frac{20}{293} \\ \frac{62}{293} & -\frac{2}{293} & -\frac{23}{293} \end{bmatrix}$$

Then; $(A^T)^{-1} = (A^{-1})^T$