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BSC (HONS.)MATHS
COMPLEX ANALYSIS PRACTICAL
INTERNAL ASSESMENT

QUESTION 1

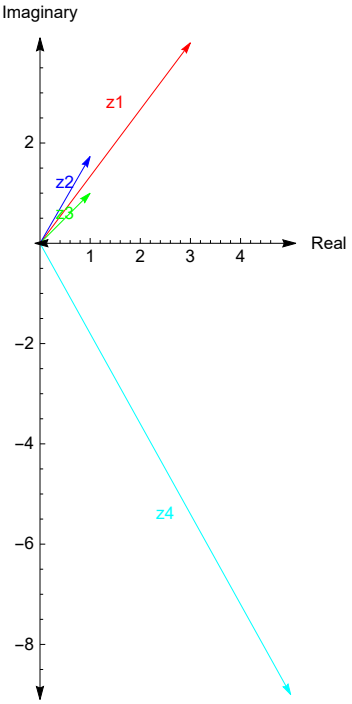
In[161]:=
```
Array[A, 4];
A = {3 + 4 i, 1 + √3 i, 1 + i, 5 - 9 i};
x = Conjugate[A];
y = Abs[A];
z = Arg[A];
Print["The conjugate of given Array A = ", x]
Print["The modulus of given Array A = ", y]
Print["The Phase Angle of given Array = ", z]
z1 = Graphics[{Red, Arrow[{{0, 0}, {Re[A[[1]]], Im[A[[1]]]}}],
    Text["z1", {Re[A[[1]]] / 2, 0.7 Im[A[[1]]]}]}, Axes → True,
   AxesStyle → Arrowheads[{-0.05, 0.05}], AxesLabel → {Real, Imaginary}];
z2 = Graphics[{Blue, Arrow[{{0, 0}, {Re[A[[2]]], Im[A[[2]]]}}],
    Text["z2", {Re[A[[2]]] / 2, 0.7 Im[A[[2]]]}]}, Axes → True];
z3 = Graphics[{Green, Arrow[{{0, 0}, {Re[A[[3]]], Im[A[[3]]]}}],
    Text["z3", {Re[A[[3]]] / 2, 0.6 Im[A[[3]]]}]}, Axes → True];
z4 = Graphics[{Cyan, Arrow[{{0, 0}, {Re[A[[4]]], Im[A[[4]]]}}],
    Text["z4", {Re[A[[4]]] / 2, 0.6 Im[A[[4]]]}]}, Axes → True];
Show[z1, z2, z3, z4]
```

The conjugate of given Array A = $\{3-4i, 1-i\sqrt{3}, 1-i, 5+9i\}$

The modulus of given Array A = $\{5, 2, \sqrt{2}, \sqrt{106}\}$

The Phase Angle of given Array = $\left\{\text{ArcTan}\left[\frac{4}{3}\right], \frac{\pi}{3}, \frac{\pi}{4}, -\text{ArcTan}\left[\frac{9}{5}\right]\right\}$

Out[173]=

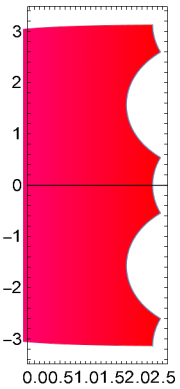


QUESTION 2

In[65]:=
```
ClearAll[x, y, z]
```

In[41]:=
```
f[z_] := Log[z]
ParametricPlot[{Re[f[x + i y]], Im[f[x + i y]]},
 {x, -10, 10}, {y, -6, 6}, ColorFunction → Hue]
```

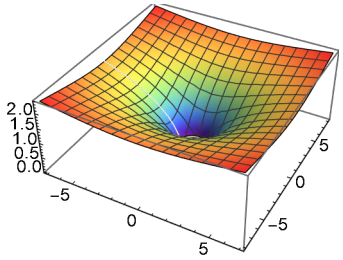
Out[42]=



In[81]:=
```
f[z_] := Log[z]
Print[Re[f[x + i y]], " = ", ComplexExpand[Re[f[x + i y]]]]
Plot3D[Re[f[x + i y]], {x, -7, 7}, {y, -8, 8}, ColorFunction → "Rainbow"]
Print[Im[f[x + i y]], " = ", ComplexExpand[Im[f[x + i y]]]]
Plot3D[Im[f[x + i y]], {x, -5, 5}, {y, -6, 6}, ColorFunction → "TemperatureMap"]
```

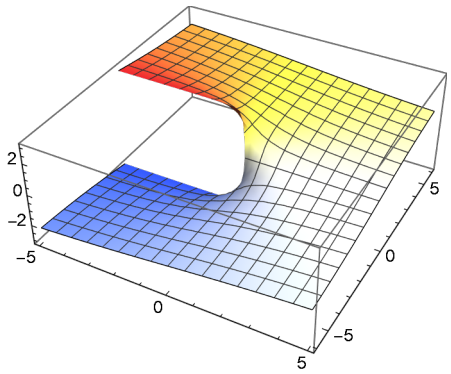
$$\text{Re}[\text{Log}[x + i\,y]] = \frac{1}{2}\text{Log}\left[x^2 + y^2\right]$$

Out[83]=



$$\text{Im}[\text{Log}[x + i\,y]] = \text{Arg}[x + i\,y]$$

Out[85]=



QUESTION 3

In[179]:=
```
ClearAll[z, t, m]
```

In[185]:=
```
f[z_] = Conjugate[z];
z[t_] = t^2 + i t;
Print["Contour C: z(t) = ", z[t], " where t∈[0,2]"]
m = Integrate[(f[z[t]] * D[z[t], t]), {t, 0, 2}];
Print["∫Conjugate[z]dz = ", m]
```

$$\text{Contour C: } z(t) = i\,t + t^2 \text{ where } t\in[0,2]$$

$$\int \text{Conjugate}[z]\,dz = 10 - \frac{8\,i}{3}$$

QUESTION 4

In[6]:=
```
f[z_] := (e^z) / ((z^2) + (π^2));
s = z /. Solve[Denominator[f[z]] == 0, z];
Print["Singularities are ", s];
For[i = 1, i ≤ Length[s], i++,
res = Residue[f[z], {z, s[[i]]}];
Print["Residue at ", s[[i]], " is ", res]]
```

Singularities are $\{-i\pi, i\pi\}$

Residue at $-i\pi$ is $-\frac{i}{2\pi}$

Residue at $i\pi$ is $\frac{i}{2\pi}$

QUESTION 5

In[1]:=
```
f[z_] := Sin[z]
n = 100;
pt = -10 - √3 i;
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, π/4, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.02, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 2% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
```

Minimum number of terms required to get a percentage error less than 2% is 29

The Percentage error is 0.00790307