7.1

The only point we have to keep in mind is that if
ROC includes |z|=1, the system is stable.

If an ROC is outside the outermost pole and includes infinity, then the system is causal.

7.2

c) For the given system functional, two different responses are possible as there can be two different ROCs. Here, we get the functional corresponding to |z|>p, which is **causal** and stable and gives **right sided impulse response** (–p)^n*u[n]. The other response possible is -(-p)^n*u[-n-1].

Clearly we have an iir filter as a^n is infinite signal.

*NOTE: In the graphs we plotted magnitude in dB which is log10(H(w)). So while analysing we have to keep this in mind.

d) For p=-0.8 we get 0.8^n*u[n] as the impulse response. This is different from the previous one as the previous one is oscillating between positive and negative values.

For p=0.8 we get a low pass filter whereas for p=-0.8 we get a high pass filter in the magnitude response.

For p=0.1 we get almost the same behaviour as p=0.8, just the magnitude is reduced a bit.

e) When we repeated the same experiment, we found that the magnitude response is constant value(1/p) So this is an **all pass filter**

7.3)

a) The poles are r(cos(theta)+sin(theta)), r(cos(theta)-sin(theta))

The zeros are cos(theta)+sin(theta), cos(theta)-sin(theta)

b)**Yes,** the system can act as both stable and causal system as the modulus of poles is r.

For **|z|>r,** the system acts as both stable and causal system because ROC includes |z|=1 which is the condition for stability and since this ROC is outside the outer most pole and includes infinity, the system is causal.

c) We noticed that in the decibel plot, the value is nearly zero at all times and is a large negative value at w=theta. This means that the magnitude response is nearly 1 at all times and is nearly 0 when w=theta.

d) As we increase r, the expression in the decibel plot approaches zero which means that in the magnitude response, the value is reaching 1(from left side) as the value of r increases from 0 to 1.

7.4)

Here instead of the decibel plot we plotted the normal H(w) vs w plot.

Observations and inferences:

We noticed that we have local minimas at 0 and pi and the graph is symmetric about pi, this means that all the roots are symmetric about the x axis meaning there are no real roots and has one pair of purely complex roots that is on y axis.

Another inference based on the number of peaks is that we have 6 roots.

We also noticed that the value at pi is greater than that of 0 meaning that the complex pair of roots nearer to zero have higher magnitude than that of the roots which are nearer to pi.