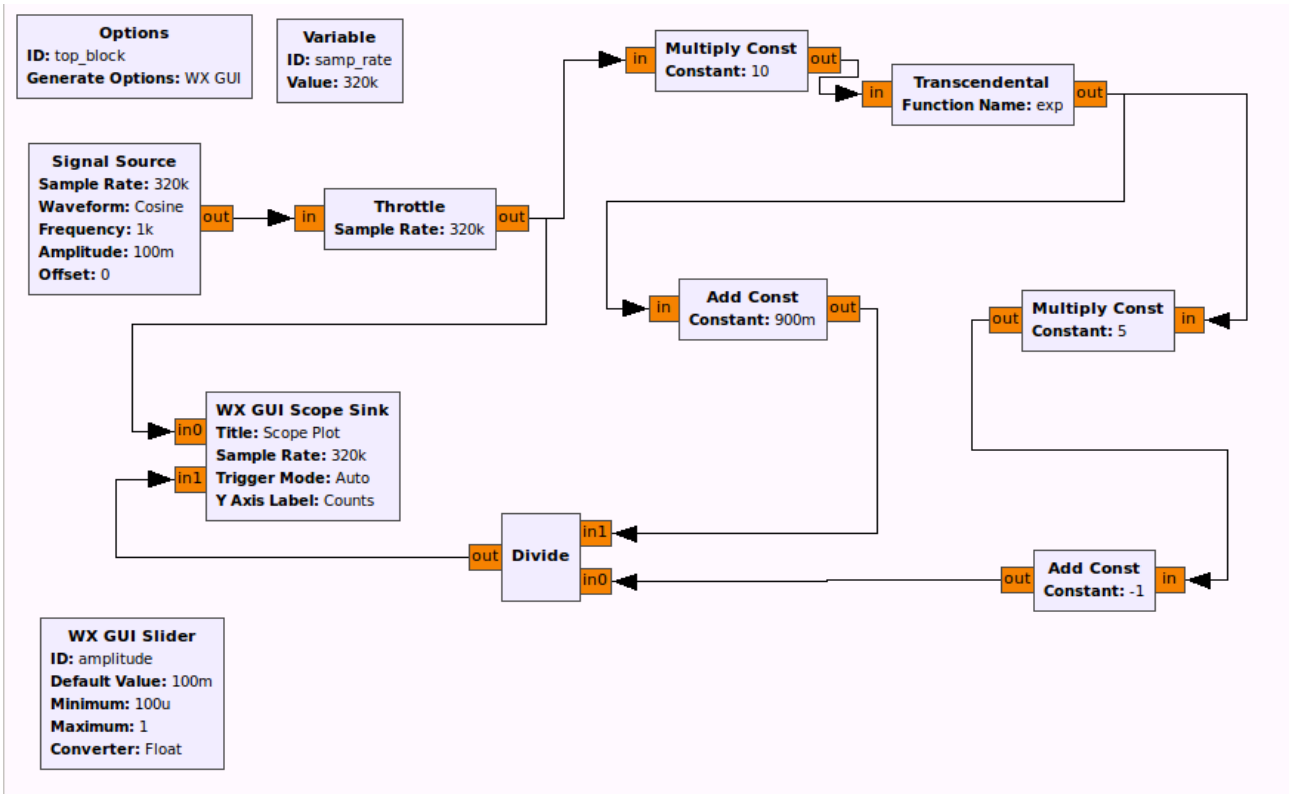
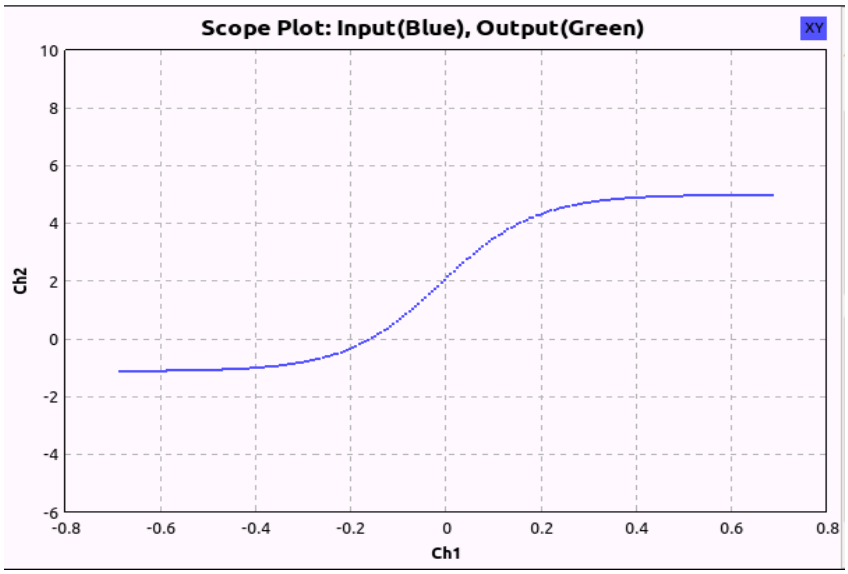
EndSem Solutions Wednesday Nov 4

Q1 [Total 13 marks + 2 extra credit]

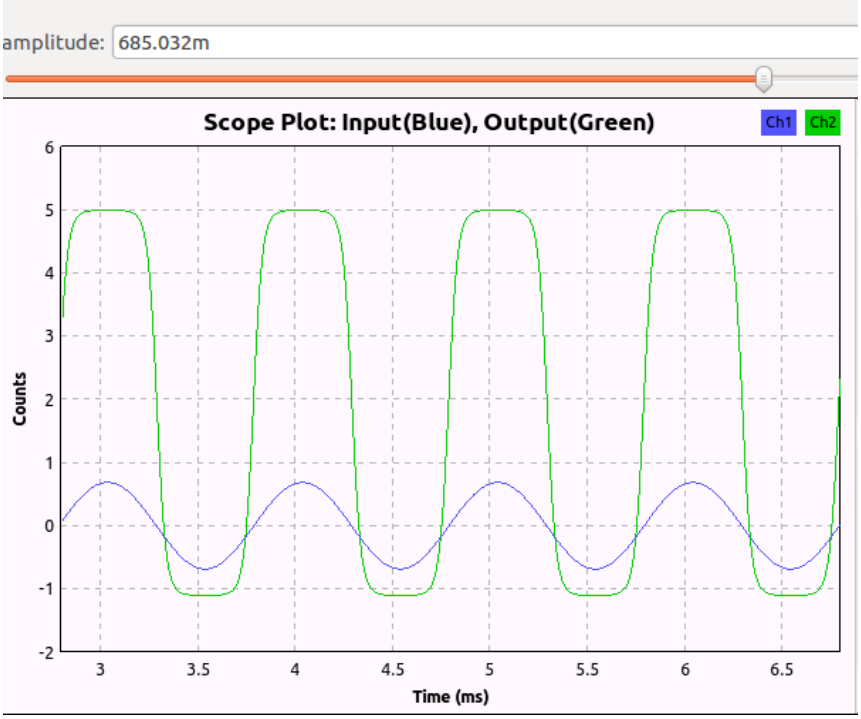
Q1 a) i)Flow graph



Q1 a) ii)XY transfer function



Q1 a) iii) Output plot



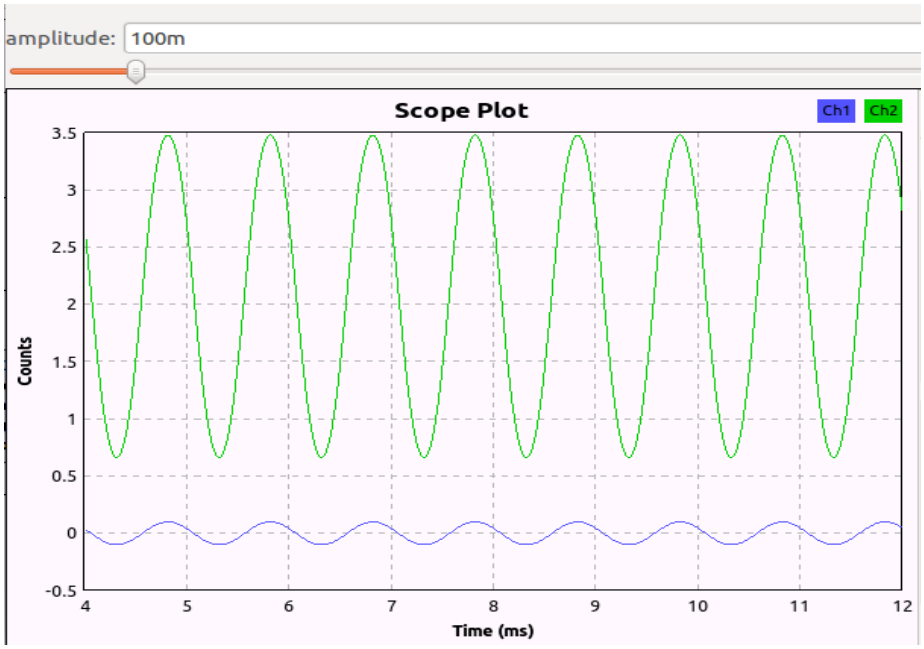
Marking Scheme Q1 a (3 marks)

==========

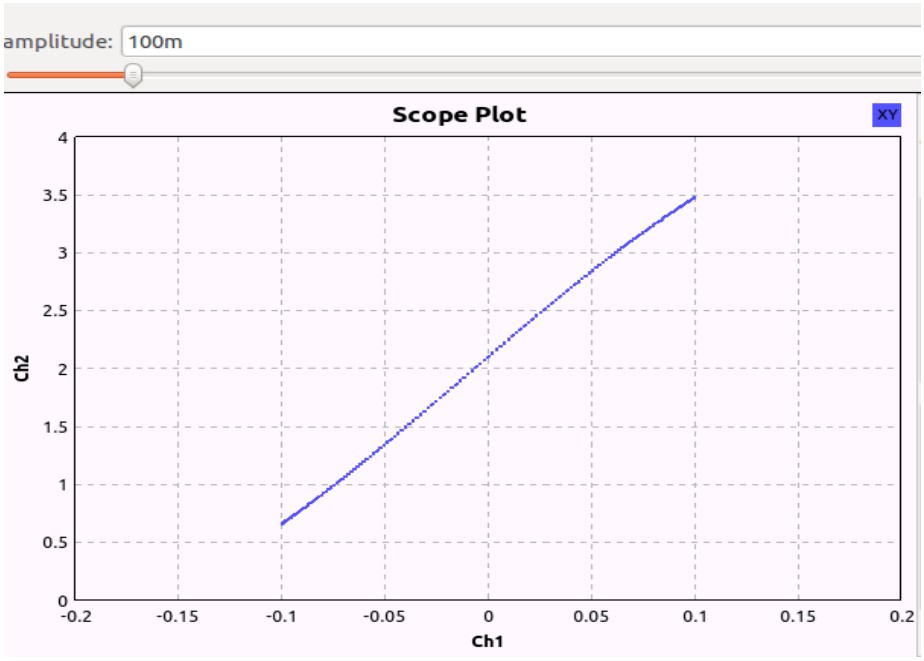
3 marks if transfer function is correct.

If transfer function is wrong, 1 mark for correct flowgraph and 1 mark for proper output plot.

Q1 b) Input and Output signals



X Y plot



For input sinusoidal signal of 0.2 V (peak to-peak), output peak to peak amplitude is 3.45-0.65 = 2.8 V

Gain = 2.8/0.2 = 14. Any value in (12 – 16) can be awarded marks.

(Or) = 22.9 dB Any value in (21.5dB - 24 dB) can be accepted

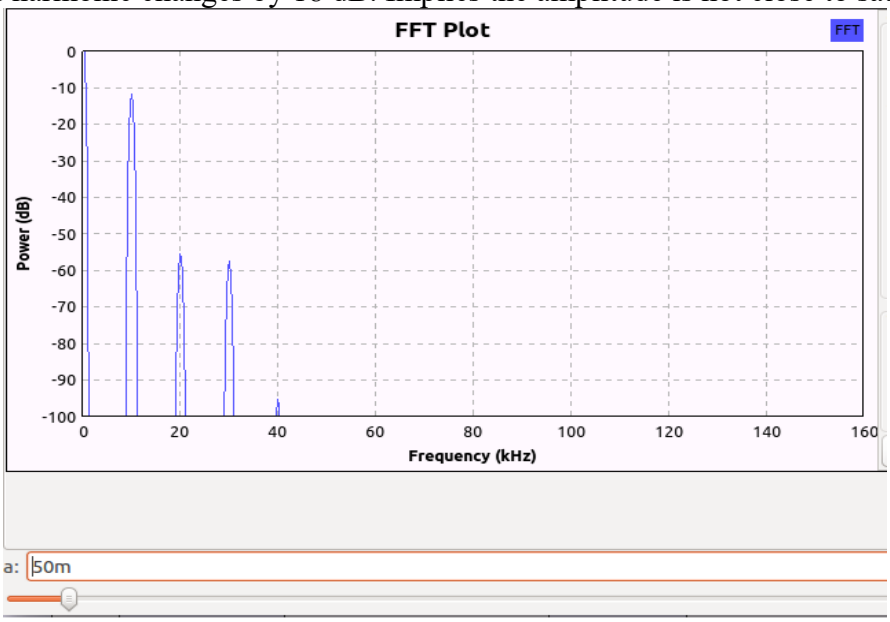
Marking Scheme Q1 b (2 marks)

==========

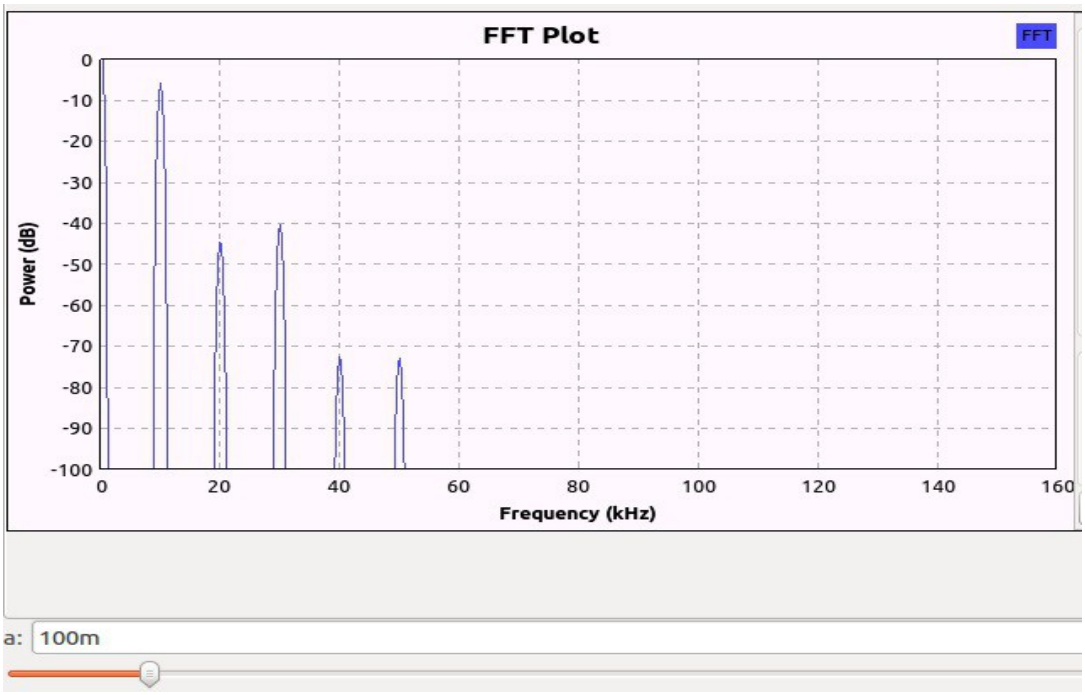
2 marks if correct, 0 if wrong

Q1 c) For $A_{in} = 50^* 10^{-3}$ V, fundamental is at -12 dB.
Third harmonic is at -58 dB.
$\Delta = (-58 - (-12)) = 46$ dB

Also at this value of input amplitude A_{in}, if amplitude is changes by a factor of 2, ie by 6 dB, the third harmonic changes by 18 dB. Implies the amplitude is not close to saturation.



Signal at amplitude A_{in} =50 mV



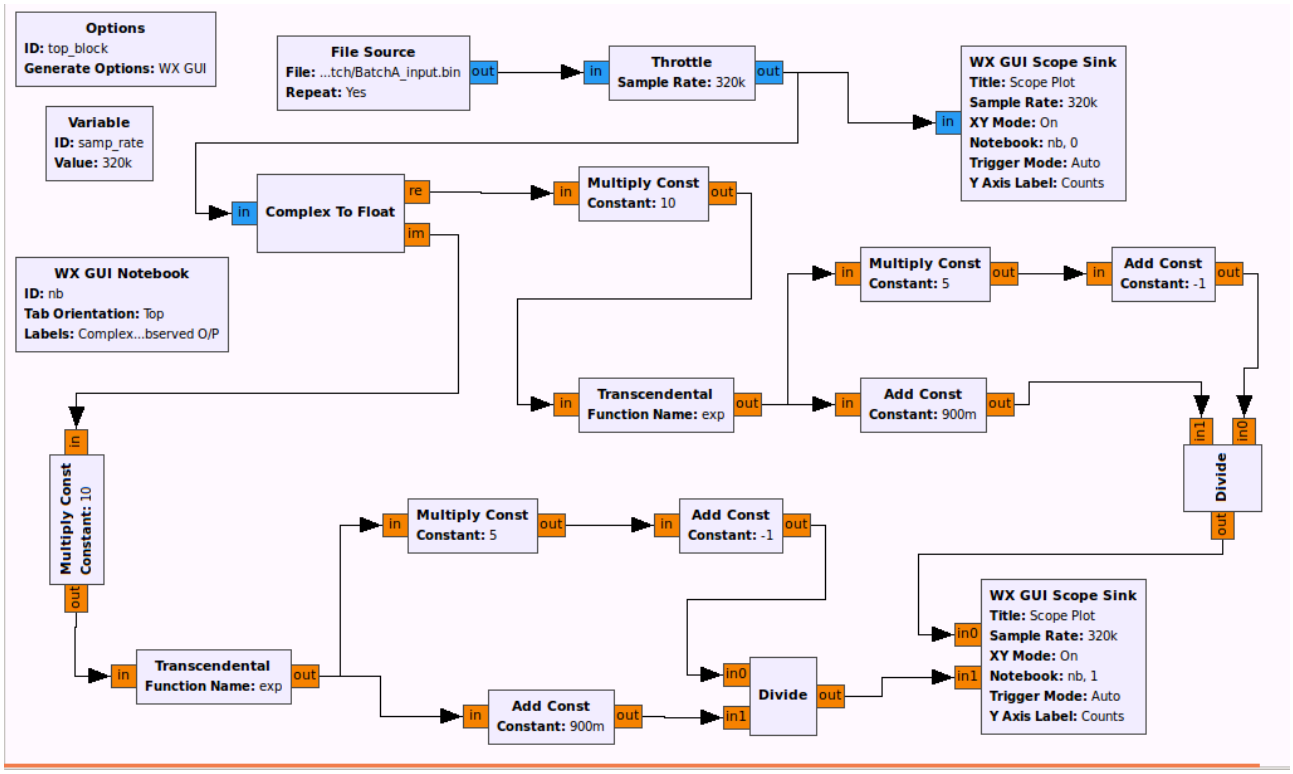
Signal at amplitude A_{in} =100 mV

(IP3) in dB = (P_{in} + Δ/2) dB = 50^*10^{-3} in dB +23 dB
20 log (IP3) = 20 log (50^*10^{-3}) +23 dB
IP3 = .706 V

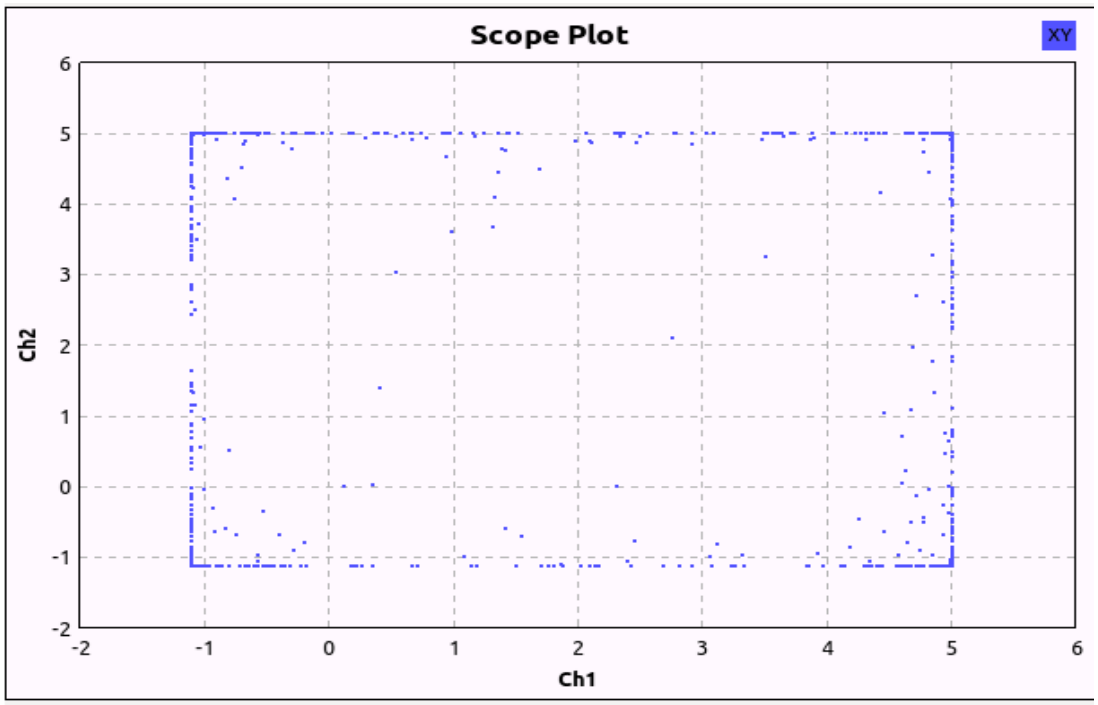
Marking Scheme Q1 c (2 marks + Extra credit 2 marks)
==========

2 marks for correct approach (using low voltage level, and finding change in dB for input variation)
2 marks extra credit for calculating IP3.

Q 1d) Flowgraph



Reason: The inphase and quadrature components are dripped off at the amplifier output. So we observe a rectangle in XY mode.



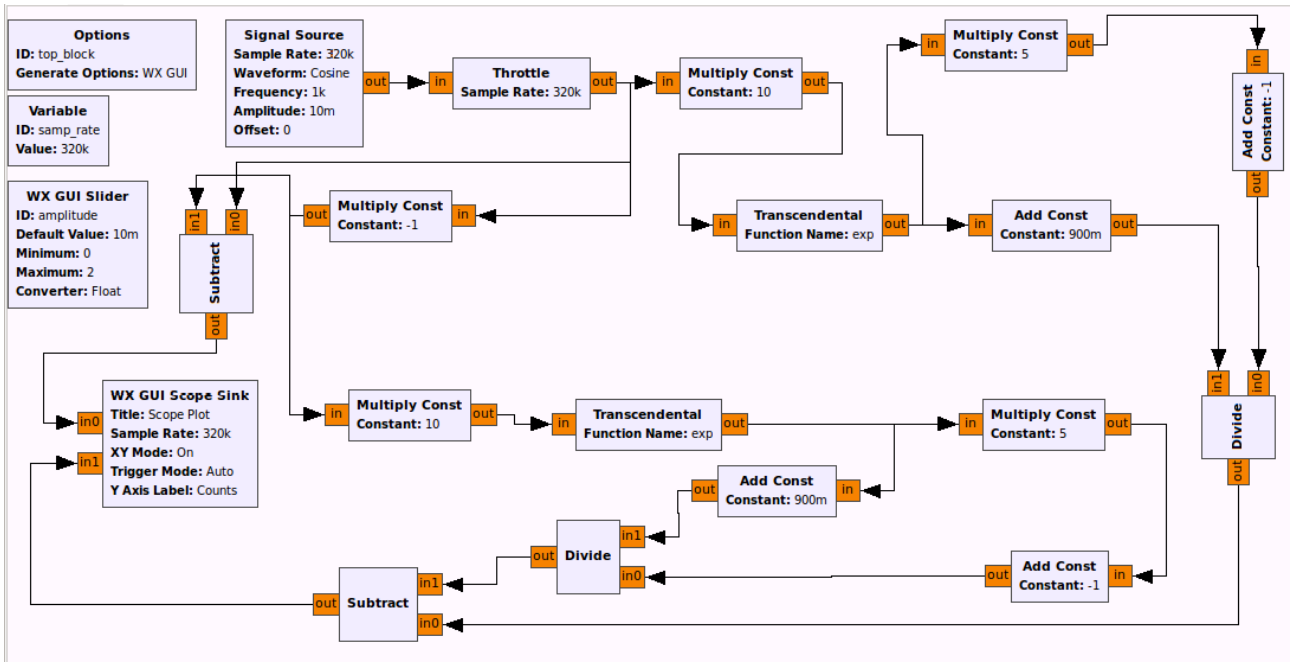
Marking scheme Q1 d (3 marks)

==========

2 marks for correct figure

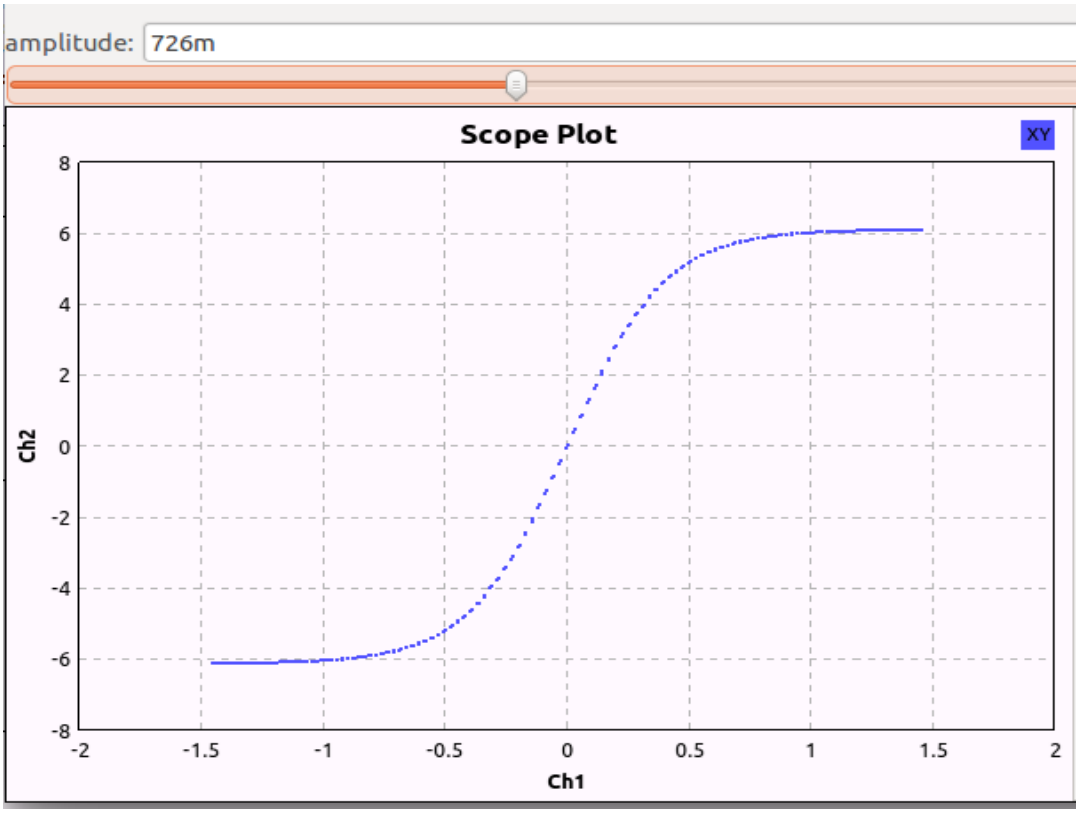
1 mark for reason

Q1e) Flowgraph



Differential output is always in range (-6, 6).

The XY plot should be antisymmetric. (Mirrored image also acceptable.)

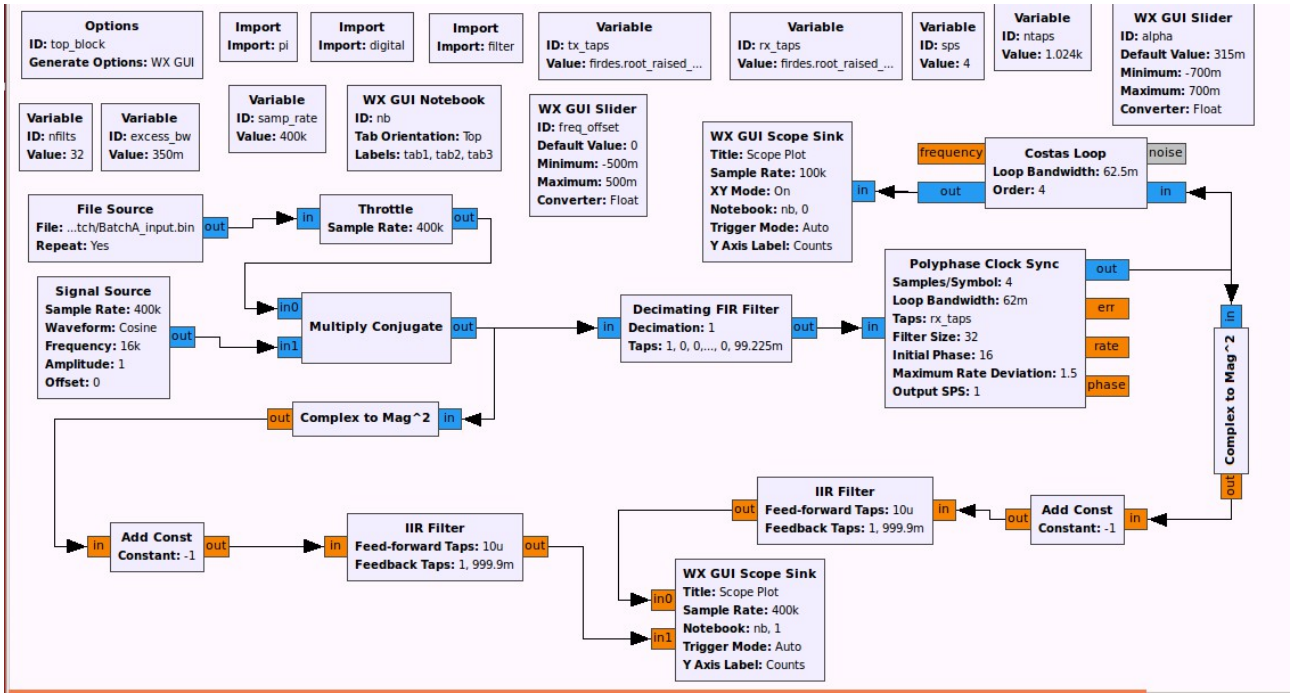


Marking scheme Q1e (3 marks)
==========

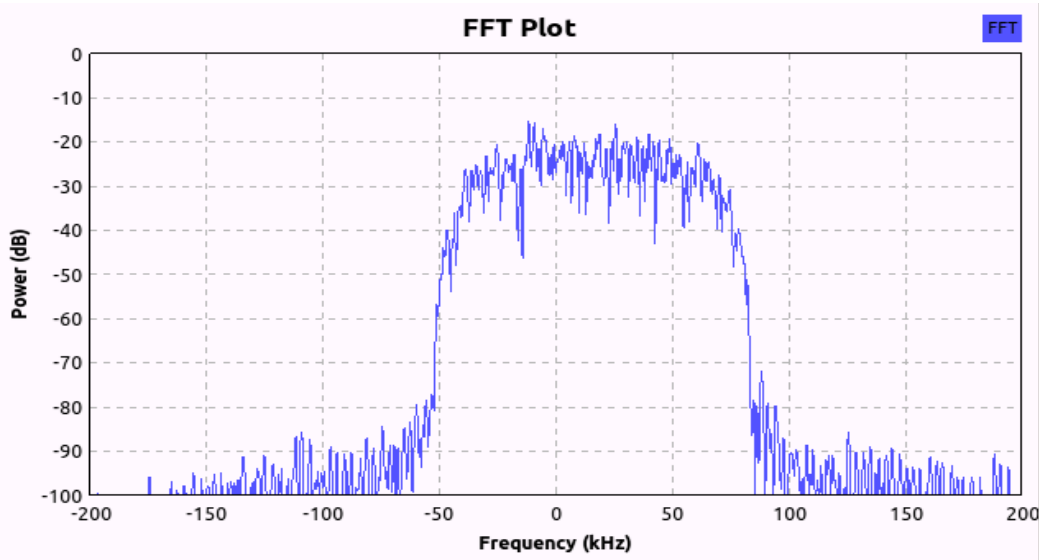
3 marks if correct XY plot
1 mark if flowgraph is correct and XY plot is wrong due to wrong input. (The correct differential input is (sin Θ, - sin Θ) or (cos Θ, -cos Θ)).

Q2 (Total 12 marks)

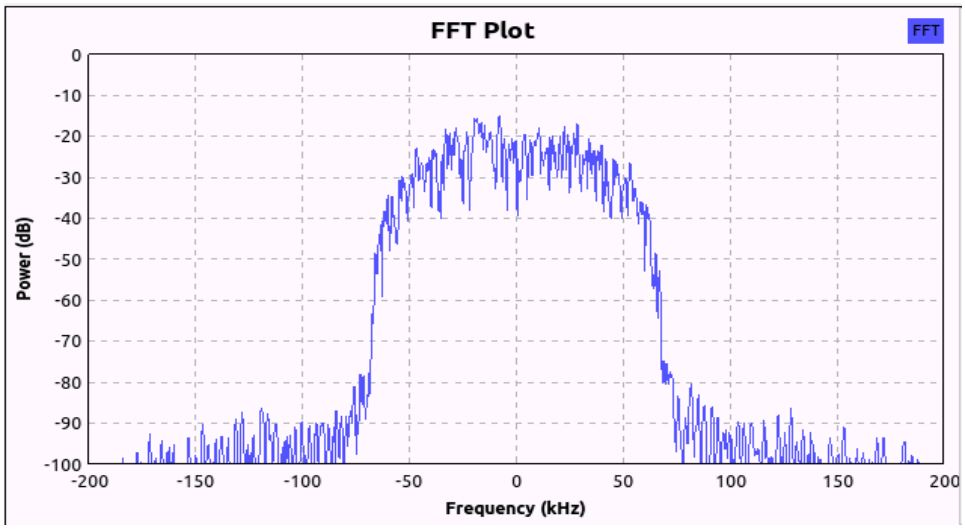
a) Flowgraph



Spectrum before removing frequency offset.

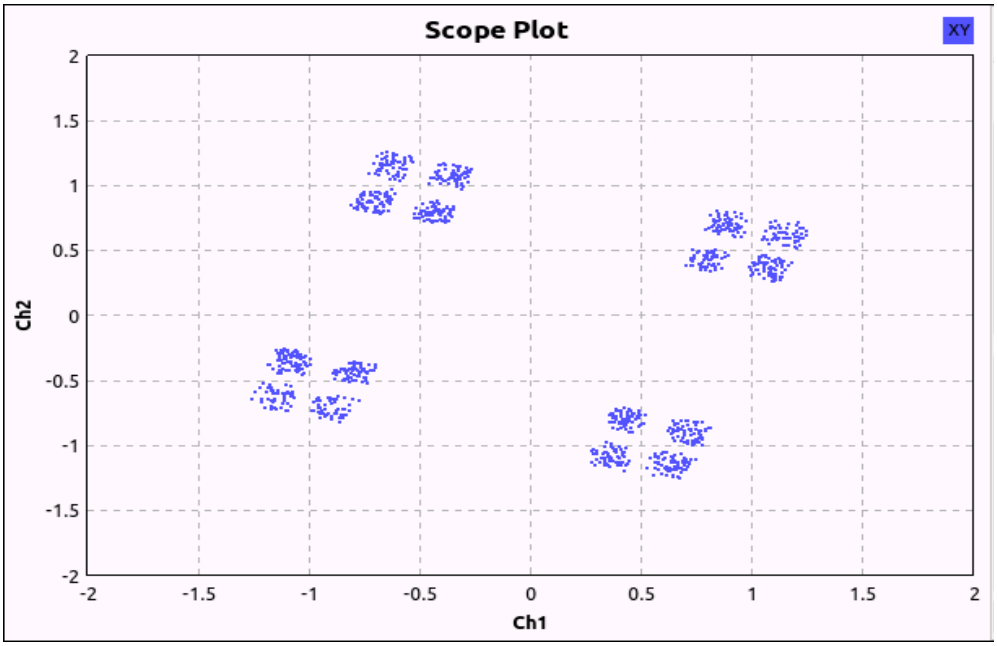


Spectrum after removing frequency offset.



Marking Scheme Q2 a (2 marks)
==========
2 marks if flowgraph is correct
Deduct 1 mark if frequency scale is wrong
Deduct 1 mark if spectrum is not properly centered.

Q2 b)



Marking Scheme Q2 b (2 marks)
==========
2 marks if correct

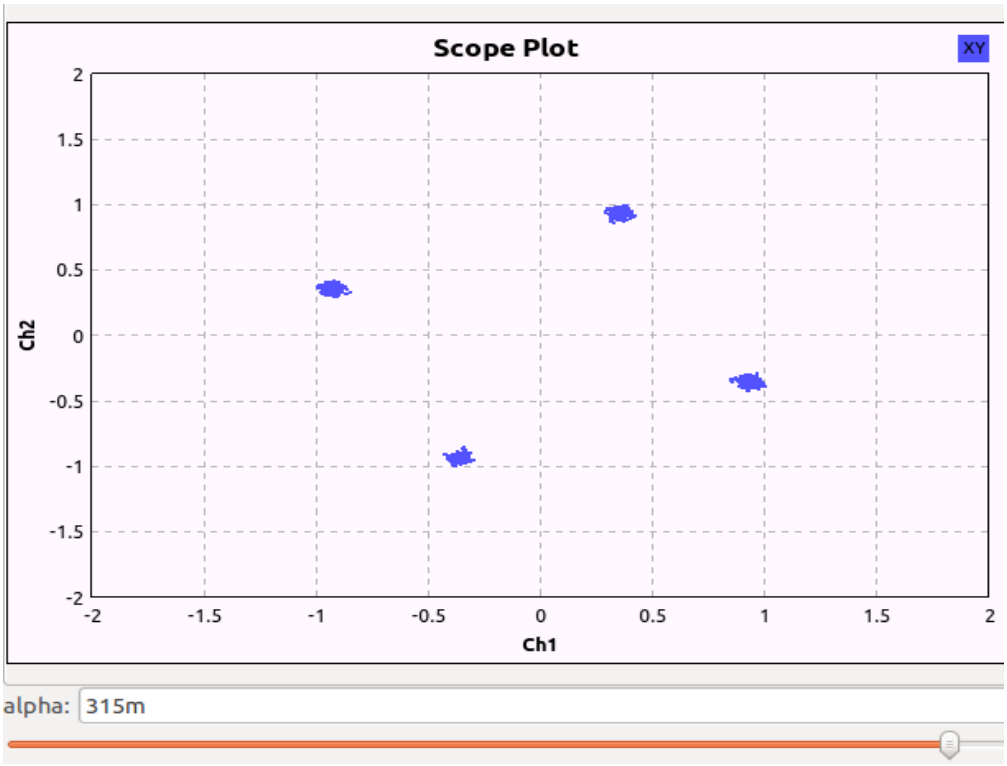
Q2 c) i) Equalization

$y(t) = x(t) + \alpha * x(t - \tau)$
$\tau = 7.5\ \mu$ sec
No. Of samples delayed = 7.5 μ sec * 400 KHz = 3

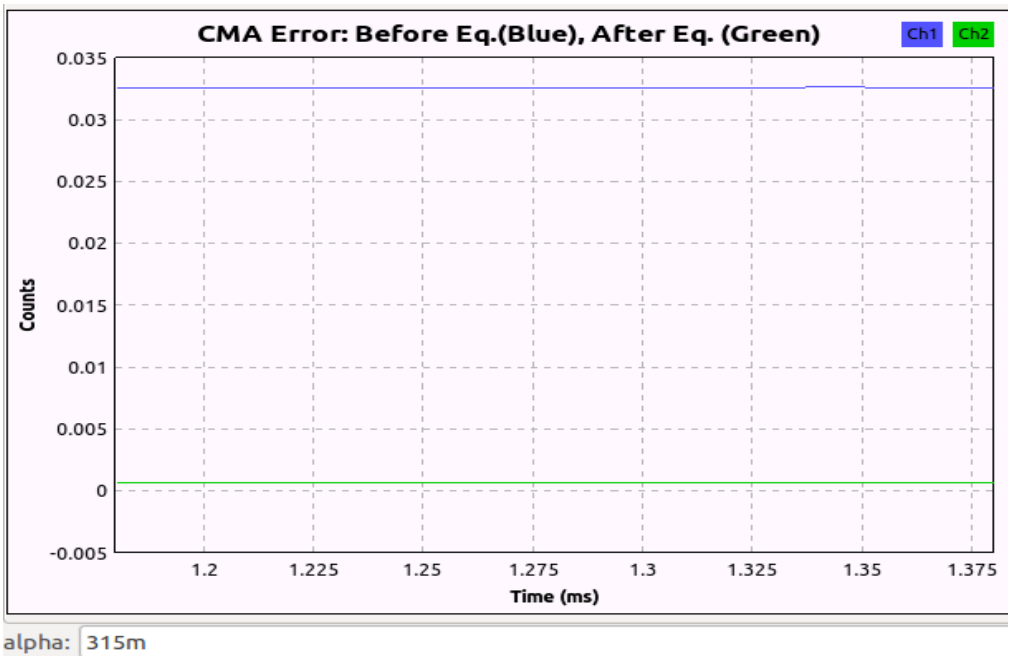
$y(n) = x(n) + \alpha * x(n-3)$
$H(z) = 1 + \alpha z^{-3}$

Equalizer transfer function $E(z) = H(z)^{-1} = 1/(1+\alpha z^{-3})$
$= 1/(1- (-\alpha z^{-3}))$
$= 1 + (-\alpha z^{-3}) + (-\alpha z^{-3})^2 + ...$
$= 1 - \alpha z^{-3} + (\alpha^2) z^{-6}$

Q2 c) ii) Resultant Constallation



Q2 c) iii) CMA Error



Marking scheme Q2 c (4 marks)
==========
2 marks for correct constallation.
1 mark for correct CMA error.
1 mark for proper use of low pass filter to find CMA error.

Q2 d) $\alpha \approx 0.315$

Marking scheme Q2 d (2 marks)
==========
2 marks if correct, 0 marks is wrong.

Q2 e) (2 marks)

Reason 1:
Phase fluctuations due to remaing frequency offset. (1 mark)

Reason 2:
Phase fluctuations due to input file discontinuity. (1 mark)