

Question 1 [TOTAL MARKS (4+2+5)]

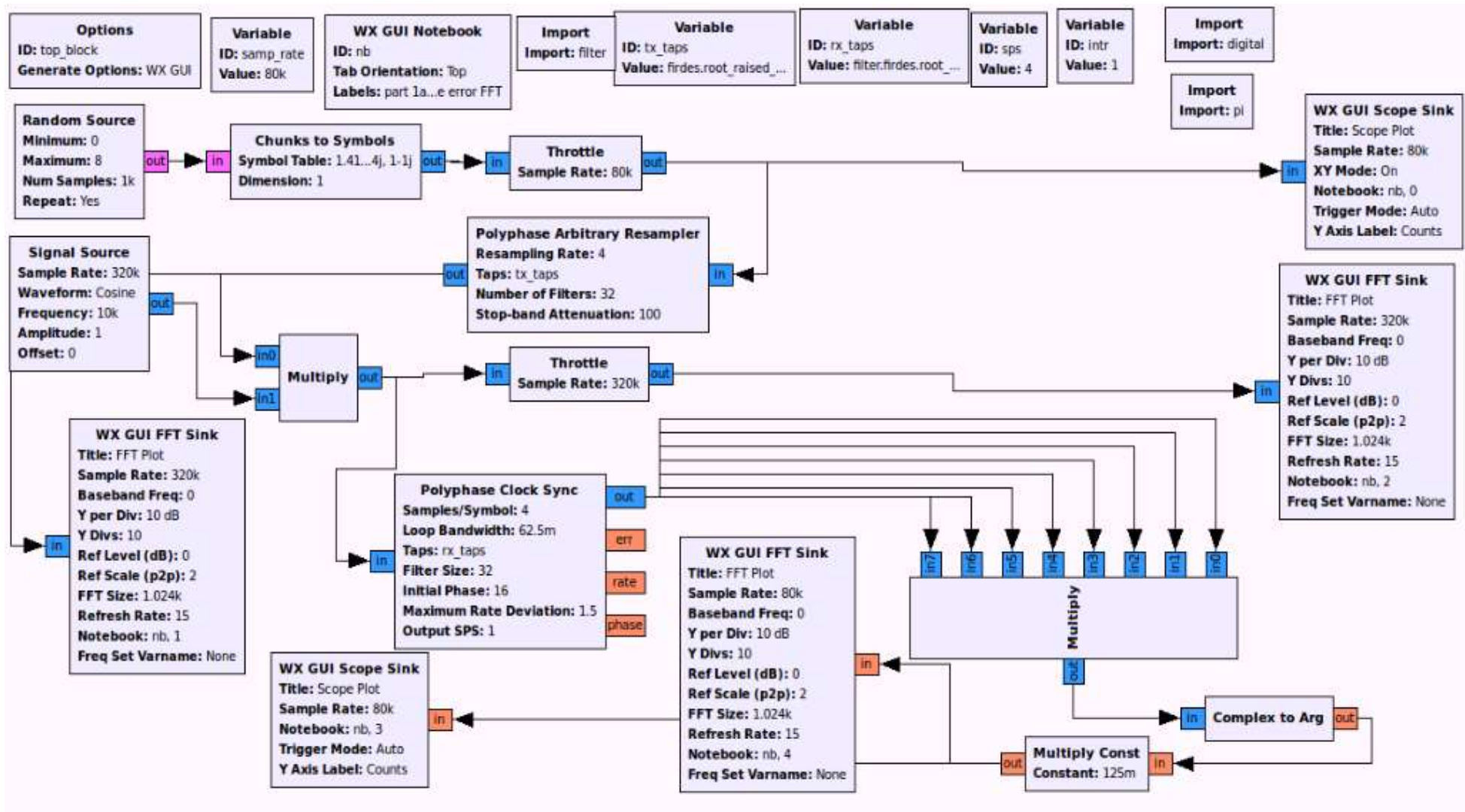


Fig1:Flow Graph for Question1

a.1) Symbol constellation before the pulse shaping filter is given in below figure

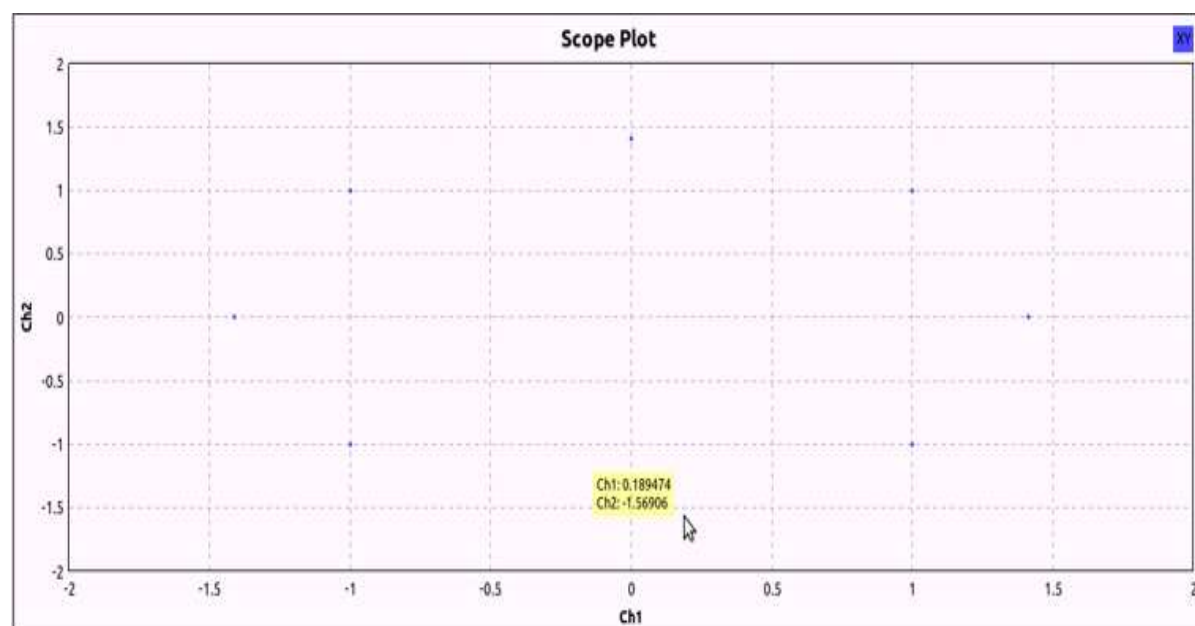


Fig 1.2: Symbol constellation before the pulse shaping filter
(This is 8-psk diagram)

MARKS:[1 mark]

1 mark if 8 points are along the circle

a.2)Signal spectrum after the pulse shaping filter is given in below figure

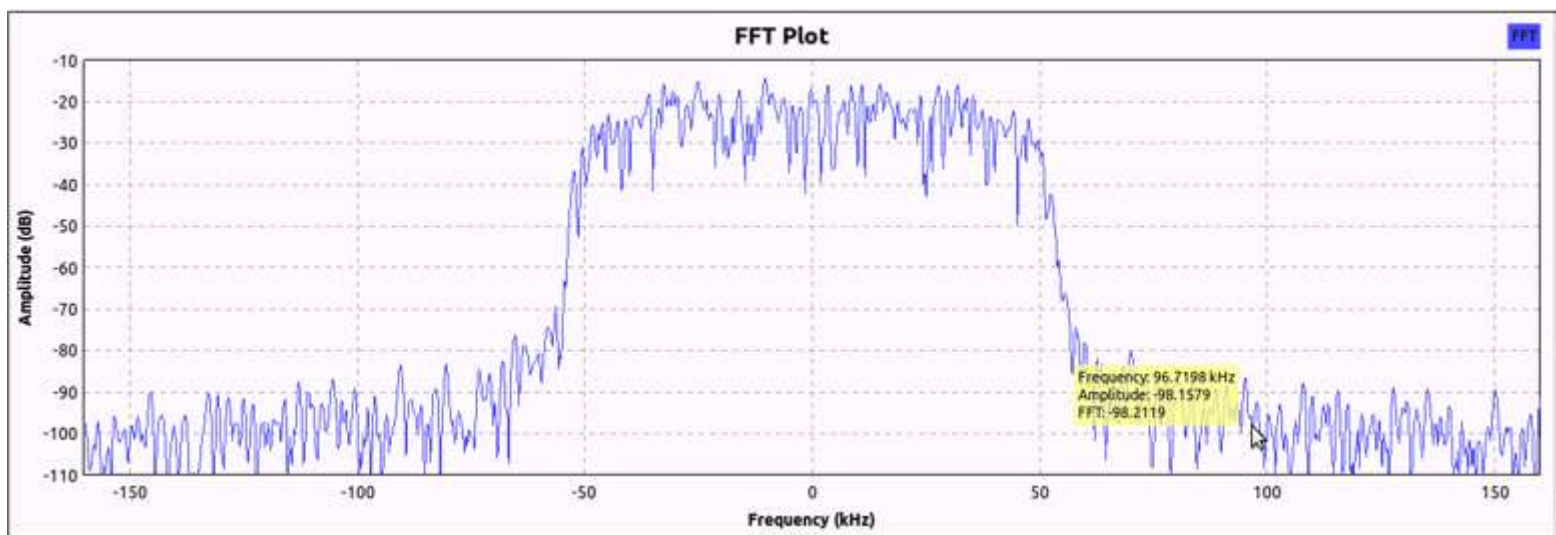


Fig 1.3: Signal spectrum after the pulse shaping filter

MARKS:[3 marks]

2marks if the spectrum (FFT) is as shown, +1 mark for correct X-scale, correct BW (~54kHz)

b) Spectrum after 10kHz carrier offset given in below figure

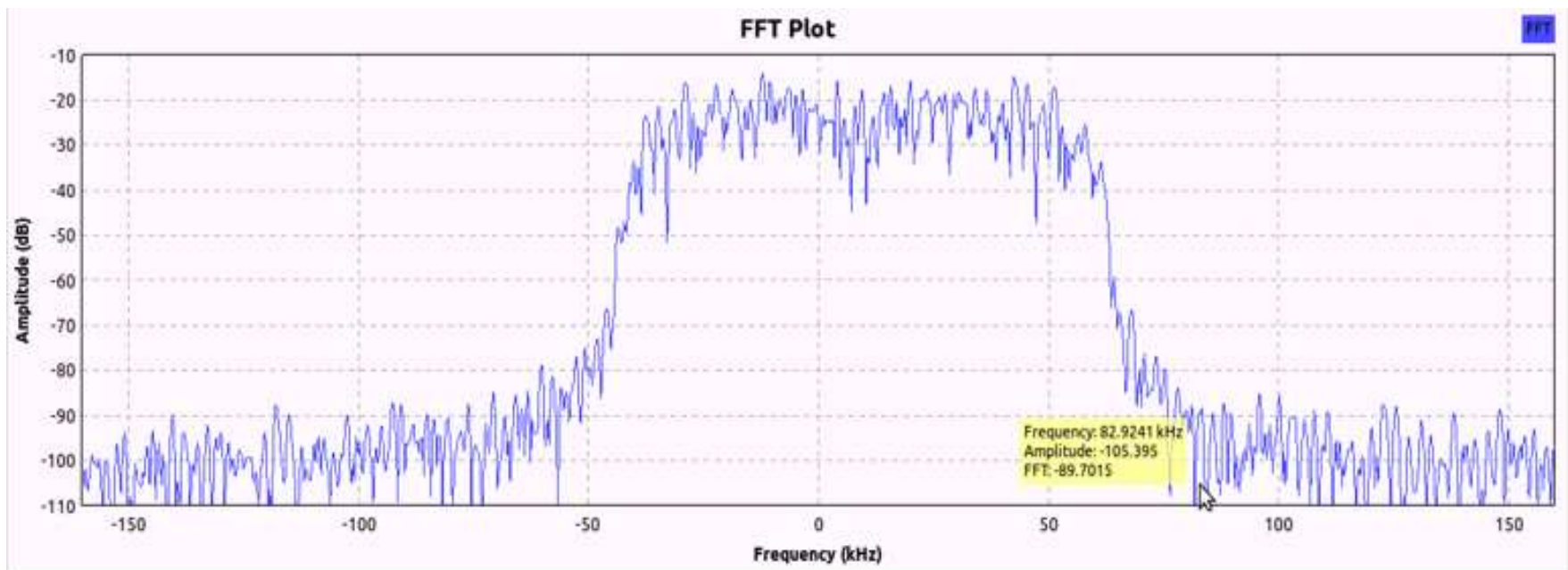
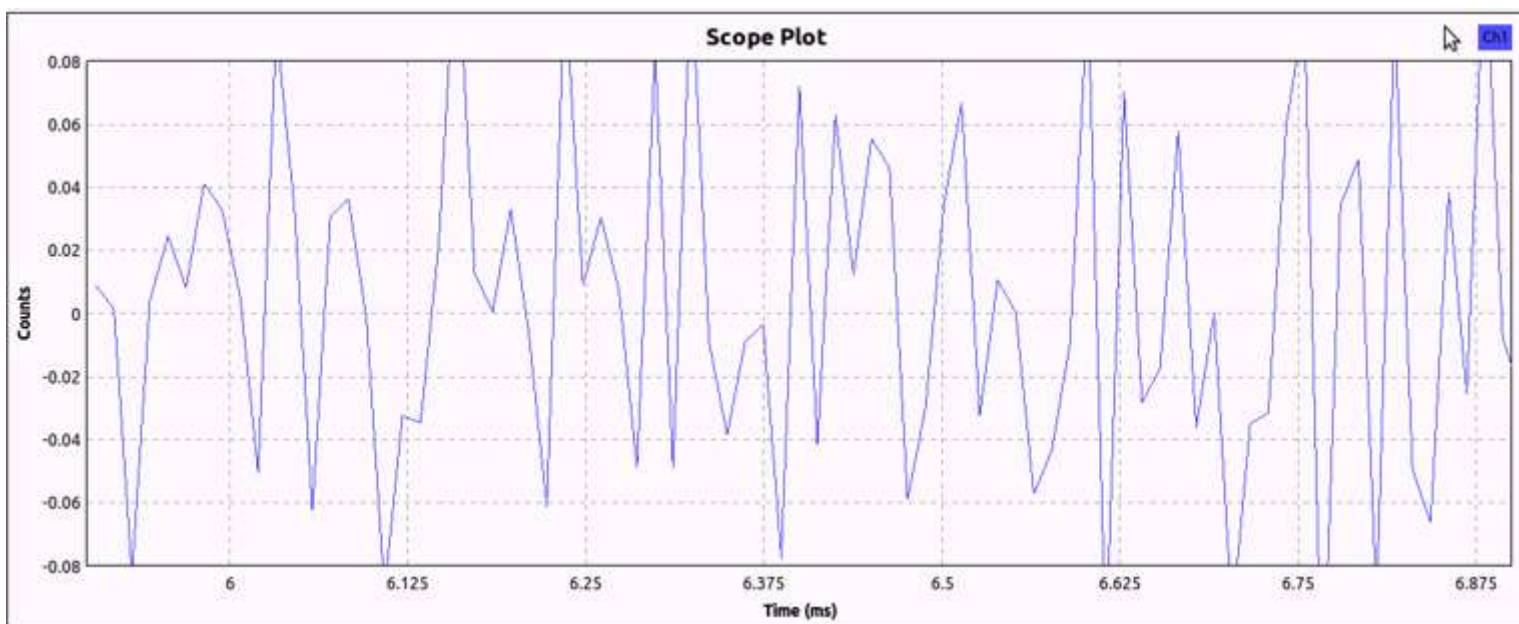


Fig 1.4: Spectrum after 10kHz carrier offset

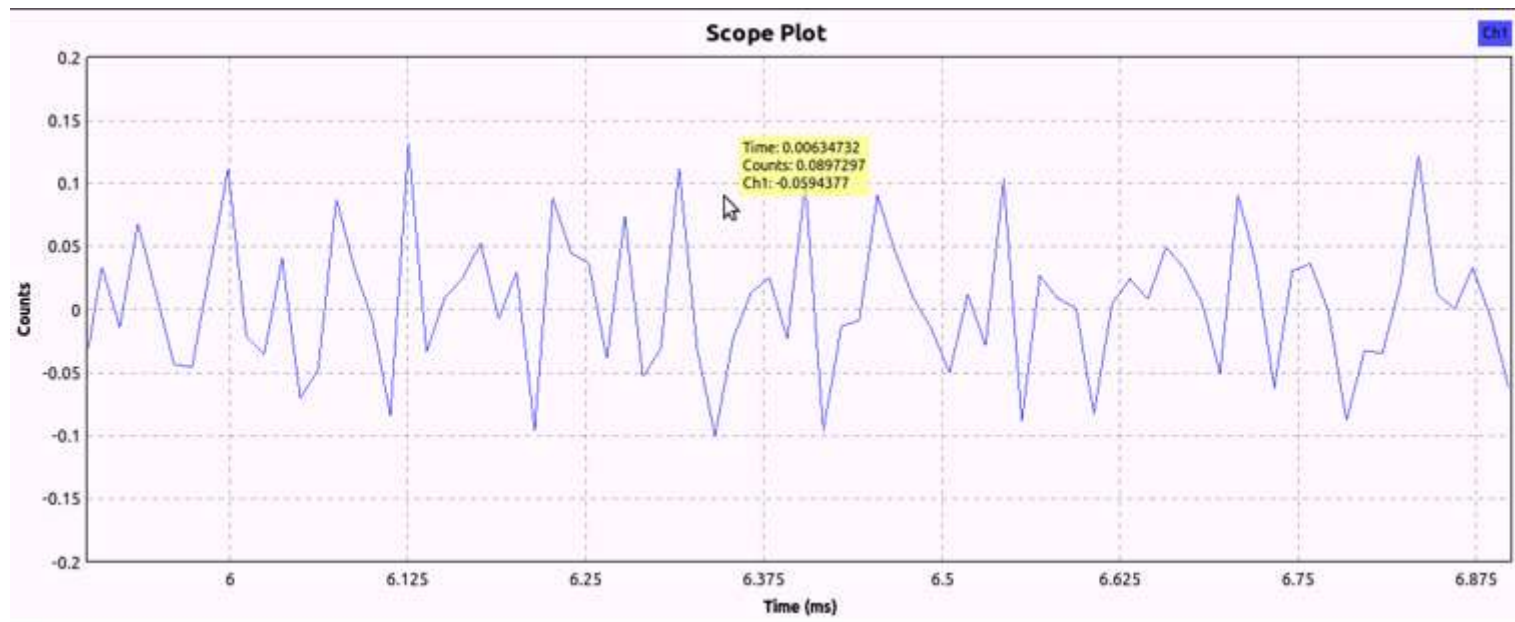
MARKS [2 marks]

2 marks if complex frequency. Check if BW is from ~(-44 to 64)kHz, Deduct 1 mark if X-scale is wrong

c.1)Phase error vs time is shown in below figure



(a)



(b)

Fig 1.5: Phase error vs time (Here, (a) and (b) are scaled version of one another)
NOTE: Answer is either a) or b)

MARKS: [3 marks]

3marks if the value is very small (-0.08 to 0.08).(shape is like pure noise, Because phase shifts by 45-degrees for every symbol period). **Deduct 2 marks** if sample rate for symbols before Arbitrary Clock Sync is not 80kHz or the resultant waveform is like sawtooth.

c.2) Error in phase vs frequency is shown in below figure

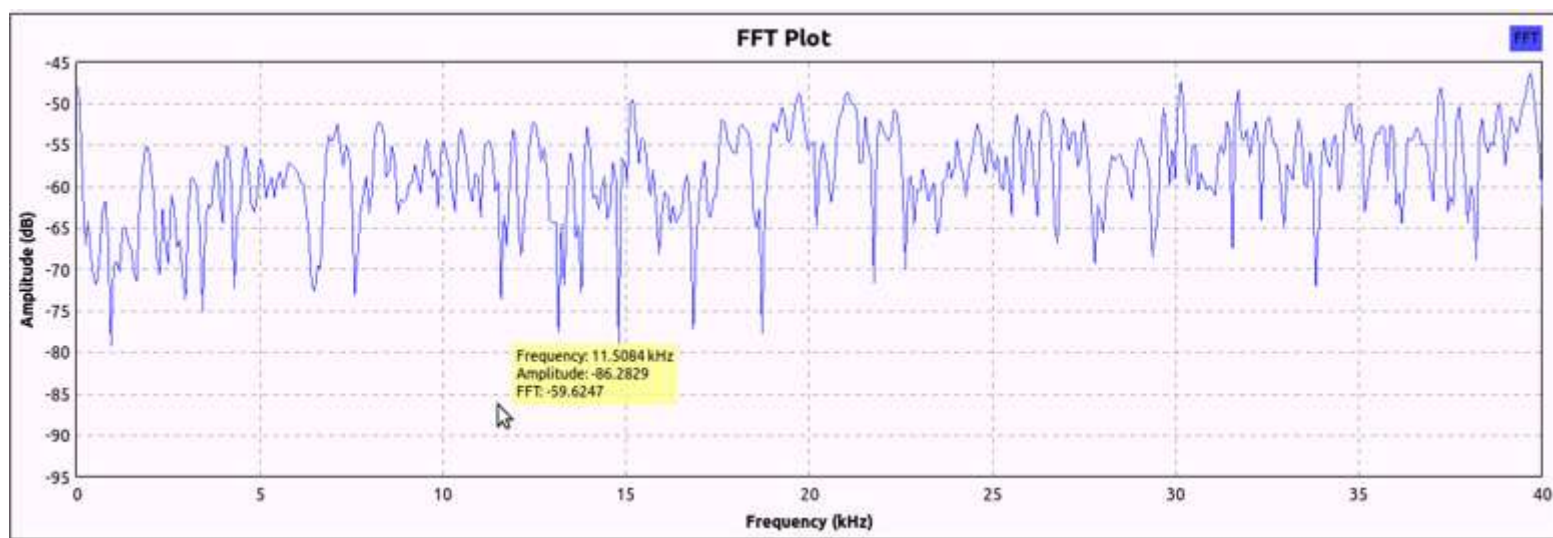


Fig 1.6: Error in phase vs frequency

MARKS: [2 marks]

2marks if only noise floor is visible. **Deduct 1 mark** if peak(s) are observed.

Question 2: [TOTAL MARKS (4+3+5+2)]

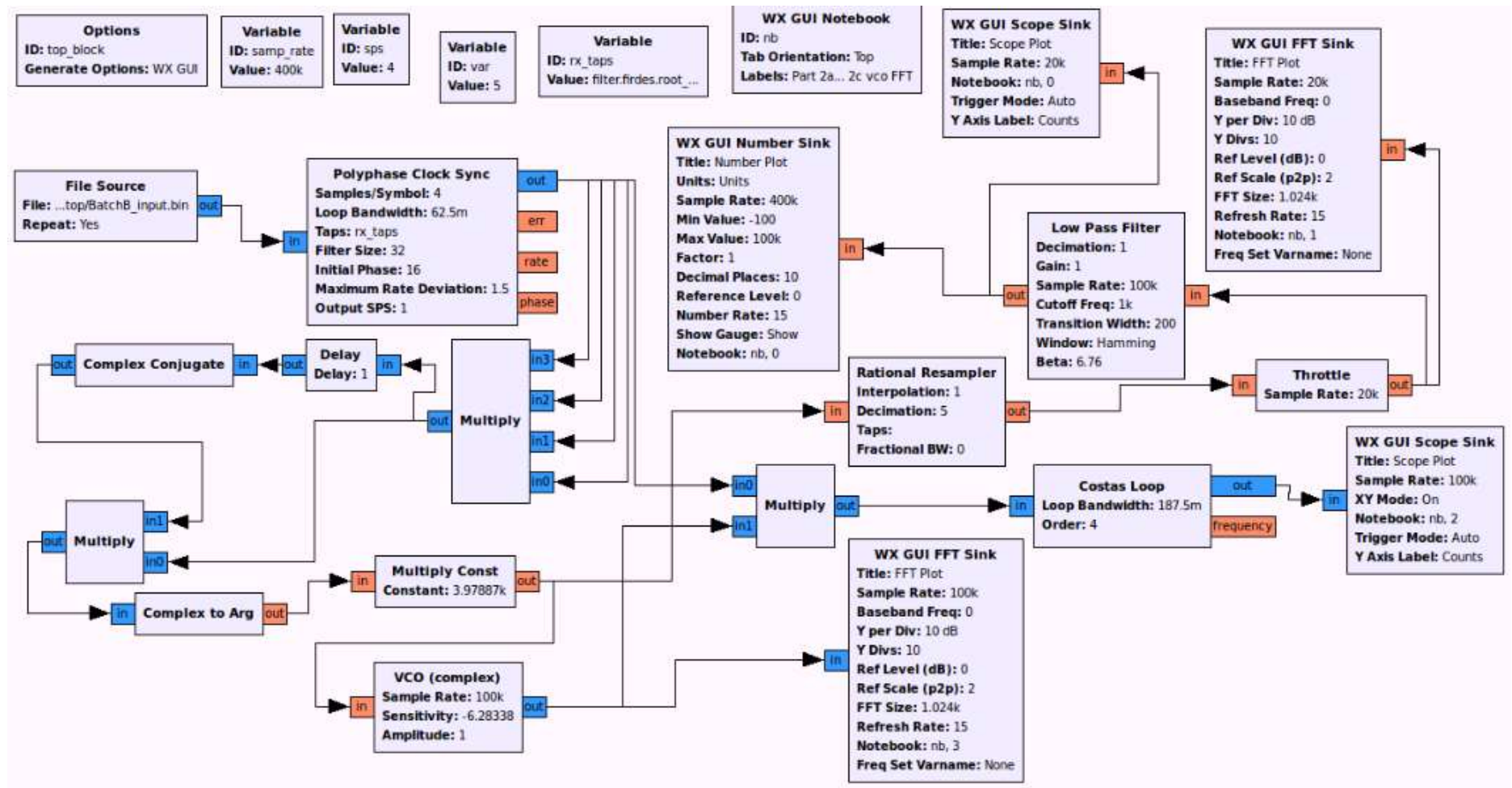


Fig 2.1: Flow graph for problem 2a to 2c

MARKS [2 marks]

2 marks if flowchart is correct

- a) Average frequency is shown in below figure

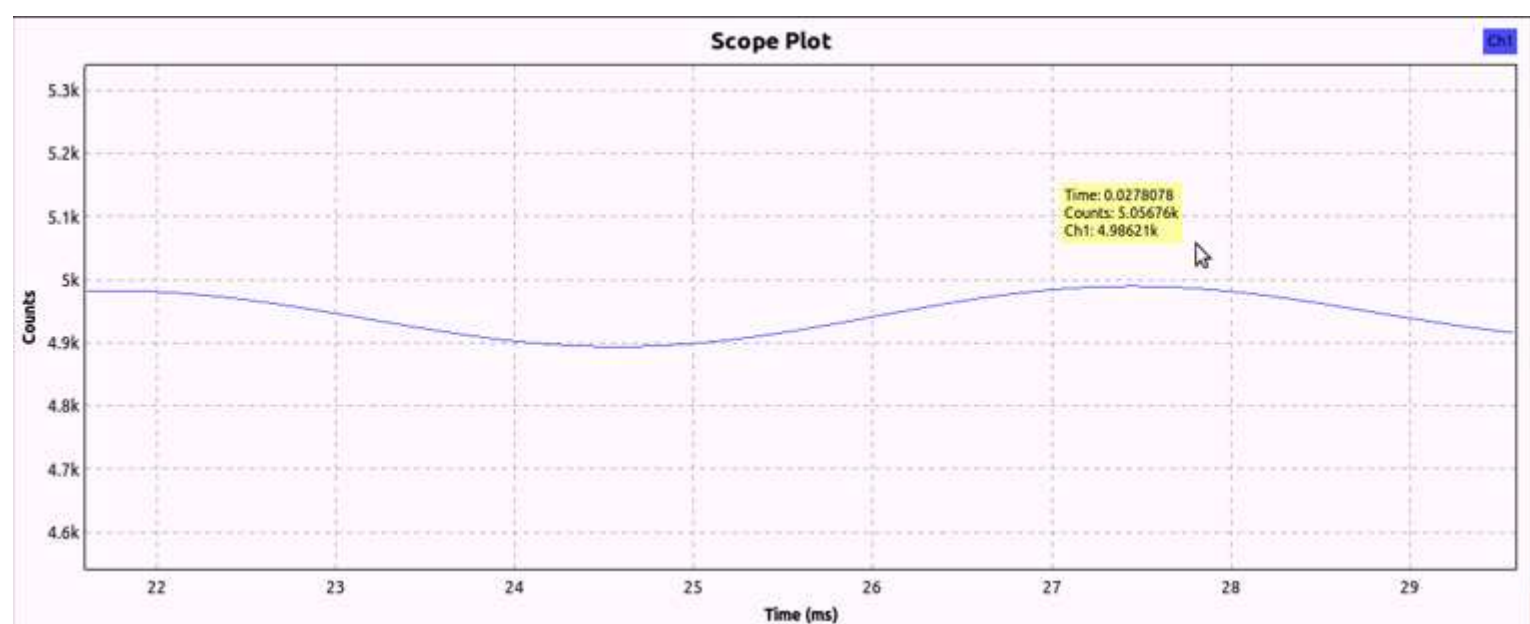


Fig 2.2: Average frequency 5kHz

MARKS [2 marks]

2 marks if average is 5 kHz, variation is small ($<0.3\text{kHz}$, i.e., appropriate filter has been used). **Deduct 1 mark** if average is 5 kHz but variation is large. If average is not 5 kHz, give 0 marks.

b) Spectrum of carrier frequency offset is shown in below figure



Fig 2.3: Spectrum of carrier frequency offset

MARKS [3 marks]

2 marks if two tones are at 2kHz and 3kHz. + **1 mark** if X-scale is correct.

c.1) Constellation at output is shown in below figure

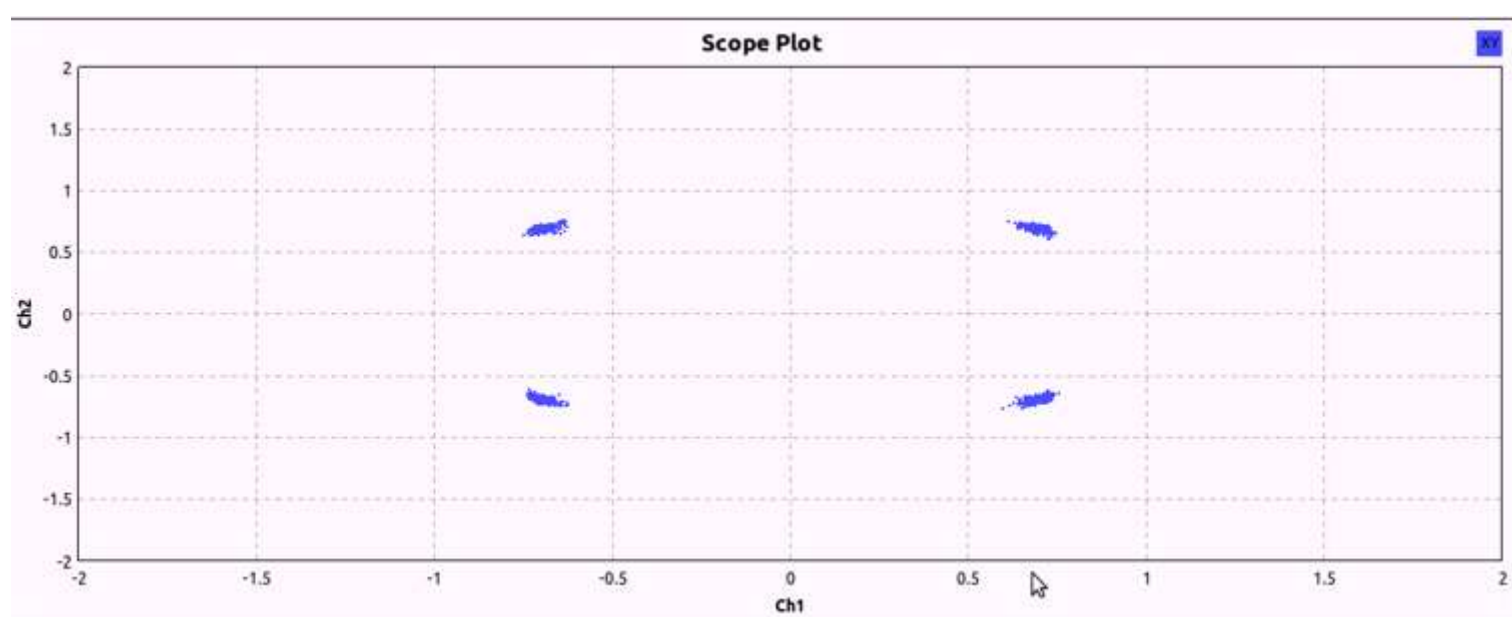


Fig 2.4: Constellation at output

[NOTE: You should also check output after disabling costasloop]

MARKS [2 marks]

2 marks if rotating (or not rotating) QPSK constellation observed even after disabling Costas Loop. Give **0 mark** if it is not QPSK without Costas Loop.

c.2) Spectrum of VCO output is shown in below figure

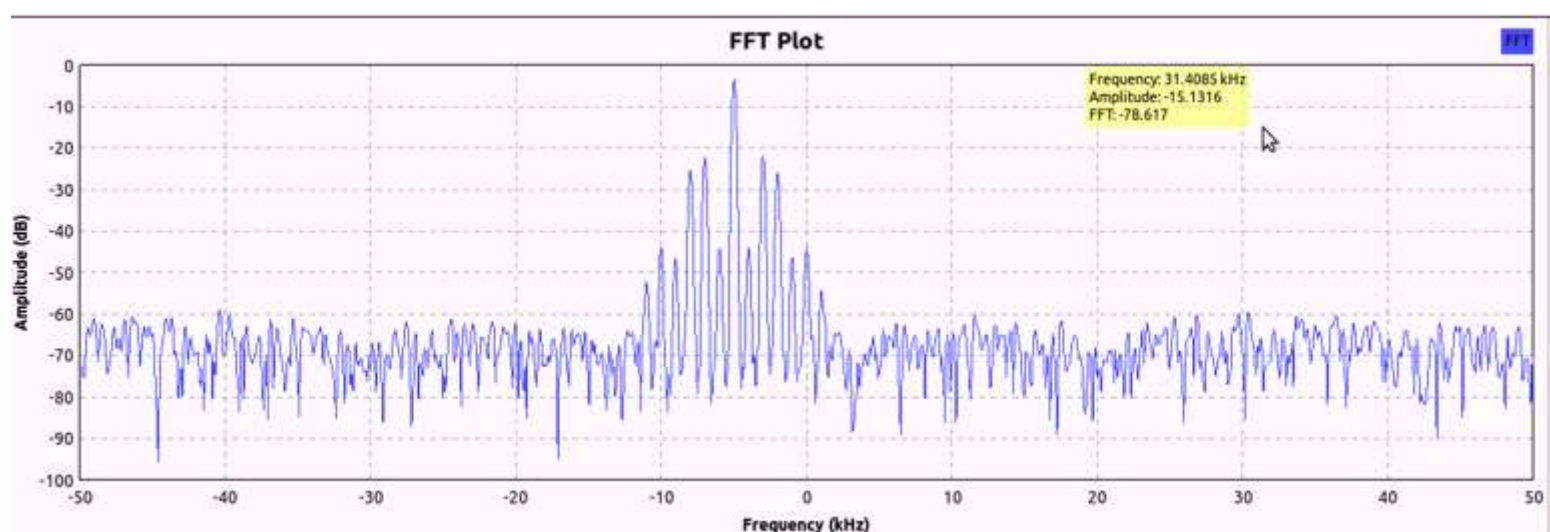


Fig 2.5: Spectrum of VCO output

MARKS: [3 marks]

3 marks if output center peak is at -5kHz, correct shape. **deduct 1 mark** if it shape is correct but scale is wrong

d. Flow chart for Question 2d is shown in below figure

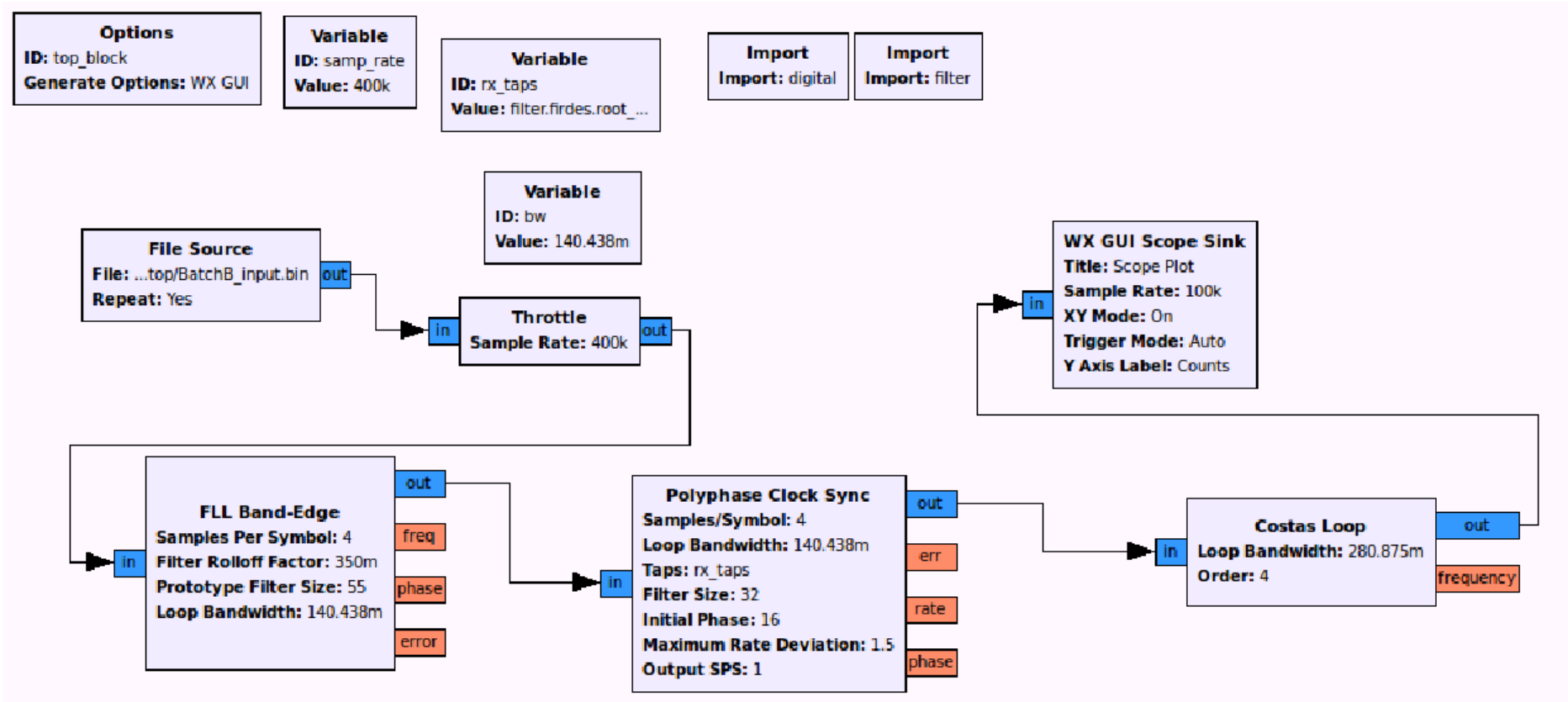


Fig 2.6: Flow chart for Question 2d

Final constellation is shown in below figure

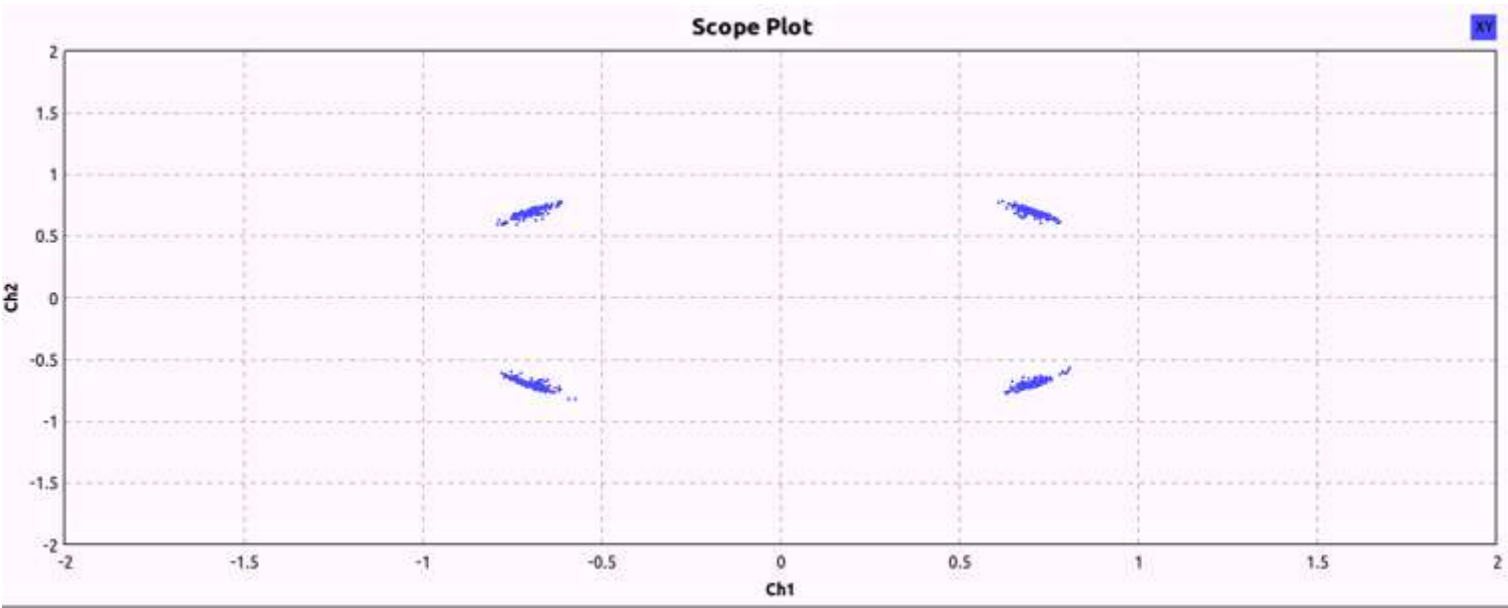


Fig 2.7: Final Constellation

MARKS: [2 marks]
2 marks if proper constellation is obtained.