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Fr. C. RODRIGUES INSTITUTE OF TECHNOLOGY

DEPARTMENT: Electronics and Telecommunication Engineering.

LABORATORY CONTINUOUS ASSESSMENT FORMAT

First ~~/ Second~~ Half of 2022

Course Name: Principles of Communication Engineering Lab (ECL403

Name of the Teacher: Prof. Sadhana Pai

Name of the Student: Rishi Raturi

Roll No: 3020148	**Semester: IV**
Batch: 2nd	**Practical No: 3**
Date of Practical: 02-02-2022	**Date of Report Submission: 04-02-2022**

Title: SSB modulation

Course Outcome: Utilise laboratory equipment to demonstrate AM DSB ,AM SSB and FM modulation techniques for a given signals.

ASSESSMENT

Sr. No.	Parameter for Assessment	Marks	Rubrics		
1.	**Practical Performance / Active Participation (03Marks)**		Above Average (03)	Average (02)	Below Average (01)
2.	**Report Presentation (02 Marks)**		Above Average (02)	Average (01)	Below Average (00)
3.	**Understanding (03 Marks)**		Above Average (03)	Average (02)	Below Average (01)
4.	**Regularity in Submission (02 Marks)**		Timely (02)	Late (01) (≤ 2 Weeks from the date of Practical)	Very Late (00) (> 2 Weeks from the date of Practical)

Total Marks (10):

Teacher's Signature: **Date:**

Fr.C.Rodrigues Institute of Technology, Vashi Dept. of Electronics and Telecommunication Engineering.

IV SEM EXTC

SUB: Principles of Communication Engg. Lab

SSB Modulation

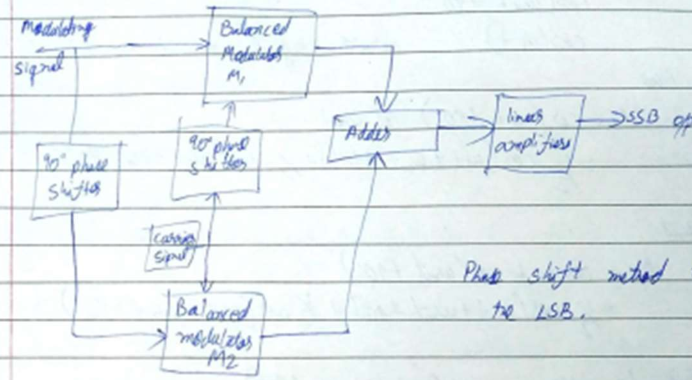
Expt No.	3	**Date: 01-02-2022**
AIM	Generate AM SSB using Phase Shift Method for a given carrier and modulating frequencies. Assume $f_c = 1000$ Hz and $f_m = 100$ Hz	
Course Outcome	ECL403.2 (CO-2): Utilise laboratory equipment to demonstrate AM DSB , AM SSB and FM modulation techniques for a given signals.	
Software Tool	LTSpice software	
THEORY	Explain: 1. SSB generation using Phase shift Method.	

Theory:

(1) SSB generation using using Phase shift method

→ SSB generation using phase shift is the method used for suppression of side band.

- Two balanced modulators and two 90° phase shifting networks are used



Phase shift method to suppress the LSB.

Operation:

(1) M_1 is balanced modulator is with two i/p. where as M_2 is with 2 i/p, modulating signal with 90° shift and carrier without any phase shift (exact opposite like M_1)

(2) At o/p of both the balanced modulators DSB-SC signal consisting of both side bands. The carrier is completely removed.

(3) The upper sidebands at o/p of both balanced modulators lead the carrier by 90°

(4) But LSB at o/p of M_1 leads the carrier by 90° and LSB at o/p of M_2 lags behind the carrier by 90°. Hence LSBs are out of phase.

(5) When o/p of M_1 and M_2 are applied to adder, LSBs are cancelled out and the o/p of the adder consists of only the upper side band.

(6) Linear amplifiers will follow adder Mostly class B or AB type

amplifiers used to amplify USB without distortion.

(7) Mathematical proof:

i/p to M_1

$\cos \omega_m t$ modulation signal as it is

$\cos(\omega_c t + 90°)$

i/p to M_2,

$\cos(\omega_m t + 90°)$

$\cos(\omega_c t)$ carrier signal as it is

Now

$$M_1 = \cos(\omega_c t + 90°) \cos \omega_m t$$

$$= \frac{1}{2}\cos(\omega_c t + \omega_m t + 90°] + \frac{1}{2}\cos(\omega_c t - \omega_m t + 90°)$$

And

$$M_2 = \cos \omega_c t \cdot \cos(\omega_m t + 90°)$$

$$= \frac{1}{2}\cos(\omega_c t + \omega_m t + 90°] + \frac{1}{2}\cos(\omega_c t - \omega_m t - 90°)$$

And o/p adder $= \cos(\omega_c t + \omega_m t + 90°)$

(8) LSBs in o/p ... of M_1 and M_2 are $180°$ out of phase with respect to each other.

(9) Hence they are cancelled out when added. so the adder o/p contains only upper side band.

In similar way we can do phase shift method to suppress the USB, by doing changes.

In block diagram of it, carrier source is between M_1 and $90°$ phase shifter keeping rest same.

Modulating and carrier signals are applied to upper balanced modulator M_1 directly. where as both signals are $90°$ phase shifted and applied to lower balanced modulator M_2.

i/p of $M_1 \Rightarrow \cos \omega_m t$ and $\omega_c t$

i/p of $M_2 \longrightarrow \cos(\omega_m t + 90°)$ and $\cos(\omega_c t + 90°)$

o/p of $M_1 = \cos \omega_m t \cos \omega_c t$

$$= \frac{1}{2}\cos(\omega_c t + \omega_m) t + \frac{1}{2}\cos(\omega_c t - \omega_m t)$$

	o/p of $M_2 = \frac{1}{2}\cos(\omega_c t + \omega_m t + 180°) + \frac{1}{2}\cos(\omega_c t - \omega_m t)$ Adder o/p $= \cos(\omega_c - \omega_m) +$ – USB in o/p of M_1 and M_2 are 180° out of phase. So in the adder they cancel each other and only LSB is obtained.
PROCEDURE	1. Click on 'File' on menu bar and click on 'New Schematic' to get schematic window. 2. Get the following components from LTSpice Library and place them as shown in the circuit diagram: • Modulate2: 2 nos. • Opamp OP07: 2 Nos • Resistors 10KΩ: 6 Nos. • Voltage source : 2 Nos , set to 12 V DC. • Voltage source : 2 No. , one set for SINE function, 0 offset, 1 V amplitude, 100 frequency, zero phase shift. The other set for SINE function, 0 offset, 1 V amplitude, 100 frequency, 90 degree phase shift as shown.

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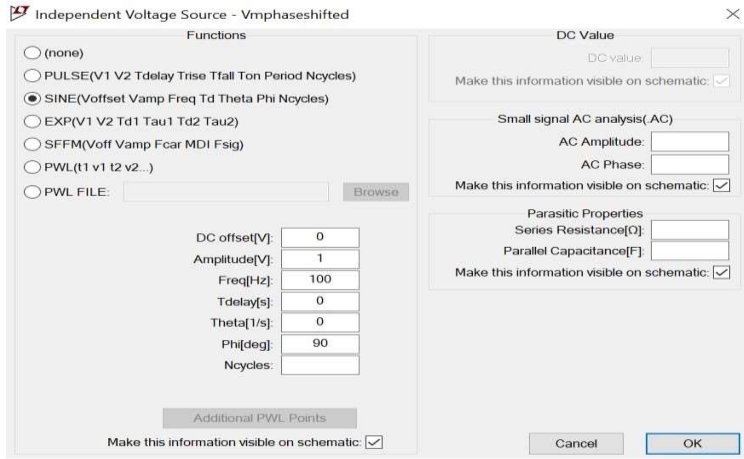
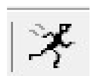
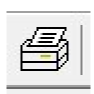


3. Connect the Circuit as shown in the circuit diagram using ‘wire’ tool.
4. Label the Net as shown.
5. Simulate using  Run. Set stop time to 100 msec.
6. Click on ‘Run’ again.
7. Observe Vm, phase shifted Vm, modulator outputs, USB and LSB outputs.
8. Note the frequencies of each of the above signals using FFT tool.
9. Click on  on Tool bar to print or save as PDF the above outputs and the spectrum.
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<tr>
<td>Observation</td>
<td>Note down all waveforms and spectrums</td>
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Conclusion

Conclusion:-

① Here we understood SSB modulation.

② With the help of tool LTspice Am SSB using phase shift method for given carrier and modulating frequency is generated. ($f_c = 1000\,Hz$ & $f_m = 100\,Hz$) get required O/p.

③ Understood AM DSB, AMSSB and FM modulation technique.

Answer the following Questions.

1. Compare AM , DSB SC and SSB modulation techniques

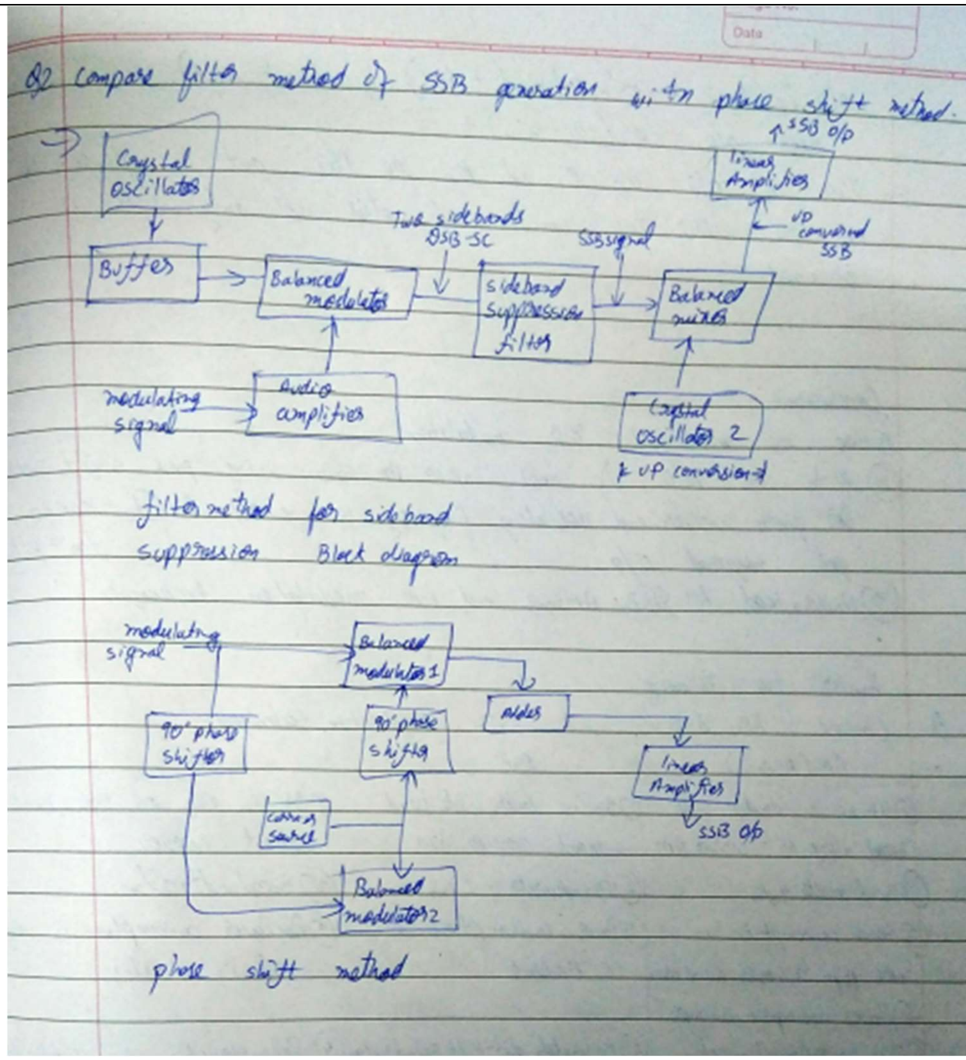
2. Compare filter method of SSB generation with Phase shift method.

Answer the following.

Q1 Compare AM, DSB SC and SSB modulation techniques.

→

AM (DSBFC)	DSB - SC	SSB
① It is a double side band along with carrier AM	① It is double side band without carrier AM	① It is only one side band AM without carrier.
② Band width $2 f_m$	② Bandwidth $= 2 f_m$	② Bandwidth $= f_m$
③ Power consumption is more. High to cover some area ~~③ Power consumption is more~~	③ Power consumption is Moderate	③ ~~Be~~ Power consumption is very small is least.
④ Easy reconstruction at Rx end	④ Moderately difficult reconstruction	④ Reconstruction is difficult.
⑤ less number of channels in a given frequency range	⑤ less number of channels in a given frequency range	⑤ More no. of channels in a given freq. range.
⑥ more redundant data	⑥ Moderately redundancy and data	⑥ least redundant data
⑦ No need of synchronization	⑦ Tracking might be required.	⑦ Synchronization or tracking is essential.
⑧ Application in Radio. broadcasting	⑧ Application Radio. broadcasting	⑧ Application in pt to pt mobile communication.



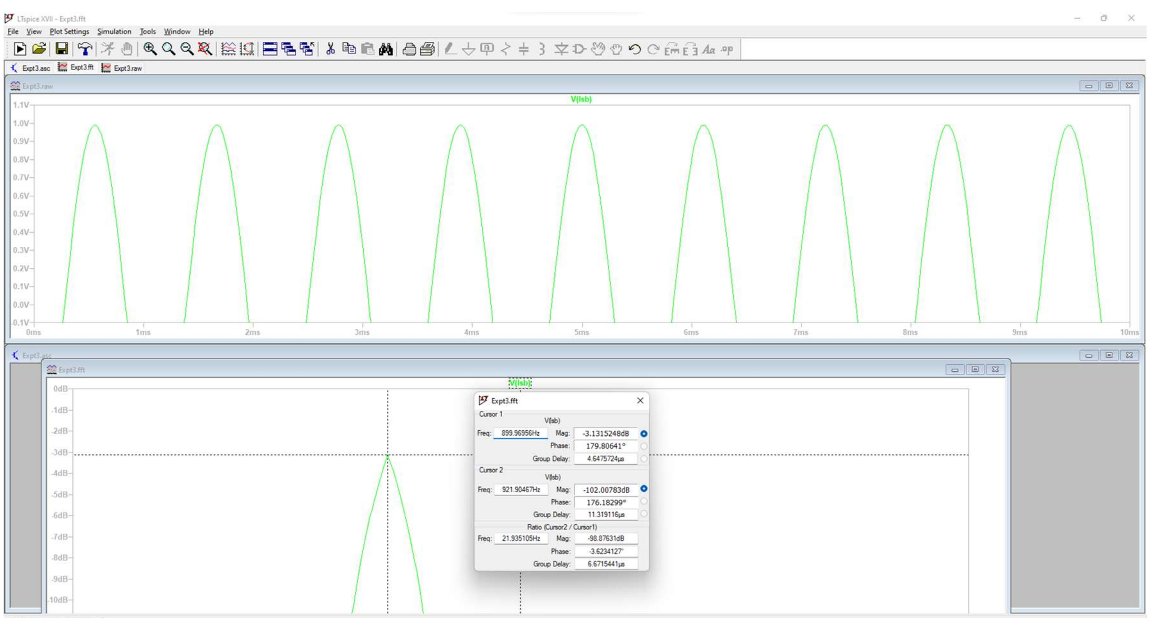
Q2 compare filter method of SSB generation with phase shift method.

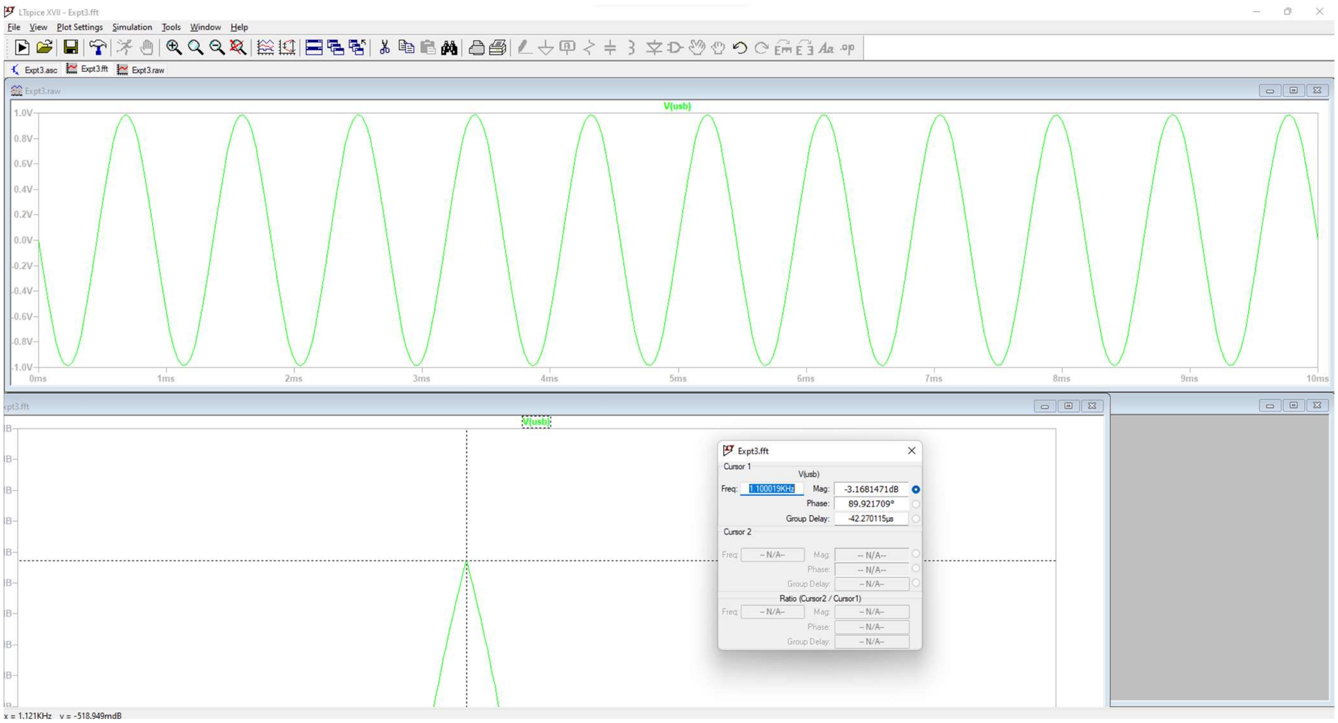
filter method for sideband suppression Block diagram

phase shift method

	Filter method	Phase shift method.
	(1) Unwanted sideband can be canceled using filters	(1) Unwanted sideband can be canceled by shifting AF and RF signal to BM by 90°
	(2) Design of 90° shifter at modulating frequency is not applicable.	(2) Design of 90° shifter at modulating frequency is critical.
	(3) SSB generation not possible at any frequency	(3) SSB generation is possible at any frequency.
	(4) There is need on conversion	(4) Conversion is not needed.
	(5) Use of low modulating frequency is not possible	(5) Use of low modulating frequency is possible.
	(6) Filter characteristics, its size and weight, cutoff frequency are the critical points in system design	(6) Design of 90° phase shifter for modulating frequency symmetry of balanced modulators is the critical pt while designing.

Results:





Circuit Diagram: