Department of Electrical and Electronic Engineering (EEE)
Bangladesh University of Engineering and Technology (BUET)

EEE 310: Communication Laboratory

EXPERIMENT NO: 3
FDM AND QM COMMUNICATIONS

Objectives:

- Demonstration of the operation of a two-channel frequency division multiplexed (FDM) base-band circuit.
- Demonstration of the operation of a two-channel quadrature modulated (QM) base-band circuit.

Introduction:

Frequency division multiplexing systems can send two or more channels of information over the same channel. In this experiment, two different intelligence signals are modulated on separate carriers. The balanced modulator in each channel suppresses the corresponding carrier. The resulting sidebands are combined by a summer. As for quadrature modulation, the carriers will have same frequency, but they will have a 90 degree phase shift between them. So the sidebands will overlap in frequency spectrum.

The ability of a synchronous detector to demodulate the signals that are of the same frequency and phase as BFO signal is used to recover the intelligence signals in both cases. Synchronous detectors require BFO signal, which must be of the same frequency and phase as the carrier of the intelligence signal being demodulated.

Procedure:

(a) Frequency division multiplex operation:

1) Connect the circuit as shown in figure-1.

2) An AF generator will be used to produce a 1 V p-p sine wave at 1600 Hz, approximately double the frequency of tone generator.

3) By adjusting the CARRIER ADJ. knob, obtain the the balanced modulated waveshape at J4& J7. Explain the observed waveform.

4) Observe the output of the summer (J10). Explain the observed waveform.

5) Observe the output of the predetection filters (J20& J18).

6) Observe the output of the product detectors (J23 & J26). Explain the observed waveform.

7) Observe the reconstructed outputs at J28 & J30.

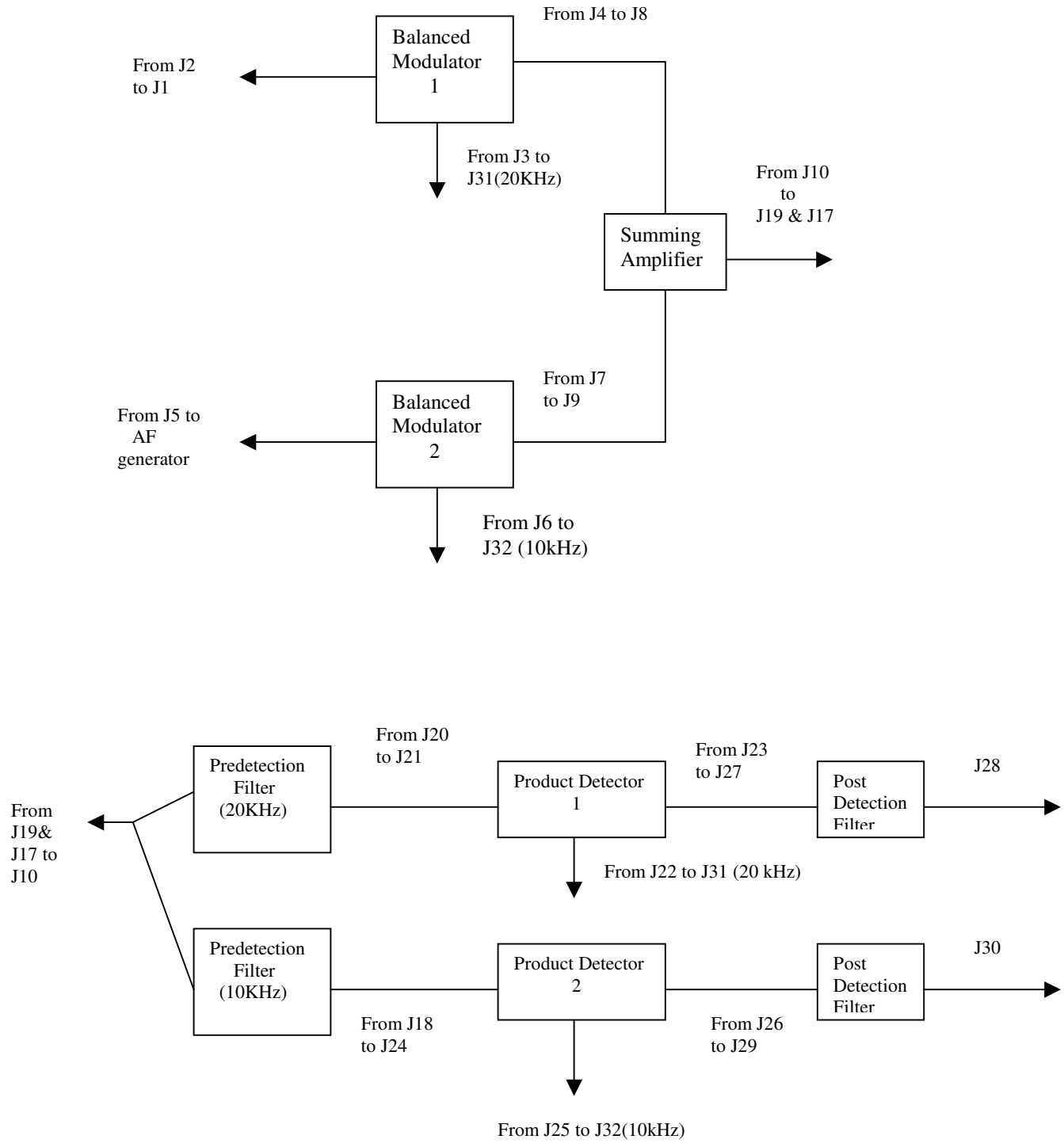

Figure1- **Frequency division multiplexing circuit**

(b) Quadrature modulation operation

1) Connect the circuit as shown in figure-2.

2) An AF generator will be used to produce a 1 V p-p sine wave at 1600 Hz, approximately double the frequency of Tone generator.

3) Obtain the balanced modulated waveshape at J4& J7. Explain the observed waveform.

4) Observe the output of the summer (J10). Do you notice any difference with the waveform previously obtained for FDM circuit?

5) Observe the output of the predetection filter (J18).

6) Observe the output of the product detectors. (J23 & J26). Explain the observed waveform.

7) Observe the reconstructed outputs at J28 & J30.

8) Remove the connection between J33 and J22. Connect J32 and J14.Connect another wire between J16 and J22.

9) Set the FREQ SEL switch on the FM detector to LO. Vary the Phase adjust control and observe the reconstructed outputs. Explain.

10) Return the circuit to its original state. Now interchange the subcarriers (Interchange the plug at J22 with the plug at J25). Observe the final outputs and explain.

- Both product detectors receive the same QM signal from a common source-the 10 kHz predetection filter. A product detector will demodulate sidebands that have same phase as the BFO signal. Sidebands that are not the same phase as the BFO will not be demodulated. Full suppression of the unwanted sidebands occurs at 90 degrees, and the demodulated intelligence signal from a product detector is maximum when the phase difference is exactly zero. Between the two extremes, the suppression or demodulated signal amplitude is proportional to the actual phase shift.

- The LO position in the FM detector block sets the center frequency at approximately at 10KHz. The PHASE ADJ. Is a potentiometer used in the LO frequency range to shift the frequency of a 10 KHz test signal at its input(J14) approximately 20 to160 degrees.

CAUTION:
Before giving any analog input, check whether a square wave of frequency 20KHz and 10KHz are available at points J31 and J32,J33 respectively, by using a frequency counter. You have to do it in both parts of the experiment(FDM and QM).

Labsheet Revised by:
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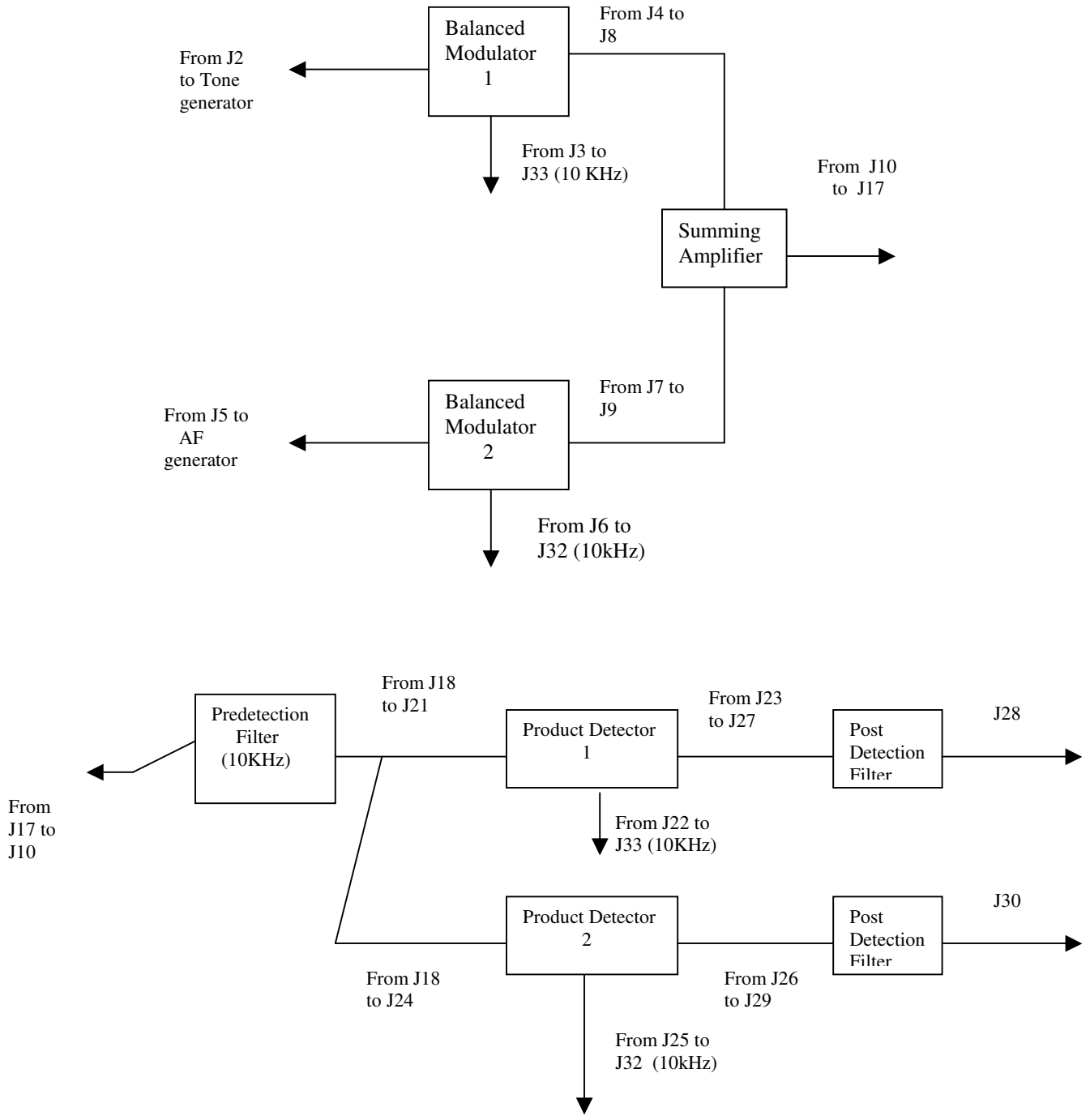

Figure 2 - **Quadrature modulation circuit**