B.Sc. in EEE, 4th Semester — February 17, 2023 **(Afternoon)**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — Summer Semester, A. Y. 2021-2022
Course No.: EEE 4403 — Time: 90 Minutes
Course Title: Communication Engineering I — Full Marks: 75

There are 3 **(three)** questions. Answer all 3 **(three)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

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1. a) Describe Quadrature Amplitude Modulation (QAM) and its comparison to other modulation techniques such as Amplitude Modulation (AM). **5**

   b) Explain the concept of vestigial sideband (VSB) modulation and its applications. **5**

   c) You are asked to design a DSB-SC modulator to generate a modulated signal $km(t)\cos(\omega_c t + \theta)$, where $m(t)$ is a signal band-limited to B Hz. Figure 1(c) shows a DSB-SC modulator. The carrier generator available generates not $\cos(\omega_c t)$, but $\cos^3(\omega_c t)$. Explain whether you would be able to generate the desired signal using only this equipment. You may use any kind of filter you like. **15**

   (i) Find the kind of filter is required.
   (ii) Determine the signal spectra at points "b" and "c" indicate the frequency bands occupied by these spectra.
   (iii) Find the minimum usable value of ω_c.
   (iv) Would this scheme work if the carrier generator output were $\sin^3(\omega_c t)$? Explain.

   CO1, PO1

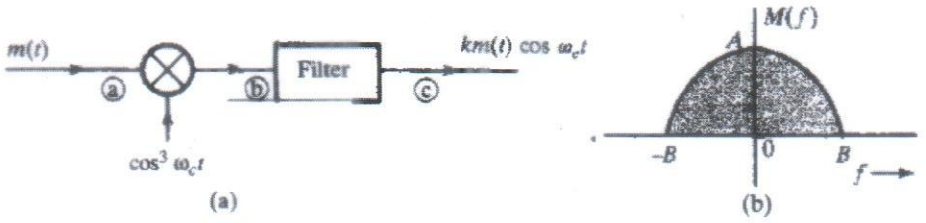

Figure: 1 (c)

2. a) Compare and contrast single sideband (SSB) modulation with double sideband (DSB) modulation in terms of bandwidth utilization and power efficiency. **5**

   b) Explain the distinction between coherent and noncoherent detection in analog communication systems. **10** **CO1, PO1**

c) Classify the following signals as energy signals or power signals. Find the normalized energy or normalized power of each **10**

(i) $x(t) = \cos t + 5\cos\ 2t \qquad for\ \ -\infty < t < \propto$

(ii) $x(t) = \begin{cases} A\exp(-at) & for\ t > 0, a > 0 \\ 0 & elsewhere \end{cases}$

3. a) Describe the working principle of a Costas receiver and its importance in phase synchronization. **10**

b) Derive the power of an amplitude modulated (AM) signal related to the modulating signal and the amplitude of the carrier wave. **10**

CO1, PO1

c) Consider the signal $x(t) = A\cos(2\pi f_c t) + K\sin(2\pi f_m t)$ passed through a square law device with output $y(t)$ corresponding to input $x(t)$ given as $y(t) = x^2(t)$. The output is passed through a bandpass filter with center frequency f_c. Find the DSB-SC signal generated. **5**