

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

Semester Final Examination  
Course No.: EEE 4403  
Course Title: Communication Engineering I

Summer Semester, A. Y. 2021-2022  
Time: 3 Hours  
Full Marks: 150

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) With pictorial demonstration of sinusoidal modulated signal, explain frequency and phase modulation scheme. 15
- b) Find the spectrum of the complex equivalent baseband of an FM signal. 15
- c) An angle-modulated signal with carrier frequency  $\omega_c = 2\pi \times 10^5$  is described by the equation: 10

$$\varphi_{EM}(t) = 10\cos(\omega_c t + 5\sin 3000t + 10\sin 2000\pi t).$$

CO1,  
PO1

Find:

- (i) Power of the modulated signal,  
(ii) Frequency deviation,  
(iii) Deviation ratio,  
(iv) Phase deviation,  
(v) Bandwidth.
- d) Consider a narrowband frequency modulated (FM) signal with modulation index  $\beta$  which is given as input to a frequency multiplier by a factor of  $n$ . Derive the modulation index of the output wideband FM signal. 10
2. a) For an OFDM receiver system employing coherent demodulation, show that different received sinusoidal signals are orthogonal. 15
- b) For a non-distorted received demodulate signal, find the sampling criteria. 10
- c) Consider an FM signal with carrier frequency  $f_c$ , modulation index  $\beta$  and message signal  $A_m \cos(2\pi f_m t)$ . Determine the instantaneous frequency of the signal. 10

CO1,  
PO1

d) Followings are the user's code for a CDMA system:

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$$\text{User A code} = [-1, -1, 1, 1, -1, -1, 1, 1]$$

$$\text{User B code} = [-1, -1, -1, -1, 1, 1, 1, 1]$$

$$\text{User C code} = [-1, 1, 1, -1, 1, -1, -1, 1]$$

Find:

- (i) Transmission from A, receiver attempts to recover A's transmission,
- (ii) Transmission from B, receiver attempts to recover A's transmission,
- (iii) Transmission from B and C, receiver attempts to recover B's transmission.

3. a) Describe the followings:

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- (i) Delta modulation,
- (ii) Advantage of PPM over PWM,
- (iii) Quantization and Sampling,
- (iv) TDMA.

b) A frequency modulated (FM) signal is described as follows:

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CO1,  
PO1

$$x_c(t) = 10 \cos \left( 6\pi \times 10^6 t + \frac{1}{4} \sin(8 \times 10^2 \pi t) \right)$$

Calculate the approximate bandwidth of  $x_c(t)$  using Carson's rule.

c) A frequency modulated (FM) signal with carrier frequency  $f_c = 5 \times 10^7$  is described by the equation:

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$$\Phi(t) = 5 \cos(2\pi f_c t + 2 \sin(5000\pi t)).$$

Find the maximum frequency deviation  $\Delta f$ .