SECTION B – ANSWER ONLY THRE QUESTIONS

Part One – Answer only one question in this part. [10 marks each]

1. a) What criterion is used to in indicate an FM signal is NBFM?
   b) Draw and label block diagram of a typical communication system. Write short notes on anyone of the major blocks.
   c) Can intelligent signal be sent without a carrier signal? Explain your answer.
   d) The antenna current of an AM transmitter is 8 A when only carrier is sent, but it increases to 8.93 A when the carrier is modulated by a single sine wave. Find the percentage modulation. Determine the antenna current when the percentage modulation changes to 0.8.

2. a) Find the fundamental frequency of the periodic signal *v(t)* given by $v(t) = e^{j2t} + \cos 3t$ V.
   b) Sketch the two-sided amplitude spectrum of the signal *v(t)*.
   c) Calculate the average power of the signal.
   d) Determine the energy and the power of the signal below. Discus your answers.

$$s(t) = \begin{cases} 2, & 0 \le t \le T/2 \\ 2+j & T/2 \le t \le T \\ j & T \le t \le 2T \end{cases}$$

Part Two – Answer any two questions in this part. [10 marks each]

3. The equation for a FM wave is $s(t) = 10\cos\left[5.7\times10^{8}t + 5\sin\left(12\times10^{3}\right)t\right]$. Calculate
   i. The carrier frequency
   ii. Modulating frequency
   iii. Modulation index
   iv. Frequency deviation
   v. Power dissipated in a 100 Ω resistor load.

4. For an FM modulator with a modulation index m = 1, a modulating signal $V(t) = V_o\sin(2\pi1000t)$ and an unmodulated carrier $v_c = 10\sin(2\pi500kt)$:
   i. (a) Determine the number of sets of significant side frequencies.
   ii. (b) Determine their amplitudes.
   iii. (c) Draw the frequency spectrum.

5. An AM signal modulated by a sinewave consist of a carrier voltage given by $s(t) = 100\sin(2\pi10^6t) + 40\sin 9425t\sin\left(2\pi10^6t\right)$.
   Determine the following
   a) the modulation index
   b) the carrier frequency
   c) the modulating signal frequency
   d) the amplitude verse frequency plot of the modulated signal

TABLE 7-2 BESSEL FUNCTIONS OF THE FIRST KIND, $J_n(m)$

m_f	J_0	J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}	J_{11}	J_{12}	J_{13}	J_{14}
0.00	1.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—	—	—	—	—
2.4	0	0.52	0.43	0.20	0.06	0.02	—	—	—	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	0.01	—	—	—	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—	—	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02	—	—	—	—	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—	—	—	—	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02	—	—	—	—
8.0	0.17	0.23	−0.11	−0.29	−0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03	—	—	—
9.0	−0.09	0.25	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.31	0.21	0.12	0.06	0.03	0.01	—
10.0	−0.25	0.05	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.32	0.29	0.21	0.12	0.06	0.03	0.01