1. Determine the Fourier transform of each of the following signals:

   (a) $\cos(4\pi f_0 t)$　(8%)

   (b) $t\cos(2\pi f_0 t)$　(8%)

2. The output signal from an AM modulator is

   $u(t)=5\cos(900\pi t)+20\cos(1000\pi t)+5\cos(1100\pi t)$

   (a) Determine the modulating sinal $m(t)$ and the carrier $c(t)$.　(10%)

   (b) Determine the modulation index.　(8%)

   (c) Determine the ratio of the power in the sidebands to the power in the carrier.　(8%)

3. A message signal $m(t)$ has a bandwidth of 10 kHz and a peak magnitude $|m(t)|$ of 1 volt. Estimate the bandwidth of the signal $u(t)$ obtained when the $m(t)$ frequency modulates a carrier with a peak-frequency deviation of $f_d=20$ Hz/v.　(8%)

4. An analog signal is sampled at the rate of 6000 samples/sec, quantized using 64 quantization levels, and then transmitted using a 16-QAM system.

   (a) What is the transmission data rate?　(5%)

   (b) What is the 16-QAM symbol transmission rate?　(5%)

5. Binary data at 56000 bits/s are transmission using 16-QAM modulation. Find the theoretical minimum system bandwidth that avoids ISI.　(10%)

6. A BPSK system operates over an AWGN channel with an E_b/N_0 of 10 dB. Find the bit error probability.　(15%)

7. Consider a (7, 4) code whose generator matrix is $\mathbf{G} = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$.

   (a) Find the codeword of the message $\mathbf{m} = [1\ 0\ 0\ 1]$.　(5%)

   (b) Decode the received vector $\mathbf{r} = [1\ 0\ 1\ 1\ 0\ 0\ 1]$.　(10%)