 Code : 041603

B.Tech 6th Semester Exam., 2016

INTRODUCTION TO COMMUNICATION SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Answer any *seven* of the following questions : 2×7=14

(a) In one period, the periodic signals will have

(i) finite number of maxima and zero minima

(ii) infinite number of maxima and finite number of minima

(iii) finite number of maxima and infinite number of minima

(iv) finite number of maxima and minima

(b) Fourier spectrum (transform) of non-periodic signal will have

(i) magnitude spectrum

(ii) phase spectrum

(iii) constant value

(iv) Both *(i)* and *(ii)*

(c) Fourier transform of a DC signal with unity strength is

(i) zero

(ii) 1

(iii) $2\pi\delta(\omega)$

(iv) 2π

(d) A message signal

$$m(t) = \frac{1}{3}\cos(\omega_1 t) - \frac{1}{2}\cos(\omega_2 t)$$

is amplitude modulated with a carrier of frequency ω_c to generate

$$s(t) = [1 + m(t)]\cos(\omega_c t)$$

The power efficiency achieved by this AM scheme is

(i) 8%

(ii) 12%

(iii) 16%

(iv) 25%

(e) An angle-modulated signal is given by

$s(t) = \cos[2\pi(2\times10^6 t) + 20\sin(200t) + 50\sin(250t)]$

The maximum frequency and phase deviations of $s(t)$ are

(i) 70, 15 kHz

(ii) 140π, 15 kHz

(iii) 70, 16·5 kHz

(iv) 140π, 16·5 kHz

(f) A message signal

$m(t) = \cos(2000\pi t) + 4\cos(4000\pi t)$

modulates the carrier $c(t) = \cos(2\pi f_c t)$, where $f_c = 1$MHz to produce an AM signal. For demodulating the generated AM signal using an envelope detector, the time constant RC of the detector circuit should satisfy

(i) $0\cdot5\,\text{ms} < RC < 1\,\text{ms}$

(ii) $1\,\mu\text{s} \ll RC < 0\cdot5\,\text{ms}$

(iii) $RC \ll 1\,\mu\text{s}$

(iv) $RC \gg 0\cdot5\,\text{ms}$

(g) Which of the following camera tubes has minimum lag?

(i) Vidicon

(ii) Saticon

(iii) Plumbicon

(iv) Iconoscope

(h) The camera signal output without sync is called

(i) black burst

(ii) composite video

(iii) generator lock video

(iv) non-composite video

(i) The signal $\cos(\omega_c t) + 0\cdot5\cos(\omega_m t)\sin(\omega_c t)$ is

(i) FM only

(ii) AM only

(iii) both AM and FM

(iv) neither AM nor FM

(j) Two sinusoidal signals of same amplitude and frequencies 10 kHz and 10·1 kHz are added together. The combined signal is given to an ideal frequency detector. The output of the detector is

(i) 0·1 kHz sinusoid

(ii) a constant

(iii) 200·9 Hz sinusoid

(iv) a linear function of time

Answer any *four* from the following :

2. *(a)* Determine the Fourier series expansion of the following signals : 8

(i) $x(t) = \cos(t) + \cos(2 \cdot 5t)$

(ii) $x(t) = \cos 2\pi f_0 t + |\cos 2\pi f_0 t|$

(b) Find the complex Fourier series for the following signal : 6

$$x(t) = \cos \omega_0 t + \sin^2 \omega_0 t$$

3. *(a)* A signal $m(t)$ is multiplied by a sinusoidal waveform of frequency f_c. The product signal $v(t) = m(t) \times \cos 2\pi f_c t$. If the Fourier transform of $m(t)$ is $M(f)$, find the Fourier transform of $v(t)$.

Further assume that $m(t)$ is a sinusoidal signal, i.e., $m(t) = m \times \cos 2\pi f_m t$, where m is a constant. Now, $v(t)$ is given by

$$v(t) = m \times \cos 2\pi f_m t \times \cos 2\pi f_c t$$

Find the Fourier transform of $v(t)$. 9

(b) Verify the duality property, that is

$$X(t) \leftrightarrow 2\pi x(-\omega)$$ 5

4. *(a)* With the help of suitable block diagram(s), discuss electronic communication system. 7

(b) Explain *(i)* limiter and *(ii)* discriminator in the context of FM receiving system. 7

(Turn Over)

5. *(a)* A modulating signal $m(t)$ is applied to a DSB-SC system modulator operating at $f_c = 50$ kHz. Determine and sketch the spectrum of the modulated signal if $m(t)$ is given by

$$m(t) = 2 \cos (4000\pi t) + 5 \cos (6000\ \pi t)$$

and the carrier signal is

$$c(t) = 100 \cos(2\pi f_c t)$$ 5

(b) With the help of suitable diagram(s), derive the expression for SSB-AM signals. 9

6. With the help of suitable diagram(s), explain the following methods for generating AM-modulated signals :

(a) Power-law AM modulator

(b) Switching modulator

Also, derive the expression for AM-modulated output(s) for these AM-modulators. 7+7=14

7. *(a)* Calculate signal to noise ratio (SNR) for the single sideband suppressed carrier (SSB-SC). 9

(b) Explain the need for frequency translation. 5

(Continued)

8. *(a)* An angle-modulated signal has the form

$x(t) = 100\cos[2\pi f_c t + 4\sin 2000\pi t]$

where $f_c = 10\,\text{MHz}$.

(i) Determine the average transmitted power.

(ii) Determine the peak-phase deviation.

(iii) Determine peak-frequency deviation.

(iv) Is this an FM or a PM signal? Explain. 7

(b) A superheterodyne FM receiver operates in the frequency range of 88–108 MHz. The IF and local oscillator frequencies are chosen such that $f_{IF} < f_{LO}$. We require that image frequency f_c' fall outside of the 88–108 MHz region. Determine the minimum required f_{IF} and the range of variation in f_{LO}. 7

9. *(a)* Explain the FM generation by Armstrong's indirect method. 7

(b) Show that DSB-SC amplitude modulation is linear, while phase modulation is not. 7

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