(b) Draw the block diagram of a superheterodyne receiver and explain the function of each block.

(c) For a broadcast superheterodyne AM receiver having no RF amplifier the loaded quality factor Q of the antenna coupling circuit is 100. Now if the intermediate frequency is 455 kHz, then determine the image frequency and its rejection ratio at an incoming frequency of 1 MHz.　　3

9. (a) Compare AM and NBFM.　　2

(b) An angle modulated signal is described by the equation　　4

$$s(t) = 12\sin [6 \times 10^8 t + 5\sin 1250t]$$

Calculate:　　(i) carrier frequency
(ii) modulating frequency
(iii) modulation index
(iv) frequency deviation

(c) Explain with suitable block diagram the generation of FM signal using Armstrong method.　　6

(d) What is Carson's rule? Explain it.　　3

10. (a) What do you mean by thermal and white noise?　　2

(b) An amplifier operating over the frequency range from 18 MHz to 20 MHz has a 10 kΩ input resistor. What is the r.m.s. noise voltage at the input to this amplifier if the ambient temperature is 27° C?　　3

(c) Define SNR and Noise Figure. Why is the noise performance of the first stage of a cascade receiver so important? If each stage of a two-stage cascade amplifier has a gain of 10 dB and noise figure of 10 dB, calculate the total noise figure in dB.　　3+1+2

(d) Calculate the SNR at the output of a synchronous SSB-SC demodulator　　4

11. (a) Considering a message signal $e_m = E_m \cos \omega_m t$ and a carrier signal by $e_c = E_c \sin(\omega_c t + \theta)$, find the expression of the resultant FM wave.　　7+8

(b) Explain FM stereo Tx/Rx system with block schematic diagrams.

12. Write short notes on any three of the following:　　3×5

(a) Foster-Seeley Detector
(b) Envelope detector
(c) VSB modulation
(d) Pre-emphasis and De-emphasis
(e) TDM

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EC-501

ANALOG COMMUNICATION

Time Allotted: 3 Hours　　　　　　　　　　Full Marks: 70

The questions are of equal value
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions.　　10×1 = 10

(i) When modulating frequency is doubled, the modulation index is halved and the modulating voltage remains constant. The modulation system is

(A) AM　　　　　　　　　(B) FM
(C) PM　　　　　　　　　(D) all of these

(ii) A 10 kW transmitter is modulated to 80%. The average sideband power will be

(A) 1.8 kW　　　　　　　(B) 8 kW
(C) 3.2 kW　　　　　　　(D) 4.6 kW

(iii) For video transmission of television, which of the following is used?

(A) AM　　　　　　　　　(B) DSB-SC
(C) VSB　　　　　　　　 (D) SSB-SC

(iv) The length of the antenna to transmit a signal must be at least

(A) 1/3 wavelength　　　　(B) 2/3 wavelength
(C) 1/4 wavelength　　　　(D) 3/4 wavelength

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(v) Two sinusoidal signals are simultaneously modulating a carrier, the modulation indices being 0.3 and 0.4. The overall modulation index is

(A) 0.5   (B) 0.1

(C) 0.7   (D) 0.12

(vi) The intermediate frequency used for a superheterodyne AM receiver is

(A) 455 kHz   (B) 755 kHz

(C) 545 kHz   (D) none of these

(vii) Zero crossing detectors are used to detect

(A) SSB-SC   (B) DSB-SC

(C) FM   (D) none of these

(viii) If the radiated power of AM transmitter is 10 kW, the power in the carrier for modulation index of 0.6 is nearly

(A) 8.24 kW   (B) 8.47 kW

(C) 9.26 kW   (D) 9.6 kW

(ix) Thermal noise power in a resistor R is proportional to

(A) T (B) T^2

(C) $1/T$ (D) T^3

(x) A balance modulator circuit is used to reject

(A) Carrier   (B) LSB

(C) USB   (D) LSB and USB

(xi) White noise is specified by

(A) Gaussian distribution

(B) Rician distribution

(C) Binomial distribution

(D) Maxwell-Boltzmann distribution

(xii) Bandwidth required for PM is

(A) same as FM signal   (B) greater than FM signal

(C) less than FM signal   (D) less than SSB-SC signal

GROUP B
(Short Answer Type Questions)

Answer any *three* questions.   3 × 5 = 15

2. A modulating signal given by $v_m = 2\cos(2\pi \times 1000t)$ amplitude modulates a carrier given by $v_c = 15\cos(2\pi \times 10^6 t)$. Determine   2+1+2

(i) Modulation index

(ii) Frequencies present in the modulated signal

(iii) Total transmitter power

3. Explain with block diagram the indirect method of WBFM generation.   5

4. Derive the relationship between modulation index and modulated signal amplitude for a sinusoidally modulated DSB-TC signal.   5

5. Find the carrier and modulating frequency, the modulation index and the maximum deviation of the FM wave represented by the voltage equation $v = 5\sin(6 \times 10^8 t + 5\sin 1000t)$. What power will this FM wave dissipate across a 20 Ω resistor?   5

6. Draw and explain the square-law diode modulator.   5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions.   3 × 15 = 45

7. (a) What do you mean by DSB-SC modulation? Explain the function of ring modulator in DSB-SC generation.   1+4

(b) Prove that the efficiency for a single tone AM is 33.33% for perfect modulation. What will be the efficiency if the value of modulation index is 0.5?   3+2

(c) An AM transmitter has an unmodulated carrier power of 10 kW. It can be modulated by a sinusoidal modulating voltage to a maximum depth of 40%, without overloading. If the maximum modulation index is reduced to 30%, what is the extent up to which the unmodulated carrier power can be increased without overloading?   5

8. (a) Explain the terms – 'selectivity', 'sensitivity', and 'fidelity' of a receiver.   5

[Turn over