

Code: A-15
Time: 3 Hours

Subject: COMMUNICATION ENGINEERING
Max. Marks: 100

NOTE: There are 11 Questions in all.

- Question 1 is compulsory and carries 16 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
- Answer any THREE Questions each from Part I and Part II. Each of these questions carries 14 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following: (2x8)

- a. The output and input SNR's of an amplifier are 16 dB and 20 dB respectively. Its noise figure is
- (A) 0.8. (B) 1.25.
 (C) 4 dB. (D) 36 dB.
- b. In a superhet AM receiver, most of the adjacent channel rejection comes from
- (A) RF tuned circuits. (B) 1F tuned circuits.
 (C) Detector stage. (D) AF amplifiers.
- c. A slope detector is used for detecting
- (A) VSB signals. (B) PPM signals.
 (C) DM signals. (D) FM signals.
- d. Flat top sampling leads to
- (A) aliasing. (B) undersampling.
 (C) distortion in received signal. (D) aperture effect.
- e. The core diameter of a single mode fiber is
- (A) 0.2 – 1 mm. (B) 20 – 100 μm .
 (C) 2 – 10 μm . (D) 20 – 100 nm.
- f. The impulse response of a filter matched to rectangular pulse signals is
- (A) an impulse. (B) a rectangular pulse.
 (C) a saw-tooth. (D) a triangular pulse.

- g. The blind speed of an MTI radar varies (where PRF stands for pulse repetition frequency)
- (A) directly as PRF. (B) inversely as PRF.
 (C) inversely as $(PRF)^{1/4}$. (D) directly as $(PRF)^{1/4}$.
- h. The channel capacity of a 4 KHz channel with a 15 dB SNR is about
- (A) 20 kbps. (B) 32 kbps.
 (C) 40 kbps. (D) 124 kbps.

PART I

Answer any THREE Questions. Each question carries 14 marks.

- Q.2** a. Obtain a relationship between the noise figure and noise temperature of a two-port network (like an amplifier). (7)
- b. Consider a parallel combination of two resistors R_1 and R_2 and a capacitor C . Find the total mean squared thermal noise voltage across C . (7)
- Q.3** a. Describe any one method of generation of AM signals. (7)
- b. Consider an FM signal $10 \cos \left(2 \pi 10^6 t + 5 \sin 2 \pi 10^3 t \right)$ volt applied across a 600Ω resistor. Find
- i. the bandwidth of the FM signal.
 - ii. the frequency range occupied by the FM signal and
 - iii. the expression for the modulating signal. (7)
- Q.4** a. Compare the average transmitter power and channel bandwidth for AM, DSB-SC and SSB systems for 10 KHz modulating signal and required output SNR of 50 dB. The channel loss is 60dB and the two-sided channel noise power spectral density is 10^{-12} W/Hz . For AM, the depth of modulation is 70% and the mean squared value of the audio signal is 0.5. (7)
- b. A DSB-SC signal $= m(t) \cos \omega_c t$, with $m(t)$ bandlimited to $B \ll f_c$, multiplied with itself. The product signal is applied to an ideal LPF of cutoff $2B$. The filter output is given to a square-rooter circuit. Find the output of the square-rooter and comment on the result. (7)
- Q.5** An FM system uses a $75 \mu s$ preemphasis and the corresponding deemphasis. Find the improvement in noise performance for modulating signal frequency of 15 KHz. Derive the

formula used. (7+7)

- Q.6** a. Give a labelled block diagram of a stereophonic FM broadcast system. (7)
- b. Describe diagonal clipping in diode envelope detection of AM signals. (7)

PART II

Answer any THREE Questions. Each question carries 14 marks.

- Q.7** a. Derive an expression for signal-to-quantisation noise ratio in a Delta Modulation (DM) system with no slope overload. (7)
- b. In a single-integration DM system with 4 KHz, 1 V max amplitude modulating signal and with 64,000 / sec sampling, find
- (i) minimum step size to avoid slope overload.
 - (ii) granular noise power.
 - (iii) Signal-to-quantisation noise ratio. (7)
- Q.8** a. Compare the performance of
- (i) six bit binary PCM with linear quantisation and
 - (ii) six bit binary PCM with μ -law compression with $\mu=100$. The message signal is a full load test tone at 4 KHz. (7)
- b. Explain the reasons for normally selecting (R-Y) and (B-Y) signals in colour demodulator in a TV receiver. How is (G-Y) signal derived? (7)
- Q.9** A receiver is to receive binary pulses $s(t)$ and $-s(t)$ using a suboptimum filter. The signal $s(t)$ is a rectangular pulse of duration T_o . The filter is a simple RC-LPF and the noise is AWGN. Find the value of the RC product in terms of T_o for optimum performance. (14)
- Q.10** Derive an expression for the capacity of a Gaussian channel. (14)
- Q.11** a. Find the maximum range of a deep space radar operating at 2.5 GHz and with a peak power of 25 MW. The antenna is a 6.4 m dish and the target cross-section is $1m^2$. The amplifier has a 1.1 dB noise figure and the receiver bandwidth is only 5 KHz. (7)
- b. Describe the operation of an MTI radar. (7)