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TEST -2 EXAMINATION- Oct 2017

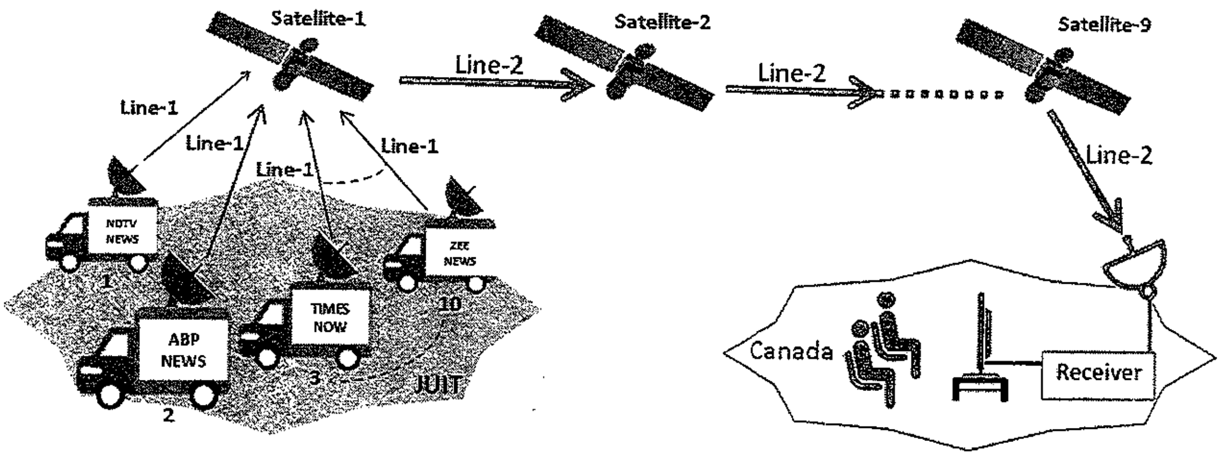
B.Tech 5th Semester

COURSE CODE: 10B11EC511 MAX. MARKS:25

COURSE NAME: Digital Communications

COURSE CREDITS: 4 MAX. TIME: One Hour Thirty Minutes

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. ***Make valid assumptions with justification whenever required.***



Hurray! Prime Minister of India Sh. Modi is visiting JUIT to address students. Of course, a bunch of media people gather to capture live event and broadcast Modi's Speech worldwide. Someone sitting in Canada is interested to hear what PM says. As a communication engineer, you are assigned the job to design the end to end communication system for all news channels as shown in the figure. During the broadcast, all the news channels simultaneously transmit using their media vehicles. There are 10 media vehicles, each fitted with a digital telephony system to capture Modi's voice and transmit it to a satellite. Hence the voice signal $X(t)$ is to be digitized by each vehicle and transmitted to settelite-1using FDM. At sattelite-1 after detection and decoding, digital signals are multiplexed using TDM and transmitted further to the next satellite. There are 9 satellites with regenerating repeaters. At the receiver in Canada the incoming data is de-multiplexed and the full receiver processing is performed, user can select any channel and listen to the speech (see Figure).

Consider the following strictly for your design to transmit $X(t)$ by optimizing ADC, Line-coding, multiplexing, and performance measure.

Speech signal characteristics:

- The speech signal $X(t)=A\cos(2\pi f_0 t+\theta)$ with $f_0=3.4KHz$ be a continuous-time waveform where θ is a random variable uniformly distributed over [0, 2π] and A is a random variable with zero mean Gaussian distributed over range [-∞, ∞] having variance $\sigma_A^2 = 2.25$.

Analogue to digital conversion:

- $X(t)$ is digitized using DPCM with first order predictor (i.e., $\hat{x}_n = cx_{n-1}$). If predictor is designed for optimal coefficient $c_{opt} = 0.482$ that minimizes the mean square prediction error, then determine the sampling rate f_s **[2 Marks]** and find the prediction gain G_p **[2 Marks]** of DPCM. A uniform quantizer with L-level and n-bits encoder is used in this DPCM system. D etermine smallest n such that the output SQNR is greater than 30dB **[2Marks]**. Find the output data rate **[2 Marks]**. Draw the block diagram of this analogue to digital converter by properly mentioning the design parameter values in the diagram **[2Marks]**. This produces digital data having 0 and 1 values ready to be transmitted.

Line-coding scheme:

- Now, 10 such binary streams are transmitted to the satellite-1 using FDM through Line-1links by using polar Quaternary signaling with outputs ±b/2 and ±3b/2, where amplitude b=+5V. Line-2 links use TDM and incorporate same Quaternary signaling as Link-1. At each satellite and the destination receiver, optimum baseband detectors are used. What is the bandwidth B required for ISI free transmission for the Link-1assuming raised cosine spectrum with α=0.5 **[2 Marks]**.

Link Performance measure:

- At detector site, assume that the optimal filters used are the ideal filters with unity gain and also assume zero path loss in all the links but AWGN channel with PSD $N_0/2$ where N_0=7.87 mW/KHz. Find BER (probability of bit error) of detector at settallite-1 using Q(.) function table given below **[2 Marks]**. Also, determine BER performance at the user end located in Canada as shown in Figure **[2 Marks]**.

Line-2 structure and TDM design:

- Design your own TDM technique for **Line-2**. (Hint: Take some idea from North American digital hierarchy. Note: no extra data bits must be inserted in Line-2 other than signaling and framing bits.)
- Explain (pictorially) full structure of the frames of your proposed Line-2 showing insertion of framing and control bits **[2 Marks]**. What pattern of framing bits have you chosen and why **[2 Marks]**? Determine the data rate of the Line-2 **[2 Marks]**. Determine the signaling rate of Line-2 **[2 Marks]**.
- For Bit/symbol synchronization, which technique will be useful for this system if scrambling is not allowed? **[1 Marks]**.

x	1.26	4.2	5.1
$Q(x)$	0.1038	$1.333*10^{-5}$	$1.7*10^{-7}$

--------------------------X--------------------X----------------------X----------------------