Section A

Answer all questions, clearly showing the workings.

(All complete and correct answers will carry 5 Marks each)

Q1 : A broadcast-quality video signal made up of 640x360 pixels per frame has been transmitted over a channel at the rate of 25 frames per second. Each pixel of the signal has been coded using 12 bits per primary colour of red, blue and green for the purpose of transmission. It was observed that when the channel was in operation for a continuous period of six hours from 0900 to 1500 hours, 5023 bits have been received in error.

(i) Calculate the total number of bits required to create a complete frame of picture.

(ii) Calculate the total number of bits transmitted during the above said period.

(iii) Calculate the bit error rate of the above channel. *(Note: State the answer in standard form.)*

Q2 : A line-of-sight direct wireless communication channel has been established between two cities separated by 15 km. In order to receive signals with sufficient power, it has been identified that both ends of the system need to be fitted with antennas of gain 40 dB each and the frequency of the signal used is 5GHz. What are the cross-sectional areas (aperture) of the antennas used?

(Assume the speed of light in free space to be $3*10^8$ m/s)

Q3 : Draw both the amplitude and phase spectra of the resulting signal S_3S_2, when the signals $S_1 = -10 + 3\sin(75\pi t) + 7\sin(225\pi t - \pi/2)$ and $S_2 = 3\cos(5\pi t) + 4\sin(6\pi t + \pi/4)$ are multiplied with each other.

Q4 : A communication satellite is suspended in a geostationary orbit in the sky. The following additional information has been given to you.

Speed of the satellite $v = \sqrt{\frac{GM_E}{h_0}}$ where,

h_0 is the altitude of the satellite from the earth's centre.

$G = 6.673 \times 10^{-11}\ Nm^2/kg^2$ is the gravitational constant

$M_E = 5.9 \times 10^{24}\ kg$ is the earth's mass and

$r = 6373km$ is the earth's radius at the equator

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