वियोज्य *DETACHABLE*

ELECTRONICS & TELECOMMUNICATION ENGINEERING

Paper II

Time Allowed : Three Hours

Maximum Marks : 300

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

There are **EIGHT** questions divided in **TWO** Sections.

Candidate has to attempt **FIVE** questions in all.

Question Nos. **1** and **5** are **compulsory** and out of the remaining, **THREE** are to be attempted choosing at least **ONE** question from each Section.

The number of marks carried by a question/part is indicated against it.

Answers must be written in the medium authorized in the Admission Certificate which must be stated clearly on the cover of this Question-cum-Answer (QCA) Booklet in the space provided. No marks will be given for answers written in medium other than the authorized one.

Assume suitable data, if considered necessary and indicate the same clearly.

Unless otherwise mentioned, symbols and notations carry their usual standard meanings.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

SECTION 'A'

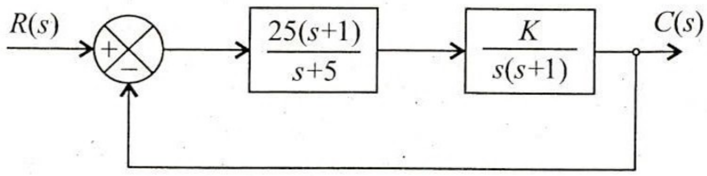
1.(a) Explain source coding. A discrete message source emits seven symbols $\{m_1, m_2, m_3 ...... m_7\}$ with probabilities $\{0{\cdot}35, 0{\cdot}3, 0{\cdot}2, 0{\cdot}1, 0{\cdot}04, 0{\cdot}005, 0{\cdot}005\}$ respectively. Give Hulfman codes for these symbols and calculate average bits of information and average binary digits of information per symbol. Calculate code efficiency. 15

1.(b) (i) With the help of proper block diagram explain the basic elements of PCM system.

(ii) An Analog voltage signal whose highest significant frequency is 4 KHz is to be digitally encoded with a resolution of 0·01% covering the voltage range of 0 – 10V using PCM. In order to avoid loss in information and to maintain given resolution determine (A) Minimum sampling rate (B) Number of bits needed for encoded PCM. 10

1.(c) A unity negative feedback control system has an open-loop transfer function consisting of two poles, two zeros and a variable gain K. The zeros are located at –2 and –1; and the poles at –0·1 and +1.
Using Routh's stability criterion, determine the range of values of K for which the closed-loop system has 0, 1 or 2 poles in the right-half s-plane. 15

1.(d) Consider the feedback control system shown :



Find the sensitivity of transfer function $T(s) = c(s)/R(s)$ to variations in parameter K. What is its magnitude at $\omega = 5$ for $K = 1$? 10

1.(e) Write about the process details of Chemical Vapor Deposition. 10

2.(a) (i) Explain and differentiate between baseland communication and carrier communication. An audio FM system with audio frequency of 1 KHz and audio frequency voltage of 4·8V is used with frequency deviation of 7·2 KHz. Calculate modulation index. If the voltage of audio signal now increased to 8·2V, what is new deviation ? Now if both audio voltage and frequency are changed to 10V and 200 Hz calculate deviation and modulation Index.

(ii) Zero mean white Gausian noise with a two sided power spectral density of 4 W/KHz is passed through an ideal low pass filter with cut off frequency of 2 KHz and pass land gain of unity to produce the noise output $n(t)$.

(A) Obtain the total power in $n(t)$.

(B) Find auto correlation function $E[n(t)\ n(t+\tau)]$ of the noise $n(t)$ as a function of τ. 20

2.(b) The open-loop transfer function of a unity feedback system is given by

$$G(s) = \frac{K}{s(1+sT_1)(1+sT_2)}.$$

Find an expression for gain K in terms of T_1, T_2 and specified gain margin G_m. What is its phase margin for $K = 1$, $T_1 = 0{\cdot}2$ and $T_2 = 0{\cdot}05$? 20

2.(c) Given a 3-stage Lattice filter with reflection co-efficients $K_1 = \frac{1}{4}$, $K_2 = \frac{1}{4}$ and $K_3 = \frac{1}{3}$. Determine FIR filter co-efficients for the direct form structure. 20

3.(a) A discrete memory less source generates either 0 or 1 at a rate of 160 Kbps; 0 is generated three times more frequently than 1. A binary PSK modulator is employed to transmit these bits over a noisy channel.

The 0 and 1 are represented by v_0 and v_1.

$v_0 = -6\sqrt{2}\cos 640\pi \times 10^3 t\ V$

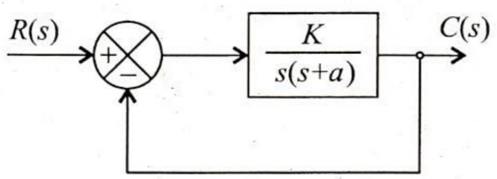
$v_1 = \ \ 6\sqrt{2}\cos 640\pi \times 10^3 t\ V$ respectively.

(i) Determine the transmitted signal energy per bit.

(ii) Determine the basis function for this binary PSK scheme.

(iii) Determine the probability of error when channel is assumed to be zero mean AWGN with pSd of $\frac{N_0}{2} = 3{\cdot}125 \times 10^{-4}$ W/Hz. 20

3.(b) Consider the feedback system shown :



(i) If the resonant peak and resonant frequency of this system is 1·04 and 11·55 rad/sec respectively, find its settling time and bandwidth. 12

(ii) Sketch its root-locus plot also as K varies from 0 to ∞. Using root-locus plot, comment on the settling time. 8

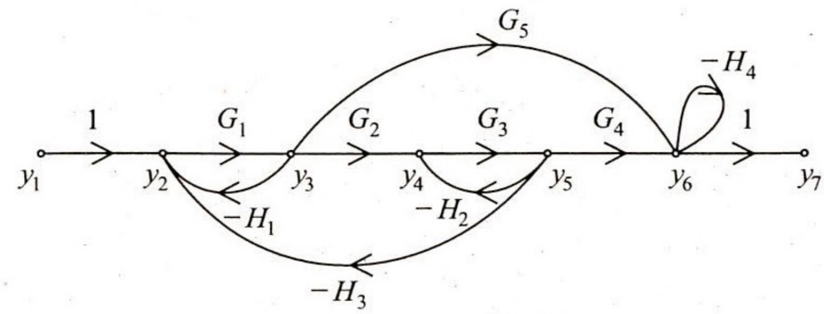
3.(c) (i) Write a program to transfer the data of 100 Bytes from RAM starting at address F000H to the place at address I000H using 8237, having channel-1 in write mode. 10

(ii) Write an 8085 assembly language program to clear 65_{16} consecutive bytes starting at 2000_{16}. 10

4.(a) (i) What are the different types of error in Delta Modulation ? How can these be removed ?

(ii) An optical fiber system employs an LED transmitter which launches an average of 300 UW of optical power at a wavelength of 0·8 Um into the optical cable. The cable has an overall attenuation of 4 dB/Km. The APD receiver requires 1200 incident photons in order to register a binary 1 with a BER of 10^{-10}. Determine the maximum distance (without repeaters) provided by the system when the transmission rate is 1 Mbps. 20

4.(b) (i) Consider the signal flow graph shown :



Find $\frac{y_2}{y_1}$ and $\frac{y_6}{y_1}$. Also find $\frac{y_7}{y_2}$. 10

(ii) Consider the open-loop unstable system with the transfer function

$$G(s)\,H(s) = \frac{s+2}{(s+1)(s-1)}$$

Using Nyquist stability criterion, determine whether the system is stable when the feedback path is closed. 10

4.(c) (i) Implement the given logic using multiplexes (3×8).

$F = \Sigma m(0, 1, 2, 3, 4, 10, 11, 14, 15)$ 10

(ii) Determine the range of a and b for which LTI system with impulse response $h(n) = \begin{cases} a^n; & n > 0 \\ b^n; & n < 0 \end{cases}$ is stable. 10

SECTION 'B'

5.(a) A c-band earth station has an antenna with a transmit gain of 54 dB. The transmitter output power is set to 100 W at a frequency of 6·100 GHz. The signal is received by a satellite at a distance of 37500 km by an antenna with a gain of 26 dB. The signal is then routed to a transponder with a noise temperature of 500 K, a bandwidth of 36 MHz and a gain of 110 dB.

(i) Calculate the path loss at 6·1 GHz if the wavelength is 0·04918 m.

(ii) Calculate the power at the output port of the satellite antenna.

(iii) Calculate the carrier power in watts at the transponder output. 5+5+5

5. (b) An Engineer wishes to make a silica-core, step index fiber with $V = 75$ and a numerical aperture NA = 0·30 to be used at 1300 nm. If $n_1 = 1{\cdot}458$, what should be the core size and cladding index ? 10

5. (c) Determine the divergence of the vector fields.

(i) $\vec{P} = x^2 yz\, \hat{a}_x + xz\, \hat{a}_z$
where $\hat{a}_x$ and $\hat{a}_z$ are unit vectors along x and z axis respectively.

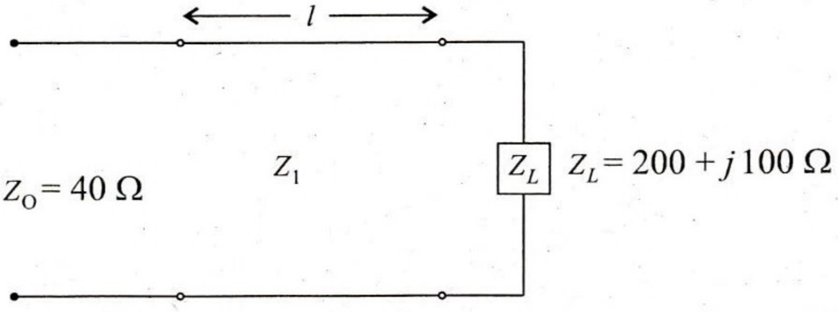
(ii) $\vec{Q} = \rho \sin\phi\, \hat{a}_\rho + \rho^2 z \hat{a}_\phi + z\cos\phi\, \hat{a}_z$
where $\hat{a}_\rho$, $\hat{a}_\phi$ and $\hat{a}_z$ are unit vectors in cylindrical co-ordinate system. 15

5. (d) In a non-magnetic medium
$\vec{E} = 4\sin(2\pi \times 10^7 t - 0{\cdot}8x)\hat{a}_z$ V/m.
Find the $\in_r$ and the intrinsic impedance of the medium. Also compute the time-average power carried by the wave. 10

5. (e) Write down binary equivalent of decimal (–5·25) in Fixed Point Notation and also in Floating Point Notation assuming Two's complement for negative numbers and decimal exponent. 4+6

6. (a) A cellular communication network, for a medium size city, uses a transmitting and receiving antennas of heights 30 metres and 4 metres respectively. If the separation between two antennas is 10 km and carrier frequency is 1000 MHz, compute the path loss and antenna height correction factor. 20

6. (b)



In a circuit as shown, a load $Z_L = 200 + j\,100\ \Omega$ is to be matched to a 40 Ω line, using a length, l, of loss less transmission line of characteristics impedance, Z_1. Find l and Z_1. 20

6. (c) (i) Write down with example one method of Deadlock Prevention in operating systems.

(ii) Give examples of Linear search and Binary search of an array. 10+10

7. (a) Consider an optical link consisting of a 5 km long step-index fiber with core index $n_1 = 1{\cdot}49$ and relative index difference 1%.

(i) Find the delay difference at the fiber end between the slowest and fastest modes.

(ii) Find the rms pulse broadening caused by intermodel dispersion.

(iii) Calculate the maximum bit rate B_T that can be transmitted over the fiber without significant errors. 20

7. (b) (i) Explain the term reflection coefficient and standing wave ratio for a transmission line terminated by load impedance Z_L.

(ii) An air filled waveguide of cross-section 5 cm × 2 cm is operating in TE_{10} mode at a frequency of 4 GHz. Determine

(A) The group velocity

(B) The guided wavelength

(C) Calculate cut off frequency

(D) What will be the attenuation if operating frequency drops to 2 GHz ?

10+10

7. (c) (i) Prove that the minimum number of instructions in a high-level Computer Programming Language for Complete Procedural Programming is *FIVE* (*05*). Exhibit them. 10

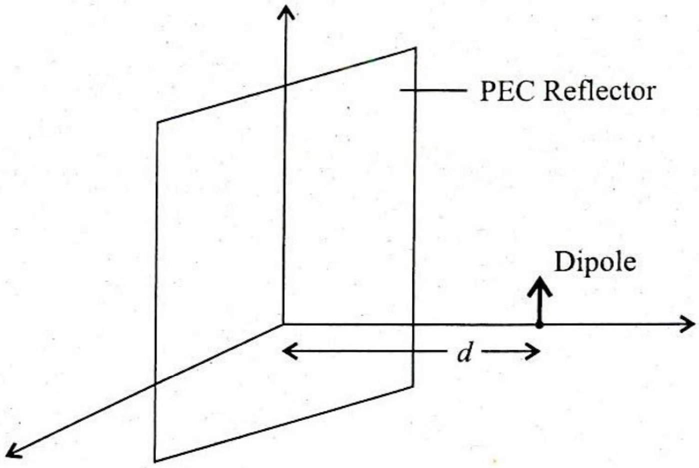
(ii) Write a code (pseudo code or that of any standard programming language (specify)) for interchanging the values of two variables

by *using* a third variable

by *not using* any extra variable. 10

8. (a) An air-filled rectangular cavity resonator has its first three resonant modes at frequencies 5·2, 6·5 and 7·2 GHz. Find the dimensions of the cavity. 20

8.(b)



Derive an expression for the half-power beamwidth of the *x-y* plane pattern of a $\frac{\lambda}{2}$ dipole placed in front of a flat reflector as shown. What is the half-power beamwidth if $d = \frac{\lambda}{4}$? 20

8.(c) In parameter passing in programming give examples to differentiate between

(i) CALL BY VALUE

(ii) CALL BY REFERENCE

Illustrate with the help of a block diagram their mechanisms. 7+7+6
