

**ELECTRONICS AND
TELECOMMUNICATION ENGINEERING**
Paper—II

(Conventional)

Time Allowed : Three Hours

Maximum Marks : 200

INSTRUCTIONS

*Candidates should attempt Question No. 1 which is compulsory, and **FOUR** more questions taking **TWO** each from Section—A and Section—B.*

*Question No. 1 carries **60** marks and each of the other questions carry **35** marks.*

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

*Answers must be written only in **ENGLISH**.*

Assume any data, if required, and indicate the same clearly.

Unless otherwise indicated, symbols and notations have their usual meanings.

Neat sketches to be drawn, wherever required.

Some useful constants are given below :

Electron charge : $e = 1.6 \times 10^{-19}$ coulomb

Electron mass : $m = 9.1 \times 10^{-31}$ kg

Planck's constant : $h = 6.625 \times 10^{-34}$ J-s

Velocity of light : $c = 3 \times 10^8$ m/s

Universal constant of gravitation : $G = 6.668 \times 10^{-11}$ m³/kg-s²

Mass of the earth : $M = 5.997 \times 10^{24}$ kg

Radius of the earth : $R = 6378$ km

Permeability of vacuum : $\mu_0 = 4\pi \times 10^{-7}$ H/m

Permittivity of vacuum : $\epsilon_0 = \frac{10^{-9}}{36\pi}$ F/m

Important note :—

All parts and sub-parts of a question being attempted are to be answered contiguously on the answer-book. That is, all the parts and sub-parts of one question must be completed before attempting the next question.

Pages left blank in the answer-book, if any, are to be struck out. Answers that follow blank pages may not be given credit.

1. (a) (i) A particular diode circuit produces the output shown in Fig. 1 a (i), when the input $V_i = 5 \sin \omega t$. Design the circuit. Draw and explain the transfer characteristic of the circuit. Neglect the diode voltage drop. Assume the forward resistance of diode to be 100Ω and the reverse resistance to be $1 \text{ M}\Omega$. 5

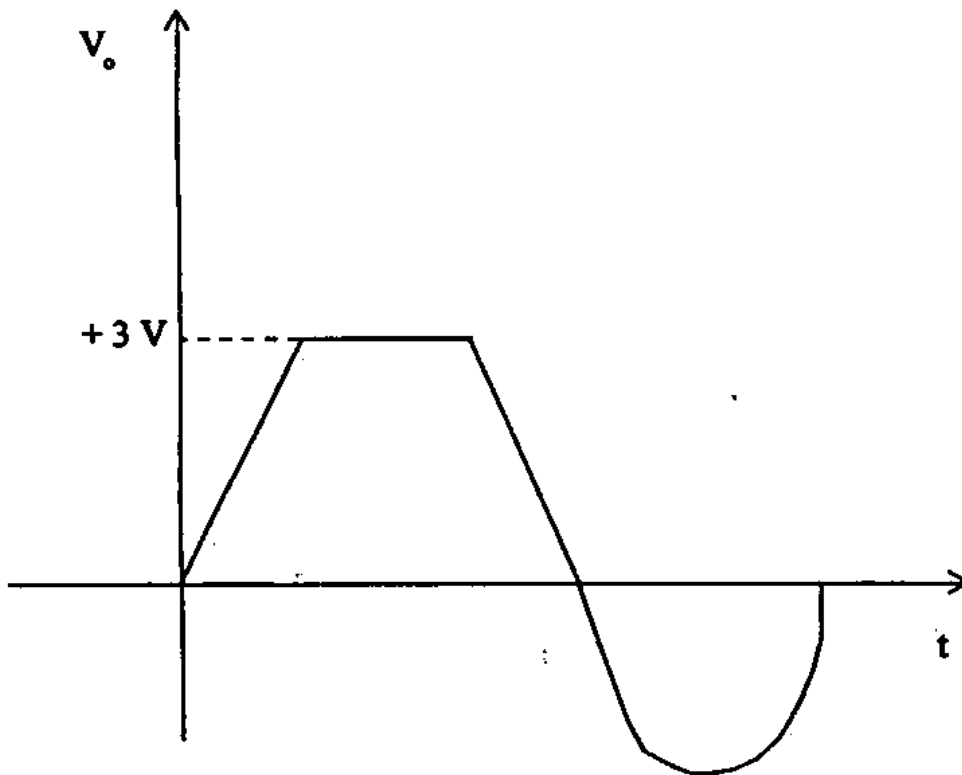


Fig. 1 a (i)

- (ii) Calculate the output $-V_o$ of the circuit shown in Fig. 1 a (ii). Calculate the value of R for which the output of the circuit becomes 0 V. 5

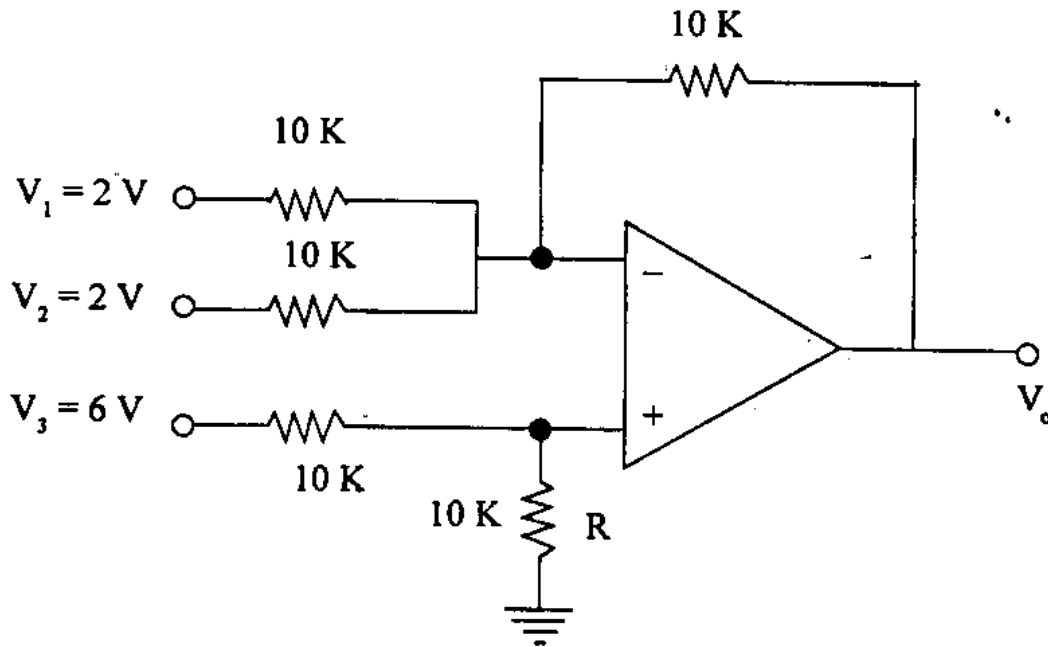


Fig. 1 a (ii)

- (b) (i) Find the decimal equivalent of hex number 1A53. 2
- (ii) Find the hex sum of $(93)_{16} + (DE)_{16}$. 3
- (iii) Find the decimal equivalent of Binary number 11010. 2
- (iv) Draw a logic circuit to convert binary code y_1, y_2, y_3 to Gray code. 3

- (c) The open-loop transfer function of a unity feedback system is given by :

$$G(s) = \frac{5}{s(s+1)}$$

Find the rise time, percentage overshoot, time of peak overshoot and settling time for a step input of 10 units. Also determine the value of peak overshoot. 10

- (d) Interface an 8-bit microprocessor with a 2K×8 ROM chip and two 1K×8 chips such that the following address map is realized :

Device	Size	Address Assignment
ROM chip	2K × 8	0000 — 07FF
RAM chip 1	1K × 8	0800 — 013FF
RAM chip 2	1K × 8	1000 — 13FF

10

- (e) A lossless parallel strip line has a conducting strip width 'w'. The substrate dielectric separating the two conducting strips has a relative dielectric constant ϵ_r of 6 and a thickness d of 4 mm. Evaluate the following :—

- (i) The required width 'w' of the conducting strip in order to have a characteristic impedance of 50 Ω . 4
- (ii) The phase velocity of the wave in the parallel strip line. 4

- (f) Sketch the electric and magnetic field configuration for TE_{10} mode and TE_{20} mode in a rectangular waveguide. 2
- (g) Explain T1 PCM system for telephone voice service. Show that T1 system has data rate of 1.544 M bits/s. 10

SECTION—A

2. (a) (i) Using the 7805 voltage regulator IC, design a current source that will deliver a current of 0.25 A to the 76Ω , 10 W load. Drop voltage for the IC is 2V. Neglect quiescent current. 5
- (ii) Design an FSK generator using 555 IC to produce 'mark' frequency $f_M = 1070$ Hz when the input digital data is logical '1' and to produce 'space' frequency $f_s = 1270$ Hz when the input digital data is logical '0'. Show the nature of output. 10
- (b) (i) Derive the truth table for a combinational circuit which has 3 binary inputs and the output is input + 3. Express each output using Boolean expression. 4

- (ii) Simplify the following expression into sum of products using Karnaugh map

$$F(A, B, C, D) = \Sigma(1, 3, 4, 5, 6, 7, 9, 12, 13).$$

6

- (c) Any system will oscillate with a frequency ω if it has no poles in the right-half of the s -plane and has poles at $s = \pm j\omega$. Find the values of K and a of the system shown in Fig. 2 (c), that makes the system to oscillate at a frequency of 2 rad/s. 10

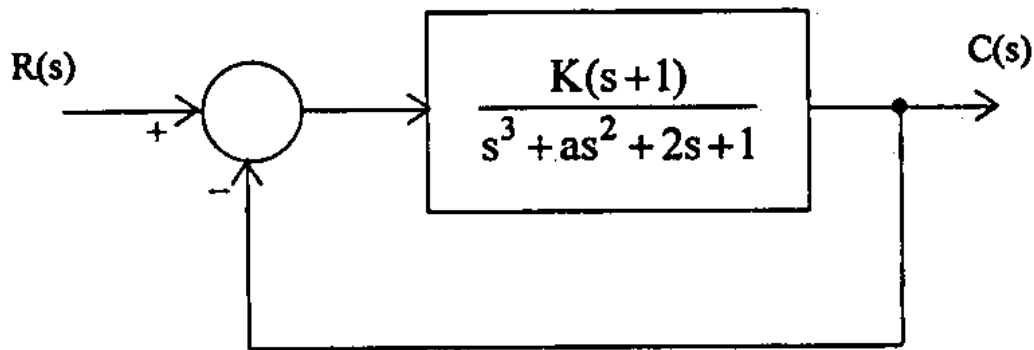


Fig. 2 (c)

3. (a) (i) Implement a 4 bit serial-in serial-out shift register using D flip flops and draw the output waveform for an input 1010. 10

- (ii) A binary ripple counter is required to count up to 16383_{10} . How many flip flops are required? If the clock frequency is 10.5 MHz, what is the frequency at the output of MSB? 5
- (b) Design a second-order active Band-pass filter with a midband gain of 33.98 dB, a center frequency of 200 Hz and a 3-dB bandwidth of 20 Hz. Use capacitors of $0.1 \mu\text{F}$ value. Draw the response of the filter. 10
- (c) A plant has open-loop transfer function as $G(s) = 1/S^2$. The plant is controlled by a forward proportional controller with gain of K_p , and a rate controller in its feedback path. The overall feedback system is shown in Fig. 3 c (i). It is desired to obtain a response to a step input as shown in Fig. 3 c (ii). Design the values of the gain K_p and K_D to get the desired response. Obtain the corresponding rise time and settling time of the overall system. 10

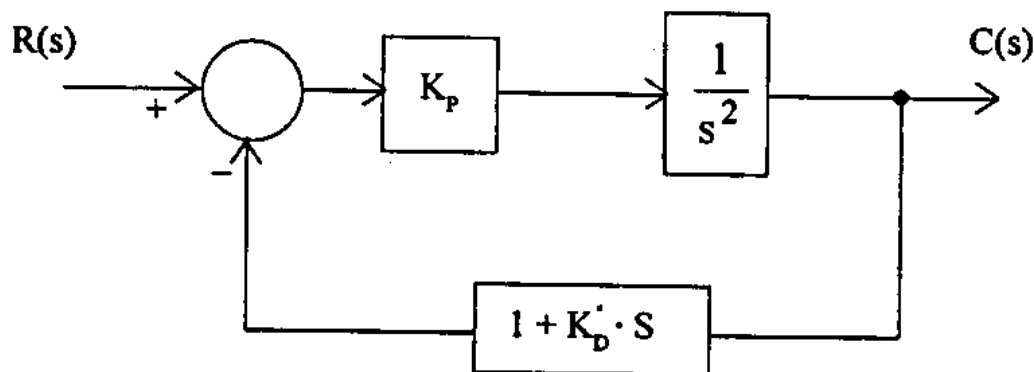


Fig. 3 (c) (i)

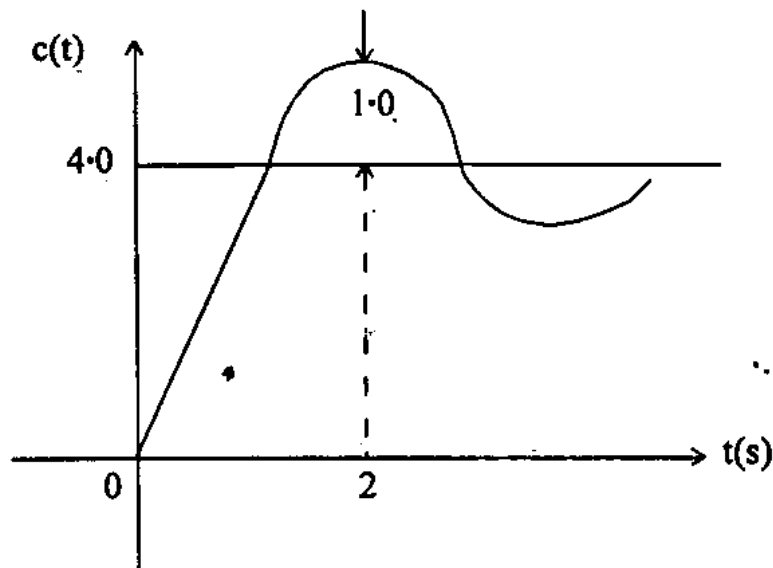


Fig. 3 (c) (ii)

4. (a) (i) Consider the feedback control system shown in Fig. 4 (a) (i) where inner loop corresponds to internal feedback of the plant. The controller is an integrator with a gain of K and plant has an inertia. 10

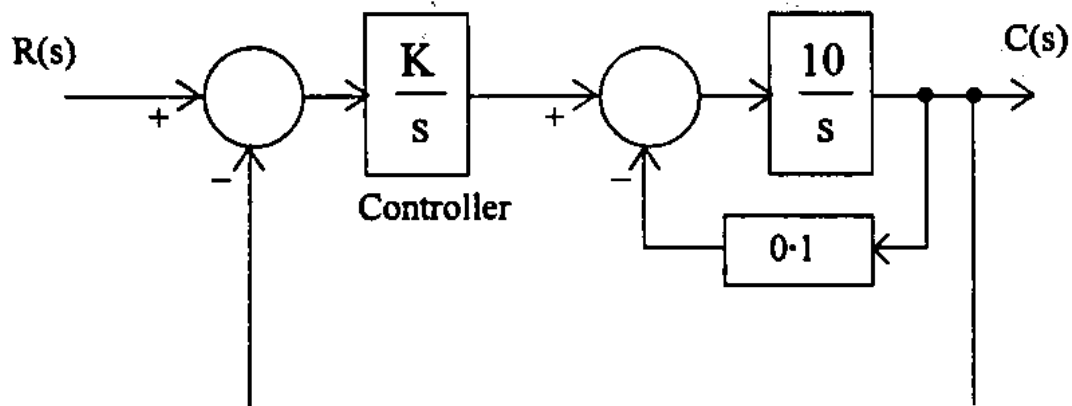


Fig. 4 (a) (i)

(A) Determine the value of K for which steady-state error to unit ramp input is less than 0.01.

(B) For the value of K calculated in part (A) find the sensitivity (S_K^T) of T with respect to variation in K , where

$$T(s) = \frac{C(s)}{R(s)}$$

value of S_K^T at low frequencies ?

(ii) A process has an open-loop transfer function

given by $G(s) = \frac{1}{s(s+\alpha)}$, where α is an

unknown parameter. A controller for unity feedback system has to be designed such that the closed-loop transfer function

becomes $\frac{1}{s(s+\alpha)}$.

The transfer function of the controller has to be found for :

(A) controller being put in the forward path.

(B) controller being put in the feedback path.

Out of these possibilities which one should be preferred ? 5

- (b) For the circuit shown in Fig. 4 (b), $V_{BE} = 0.7 \text{ V}$, $\beta = 50$ and $V_{CEQ} = 4 \text{ V}$. Determine R_E and the stability factor S . 10

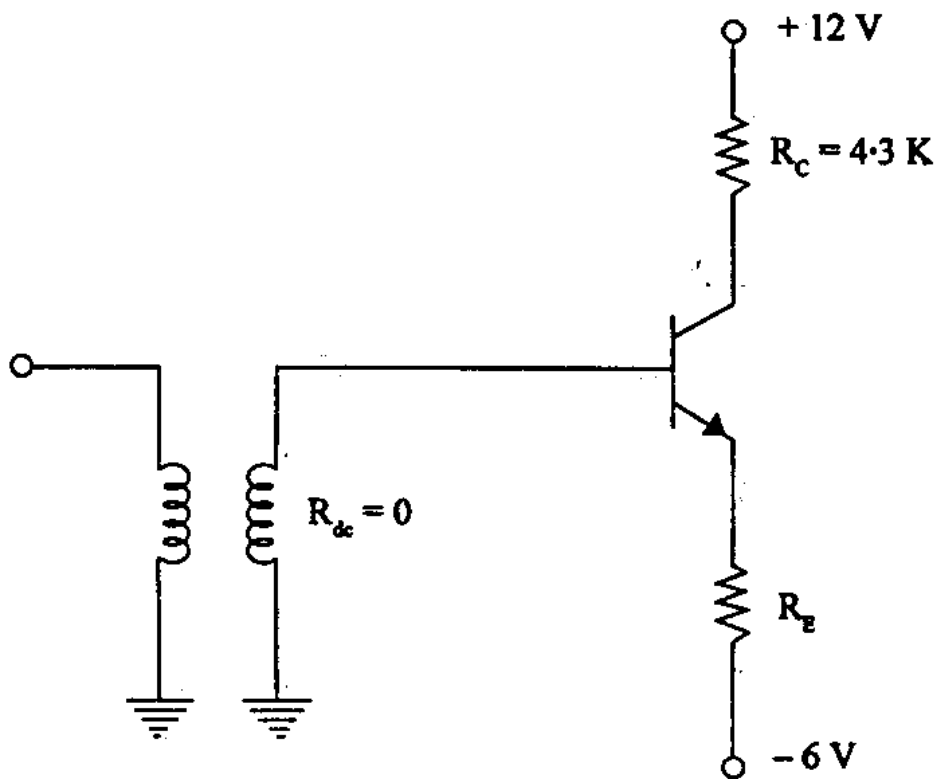


Fig. 4 (b)

- (c) Implement a four variable function

$F(A, B, C, D) = \Sigma(0, 1, 3, 4, 8, 9, 15)$
using an 8×1 multiplexer. 10

SECTION—B

5. (a) (i) If $I(x_1)$ is the information carried by message x_1 and $I(x_2)$ is the information carried by message x_2 , then prove that the amount of information carried compositely due to x_1 and x_2 is

$$I(x_1, x_2) = I(x_1) + I(x_2). \quad 7$$

- (ii) At 2 km in free space from a point source, the power density is $200 \mu\text{w}/\text{m}^2$. What is the power density 25 kms away from this source ? 3

- (iii) A graded index fiber has a core with a parabolic refractive index profile which has a diameter of $50 \mu\text{m}$. The fiber has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fiber when it is operating at a wavelength of $1 \mu\text{m}$. 5

- (b) With the help of a diagram, show how a magic Tee can be used to behave as a mixer producing IF frequency. 10

- (c) Describe scope, visibility and lifetime of variables for storage class none, extern, auto, register and static. 10

6. (a) (i) Give block diagram for a set-up for measuring VSWR using reflectometer technique and explain the same. 8

- (ii) Evaluate the VSWR of a transmission system which is operating at 10 GHz. Inside dimensions of waveguide are $a = 4$ cm and $b = 2.5$ cm. Distance between twice minimum power points is 1 mm on a slotted line.

(Use double minimum method) 7

- (b) (i) Write an 8086 assembly program to compute

$$\sum_{i=1}^n X_i Y_i$$

where X_i and Y_i are signed 8-bit numbers and $n = 100$. Assume DS is already initialized and X_i s and Y_i s are already stored in memory. Also assume no overflow. 7

(ii) Perform the operation $(12_{10} - 35_{10})$ using 2's complement method. 3

(c) In an AM Transmitter, antenna current is 8 amperes, when only the carrier is sent. But it increased to 8.93 amperes when carrier is modulated by a single sine wave. Determine the percentage of Modulation. Also evaluate the antenna current when the percentage of Modulation is changed to 80%. 10

7. (a) (i) Explain break and continue statement in 'C' language with illustration. 8

(ii) Write and explain an algorithm to evaluate

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$$

for first 10 terms. 7

(b) Explain Hamming codes.

How many Hamming bits are required for a block length of 20 message bits to correct 1 bit error ? 10

- (c) Draw the schematic diagram of a 4 port circulator.
How will you convert it into (A) a switch and
(B) a coupler ?

For a perfectly matched, lossless, non-reciprocal
four port circulator, write down the S-matrix.

10