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'.

The number of marks carried by each question is indicated at the end of the question.

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 meaning.

(Contd.)

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 : $G = 6.668 \times 10^{-11}$ m^3/kg-s^2

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

Radius of Earth : $R = 6378$ km

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

Permittivity of vacuum : $\varepsilon_0 = \dfrac{10^{-9}}{36\pi}$ F/m

1. (a) A single phase Full-wave rectifier with Silicon diodes has a load of 2 kΩ. The transformer primary voltage is 230 V rms with a frequency of 50 Hz. If the step down transformer has a turns ratio of 10 : 1, what is

   (i) The load voltage

   (ii) The load current

   (iii) The output power

   (iv) The frequency of the load voltage.   8

   (b) What is race around condition in a J-K Flip-Flop ? Explain how it occurs ? Suggest a method to overcome the race-around difficulty.

   8

   (c) What is the effect of feedback on overall gain of the control system and also explain the effect of feedback on sensitivity of the control system ?   8

   (d) Explain the effect of derivative and integral control on transient performance of feedback control system.   8

   (e) Sketch the refraction index profile and ray transmission in (i) multimode step index fibre and (ii) single mode step index fibre.   3

   A four port multimode fibre coupler has 60 µW optical power launched into port 1. The measured output powers at ports 2, 3 and 4 are 0·004, 26·0 and 27·5 µW respectively. Determine the excess loss, the insertion losses between the input and output ports, the cross talk and the split ratio for the device.   5

(f) In a binary PCM, if '0' occurs with probability $\frac{1}{4}$ and '1' occurs with probability equal to $\frac{3}{4}$, then calculate the amount of information carried by each bit.

Comment on the result obtained. 8

(g) A two cavity amplifier Klystron has the following characteristics :

Voltage gain = 15 dB,

Input power = 5 milliwatt,

Total shunt impedance of input cavity
$$R_{sh(in)} = 30 \text{ k}\Omega.$$

Total shunt impedance of output cavity
$$R_{sh(out)} = 40 \text{ k}\Omega.$$

Load impedance at output cavity $R_l = 40 \text{ k}\Omega$.

Determine :

(i) The rms value of input voltage.

(ii) The rms value of output voltage.

(iii) The power delivered to load. 3+3+2

(h) TE_{10} mode is commonly used among all modes in rectangular waveguides; justify the statement with valid reasons. 8

(i)   (i) What are the 4 primary data types in C Language ?

(ii) Give the size of each of them in bytes.

(iii) Give the output of the C statement
printf ("1st value : % 3d;
2nd value : %5d", x, y);

(iv) Write a C program to find the sum of the series $1 + x + x^2 + x^3 + ...$ 8

(j)   (i) Convert octal 756 to decimal

(ii) Convert hexadecimal 3B2 to decimal

(iii) Convert the long binary number 1001001101010001 to octal and to hexadecimal   8

Section 'A'

2. (a) Show that a feedback amplifier can be made to work as an oscillator.   10

(b) Reduce the Expression
$f(A, B, C, D) = \Pi M (2, 8, 9, 10, 11, 12, 14)$
and implement the same using NOR gates.   10

(c) Design an astable multivibrator using 555 IC to generate a square wave of 10 KHz with 60% duty cycle. Use a capacitor of 500 PF. Explain the circuit operation with waveforms. 10

3. (a)

X address

data in

enable

S

CK

R

Q

Q̄

data out
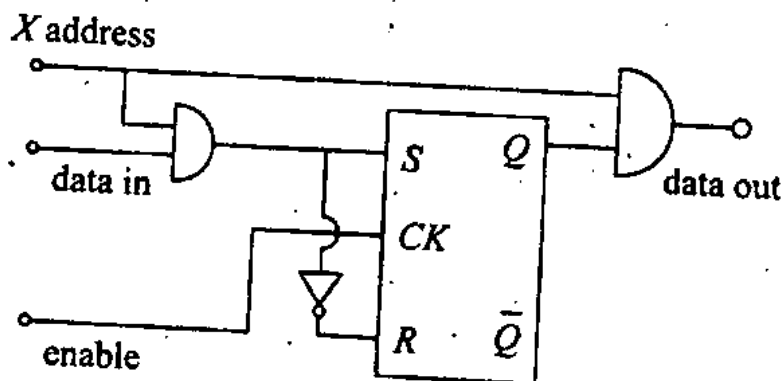
Identify the circuit shown in the above figure. Explain the operation of the same. 10

(b) What is a twisted ring counter ? Write a 4 bit twisted ring counter. Explain its operation giving the states. 10
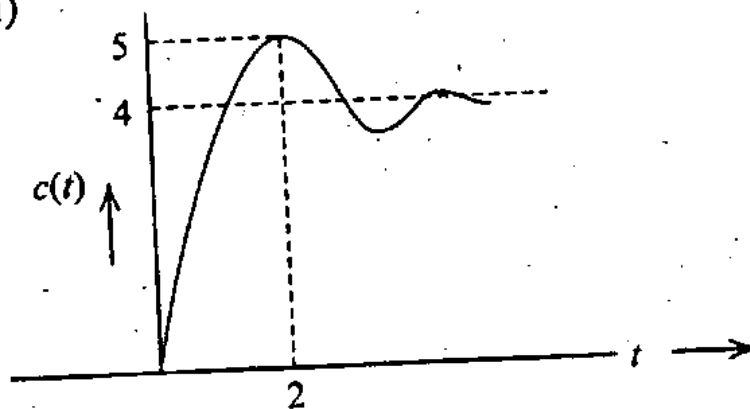
(c) A unity feedback control system has

$$G(S) = \frac{80}{S(S+2)(S+20)}.$$

Draw the Bode magnitude plot and phase angle plot on a semilog graph sheet and determine :

(i) Gain margin

(ii) Phase margin

(iii) Gain crossover frequency

(iv) Phase crossover frequency   10

4. (a) (i)

The step response of second order system is shown in the above figure for an input of $4\,u(t)$. Determine the open loop and closed loop transfer function. Assume unity feedback.
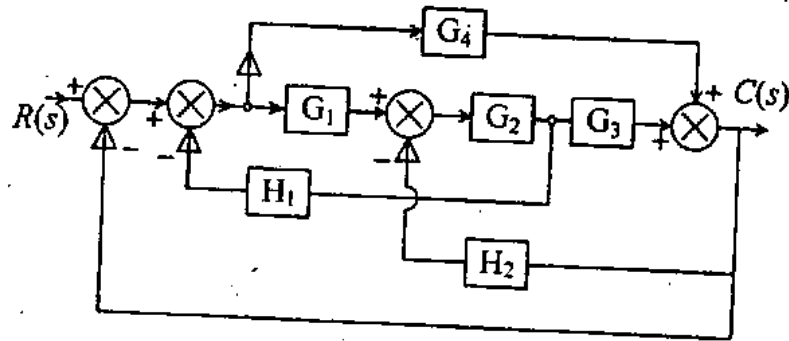
(ii) A system when excited by unit step of input gives following response :

$$c(t) = 1 - 2e^{-t} + 4e^{-3t}.$$

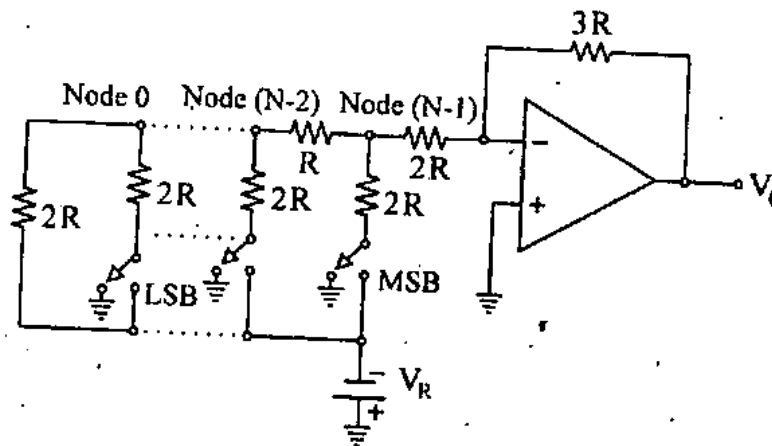Obtain transfer function of the system.   6+4

(b) (i)

Draw the signal flow graph and find $\dfrac{C(s)}{R(s)}$.

(ii) What are the limitations of Mason's Rule in obtaining transfer function. 6+4

(c)

Identify the circuit shown in the above figure. Obtain the expression for output. What is the output voltage when the second MSB is '1' and all other bits are '0' ? Given that $R = 1 \ k\Omega$ and $V_R = 5$ V.

10.

Section 'B'

5. (a) A PCM system uses a uniform quantizer followed by a v bit encoder. Show that rms signal to noise ratio is approximately given by $(1\cdot8 + 6\ v)$ dB. (Input to the PCM system is a sinusoidal signal). **10**

(b) (i) An earth station with a transmitter power of 120 W, a frequency of 6 GHz and an antenna gain of 42 dB transmits to a satellite repeater. The receiver antenna on the satellite has a gain of 31 dB. If the satellite is in a geosynchronous orbit of 35900 km above earth, what is the received power in dBm ? **5**

(ii) What is "skip distance" ? Why there is better high frequency reception during night time ?

A long distance microwave link consists of a chain of repeaters at 40 km intervals. What must be the minimum height of transmitting and receiving antennas above ground level ? (The antennas are identical to each other in order to ensure line of sight communication). **5**

(c) How can a magic-Tee be used as a duplexer in radar system ? **10**

6. (a) Discuss a method for the measurement of SWR without the use of a slotted line set-up. **10**

(b) The figure of merit for a diode nonlinear capacitor in an up-converter parametric amplifier is 8, and the ratio of the output (Idler) frequency f_o over the signal frequency is 8. The diode temperature is 300°K and the ambient temperature is also 300°K. Obtain

    (i) Maximum power gain in decibels.

    (ii) Noise figure F in decibels.

    (iii) Bandwidth for v = 0·2.   4+3+3

(c) List five distinct features each of the RISC based and the CISC based design of processors.   10

7. (a) (i) Name the data transfer scheme used for transferring data between disc storage and R/W memory of a computing system. What are the associated signals/pins available in 8085 microprocessor for this type of transfer ?

    Explain the sequence of operations in a typical such transfer.

    (ii) Explain with the help of a flow-chart "cycle stealing" and "burst-mode" data transfer schemes used in computing systems.   5+5

(b) What is the significance of the term "memory-hierarchy pyramid" with respect to a computer system ? Justify the term in terms of cost, speed and space with respect to its components by using the diagram. 10

(c) In an FM system, when the audio frequency (AF) is 500 Hz and the AF voltage is 2·4 volt, the deviation is 4·8 KHz. If AF voltage is now increased to 7·2 V, what is the new deviation ? Now, if the AF voltage is raised to 10 V and AF is dropped to 200 Hz, what is the deviation ? Find the modulation index in each case.

Mention two disadvantages of FM over AM. 10