M.Sc. 1st Semester Examination, 2012

PHYSICS

(*Analog Electronics*)

PAPER—PHS-104 (A + B)

Full Marks : 40

Time : 2 hours

Answer **Q. No. 1** and any **one** from each Group

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

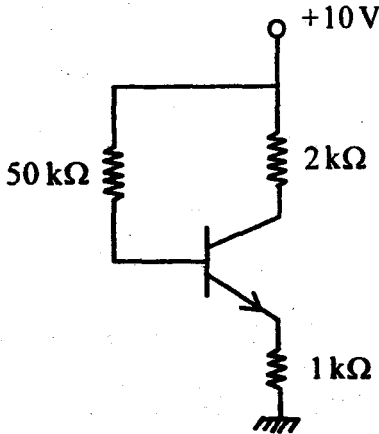**Use separate scripts for Group—A & Group—B**

GROUP – A

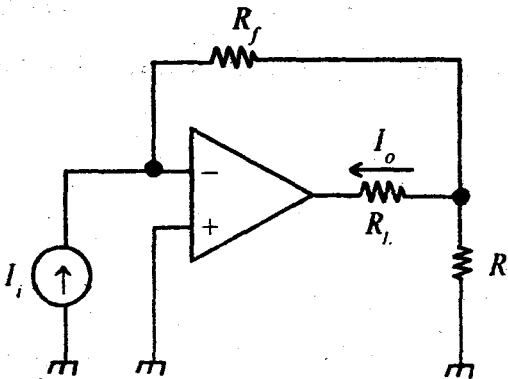[*Marks* : 20]

1. Answer any *five* questions :   2 × 5

    (*a*) What is CMRR ? Mention its typical value.

(b) Find the collector current of the silicon transistor of DC current gain 100 from the figure.

(c) Find out the expression for I_o in terms of I_i and other circuit parameters.

(Continued)

(d) A 1000 kHz carrier signal is amplitude modulated by audio signals between 100 Hz and 8 kHz. Find (i) the frequency span of each side band and (ii) the maximum upper side frequency and the minimum lower side frequency.

(e) What is a VSB+C type AM signal ? Where is it used ?

(f) What is Secant law in case of radio wave propagation ?

(g) Define an array of antenna elements. Why is it used ?

2. (a) Draw the circuit diagram of a current mirror circuit using low β (< 10) n-p-n transistors and derive the necessary theory.

(b) Explain why a constant current source is necessary at the input stage of an op-amp.

(c) Explain the detailed operation of a super-heterodyne AM radio receiver.

(d) What are the special characteristics of the diode used for demodulation of AM signal using simple diode detector circuit ? $(1 + 3) + 2 + 3 + 1$

3. (*a*) Give a brief account of the effect of the ionosphere on the sky waves. Show that the ionosphere behaves as a medium of refractive index

$$\mu = \sqrt{\frac{1 - 80 \cdot 8\,N}{f^2}}$$

where N is electron density per c.c. and f is the frequency in kHz. The effect of the earth's magnetic field and collisions in the ionosphere may be neglected.

(*b*) Define skip distance and maximum usable frequency. $(2 + 5) + 3$

GROUP – B

[*Marks* : 20]

**1.** Answer any *five* questions : 2×5

(*a*) Draw the circuit diagram of a one bit memory cell and write its truth table.

(*b*) Minimize the following expression by Karnaugh map :

$$F = ABCD + \overline{A}\,\overline{B}\,CD + A\,\overline{B}\,\overline{C}\,D + \overline{A}\,B\,\overline{C}\,D + \overline{A}\,B\,C\,D + A\,\overline{B}\,C\,D + A\,B\,\overline{C}\,D.$$

(c) Minimize the following expression by Karnaugh map :

$$F = (A + B + C)(\bar{A} + \bar{B} + \bar{C})(A + \bar{B} + \bar{C})$$
$$(\bar{A} + B + \bar{C})(\bar{A} + \bar{B} + C)(\bar{A} + B + C)$$
$$(A + \bar{B} + C)$$

(d) Draw the circuit diagram of a monostable multivibrator with transistors.

(e) In the logic circuit of a seven segment display there are four input terminals A, B, C & D and seven output terminals Y_1 to Y_7. Write the necessary truth table to make the circuit active.
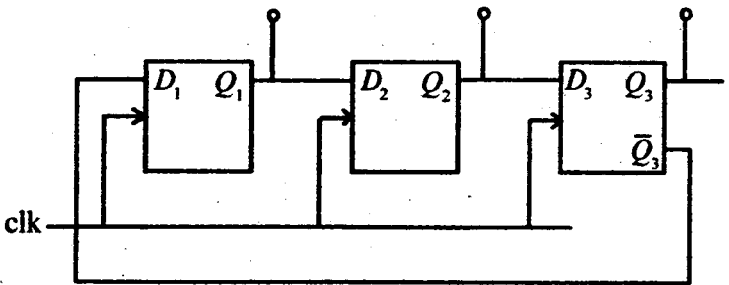
(f) Design the following circuit with NAND gate only.
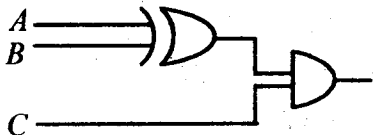
(g) What will be the output with the application
two consecutive clock pulses ?
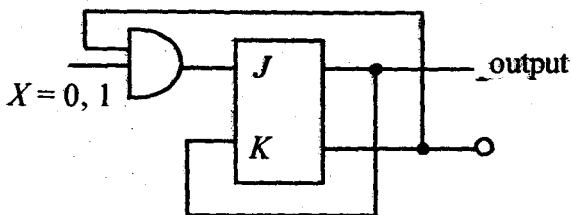
2. (a) What is a shift register ? Discuss the process
developing a serial-in serial-out shift regist
by supporting flip-flops.

(b) What do you mean by a serial-in parallel-out shi
register ? Discuss it with proper circuit diagram

(c) Write the advantage of serial-in parallel-out shi
register over serial-in serial out one.   4 + ·

3. (a) Solve the following digital equation using K'ma

$$Y = LTP + \overline{L}\,TW + \overline{L}\,\overline{T}P + \overline{L}\,\overline{W}T$$

(b) What is the difference between astable ar
monostable multivibrator ? Give example.

(Cont

(c) Design 3 bit up/down asynchronous counter with a mode selector which can control the 'up' or 'down' direction.

(d) Give the different state of the following circuit.

$$3 + 2 + 3 + 2$$

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