2015

M.Sc.

1st Semester Examination

PHYSICS

PAPER – PGS-104 (Gr. – A + B)

Full Marks : 50

Time : 2 Hours

The figures in the right hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
Answer Q1 and any one from Q2 and Q3 for each of Groups A & B.

(Gr. A – *Analog Electronics*)

1. Answer any five bits: 5 X 2 = 10

(i) What is CMRR of an OP-AMP? Write the value of CMRR of an ideal OP-AMP.

(ii) A carrier signal is amplitude modulated DSB-TC by a single frequency sine-wave signal. This broadcasting station operates with a power of 2.95kW and 95% modulation. Calculate power of the carrier signal.

(iii) Calculate the length of a half-wave dipole antenna which can receive a radio wave of frequency 107MHz.

(iv) Explain the operation of a duplexer. Where is it used?

(v) Suppose the bandwidth of an OP-AMP is infinite. What is the value of slew rate of this OP-AMP and why?

(vi) Explain the terms ‘critical frequency’ and ‘skip distance’ in case raio wave propagation through ionosphere.

(Turn Over)

(vii) Discuss the superiority of E-MOSFET over D-MOSFET.

2. (a) Discuss the architecture of an IC OP-AMP with block diagram. (2)

(b) Draw the circuit diagram of a current mirror circuit using two n-p-n transistors with high β (>100) and a current determining resistor. Show that the output current is equal to the input current of the current mirror circuit. (1+3)

(c) Derive the necessary theory of operation of any type of FM modulation with circuit diagram. (1+3)

3. (a) Neglecting the effects of the earth's magnetic field and the energy loss, show that the refractive index of the ionosphere is given by $n = \sqrt{1 - \frac{80.8N}{f^2}}$, where N is the number of electrons per cc and f is the frequency in kHz. (6)

(b) From the above result deduce Secant law. (2)

(c) What do you mean by tropospheric waves? (2)

(Gr. B – *Digital Electronics*)

1. Answer any five bits: 5 X 2 = 10

(i) Draw the internal structure of IC555.

(ii) Draw the circuit diagram of an astable multivibrator using transistor.

(iii) Give the idea of 7-segment display system for octal number.

(iv) Using the K-map method simplify the following function:

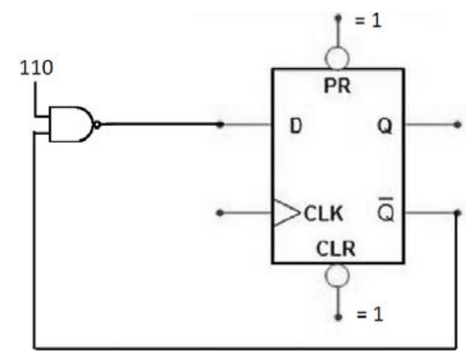
$$Y = \sum m(0,2,3,6,7) + \sum d(8,10,13,15)$$

…Continued

(v) Give the simplest circuit to realize the following K-map representation:

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	0	0
11	1	0	0	0
10	1	0	0	1

(vi) What will be the output of the following circuit in three consecutive pulses?



(vii) Rewrite the following expression in standard SOP and POS form:

$$f(A,B,C) = AB + B\bar{C}$$

(viii) Construct a logic circuit with output $Y = A\bar{B} + C$ using NAND gates only.

2. (a) Convert a D flip flop into a JK flip flop. (3)

(b) Design a 3-bit synchronous up counter using K-map. (5)

(c) Draw the circuit of a Mod-9 counter. (2)

3. (a) Design he circuit of a 3-bit shift register and briefly describe its function. (5)

(b) Draw the circuit diagram of an astable multivibrator using IC555. Find the expression of its frequency. (5)

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(Internal Assessment – 10)