Roll No. ……..

PHY–504

Semiconductor Devices, Analog and Digital Electronics

M. Sc. PHYSICS (MSCPHY–12/13/16)

First Year, Examination, 2017

Time : 3 Hours **Max. Marks : 70**

Note : This paper is of **seventy (70)** marks containing **three (03)** sections A, B and C. Attempt the questions contained in these sections according to the detailed instructions given therein.

Section–A

(Long Answer Type Questions)

Note : Section 'A' contains four (04) long answer type questions of fifteen (15) marks each. Learners are required to answer *two* (02) questions only.

1. Explain with the help of neat diagrams, the structure of a N-channel FET and its volt ampere characteristics. In what ways it is different from a bipolar junction transistor ?
2. Setup an analog computer in block diagram using op-amp to solve the following differential equations :

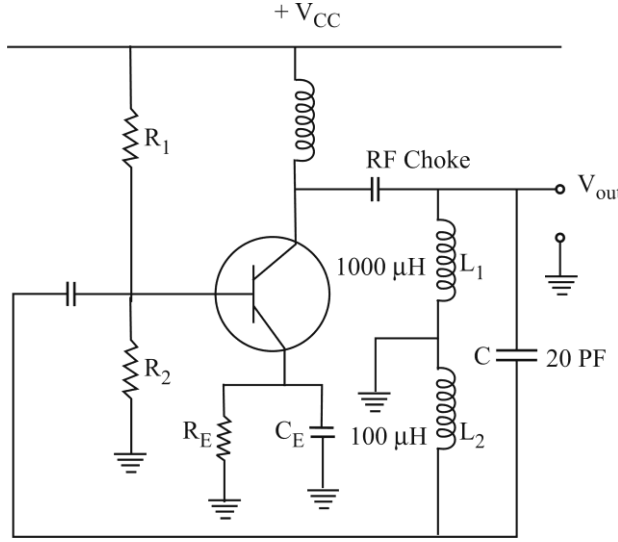
   (i) $\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 6.8y + c(t) = 0$

(ii) $\frac{d^2V}{dt^2} + 6\frac{dV}{dt} + 3V - V_i = 0$

(iii) $\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = 3\sin t$

where V_i is a given function of time.

2. Calculate the (i) operating frequency and (ii) feedback fraction for Hartley oscillator shown in Fig. The mutual inductance between the coils, M = 20μH.



4. Explain R-2R ladder networks in details with circuit diagrams.

Section–B

(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short answer type questions of five (5) marks each. Learners are required to answer *six* (06) questions only.

1. Draw the circuit diagram of bridge rectifier and explain in brief.

2. Explain the concept of feedback with the help of neat circuit diagrams.
3. With the help of circuit diagram, explain the working of a 4-bit subtractor.
4. Simplify the Boolean function with map :

$$f(x, y, z) = \Sigma(3, 4, 6, 7)$$

5. State and prove De-Morgan's laws.
6. Explain digital to analog converters with example.
7. Explain the difference between synchronous and asynchronous counter.
8. What is a varactor diode ? Explain its action.

Section–C

(Objective Type Questions)

Note : Section 'C' contains ten (10) objective type questions of one (01) mark each. All the questions of this section are compulsory.

Choose the correct alternative.

1. A device uses small amount of energy to control large amount of energy is :
   (a) Transistor
   (b) Diode
   (c) Resistor
   (d) Amplifier
2. Transistor consists of :
   (a) Emitter, Base, Collector
   (b) Electron, Proton, Neutron
   (c) Resistor, Capacitor coil
   (d) None of the above

3. Determine the output frequency for a frequency division circuit that contains 12 flip-flops with an input clock frequency of 20.48 MHz :

   (a) 10.24 kHz

   (b) 5 kHz

   (c) 30.24 kHz

   (d) 15 kHz

4. Which of the following logical operations is represented by + sign in Boolean Algebra ?

   (a) Inversion

   (b) AND

   (c) OR

   (d) Complementation

5. How many flip-flops are required to construct a decade counter ?

   (a) 10

   (b) 8

   (c) 5

   (d) 4

6. To implement the expression $A\overline{B}CD + AB\overline{C}D + ABC\overline{D}$, it takes one OR gate and .....

   (a) Three AND gates and three NOT gates

   (b) Three AND gates and four NOT gates

   (c) Three AND gates

   (d) One AND gate

Fill in the blanks.

7. MOSFET means .....
8. CMOS means .....
9. ..... is an electronic device that converts energy from one form to another.
10. ..... is a measure for the degree a component resist the flow of the electrical current in given voltage.