MSCPHY-12 (M.Sc. PHYSICS)
First Year Examination-2015

PHY-504

Semiconductor Devices, Analog and Digital Electronics

Time : 3 Hours   **Maximum Marks :** 60

Note : This paper is of sixty (60) marks divided into 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 any two (02) questions only.   (2×15=30)

1. Differentiate between FET and MOSFET. Derive the relation between drain current, gate current, gate voltage and pinchoff voltage in JFET and discuss its drain and trans-characteristics.

2. (a) What is the criterion for oscillations? Discuss Wein bridge oscillator with circuit diagram.

    (b) The value of each resistance and capacitanc e of a RC network in a phase shift oscillator is 1 $M\Omega$ and 68 pF respectively. Find the frequency of oscillations.

3. What is a differential amplifier?

With a circuit and necessary theory, derive expressions for voltage gain and input resistances. Using inverting configuration of an OPAMP, explain:

(i) Summing amplifier (ii) Scaling amplifier.

4. (a) Define a De-multiplexer. Show how to convert a decoder into a De-multiplexer.

   (b) Draw a master-slave flip-flop system. Explain its operation and show that race around condition is eliminated.

Section - B

(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short-answer-type questions of five (05) marks each. Learners are required to answer any four (04) questions only.   (4×5=20)

1. A Zener is used to regulate output voltage for which the load current varies from 12 mA to 100 mA. Find the value of the series resistance to maintain a voltage of 7.2V across the load. The input voltage is constant at 12V and the minimum Zener current is 10mA.

2. Draw the symbol and characteristics of an N-channel FET and mark linear region, saturation region and breakdown region.

3. Explain why open loop op-amp configurations are not used in linear applications. Explain CMRR and slew rate of an op - amp.

4. A transistor amplifier employs a 4 KΩ as collector load. If the input resistance is 1 KΩ, determine the voltage gain. (*Given.* β = 100, g_m=10mA/volt and signal voltage = 50m V).

5. Describe the RC coupled amplifier. Obtain the expression for its voltage gain in mid frequency region.

6. With necessary theory and circuit, explain the working of an astable multi vibrator.

7. Find the operating point of the following circuit:
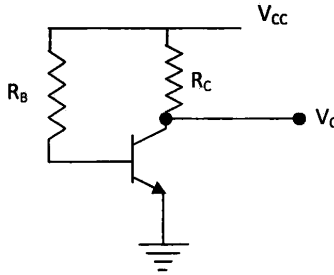
Given; V_{CC}= volts, R_B= 400 kΩ, R_C= 1 kΩ, β=100, V_{BE}=0.3 volts.

8. An inverting amplifier using the 74 1C must have flat response up to 40k Hz. The gain of the amplifier is 10. What peak to peak input signal can be applied without distorting the output if the slew rate of 741C is 0.5 Volt/μ s?

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. **(10×1=10)**

Write True (T) or False (F)

1. Flip-flops consist of clock signal and latchs does not contain clock signal.

2. The breakdown mechanism in a lightly doped p-n junction under reverse biased condition is called Zener breakdown.

3. In level trigger mode, the input signal is sampled when the clock signal is either high or low whereas in edge trigger mode the input signal is sampled at rising or at the falling edge.

4. Wien bridge oscillator can typically generate frequencies in the range of 100MHz 150MHz.

5. The minimum number of flip-flops required to construct a mod-75 counter is 8.

Choose correct alternative of the following:

6. For a large value of $|V_{DS}|$, a FET behaves as:
   (a) Voltage controlled resistor
   (b) Current controlled current source
   (c) Voltage controlled current source
   (d) Current controlled resistor

7. When a ramp-input is given to an op-amp integrator, the output will be:
   (a) A step
   (b) A sinusoidal wave
   (c) A rectangular wave
   (d) Triangular wave with de bias

8. A min-term of the Boolean-function, f(x, y, x) is:
   (a) x' + y + z
   (b) x y z'
   (c) x z
   (d) (y +z) x

9. In a voltage shunt negative feedback amplifier system, the input resistance R_i and the output resistance R_o of the basic amplifier are modified as follows:
   (a) R_i is decreased and R_o increased
   (b) Both R_i and R_o are decreased
   (c) Both R_i and R_o are increased
   (d) R_i is increased and R_o is decreased

10. The circuit is equivalent to
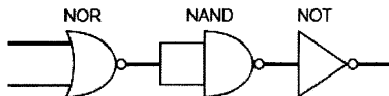
   (a) OR gate
   (b) AND gate
   (c) NAND gate
   (d) NOR gate