Code: AC03 / AT03   **Subject: BASIC ELECTRONICS &**
Time: 3 Hours   **DIGITAL CIRCUITS**   **DECEMBER 2007**
                                                              Max. Marks: 100

NOTE: There are 9 Questions in all.
- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1   **Choose the correct or best alternative in the following:**   **(2x10)**

a.   The most accurate determination of carrier concentration in a semiconductor is done by measuring

   (A) depletion width.   **(B)** drift current.
   (C) diffusion current.   **(D)** Hall voltage.

b.   A unijunction transistor is same as

   (A) pnp or npn transistor.   **(B)** JFET.
   (C) unipolar transistor.   **(D)** double-based diode.

c.   In a CE configuration, the output characteristics of the transistor will be described by plots of

   (A) v_{CB} versus i_C for constant values of I_E
   (B) v_{CB} versus i_B for constant values of I_E
   (C) v_{CE} versus i_E for constant values of I_B
   **(D)** v_{CE} versus i_C for constant values of I_B

d. The operation of a JFET involves

   (A) a flow of minority carrier through the channel.
   (B) recombination in the channel.
   (C) a flow of majority carriers through the channel.
   (D) negative resistance characteristics.

e. The PIV of a diode used in a bridge rectifier circuit is equal to

   (A) half the peak of the transformer secondary voltage.
   (B) twice the peak of the secondary voltage.
   (C) the peak of the transformer secondary voltage.
   (D) None of the above.

f.   The expression for output of the circuit shown after simplification using DeMorgan's theorems is
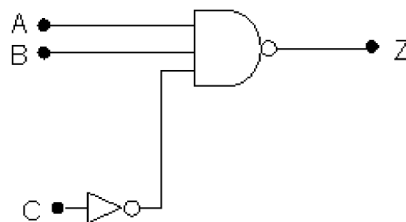
   (A) $Z = \overline{ABC}$

    (B) $\overline{A} + \overline{B} + \overline{C}$

    (C) $A + \overline{BC}$

 (D) $\overline{A} + \overline{B} + C$

g.   A 2's complement number 11010 is subtracted from 01001. The result, as a signed binary number, is equal to

    (A) 11111_2 (B) 10111_2

    (C) 01001_2 (D) 01111_2

h.   The time taken to write data into an EPROM location is approximately equal to

    (A)   50 ms.   (B)   20 ms.

    (C)   5 ms.   (D)   10 ms.

i.   The programmable array logic has

    (A)   a programmable OR array.

    (B)   both programmably AND and OR arrays.

    (C)   a programmable AND array.

 (D)   none of the above.

j.   The binary equivalent of $(11.6)_{10}$ is, approximately

    (A) $(1101.1010)_2$ (B) $(0111.10011)_2$

    (C) $(1111.1001)_2$ (D) $(1011.10100)_2$

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2   a.   What is an intrinsic semiconductor? Which are the most important intrinsic semiconductors? Briefly explain the two-dimensional representation of the crystal structure for the above.   **(6)**

     b.   Explain the operation of a positive diode clipper circuit when the diode is used as a series element. Assume sinusoidal excitation.   **(6)**

     c.   Briefly explain the output characteristics of a common-base configuration.   **(4)**

Q.3   a.   What do you mean by quiescent operating point as applied to a transistor amplifier? How do you draw the d.c. load line for a CE circuit? Write the hybrid model for a CE transistor and define the various hybrid parameters for the model.   **(10)**

     b.   Draw the circuit of a two-stage RC-coupled amplifier and comment on each one of the components used in the circuit.   **(6)**

Q.4   a.   How does an FET differ from a conventional junction transistor? Define the important parameters of a JFET. For a JFET, the typical value of amplification factor is 80 and of transconductance is specified as 200 micromhos. Calculate the dynamic drain resistance of this device.   **(8)**

     b.   Draw the circuit of an RC phase-shift oscillator and briefly explain its operation. A phase-shift oscillator uses three identical RC sections in the feed back circuit. The values of the components are $R = 100K\Omega$ and $C = 0.01\mu F$. Calculate the frequency of oscillation.   **(8)**

Q.5   a.   What is a rectifier? Draw the circuit of a full wave rectifier using a center-tapped transformer and explain its operation.   **(8)**

b.   A bridge rectifier uses a 4:1 transformer and drives a load of 200 ohms. If the input voltage to the transformer is $230\mathrm{V}/50\mathrm{Hz}$, calculate V_{dc}, I_{dc}, PIV and frequency of the output signal.   **(4)**

c.   Explain briefly how an OPAMP can be used as a inverting summer of input signals.   **(4)**

Q.6   a.   Express the Boolean function, $F = A + B'C$ in a sum of minterms and also interms of a short notation.   **(4)**

b.   Simplify the Boolean function given using K-Map.
$F = A'B'C' + B'CD' + A'BCD' + AB'C'$ **(4)**

c.   What is a digital multiplexer? How are the number of input lines related to the number of select lines in a multiplexer? Draw the block diagram and the logic circuit of a basic four line-to-one line multiplexer using basic gates.   **(8)**

Q.7   a.   What is the material used in making IC BJT transistors and what is the type of transistor commonly made? Comment on the switching speeds in FET devices.   **(8)**

b.   Which are the principal circuit elements of a CMOS digital circuit? What are the advantages of CMOS circuits? Write the circuit of a two-input CMOS NAND gate and briefly explain. **(8)**

Q.8   a.   What is TTL family? Mention the different versions of the TTL. What are the different types of output configurations in which the TTL gates are available?   **(7)**

b.   What is an LED 7-segment display? Illustrate the display arrangement for standard BCD code. Write the truth table for the BCD-to-seven segment decoder, assuming that a '1' on the segment turns the segment ON.   **(9)**

Q.9   a.   Distinguish between a synchronous sequential circuit and an asynchronous sequential circuit. Draw the circuit of a clocked RS flip-flop that uses NOR and AND gates. Explain its operation. **(8)**

b.   What is a shift register? How is a shift register configured? Draw the diagram of a 4-bit shift register using D flip-flops and briefly explain.   **(8)**