ME307 EXAM I (Example Questions)

NAME: ________________________________

NOTE:

- CLOSED BOOK, CLOSED NOTES.
- NO CALCULATORS ALLOWED.
- DO YOUR WORK ON THE EXAM ONLY (NO SCRATCH PAPER ALLOWED).
- READ THE QUESTION AND ALL ANSWERS CAREFULLY AND SELECT THE **BEST** ANSWER.
- ALL QUESTIONS ARE WEIGHTED EQUALLY.

USEFUL EQUATIONS:

Resistor Color Codes:

Black:0, Brown:1, Red:2, Orange:3, Yellow:4, Green:5, Blue:6, Violet:7, Grey:8, White:9
Gold: ±5%, Silver:±10%

Complex Impedances:

$$Z_R = R \qquad Z_C = \frac{1}{j\omega C} = -\frac{j}{\omega C}, \qquad Z_L = j\omega L$$

(1) Select the statement below that is most true:
   (a) a mechatronic system is usually a small component (sub system) within a measurement system.
   (b) a measurement system is usually a small component (sub system) within a mechatronic system.

(2) A pF is equivalent to
   (a) 10^{-3} F
   (b) 10^{-6} F
   (c) 10^{-9} F
   (d) 10^{-12} F
   (e) 10^{-15} F

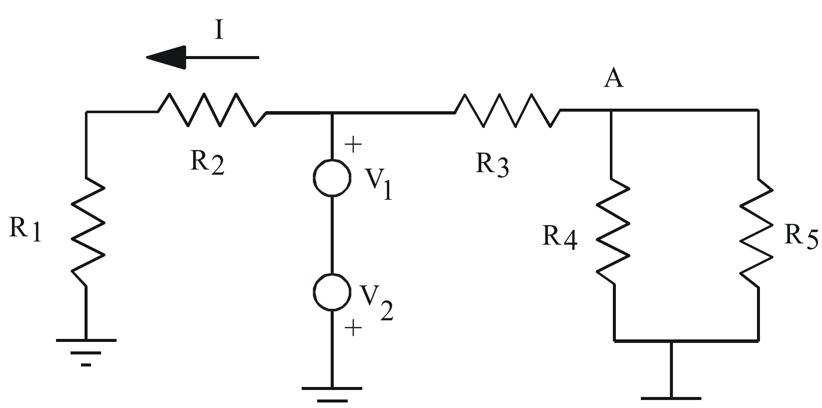
(3) In a dc electrical circuit, electrons flow from
- (a) the negative side of the voltage source to the positive side.
- (b) the positive side of the voltage source to the negative side.

(4) A 1 kV voltage across a 10 MΩ resistor will produce a current of
- (a) 10 kA
- (b) 0.1 kA
- (c) 10 mA
- (d) 1 mA
- (e) 0.1 mA

(5) What is the nominal (average) resistance value of a resistor with color bands: a=gray, b=orange, c=black?
- (a) 83
- (b) 38
- (c) 3×10^8
- (d) 8000
- (e) 1

(6) The equivalent resistance of three resistors (each of resistance R) in series is
- (a) R
- (b) 3R
- (c) R/3
- (d) 2R/3
- (e) 3R/2

Questions 7 through 10 deal with the circuit below where:
R_1=1kΩ, R_2=9kΩ, R_3=10kΩ, R_4=1kΩ, R_5=1kΩ, V_1=5V, and V_2=10V.



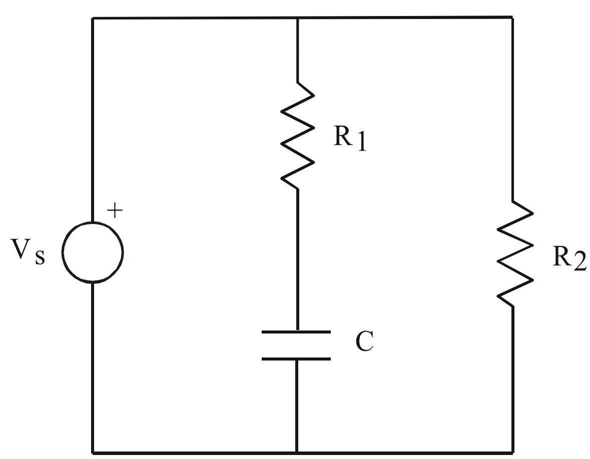
(7) What is the equivalent resistance between node A and ground?
(a) 1000 Ω
(b) 2 kΩ
(c) 0 Ω
(d) 0.5 Ω
(e) 500 Ω

(8) What is the voltage across R_1?
(a) 5 V
(b) 0 V
(c) 9 V
(d) 4.5 V
(e) 0.5 V

(9) What is the current (I) through resistor R_2 given the direction shown?
(a) –0.5 mA
(b) –0.5 A
(c) 0.5 mA
(d) –1.0 mA
(e) –1.0 A

(10) What is the voltage at node A?
(a) –0.238 kV
(b) –0.238 mV
(c) –0.238 V
(d) 0.238 V
(e) 0.238 mV

Questions 11 through 13 deal with the circuit below where:
V_s=10V dc, R_1=1kΩ, R_2=1kΩ, and C=0.01µf
Assume the circuit is operating in steady state (transients are already dissipated).



(11) What is the voltage across R_1?
- (a) 20 V
- (b) 10 V
- (c) 5 V
- (d) 0 V
- (e) –20 V

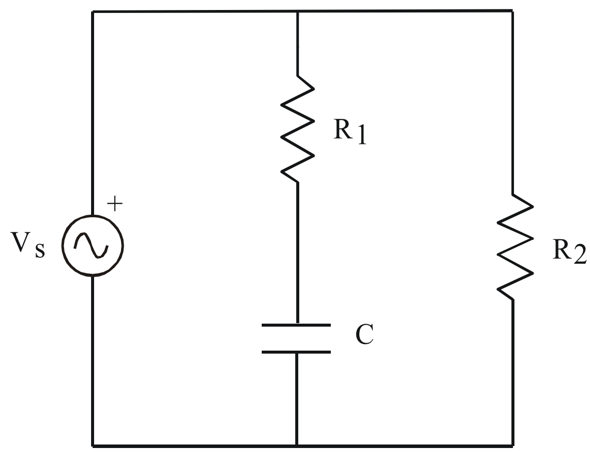
(12) What is the voltage across R_2?
- (a) 20 V
- (b) 10 V
- (c) 5 V
- (d) 0 V
- (e) –20 V

(13) What is the voltage across C?
- (a) 20 V
- (b) 10 V
- (c) 5 V
- (d) 0 V
- (e) –20 V

(14) When an ammeter is used to measure the current in a circuit branch, the meter will introduce a voltage drop in the branch which
- (a) increases with current
- (b) decreases with current
- (c) is independent of current

(15) When measuring the voltage across a circuit branch with a voltmeter, the reading will have the largest percentage error when the branch has
- (a) small resistance
- (b) large resistance
- (c) no resistance

Questions 16 through 18 deal with the circuit below where:
V_s=2 sin (100 t) V, R_1=1kΩ, R_2=1kΩ, and C=1μf
Assume the circuit is operating in steady state (transients already gone),



(16) What is the voltage across R_2?

(a) 2 sin (100 t)
(b) 1 sin (100 t)
(c) 2
(d) 1
(e) 0

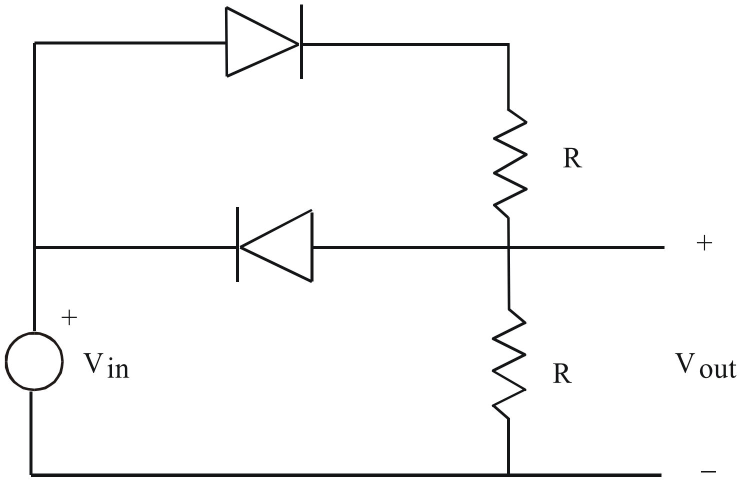
(17) What is the polar form of the equivalent impedance (in Ω) across the R_1-C branch?

(a) $10050 \angle 84.3°$
(b) $10050 \angle -84.3°$
(c) $1005 \angle -5.71°$
(d) $1005 \angle 5.71°$
(e) $1000 \angle 0$

(18) For very high input frequencies [$V_s = 2 \sin(\omega t)$ where ω is large], the voltage across C approaches

(a) 2 sin (100 t)
(b) 1 sin (100 t)
(c) 2
(d) 1
(e) 0

Questions 19 through 21 deal with the circuit below:



(19) When V_{in} is positive and the diodes are assumed to be ideal (no drop), V_{out} is equal to
- (a) $-V_{in}$
- (b) 0
- (c) V_{in}
- (d) $V_{in}/2$
- (e) $-V_{in}/2$

(20) If V_{in} is 5 V and the diodes are assumed to be ideal (no drop), the voltage across the top diode is
- (a) 0
- (b) 2.5 V
- (c) 5 V
- (d) 10 V
- (e) infinite

(21) If V_{in} is a sine wave and the diodes are assumed to be ideal (no drop), which of the following describes the output V_{out}?
- (a) half-rectified sine wave (bottom half chopped off at 0V)
- (b) full-rectified sine wave (bottom half inverted)
- (c) a full sine wave with the top halves having the same amplitude as the bottom halves
- (d) a full sine wave with the top halves having different amplitude from the bottom halves

(22) If the voltage at the emitter of an npn bipolar transistor is 5 V and the transistor is in saturation, the voltage at the collector is approximately
- (a) 5.0 V
- (b) 5.2 V
- (c) 5.7 V
- (d) 4.8 V
- (e) 4.3 V

(23) The hexadecimal equivalent of the binary number 1101 is

(a) A
(b) B
(c) C
(d) D
(e) E

(24) The binary sum of the binary numbers 1001 and 0011 is

(a) 1101
(b) 1011
(c) 1001
(d) 1110
(e) 1100

(25) $A + A$ is equivalent to

(a) A
(b) 0
(c) 1

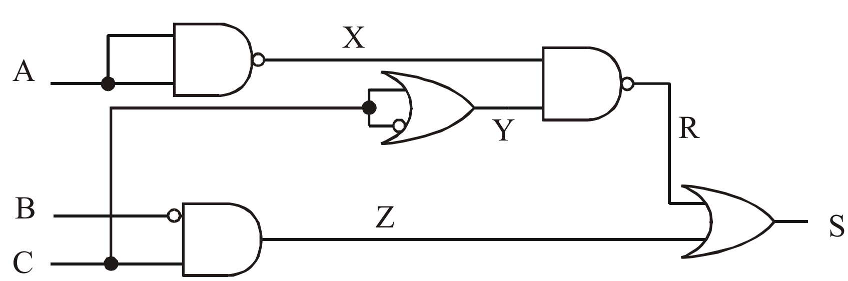
(26) $A\overline{A}$ is equivalent to

(a) A
(b) 0
(c) 1

(27) An all-OR realization of $B(C + \overline{A})$ is

(a) $B + C + A$
(b) $B + \overline{\overline{C} + A}$
(c) $\overline{B + \overline{C} + A}$
(d) $\overline{\overline{B} + C + \overline{A}}$
(e) $\overline{\overline{B} + \overline{C + \overline{A}}}$

Questions 28 through 30 deal with the circuit below



(28) What is a simplified Boolean expression for X?
(a) A
(b) $\overline{A}$
(c) 0
(d) 1

(29) If A=1, B=1, and C=1, what is X?
(a) 0
(b) 1

(30) If X=0, Y=1, and Z=1, what is S?
(a) 0
(b) 1

Question 31 deals with the truth table below where A and B are inputs and X and Y are outputs

A	**B**	**X**	**Y**
1	0	1	0
0	1	1	1
1	1	0	1

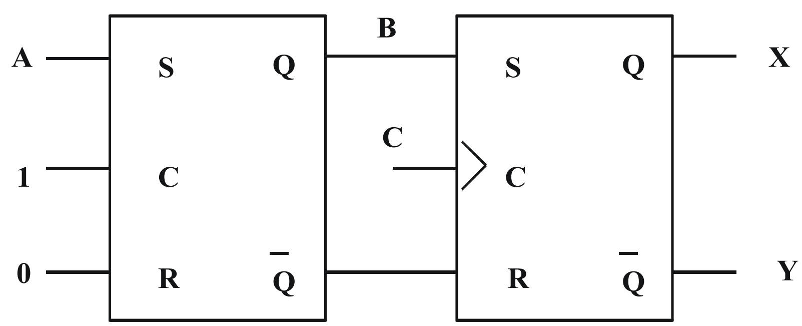
(31) Using the sum-of-products method, what is the correct expression for X?
(a) $A + B$
(b) $A + \overline{B}$
(c) AB
(d) $A\overline{B} + \overline{A}B$
(e) $\overline{A}B + A\overline{B}$

(32) A simplified Boolean expression for $(A\overline{B}) + (A(A + B))$ is
(a) A
(b) B
(c) $A + B$
(d) 1
(e) 0

(33) If the D input of a positive edge-triggered D flip-flop is connected to ground, at every positive edge of the clock input (CK) the output
(a) changes to (or remains at) 0
(b) changes to (or remains at) 1
(c) remains unchanged
(d) toggles

(34) If a flip-flop has a "Preset" input marked with an inversion circle, applying a HI signal to this input will
- (a) make the output of the flip-flop go HI
- (b) make the output of the flip-flop go LO
- (c) always make the output toggle
- (d) have no effect on the output of the flip-flop

Questions 35 through 36 deal with the circuit below:



(35) If A changes from 1 to 0, B will be
- (a) definitely 0
- (b) definitely 1
- (c) uncertain (depends on the power-on state and signal histories)

(36) If B=1 while C changes state from 1 to 0, X will
- (a) become (or remain) 0
- (b) become (or remain) 1
- (c) remain unchanged (regardless of whether the initial value is 0 or 1)