MECH307 EXAM I (Example Questions)

NAME: _____

NOTE:

- THE ONLY INFO REQUIRED ON THE SCANTRON SHEET IS YOUR NAME, CSU ID # (NOT SSN), AND ANSWER DOTS. **THERE WILL BE A PENALTY IF THE DOTS FOR YOUR LAST NAME AND CSU ID # ARE NOT CORRECT.**
- CLOSED BOOK, CLOSED NOTES. SOME REFERENCE INFORMATION IS PROVIDED.
- **NO ELECTRONIC DEVICES ALLOWED** (CALCULATOR, CELL PHONE, PDA, MUSIC PLAYER, ETC.). THE ONLY AIDS ALLOWED ARE A PENCIL AND AN ERASER.
- DO YOUR WORK ON THE EXAM ONLY (NO SCRATCH PAPER ALLOWED).
- **PLEASE REMOVE YOUR HAT OR TURN IT SO YOUR FACE AND EYES ARE VISIBLE.**
- "ROAMING EYES" WILL NOT BE TOLERATED.
- READ THE QUESTION AND ALL ANSWERS CAREFULLY AND SELECT THE **BEST** ANSWER.
- ALL QUESTIONS ARE WEIGHTED EQUALLY.
- **NOTE** - THE DOTS ON YOUR SCANTRON SHEET INDICATE YOUR OFFICIAL ("FINAL") ANSWERS, SO BE CAREFUL WHEN YOU FILL THEM IN. ALSO, IF YOU WAIT UNTIL THE END TO FILL IN THE DOTS, MAKE SURE YOU ALLOCATE ENOUGH TIME FOR THIS TASK.

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

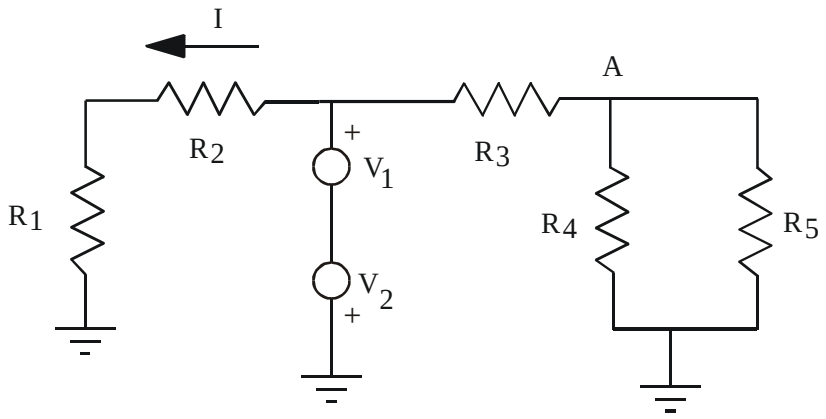
(3) In a dc electrical circuit with a single voltage source, electrons flow through the circuit (outside of the voltage source) from
   (a) the negative side of the voltage source to the positive side.
   (b) the positive side of the voltage source to the negative side.
   (c) the surrounding air to the circuit components.

(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.



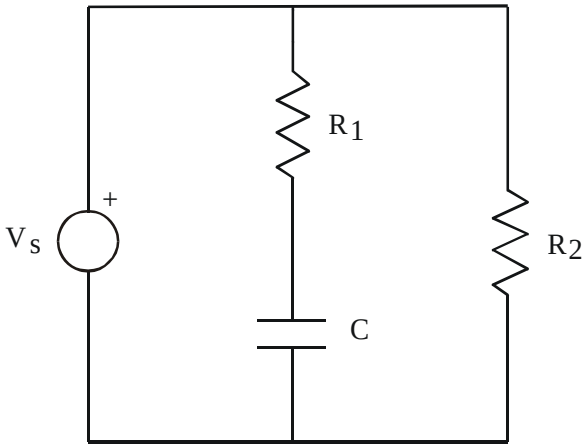
(7) What is the equivalent resistance between node A and ground?
- (a) 1000 Ω
- (b) 2 kΩ
- (c) 0 Ω
- (d) 0.5 Ω
- (e) 500 Ω

(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

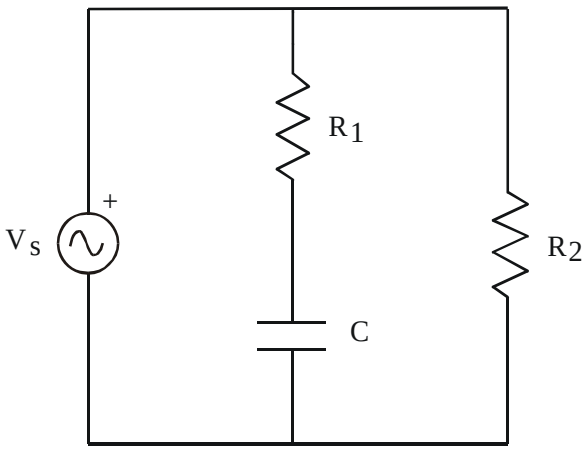
(12) What is the voltage across R_2?
- (a) 20 V
- (b) 10 V
- (c) 5 V
- (d) 0 V
- (e) –20 V

(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 increasing current
- (b) decreases with increasing 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),

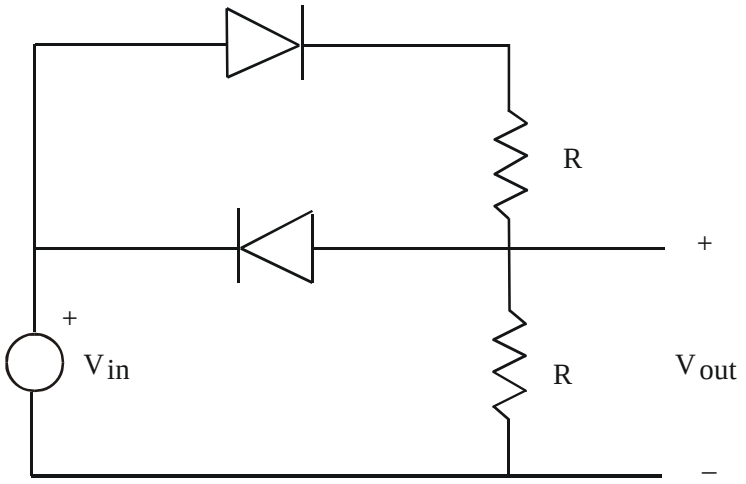


(16) What is the voltage across R_2?
(a) 2 sin (100 t)
(b) 1 sin (100 t)
(c) 2
(d) 1
(e) 0

(17) What is the polar form of the equivalent impedance (in Ω) across the R_1-C branch?
(a) 10050 <84.3°
(b) 10050 <–84.3°
(c) 1005 <–5.71°
(d) 1005<5.71°
(e) 1000 < 0

(18) For very high input frequencies [V_s = 2 sin (ωt) 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

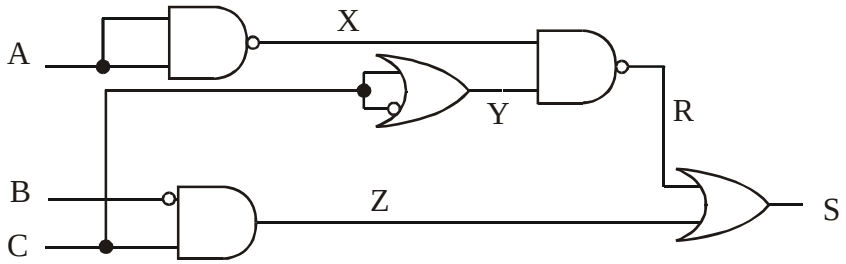
(24) The binary sum of the binary numbers 1001 and 0011 is
(a) 1101
(b) 1011
(c) 1001
(d) 1110
(e) 1100

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

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

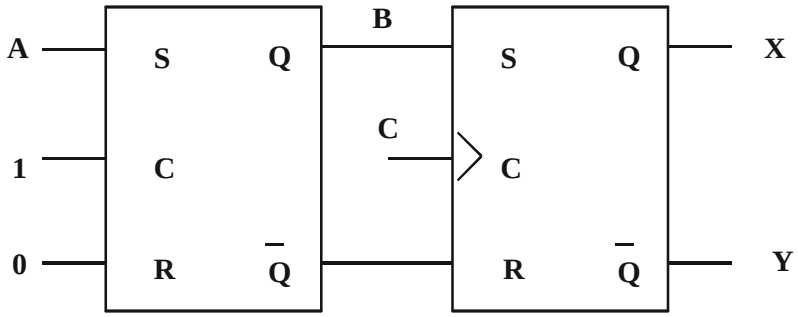
(31) Using the sum-of-products method, what is the correct expression for X?
- (a) A + B
- (b) $A + \overline{B}$
- (c) AB
- (d) $A\overline{B} + \overline{A}B$
- (e) $\overline{A}B + A\overline{B}$

(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)