ภาค.61.

Student Name:_____ Student I.D.:_____

Seat No.

King Mongkut's University of Technology Thonburi

Midterm Examination

Semester 1, Academic Year: 2018

INC 223 Electronics for Automation System

For Automation Engineering Students (2nd Year, International Program)

Date: Monday 8 October 2018 Time: 13.00 – 16.00

Instructions

1. The examination paper consists of 12 pages (including this front page).
2. Documents, text books, dictionary, and computer are not allowed in the examination room.
3. Calculators approved by the university are allowed.

Cautions

1. Students are not allowed to take examination scripts, answer booklets or any materials out of the examination room. Violation of the rule shall result in a penalty of student receiving a zero in that examination.
2. Students who are caught cheating in the examination shall be penalized by receiving Fail grade (F) in that subject and is forced to withdraw (W) from all remaining subjects in that semester. The maximum penalty may include expulsion.

Wanchak Lenwari

(Assoc.Prof.Dr. Wanchak Lenwari)

Examiner

This examination paper has been approved by the Department of Control System and Instrumentation Engineering.

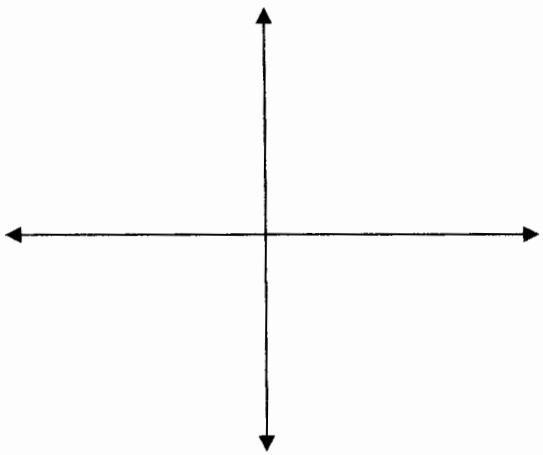
Sudchai Boonto

(Asst.Prof.Dr. Sudchai Boonto)

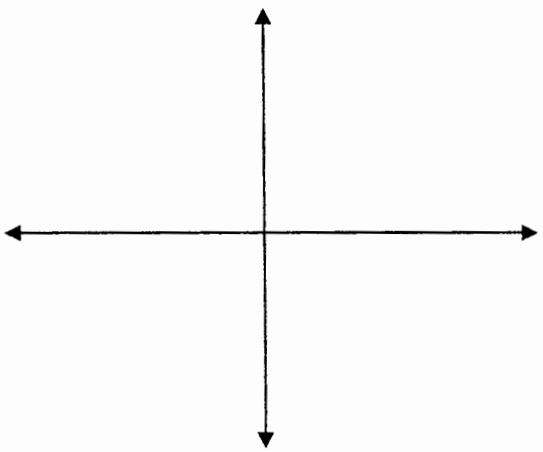
Head of Department

1. Draw the symbol and structure of a diode. (2 marks)

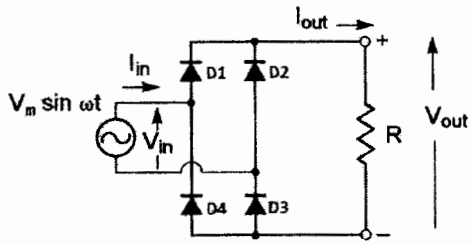
2. Plot the complete voltage-current (V-I) characteristic curve for a practical diode in the graph provided. Assume a breakdown voltage is 300 V and a forward-biased voltage is 0.7 V. Note. Graph must be completed with x-axis and y-axis labels. (4 marks)



3. Draw the complete voltage-current (V-I) characteristic curve for an ideal zener diode in the graph given below. Assume a zener voltage is 7.5 V and a forward-biased voltage is 0.7 V. Note. Graph must be completed with x-axis and y-axis labels. (4 marks)



4. From a circuit given below, answer the following questions. Assume the peak-peak of input voltage (V_{in}) is 20 V, R is 50 Ω and the voltage across a diode when it is forward-biased is 0.7 V.



4.1 What is the name of this circuit? _____. (1 mark)

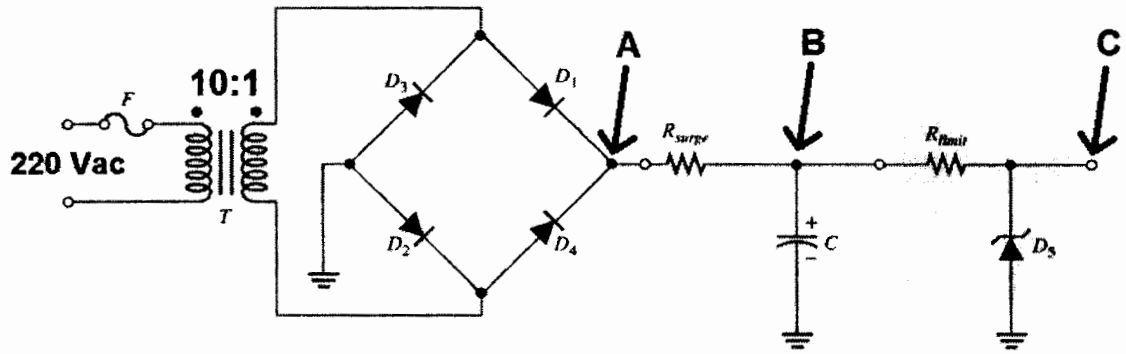
4.2 Draw the waveforms of a voltage across R, current flowing through R, voltage across diode D1, D2, D3 and D4. (6 marks)

4.3 Derive the equation of average voltage across R and calculate its value. (2 marks)

4.4 What is the minimum PIV (Peak Inverse Voltage) rating of the diode that can be used in this circuit?

PIV= _____ V (1 mark)

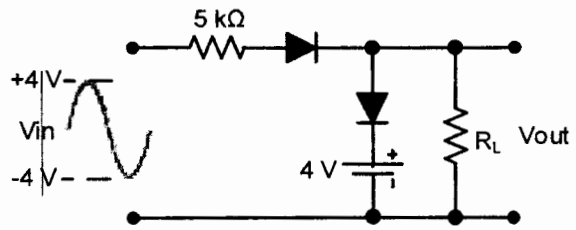
5. One of zener diode applications is to make a dc power supply. From a given circuit roughly draw the voltage waveforms at point A and B. Assume a zener voltage (Vz) of D5 is 7.5 V. (3 marks)



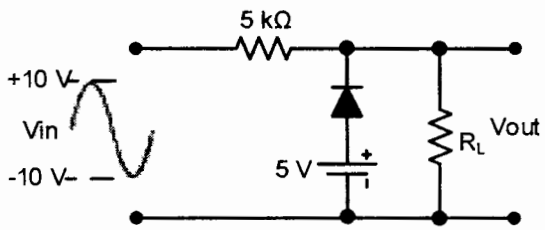
6. Explain main functions of transistors in electronic circuits. (2 marks)

7. Draw the output voltage (Vout) for circuits given below. Assume the voltage across diode when it is forward-biased is 0.7 V and R_L is much higher than 5 kΩ. (5 marks for each circuit)

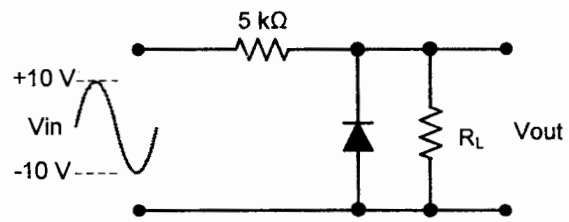
Note. For a circuit with a capacitor assume a RC time constant is much higher than time period of Vin.



(a)



(b)



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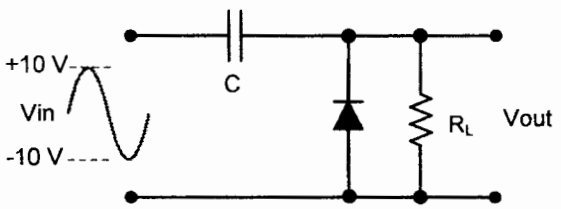
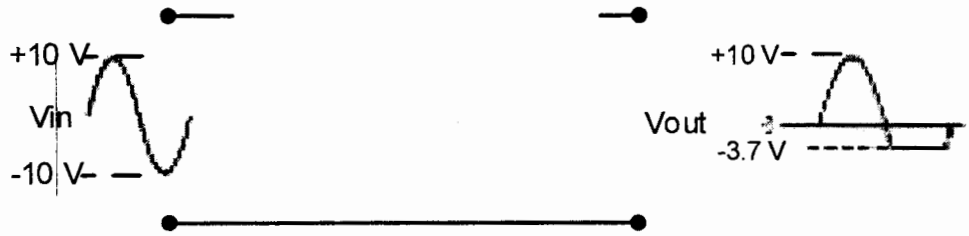
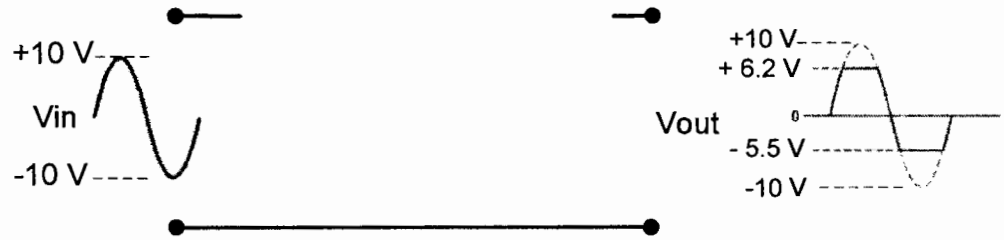
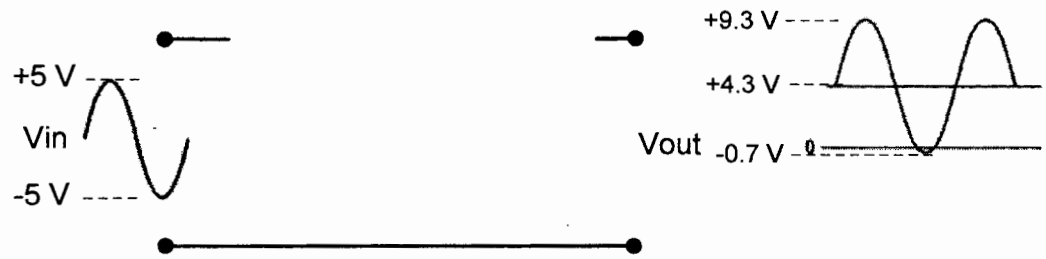


(d)

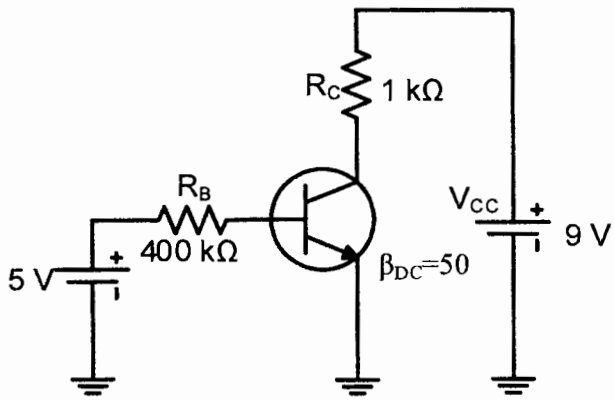
8. Draw the circuits which give the following output waveforms. Assume the voltage across diode when it is forward-biased is 0.7 V. (5 marks for each circuit)





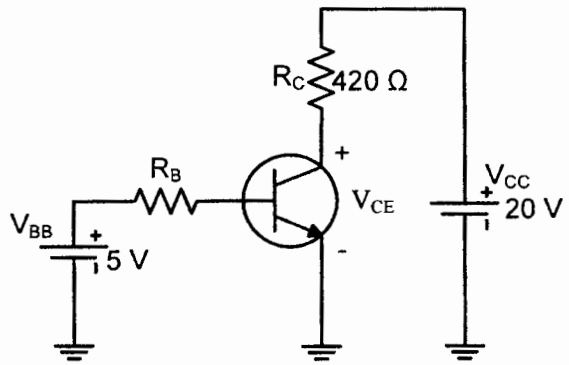


9. From a given transistor circuit, determine I_C, I_B, I_E and V_{CE}. Assume $V_{BE} = 0.7$ V when the transistor is on and $V_{CE(SAT)} = 0.1$ V. (4 marks)



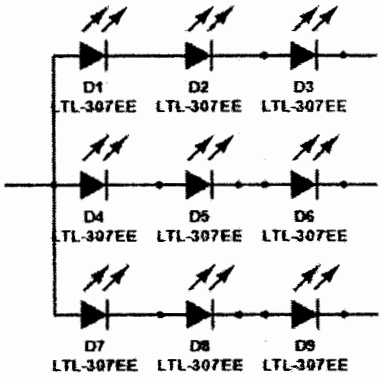
Whether or not the transistor is saturated? _____ (1 mark)

10. From a given circuit, design R_B and β_{DC} to get V_{CE} = 10 V. Assume V_{BE} is 0.7 V when the transistor is on and $V_{CE(SAT)}$ = 0.1 V. (4 marks)



Whether or not the transistor is saturated? _____ (1 mark)

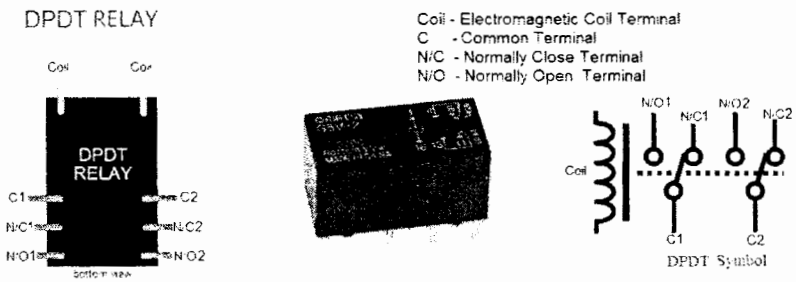
11. Design a transistor circuit to drive a LED array (given below) from a +12V DC supply. The control signal +5V from the microcontroller board is used to drive the base of a transistor. Assume a DC current gain of a transistor = 100, $V_{BE(ON)} = 0.7$ V and $V_{CE(SAT)} = 0.2$ V. A LTL-307EE is red color LED with a forward voltage of 2.0 V and a desired current is 20 mA to generate a proper brightness. (15 marks)



12. Design a DC motor direction control circuit using a relay driven by a transistor. When the coil of relay is not energized the motor is running forward. The motor will run reverse when the coil is energized. The control signal +5V from the microcontroller board is used to drive the base of a transistor. Student can use components listed below in the design. Extra components or devices can also be used or added. (15 marks)

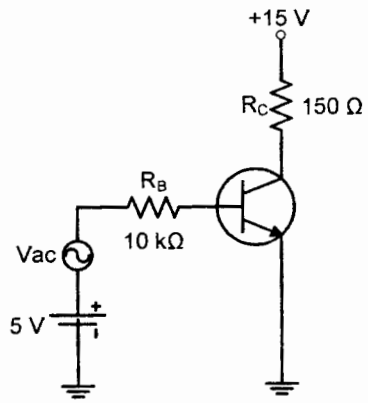
Main component list:

- Battery 12V
- DC Power supply 5V
- 12V DC Motor
- Power Relay: DPDT, 5V DC Coil, nominal coil current 30 mA, coil resistance 150 Ω



- Transistor 2N3904: DC current gain (β or hFE)=100 , V_{BE}(ON)=0.7 V , V_{CE}(SAT)=0.3 V
- Resistors (any values)

13. From a given transistor circuit, if Vac = 2 V(peak to peak), $\beta = 100$, $V_{BE(ON)} = 0.7$ V and $V_{CE(SAT)} = 0.2$ V, determine Q-point and draw the complete load line including the variation of I_C, I_B and V_{CE} . (10 marks)



What are the maximum peak variations of I_C and I_B for linear operation (no distortion)? (2 marks)

14. From a given circuit, select R_B , R_C and β to obtain the Q-point at V_{CE} = 5 V and I_C = 10 mA. Assume $V_{BE(ON)}$ = 0.7 V and $V_{CE(SAT)}$ = 0.2 V. (10 marks)