The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

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Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Codes and Title	**: EEX4351 ELECTRONICS II**
Academic Year	: 2020/21
Date	: 09th January 2021
Time	: 14:00-17:00hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **seven (07)** questions in **five (05)** pages.
3. Answer all the questions in Section I (60 marks).
4. Answer only **two (02)** questions in Section II (40 marks).
5. Calculators are permitted to use.
6. This is a Closed Book Test (CBT).
7. Do not use a red colour pen to write the answers.

SECTION I

Question 1 **(20 marks)**

(i) Draw the state diagram for a Mealy-type sequence detector to detect the overlapping binary sequence 0101.
In your answer clearly identify the states,inputs and outputs. (03 marks)

(ii) A binary serial adder circuit has two input bit streams and one output. Addition is performed serially with the least significant bit (LSB) of the two inputs arriving first synchronously. Sum of the bits appear at the output.
Draw the statetable and the state diagram for the serial adder. In your answer clearly identify the states,inputs and outputs. (10 marks)

(iii) Consider a process control facility with four input lines denoted as L1, L2, L3 and L4. Each input carries digital data to a common repository. Depending on the input priority is assigned as shown in Table 1. Numerical values to indicate the priority 1 has the highest priority and 4 has the lowest priority.

Table 1

Input lines	Priority
L1	1
L2	2
L3	3
L4	4

Design a suitable digital circuit to select the highest priority input line. In your answer, clearly show the inputs, outputs, truth table and the schematic diagram of the digital circuit. Use standard symbols to denote the components in the schematic diagram. (07 marks)

Question 2 **(20 marks)**

(i) List one application for each Buck converter, Boost converter and Buck-Boost converter circuits. (03 marks)

(ii) Explain the operation of the Buck converter. In your answer, clearly show the schematic diagram and the relevant equations, duty cycle related to voltage conversion. (06 marks)

(iii) Explain the operation of the Boost converter. In your answer, clearly show the schematic diagram and the relevant equations, duty cycle related to voltage conversion. (06 marks)

(iv) Compare the linear and switch mode power supplies considering the operation, efficiency, and voltage regulation mechanism. (05 marks)

Question 3 **(20 marks)**

(i) Draw the general topologies for the following feedback topologies with a source resistance R_S and a resistive load R_L: (04 marks)

a. Voltage gain amplifier with voltage series feedback
b. Current gain amplifier with current shunt feedback

In your answer, clearly indicate the input output voltages and currents as V_{in}, V_{out}, I_{in}, I_{out} respectively.

(ii) In a negative feedback amplifier, input voltage is 40mV, open loop gain is 100 and the feedback factor is 0.06. Calculate the following parameters: (06 marks)

a. Closed-loop gain
b. Output voltage
c. Feedback voltage

In your answer, clearly indicate the relevant units and the equations for each calculation.

(iii) Consider the circuits shown in Figure 1 in page 3 and answer the following: (10 marks)

a. Draw the h-parameter equivalent model with the appropriate standard parameters for the circuit shown in Figure 1.
b. Derive an expression for $A_{vf}= Vo/Vs = G_{mf} R_L$ using the h-parameter equivalent model that you have drawn in (iii) b. above.
Given that $G_{mf} = - h_{fe}/(R`_s + h_{ie} +(1+h_{fe})R_e)$ where $R`_s= R_s \| R_a \| R_b$

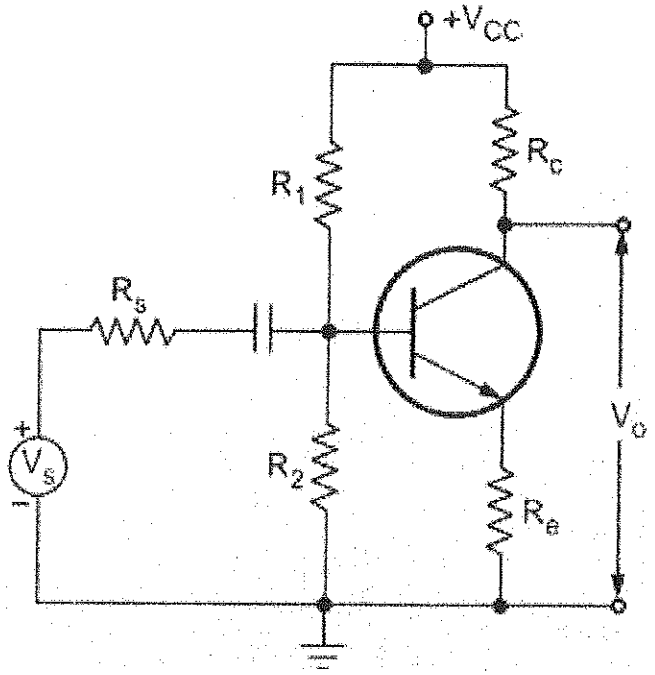


Figure 1

SECTION II

Question 4 **(20 marks)**

(i) Consider a 10 bit analog-to-digital converter (ADC) circuit with full-scale operating voltage of 30V. Calculate the output voltage value when the binary input is 0101101010. In your answer, clearly show all the calculations. (06 marks)

(ii) Calculate the number of comparisons carried out by a 06-bit flash type analog-to-digital converter. (04 marks)

(iii) Consider a four (04) bit successive approximation ADC with an input voltage range of 0V to 15V.

a. Calculate the resolution. (02 marks)

b. Compute the number of clock cycles required to traverse an analog input of 13.2V. (08 marks)

Question 5 **(20 marks)**

(i) Draw the physical structures of a typical TRIAC and DIAC. In your answer clearly identify all the layers and name them using standard notations. (06 marks)

(ii) Using the structure of a TRIAC described in (i) above, describe the four modes of triggering. (04 marks)

(iii) List two applications of a TRIAC. (02 marks)

(iv) Describe the smooth light dimmer circuit using a DIAC and TRIAC. In your answer clearly show the schematic diagram of the circuit. Based on the circuit that you have described, answer the following questions: (08 marks)

a. Draw the waveforms of the input AC source and the controlled output waveform considering smooth dimming.

b. What effect will you observe in absence of smooth dimming?

Question 6 **(20 marks)**

(i) Write the values of the following parameters for an ideal operational amplifier (OpAmp). (04 marks)

a. Voltage gain
b. Input impedance
c. Output impedance
d. Bandwidth

(ii) Draw the circuit diagram of an OpAmp integrator circuit and derive an expression for the output voltage considering it is an ideal OpAmp. (06 marks)

(iii) Consider that the resistor and capacitor values of an ideal OpAmp integrator circuit is given as 100kΩ and 1μF. If the input voltage is given as 4sin500t, calculate the magnitude of the output voltage. (04 marks)

(iv) Draw the circuit diagram of an OpAmp differentiator circuit and derive an expression for the output voltage considering it is an ideal Op Amp. (06 marks)

Question 7 **(20 marks)**

(i) List two main disadvantages of using passive filter circuits for low frequency applications compared to the use of active filters. (04 marks)

(ii) Draw the circuit diagram of a first order active low pass filter. Consider that the input is a sinusoidal signal of 1kHz with a peak value of 1.5V and answer the following questions: (06 marks)

a. Draw the input and output waveforms.
b. Identify if there is a change in the phase and amplitude of the output compared to the input sinusoidal signal. Give reasons for your answer.

(iii) Derive an expression for sustaining the oscillations for non-zero input voltage in a Wein bridge oscillator considering the bridge is balanced. (10 marks)