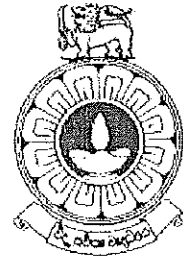


The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme



Department	: Physics
Level	: 05
Name of the Examination	: Final Examination
Course Code and Title:	PHU5318/PCU3170 – Electronics for Biology Students
Academic Year	: 2019/2020
Date	: 2020-01-03
Time	: 9.30 am – 11.30 am
Duration	: 02 hours

General Instructions

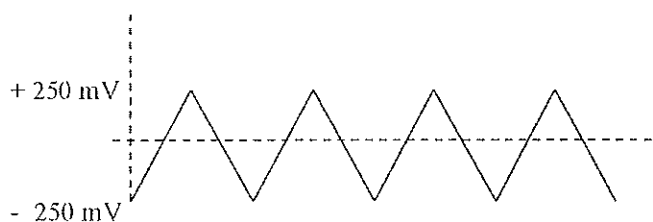
1. Read all instructions carefully before answering the questions.
 2. This question paper consists of 06 questions in 03 pages.
 3. Answer any **04** questions only. All questions carry equal marks.
 4. Answer for each question should commence from a new page.
 5. Draw fully labelled diagrams where necessary
 5. Relevant log tables are provided where necessary.
 6. Having any unauthorized documents/ mobile phones in your possession is a punishable offense.
 7. Use blue or black ink to answer the questions.
 8. Circle the number of the questions you answered in the front cover of your answer script.
 9. Clearly state your index number in your answer script
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(1)

- (a) Operational amplifier is a useful integrated circuit used in many areas in electronics. Copy the following table and fill the blanks with approximate numerical values.

Characteristics	Ideal	Real
Input impedance		
Output impedance		
Voltage gain		
Input biased current		

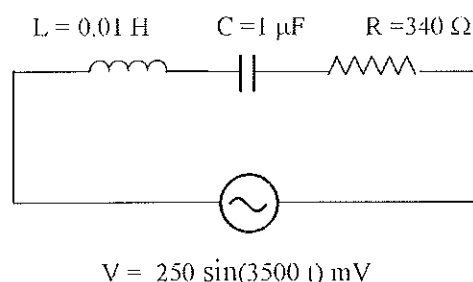
- (b) Write down the equation for the output voltage (V_{out}) of open loop amplifier, considering the differential voltage gain (A_d), non-inverting (V_+) and inverting (V_-) voltages.
- (c) Explain why an open loop amplifier is impracticable.
- (d) Derive the expression for the voltage gain of an inverting amplifier in terms of resistors with the help of two Golden rules.
- (e) A symmetrical triangular voltage signal with the amplitude of ± 250 mV is connected to the input of an inverting amplifier.



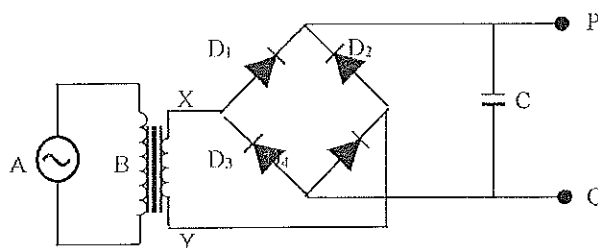
The output voltage of the amplifier is saturated at the 90 % of its power supply voltage (± 18 V). What would be the maximum voltage gain of the amplifier to produce the output without the distortion ?

- (f) Considering the voltage differentiation, propose a operational amplifier circuit to connect with the output of the above circuit to obtain square voltage signal. (values of the components are not necessary)

- (2) The following figure shows an alternative current circuit consisted of ac voltage source ; $V = 250 \sin(3500 t) \text{ mV}$, an inductor (0.01 H), a capacitor ($1 \mu\text{F}$) and a resistor (340Ω).

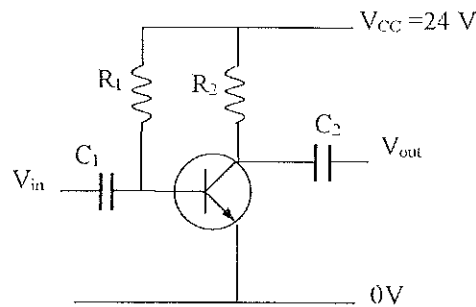


- Calculate the total impedance of the circuit.
 - Considering the peak voltage of the power source, find the peak current through the circuit.
 - If you measure this current in your laboratory , what would be the value you obtain ?
 - Draw the phasor diagram of the voltages across each component.
 - Calculate the resonance frequency of the circuit considering the minimum value of the total impedance .
- (3) The following figure shows the circuit diagram of a low voltage power supply.



- Name each component indicated in the figure as A, B, C & D₁.
- Sketch on the same graph, the voltage wave pattern with the time at B , across XY and across OP .
- When the voltage at X is higher than Y , which components out of D₁ , D₂ , D₃ & D₄ are forward biased and reversed biased ?
- Sketch the output voltage patterns with the time for two different values of C component ($C_1 \gg C_2$) when a load is connected .
- Extend the above circuit with a additional component to obtain stabilized 6 V power supply ($V_{OP} > 9 \text{ V}$).

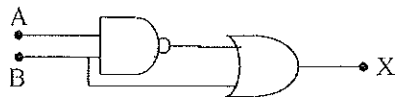
- (4) A transistor can be used to amplify the current. The base-emitter voltage drop of the following NPN bipolar junction transistor is 0.6 V and the current gain is 180.



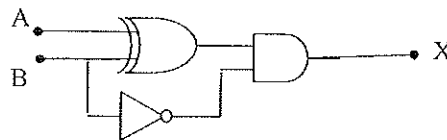
- Redraw the above circuit diagram on your answer script and mark the directions of current flow through R_1 , R_2 and each pin of the transistor.
- Find a suitable value for the resistor R_1 , to maintain the base current at $35 \mu\text{A}$.
- Under the given condition, what would be the current through the resistor R_2 ?
- Then, if you want to maintain the output voltage half of the supply voltage, what would be the value for R_2 ?
- What is the purpose of using C_1 and C_2 capacitors?

(5)

- (a) Give the truth tables for the following logic circuits.



(i)



(ii)

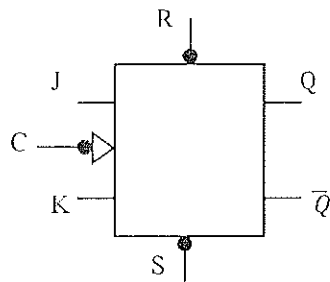
- (b) Write down the simplified results for the following expressions.

(i) $A + 1$ (ii) $A \cdot A$ (iii) $A \cdot \bar{A}$ (iv) $A + \bar{A}$

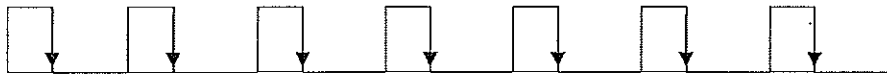
- A combinational logic circuit is designed with three inputs (A, B & C) and a output (Q). The output goes high when the state of A & B inputs are opposite to each other and the state of C input is high. Construct the truth table according to the above condition.
- Derive the Boolean expression for the above, considering the functions of AND, OR & NOT gates.
- Draw the combinational logic circuit according to the Boolean expression.

(6)

(a) The symbol of the negative-edge-triggered J-K Flip flop is shown below .



- (i) Name all the terminals indicated in the above diagram .
 - (ii) Give the truth table .
 - (iii) In what way is the clock input in a J-K Flip flop important?
- (b) Draw the circuit diagram connecting four negative-edge-triggered J-K Flip flops to construct a counter.
- (c) Seven clock pulses as shown below are fed to the counter. Draw the voltage pattern at the each output of the counter corresponding to each clock pulse (timing diagram)



- (d) How do you modify the counter to reset automatically when the output represents decimal 5 (or binary 0101)

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