UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION 2005/2006

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

TITLE OF PAPER: ELECTRONIC SYSTEM DESIGN

COURSE CODE: E330

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:

1. **There are four questions in this paper. Answer Question ONE and any other TWO questions.**
2. **Question one carries 50 marks while the other questions carry 25 marks each.**
3. **If you think not enough data has been given in any question you may assume any reasonable values.**

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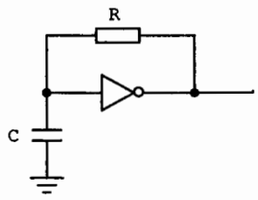
THIS PAPER CONTAINS SIX (6) PAGES INCLUDING THIS PAGE

QUESTION 1 (COMPULSORY) ***(50 marks)***

Answer all parts of this* question. *Only short answers are expected.

(a) With the aid of waveform sketches explain how the following circuit produces a square wave signal. The positive going threshold is 1.8 V and the negative going threshold is 0.8 V.

(5 marks)

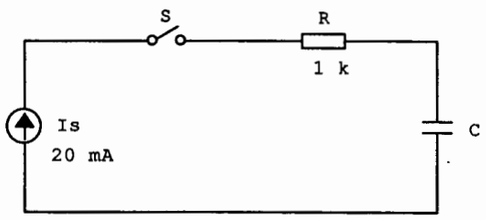


(b) What is temperature coefficient and why is it an important parameter in the design of electronic circuits? *(4 marks)*

(c) The following circuit is used for measuring the value of an unknown capacitor. With the capacitor initially uncharged the switch S is closed for 5 ms and then opened. The value of the voltage across C is then measured to be 10 V.

(i) What is the value of C? *(4 marks)*

(ii) What type of switch can be used to implement S? *(1 mark)*



(d) Explain why a diode is used across the relay coil in an electronic switching circuit for a relay switch. *(5 marks)*

(e) What are the advantages of surface-mount technology over through-hole technology? *(3 marks)*

(f) What is capacitor bypassing and why is this technique important in the fabrication of electronic circuits? *(4 marks)*

(g) What is shielding and why is it used in the fabrication of some circuits? *(4 marks)*

(h) The number of turns in an inductor coil is halved, by what factor does its inductance change? Explain. *(2 marks)*

(i) Why are magnetic cores of low frequency power transformers laminated? *(2 marks)*

Question 1 continued

(j) A circuit module which takes a current of 5 A form the dc supply is connected to a 12V dc supply using a 7/0.2 PTFE insulated wire. The circuit is 1.5 m wiring distance from the supply. Calculate the voltage appearing at the supply terminals of the circuit. *(6 marks)*

(k) A walkie-talkie used by a security guard uses a 6-V rechargeable battery. On an 8-h shift the guard on average spends 1h 30min transmitting and the rest of the time listening. The walkie-talkie consumes from the battery 4W when transmitting and 0.3 W when listening. What minimum A-h rating is required for the battery so that the walkie-talkie may be used throughout the duration of the shift without needing to be recharged? *(5 marks)*

(l) Three system modules A, B and C have reliabilities of 0.95, 0.93 and 0.90 respectively for 1,000 hours of operation. The modules are connected in series, operated for 1,000 h and then inspected.

(i) What is the probability that A and B will both be found working? *(1 mark)*

(ii) What is the probability that C will be found to have stopped working? *(1 mark)*

(iii) What is the probability that A and B will be found to be working but C has stopped working? *(2 marks)*

QUESTION TWO *(25 marks)*

(a) An amplifier has a voltage gain of -43 and a current gain of 105.

(i) Calculate the voltage gain, current gain and power gain all in dB. *(3 marks)*

(ii) If the amplifier feeds into a load resistance of 50 Ω, calculate the input resistance of the amplifier. *(3 marks)*

(b) An opamp-based de-emphasis circuit is shown in Fig. 2.1. Use the following steps to design the de-emphasis circuit.

(i) Derive the frequency response $V_o(j\omega)/V_{in}(j\omega)$ of the circuit and show that it has one zero and one pole. *(5 marks)*

(ii) Sketch the magnitude response due to a pole and that due to a zero and show how the de-emphasis frequency response curve of Fig. 2.2 can be obtained from your pole and zero sketches. *(8 marks)*

(iii) Specify values of the resistors and capacitors needed to obtain the response in Fig.2.2 which has midband gain 34 dB and corner frequencies 1 kHz and 5 kHz respectively. *(6 marks)*

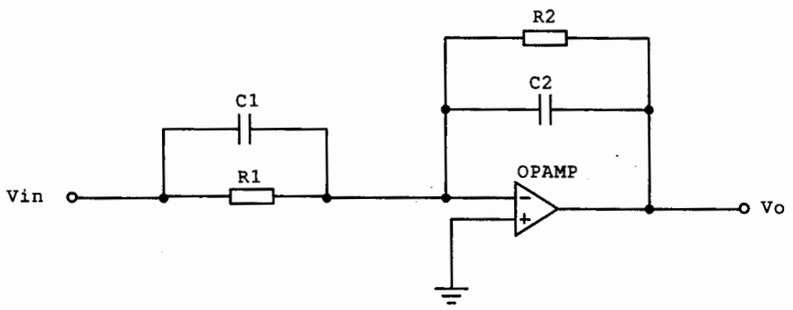


Fig 2.1

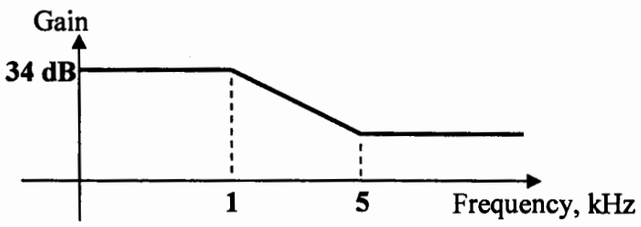


Fig. 2.2

QUESTION THREE ***(20 marks)***

(a) What is a module in electronic circuit design? Briefly discuss five advantages of designing and fabricating circuits as modules. *(6 marks)*

(b) What is hysteresis in comparator circuits? With the aid of illustrations discuss its purpose and how it typically functions. *(5 marks)*

(c) A designer wishes to cascade a number of standard amplifiers to amplify a signal from a source of 2 mV and 5 kΩ internal resistance, to feed 2W into a 50-Ω load. The standard amplifiers are identical, each having internal resistance 1 kΩ, voltage gain 30 and output resistance 500 Ω. How many standard amplifiers will be needed? *(14 marks)*

QUESTION FOUR ***(20 marks)***

(a) Define the following terms as used in the description of equipment performance:

Reliability

Failure rate

Maintainability *(5 marks)*

(b) A system uses three amplifiers A, B and C which deliver output powers of 100 W, 200 W and 300 W respectively. Each amplifier operates independently and when working, adds its power to the output so that the total power output of the system is the sum of the powers of the working amplifiers. The reliabilities of three amplifiers for 1000 hours of continuous operation are 0.9, 0.8 and 0.7 respectively. What are the reliabilities of the system for 1000 hours of operation for each of the following minimum output power requirements: 600W, 500W, 400W, 300W, 200W and 100W? *(20 marks)*

END. There are no more questions in this paper