

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF TEXTILE TECHNOLOGY

END OF SEMESTER EXAMINATIONS MAY 2004

PRINCIPLES OF ELECTROTECHNICS – TXT 1212

TIME: 3 HOURS

INSTRUCTIONS

Answer **ALL** questions in section A and any **THREE** questions in section B

Show all your steps clearly in any calculations.

Start each new question on a fresh page.

1. (a) Write down the names of the two semiconductor materials commonly used in the manufacture of semiconductor devices. (2 marks)
- (b) Draw fully labelled schematic diagrams of the two types of bipolar junction transistors (3 marks)
2. With reference to a p-n junction
 - (i) explain what you understand by the depletion region (3 marks)
 - (ii) write down the value of the barrier voltage for a germanium junction (2 marks)
3. Draw the fully labelled schematic symbols for the six types of field effect transistors. (5 marks)
4. Briefly explain why the following are considered to be transducers.
 - (i) Strain gauge (2 marks)
 - (ii) Linear variable differential transformer (3 marks)
5. Reduce the block diagram in Fig 1 to a single block diagram.

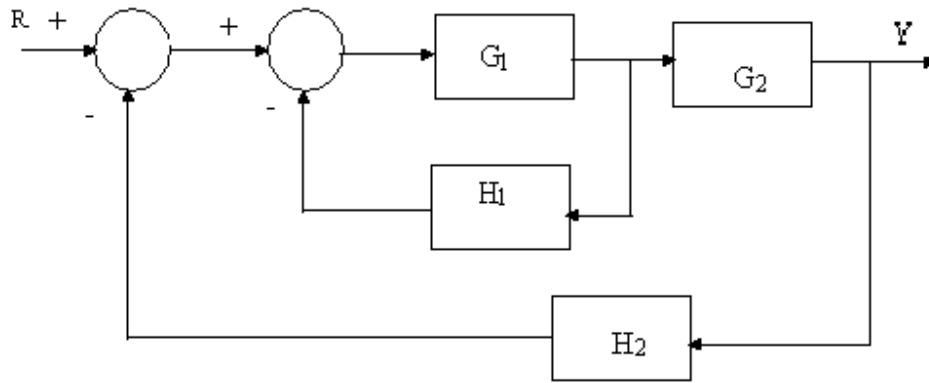


Fig 1

6. State the difference between regulation control and tracking control. (5 marks)
7. Give six advantages of integrated circuits over discrete component circuitry. (5 marks)
8. (a) Draw the symbol of an operational amplifier (2 marks)
 (b) Explain the meaning of the (-) and (+) on the operational amplifier inputs.

SECTION B

1. For the system in Fig 2 determine the output function Y

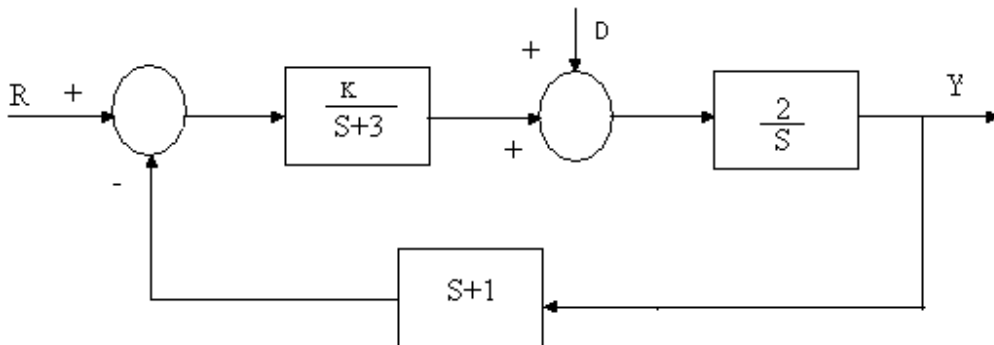


Fig 2

(20 marks)

2. (a) Write down the formula for the capacitance C of a parallel plate capacitor. (6 marks)
- (b) List the three parameters in the formula that can be varied for the capacitor transducer. (4 marks)
- (c) Explain the principle of operation of the variable separation capacitor transducer and state its practical application. (10 marks)
3. (a) (i) Draw a diagram of an OPAMP as a differentiator. (5 marks)
- (ii) Deduce the formula for the OPAMP as a differentiator. (4 marks)
- (b) Draw the diagram of an OPAMP as an astable multivibrator. (5 marks)
- (c) Draw waveforms to show the operation of the astable multivibrator. (6 marks)

4.

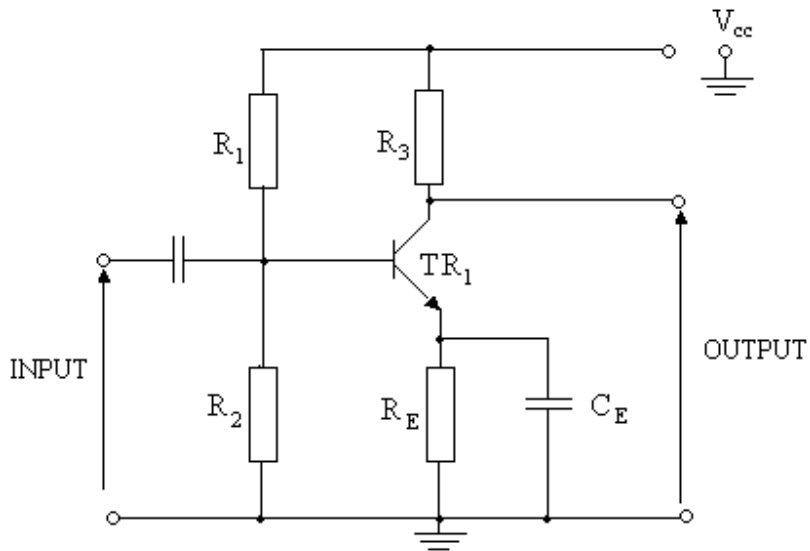


Fig 3

- 4
- (a) Show the polarity of the supply voltage V_{cc} in Fig 3. (2 marks)
 - (b) Explain how R_1 and R_2 achieve correct biasing of the circuit in Fig 3 (4 marks)
 - (d) Use arrows to show the direction of electron flow in the transistor in Fig 3. (3 marks)
 - (e) Explain why the common emitter configuration is commonly used in circuits. (3 marks)
 - (f) Draw a labelled silicon junction diode and its characteristics. Use the characteristics to explain the diode operation. (8 marks)

5.

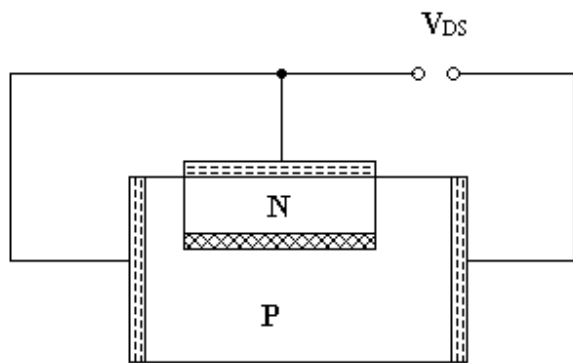


Fig 4

- (a) Label the terminals of the field effect transistor and show polarity of the supply voltage V_{DS} in Fig 4. (5 marks)
- (b) Explain the functions of the three terminals in Fig 4. (3 marks)
- (c) State what you understand by the pinch off voltage with respect to field effect transistors. (3 marks)
- (d) Draw diagrams and briefly explain the following conditions
 - (i) V_{DS} less than pinch off voltage
 - (ii) V_{DS} equal to pinch off voltage
 - (iii) V_{DS} greater than pinch off voltage (9 marks)

END OF QUESTION PAPER