BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF RNGINEERING AND PHYSICS

Bachelor of Science Honours Degree in Electronic Engineering

EEE2202: **ELECTRONIC DRIVES**

Duration: 3 hours **Total marks: 100**

INSTRUCTIONS

This paper contains seven questions each carrying 20 marks.

Answer any **FIVE** questions.

Question 1

a) (i) Highlight any two typical applications of the Schottky diode. [2]

(ii) State any two advantages of the Schottky diode. [2]

b) State the four types of transistor power losses, hence give a brief description of the losses. [8]

c) Highlight any five different turn ON methods for the Silicon controlled rectifier. [5]

d) State three advantages associated with the use of the stepper motor. [3]

Question 2

a) With the aid of a circuit diagram and supporting equations, describe the principle of operation of the Silicon Controlled Rectifier half-wave power control. [8]

b) Briefly describe how thyristor protection is achieved. [5]

c) With the aid of a circuit diagram, briefly describe the operation of the crowbar protection circuit. [7]

Question 3

a) With the aid of the Insulated-Gate Bipolar Transistor (IGBT) equivalent circuit diagram, describe its principle of operation. [8]

b) (i) State the two classes of IGBTs. [2]

c) Explain why the PT IGBTs cannot be as easily paralleled as MOSFETs, while the NPT IGBTs can be paralleled. [4]

d) Briefly describe the three basic elements of the stepper motor system. [6]

Question 4

a) (i) Describe the purpose saved by the servomotor. [2]

(ii) Hence highlight the components that constitute the servomotor. [3]

b) (i) Draw the block diagram of the servo mechanism. [5]

(ii) State the fundamental characteristics to be sought in any servo motor. [2]

c) (i) Highlight any four advantages of DC servomotor. [4]

(ii) Give any four typical applications of the DC servomotor. [4]

Question 5

a) With the aid of a tree diagram, highlight the classifications of the stepper motor. [5]

b) With the aid of a diagram/s, explain how the Linear Variable Differential Transformer (LVDT) is used to measure displacement. [5]

c) (i) Describe regenerative braking. [4]

(ii) Hence, highlight any three advantages of regenerative braking. [3]

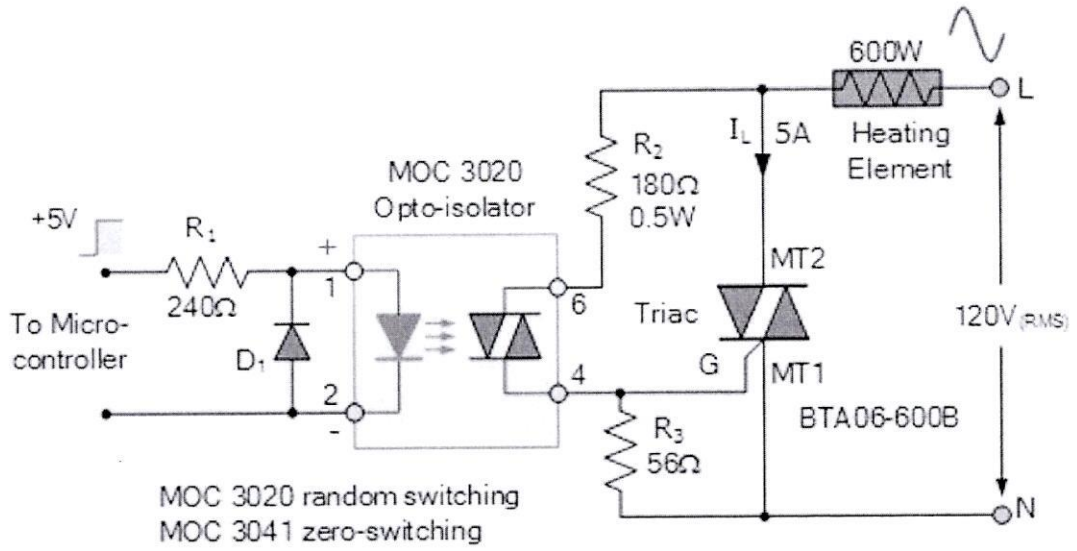
d) In power electronic systems with rectifier front-ends, describe with the aid of diagram, a means to avoid transient inrush currents at starting. [3]

Question 6

a) With the aid of a block diagram, highlight the stages for an instrumentation measuring system. [4]

b) With the aid of a circuit diagram and supporting equations, describe the operation of the stepdown converter. [7]

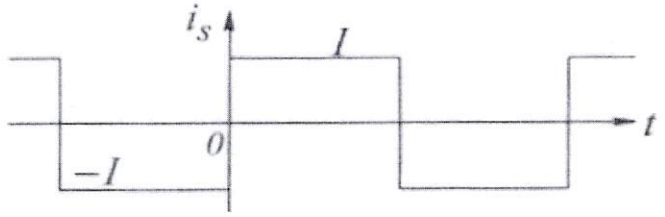
c) Describe the operation of the AC Solid State Relay Circuit below. [5]



d) A current i_s, of square waveform is shown in Figure below. Hint,

From Fourier analysis, $i_s(t)$ can be expressed as

$$i_s = \frac{4}{\pi} I(\sin \omega_1 t + \frac{1}{3}\sin 3\omega_1 t + \frac{1}{5}\sin 5\omega_1 t + \frac{1}{7}\sin 7\omega_1 t + ...)$$



(i) Calculate and plot its fundamental frequency component and its distortion component. [3]

(ii) What is the %THD associated with this waveform? [1]

The fundamental frequency component and the distortion component are plotted in Figure below.

Question 7

a) Briefly describe the, Deleterious Effects of Harmonic Distortion and a Poor Power Factor. [6]

b) With the aid of waveforms and circuit diagram, describe the principle of operation of the flyback converter. [10]

c) Describe four characteristics required for the selection of a driving motor. [4]