CEL –Power Electronics and Electromechanical Systems

T009

Wednesday, 21/11/2018

08:30 – 11:30 AM

WORKFORCE DEVELOPMENT AUTHORITY

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ADVANCED LEVEL NATIONAL EXAMINATIONS, 2018, TECHNICAL AND PROFESSIONAL STUDIES

EXAM TITLE:

POWER ELECTRONICS AND ELECTROMECHANICAL SYSTEMS

OPTION: Computer Electronics (CEL)

DURATION: 3 hours

INSTRUCTIONS:

The paper is composed of **three (3) main Sections** as follows:

Section I: Sixteen (16) compulsory questions.   **55 marks**

Section II: Attempt **any three (3)** out of five questions.   **30 marks**

Section III: Attempt **any one (1)** out of three questions.   **15 marks**

Note:

Every candidate is required to carefully comply with the above instructions. Penalty measures will be applied on their strict consideration.

Section I. Sixteen (16) Compulsory questions   55 marks

01. List the terminals of a bipolar junction transistor.   **(3 marks)**

02. If electrons had four different internal states that could be distinguished from one another, how many electrons could occupy the same level without violating the Pauli Exclusion Principle?

(2 marks)

03. Explain the main difference between SCR (Silicon controlled rectifier) and GTO (Gate Turn-off thyristor).   **(2 marks)**

04. Explain the working principle of a UPS (uninterruptible power supply).

(2 marks)

05. Label the terminals of the semiconductor symbol shown below and give its name.   **(2 marks)**
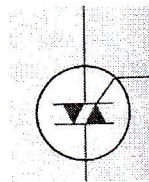

06. Differentiate between self and external commutation of the thyristor.

(4 marks)

07. A unijunction transistor (UJT) with an intrinsic standoff ratio of 0.8 is powered by a 15volt DC source. Calculate the emitter voltage needed to trigger this UJT into conductive state.   **(3 marks)**

08. What is the main application of PUT (Programmable Unijunction Transistor)?   **(3 marks)**

09. What is the difference between cyclo-converter and AC Voltage regulator?   **(4 marks)**

10. Define the following terms:

   a) Rectifier

   b) Chopper

   c) Inverter

   d) Diode   **(4 marks)**

11. What is the name of semiconductor symbol shown below:
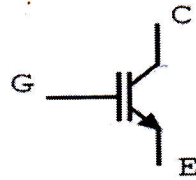
                                                                   (2 marks)

12. Draw the Darlington transistor and explain its advantage.   **(4 marks)**

13. The indication: **TI741CJ** is written on one IC. Explain it.   **(4 marks)**

14. What is the main difference between buck and boost choppers?

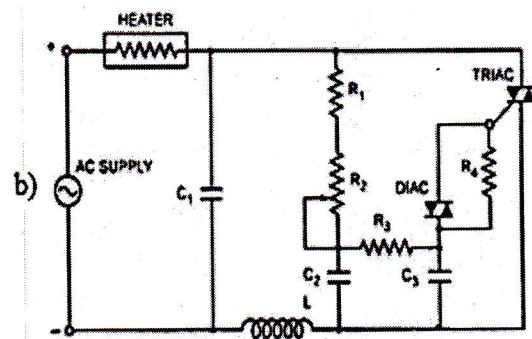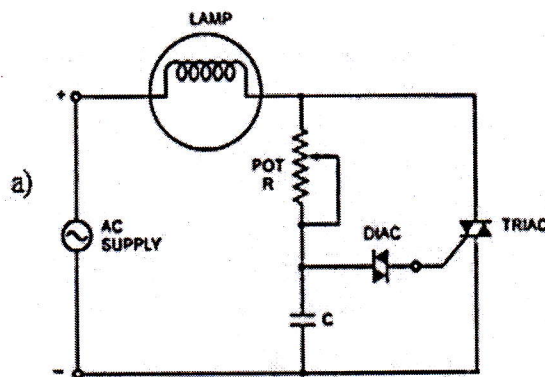   **(5 marks)**

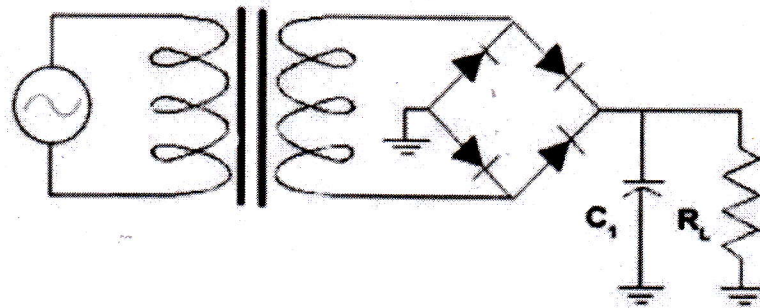**15.** Draw the symbol of a Diac and put the names of its terminals.

                                                                   (3 marks)

**16.** Name the circuits below: **(5 marks)**

17. In the circuit shown below try to plot its output wave form signal across RL and give an explanation on the role of Capacity C1 in that circuit.


(10 marks)

18. List at least five (5) feature of TRIAC device and show its circuit symbol and basic structure. **(10 marks)**

19. Briefly give the difference between the Ideal Switch and the Practical Switch for a semiconductor device operation. **(10 marks)**

20. Give the types of DC–DC Converters and also state their functions.

(10 marks)

21. Calculate the output voltage silicon control rectifier (SCR) that will be used to convert AC to DC signal if the anode supply and frequency are 230Volts and 50Hz respectively and the firing angle is adjusted to 45º.

(10 marks)

22. The circuit below shows a two-stage amplifier circuit, you are required to give the function of each component in that circuit.
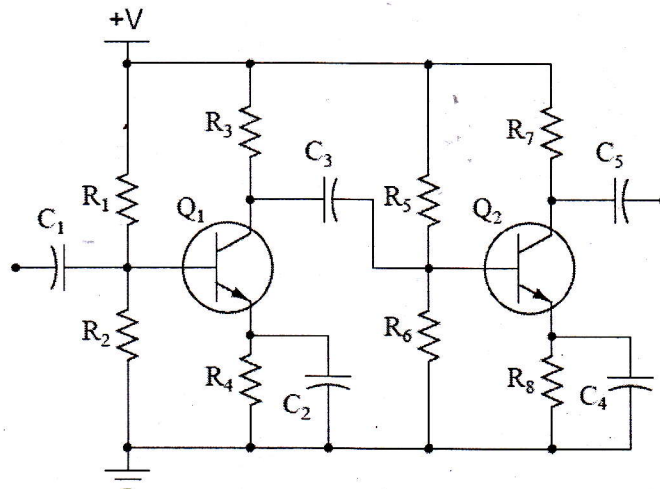
(15 marks)

23. For the half-wave rectifier circuit shown below, the source is a sinusoid of 220 V_{rms} at a frequency of 50 Hz. The load resistor is 10Ω.
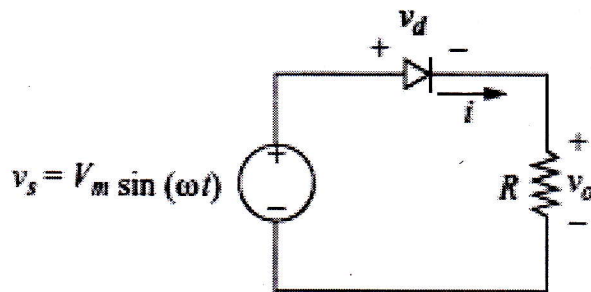
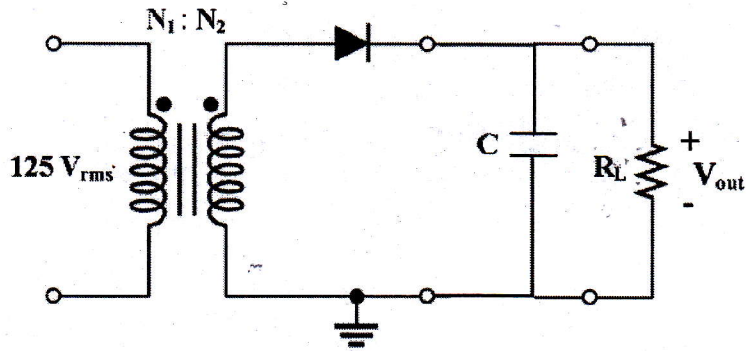**Half-wave rectifier circuit**

Determine:

      (a) The average load current,

      (b) The average power absorbed by the load and

      (c) The power factor of the circuit.

(15 marks)

24. The circuit below shows a filtered half-wave rectifier. Assume the frequency f= 60 Hz and V_{on} = 0.7 V. Given the following conditions:

(1) VDC = 15 V when RL = 1 kΩ

(2) VDC = 20 V when RL = 1.5 kΩ

Determine:

(a) Filter capacity (C)

(b) Maximum ripple voltage (Vp(rect) or VM)

(c) Turn ratio (N1: N2)