WORKFORCE DEVELOPMENT AUTHORITY

WDA

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ADVANCED LEVEL NATIONAL EXAMINATIONS, 2016, TECHNICAL AND PROFESSIONAL STUDIES

EXAM TITLE: Power Electronics

OPTION: Electronics and Telecommunication (ETL)

DURATION: 3hours

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.

01. Give the proper technical names of AC to DC, AC to AC, DC to AC, and DC to DC Converters?   **4marks**

02. How a triac can be turned on?   **2marks**

03. Explain the Silicon controlled rectifier (SCR)?   **4marks**

04. An *SCR* can only control the positive half-cycle or negative half-cycle of a.c.

True or False   **2marks**

05. An *SCR* is a controlled unidirectional switch because it can conduct only in one direction.

True or False   **2marks**

06. Referring to figure below, explain the effect of triac when switch S is thrown to position 1 or 2.   **5marks**
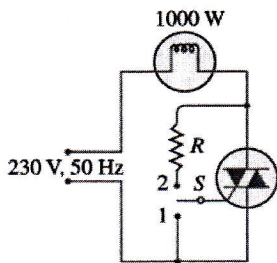

07. The data sheet of a certain UJT gives η=0.6. Determine the peak-point emitter voltage V_P if V_{BB}=20V   **3marks**

08. What are the Advantages of UJT?   **3marks**

09. Write fully and correctly the sentence by filling in the following statements:

A UJT has........................ (two pn junctions; one pn junction; three pn junctions or none of the proposed components)   **2marks**

10. A differential amplifier has an open-circuit voltage gain of 100. The input signals are 3.25 V and 3.15V. Determine the output voltage?   **3marks**

11. Determine the lower frequency limit (critical frequency) for the integrator circuit shown in the following figure.   **5marks**
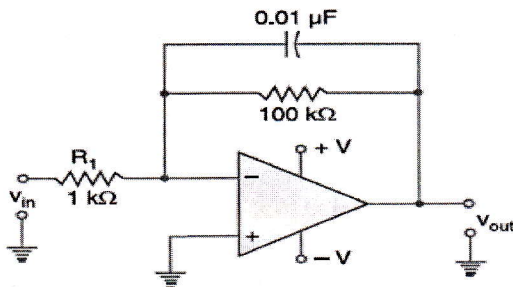
12. Why not germanium controlled rectifier?   **3marks**

13. Explain the two ways to turn on the silicon controlled rectifier?   **5marks**

14. From the figure below, name all terminals?   **6marks**

Fill out the names of corresponding terminals
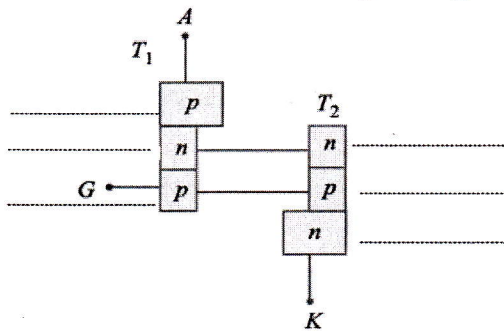
15. What is holding current in SCR? **3marks**

16. What value of capacitor is required to force commutate a thyristor with a turn-off time of 20µs with a 96V battery and a full- load current of 100A? **3marks**

Section II. Choose and answer any three (3) questions. **30marks**

17. Differentiate:

   a) Thyristor from transistor. (List out seven points)

   b) Holding current from latching current. **10marks**

18. a) Give the static characteristics of a DIAC.

   b) What are different methods used for controlling a TRIAC in normal operation? (Verify phase control and zero crossing detection)

   c) Differentiate the above stated methods.

   d) What are the mostly used quadrants of a TRIAC? Why? **10marks**

19. A collector supply voltage V_{CC}=200V, R_C=20Ω, t_{ON}=1.0µs. and t_{OFF}=1.5µs. if the switching frequency is 5KHz, find: **10marks**

   a) The turn-on energy loss

   b) The turn-off energy loss

   c) The switching power loss.

20. i) In a negative-feedback amplifier, A = 100, β= 0.04 and Vi = 50 mV.

   Find: **(a)** gain with feedback, **(b)** output voltage,

   (c) Feedback factor, **(d)** feedback voltage

   ii) What are the five (5) applications of multivibrator? **10marks**

21. List out five (5) disadvantages of load commutated chopper. **10marks**

**Section III. Choose and answer any one (1) question.** **15marks**

22. Answer to all of the following questions:

a) Draw and explain why a Snubber circuit across the thyristor is necessary.

b) In the circuit bellow, explain how the SCR is triggered and propose one of the applications of the circuit.

c) If the source E_A is replaced by an AC source, what would happen to the SCR after the DIAC turns off?

e) If the source remains the same, DC source, what would happen if the DIAC turns off?

f) What would happen if the capacitor become enables to produce a voltage greater or equal to the break over voltage of the DIAC?
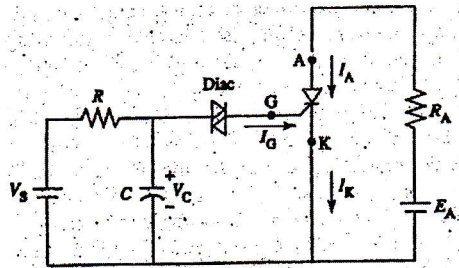
23. Below is a circuit:
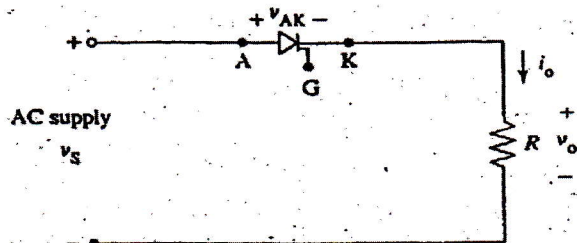
i. Name it.

ii. By the use of waveforms, draw the waveforms of the following electrical quantities across both SCR and LOAD on the same graph for the delay angle of 30^0 ($a= 30^0$).

    a) Voltage   b)Current

iii. Explain why the half wave rectifiers are not practically used.

iv. Calculate the average output voltage for Vs = 120v and R= 10k.

24. Answer to all of the following questions:

i) What are the main properties of an op- amp? (List out Three).

ii) A differential amplifier has an open-loop voltage gain of 120 and a common input signal of 3.0 V to both terminals. An output signal of 24 mV results. Calculate the common-mode gain and the CMRR.

iii) For the op amp shown in Figure below, R1= 4.7 kΩ and R2 = 10 kΩ. If the input voltage is -0.4 V,
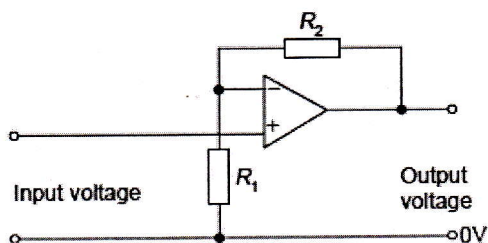
Determine:

(a) The voltage gain;

(b) The output voltage