UNIVERSITY OF NOTTINGHAM

FACULTY OF PURE SCIENCE

FIRST YEAR PART I EXAMINATION, 1966

ELECTRONICS (i)

SATURDAY *June* 4*th* 9.45 - 12-45

Answer THREE *question from Section* A

and TWO *questions f rom Section* B.

SECTION A

1. Derive from first principles an expression for the average power dissipated in a linear circuit through which a sinusoidal alternating current is flowing. Draw diagrams of the variation in current and voltage with time to show that the average power dissipation in a pure inductor and pure capacitor is zero. Explain the physical reasons for this. The voltage of a generator is 15 V r.m.s. and its internal imnpedance is (15+*j*20) ohm. What is the maximum power that can be supplied by the generator and what will be the load under this condition? Prove any formulae used.

2. What do vou understand by the term resonance as applied to alternating current circuits? What are the criteria which may be used to determine the resonant frequency of a circuit?

A parallel circuit consists of two branches, one with a resistor R_1 and inductor L in series, the other with a resistor R_2 and capacitor C in series. Find the resonant frequency of the circuit.

If $R_1 = R_2 = \sqrt{(L/C)}$ find the impedance of the circuit and comment on its form.

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3. Define carefully the terms mutual conductance g_m, dynamic resistance R_a and amplification factor μ. of a thermionic valve. Derive the relation that exists between g_m, R_a and μ and describe, in detail, experimental methods by which any two of the coefficients may be measured.

*G*ive order of magnitude values of g_m, R_a and μ for (*a*) a triode and (*b*) a pentode.

4. Explain the use of equivalent circuits to describe the operation of valves used as amplifiers. Derive the two standard circuits used in the case of triodes and obtain an expression for the stage gain *m* of a triode with a resistive anode load R_L. Illustrate graphically the variation of *m* with R_L..

What are the limitations of the equivalent circuit method in analvsing the behaviour of a valve circuit?

5. What are *p* and *n* type semiconductors? Explain, as fully as you can, the rectifying action of a *p*-*n* junction and account for the differences in the form of the characteristics of thermionic diode and *p*-*n* junction rectifiers.

6. Write short notes on FOUR of the following:

(*a*) secondary emission,

(b) cold cathode diodes,

(*c*) trigger triodes,

(*d*) transistor biassing,

(*e*) emitter stabilization,

(*f*) transistor equivalent *T*-networks.

SECTION B

7. A full wave rectifying circuit is required to provide a direct current of 500 mA to a resistive load at 12 V. The 240 V a.c. mains supply is to be used. Assuming capacitor smoothing is employed, describe the action of the circuit and the factors to be taken into account in the selection of the transformer, rectifier and capacitor.

8. How can a two-stage voltage amplifier with a bandwidth from 20 c/s to 1 Kc/s be designed if a 12 V power supply is available and *p-n-p* transistors are to be used? If the transistors have a maximum collector current of 10 mA and $\alpha = 0.98$ describe how the remaining components would be selected

9. Indicate the advantages and disadvantages of the three modes of operation, class A, class B and class C for (*a*) an amplifier and (*b*) an oscillator.

Explain how a push-pull output stage would be designed to operate under class B conditions into a low impedance load.

10. Explain the concept of a virtual earth and hence indicate how a d.c. amplifier of high gain can be used as an operational amplifier.

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