1934

Electrical Engineering (4th Year): Technical School Examinations 1934

Department of Education: Technical Instruction Branch

COURSE IN ELECTRICAL ENGINEERING.

(55.)

AN ROINN OIDEACHAIS.
(Department of Education.)

BRAINSE AN CHEÁRD-OIDEACHAIS.
(Technical Instruction Branch.)

TECHNICAL SCHOOL EXAMINATIONS.
1934.

ELECTRICAL ENGINEERING.
(Fourth Year.)

Tuesday, May 15th—7 p.m. to 10 p.m.

Examiner—PROFESSOR W. BROWN, B.SC., M.I.E.E.
Co-Examiner—J. P. HACKETT, ESQ., B.E., A.R.C.SC.I.

GENERAL INSTRUCTIONS.

You are carefully to enter on the Answer Book and Envelope supplied your Examination Number and the subject of examination, but you are not to write your name on either. No credit will be given for any Answer Book upon which your name is written, or upon which your Examination Number is not written.

You must not have with you any book, notes, or scribbling-paper.

You are not allowed to write or make any marks upon your paper of questions.

You must not, under any circumstances whatever, speak to or communicate with another candidate ; and no explanation of the subject of the examination may be asked for or given.

You must remain seated until your answer-book has been taken up, and then leave the examination-room quietly. You will not be permitted to leave before the expiration of twenty minutes from the commencement of the examination, and will not be re-admitted after having once left the room.

If you break any of these rules, or use any unfair means, you are liable to be dismissed from the examination, and your examination may be cancelled by the Department.

Three hours are allowed for this paper. Answer-books, unless previously given up, will be collected at 10 *p.m.*

INSTRUCTIONS.

Read the General Instructions on page 1.

(*a*) You are not permitted to attempt more than *seven*, questions.

(*b*) Equal values are attached to the questions.

(*c*) The use of drawing instruments and logarithmic tables is allowed.

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1. Define the terms *inductive reactance*, *capacity reactance* and *resonance*.

A circuit consists of a 10 ohm non-inductive coil, an inductance coil of 0·2 henry and negligible resistance, and a condenser of capacity 30 microfarads all joined in parallel across 200 volt mains at frequency 50.

Find (1) the current supplied to the combination, (2) the power factor of the circuit, (3) the capacity which would give current resonance.

2. Explain what is meant by the growth of current in inductive circuits.

A circuit has a resistance of 20 ohms and inductance one henry and a steady E.M.F. of 200 volts is applied. Find the value of the current one-tenth of a second after closing the circuit, given $\varepsilon^{-2}=0{\cdot}1353$.

3. A voltage wave represented by

$$40 \sin \omega t + 20 \sin 7 \omega t$$

operates over two circuits joined in parallel. One circuit consists of a condenser with capacity 1,000 microfarads, the other of an inductance of 0·004 henry. Find the current in each circuit which would be indicated on a hot-wire ammeter. [The fundamental frequency of the voltage multiplied by $2\pi = 300$].

4. Describe, with the help of a neat diagram, the construction and action of any form of oscillograph with which you are familiar.

An alternator has 20 poles and 200 slots. What harmonics would be expected to appear in its voltage wave? Give reasons ?

5. Describe, with a diagram, the main features of a choking coil with adjustable core.

A choking coil is put in series with a bank of lamps which take 100 volts and 3·2 amperes, and the combination is put on a 210 volt A.C. circuit. Find the reactance of the choking coil if its resistance is 4 ohms, and compare the efficiencies if you were to replace the choker by a resistance.

6. Show, by means of a clear diagram, the arrangement of the stationary armature coils in a star wound three phase alternator.

Such an alternator is required to develop an open circuit voltage of 2,200 volts between the lines at frequency 50. The flux per pole is 20×10^6 lines, the armature winding being distributed. Find the necessary number of armature conductors, assuming form factor=1·2, and phase factor= 0·96.

7. A three phase alternating current feeder supplies 220 k.w. of actual power at power factor 0·75, the frequency being 50, and voltage between the lines 2,000. Find the capacity which when connected to the feeder would raise the power factor to unity when the system is star connected.

8. Describe briefly, with the help of diagrams, the construction and action of a three-phase induction motor.

A 70 B.H.P. three-phase induction motor is supplied with 400 volts, the efficiency being 86 per cent, and power factor 0·83. Find (1) the line current, (2) the cost of running the motor at full load for 20 hours if the cost of energy is 1·2 pence per Board of Trade Unit.

9. Describe, giving a clear diagrammatic drawing, the essentials of a power factor meter *either* single phase *or* three-phase. Give a simple explanation of its theory of operation.

10. Three-phase alternating current at pressure 100,000 volts and frequency 50 is produced at the hydro-electric power station on the Shannon.

Give a general description of how you would, from that source, obtain in the City of Dublin, electric power (*a*) at 346 volts a.c. for motors, (*b*) at 200 volts a.c. for lamps, (*c*) at 500 volts d.c. for the Dublin tramway system, (*d*) at low d.c. voltage for electro-plating.