

1934

## Electrical Engineering (3rd Year): Technical School Examinations 1934

Department of Education: Technical Instruction Branch

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# COURSE IN ELECTRICAL ENGINEERING.

(53.)

AN ROINN OIDEACHAIS.

(Department of Education.)

BRAINSE AN CHEÁRD-OIDEACHAIS.

(Technical Instruction Branch.)

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TECHNICAL SCHOOL EXAMINATIONS.

1934.

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ELECTRICAL ENGINEERING.

(Third Year.)

*Thursday, May 24th—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.S.C.I.

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## 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 beginning 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) Not more than seven questions are to be attempted.
- (b) Equal values are attached to the questions.
- (c) Answers must be written in *ink*; diagrams may be made in *pencil*.
- (d) Write the number of the question distinctly, in the margin of your paper, before the answer.

1. Give a clear diagram of the essential parts of any commercial form of ammeter which you have used. Explain briefly how you would (1) calibrate the instrument, (2) change it so as to make it indicate *half* of its normal scale reading for a given current.

2. Describe, with the help of a clear sketch, the construction and action of an ampere-hour meter.

An ampere-hour meter has been adjusted to indicate Board of Trade Units correctly on a 200 volt circuit. It is used on a 220 volt circuit and records 860 units. What is the energy actually supplied?

3. Explain, with the help of a neat diagram, how you would measure the electrical conductivity of a piece of the transmission lines of the Shannon power scheme, as compared with pure copper of conductivity 100.

A copper bus-bar of conductivity 99 per cent. of pure copper, is 12 feet long, 3 inches wide and half-an-inch thick. Find the resistance of the bar. Given the specific resistance of pure copper =  $1.724 \times 10^{-6}$  ohms per cm. cube.

4. Give a short description of the general effects of *heat* and *moisture* on (1) insulators, (2) conductors. The electric lighting and heating systems in a dwelling house have just been finished and you are asked to report on the matter. State what instruments you would employ, and explain carefully the tests you would make on the installations.

5. State the apparatus you would use, and explain, with diagram, how you would obtain, by experiment, the permeability curve of a sample of soft iron. Find the *reluctance*.

*magnetomotive force* and the ampere-turns required to produce a flux density of 6,000 lines per sq. cm. in an iron core with a mean length of magnetic path = 50 cms. and cross-sectional area = 30 sq. cms., the permeability of the iron being 1,600.

6. Show, by means of simple diagrams, what is meant by *wave-winding* and *lap-winding* on the armature of a dynamo.

The terminal P.D. of a four pole dynamo is 550 volts, and the armature speed is 660 r.p.m. The full load armature current is 60 amperes, there is a brush contact drop of 2.5 volts at full load. If the armature resistance is 0.125 ohm, the flux per pole  $3.51 \times 10^6$  lines and the number of armature conductors 726, find whether the armature is lap or wave wound.

7. A shunt wound motor with armature resistance 0.55 ohm, is running at 580 r.p.m., and takes 18 amperes at 200 volts in addition to its field current. Find the resistance required to reduce the speed to 400 r.p.m., with no change in the armature current. In what ratio is the horse-power reduced?

8. State Kelvin's Law for the most economical cross-sectional area of a cable.

A two wire feeder cable supplies 80 k.w. at 500 volts at a place 400 yards from the power station. If the current density is 800 amperes per sq. inch and the copper wires have specific resistance 0.7 microhm per inch cube, find the voltage at the generator end of the cable and the efficiency of transmission.

9. Why are glow lamps rapidly replacing arc lamps in the lighting of streets and open spaces? Define the term *candle foot*. In order to get good light, an illumination of two candle feet should be produced on the floor of the room. How many 32 c.p. lamps would be required to produce this illumination in a room 60 ft.  $\times$  45 ft. if 65 per cent. of the emitted light falls on the floor?

10. Write a short description on what you know about the rail and over-head equipment of an electric tram system. Find the current required for a 500 volt motor which has to propel a car at the rate of 15 miles per hour, given that 340 lbs. weight propels the car at this speed, the efficiency of the motor and gear being 60 per cent.