1933

Electrical Engineering (4th Year): Technical School Examinations 1933

Department of Education: Technical Instruction Branch

COURSE IN ELECTRICAL ENGINEERING.

(55.)

AN ROINN OIDEACHAIS.
(Department of Education.)

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

TECHNICAL SCHOOL EXAMINATIONS.
1933.

ELECTRICAL ENGINEERING.
(Fourth Year.)

Friday, May 19th—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. Explain what is meant by the "capacity" current in a cable. How does it vary with (1) the length of the cable, (2) the nature of the insulation?.

An unloaded concentric cable 10 miles long is subjected to an alternating pressure of 10,000 volts at frequency 50. The capacity of the cable is 0·2 microfarad per mile, find the capacity current. How would the current be changed by putting a non-inductive load of 60 K.W. on the machine?

2. When the electric circuit of a large electro-magnet, such as the field coils of a large dynamo is completed the current does not at once rise to its maximum. Explain this.

A circuit has a resistance of 20 ohms and inductance of *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. [$\varepsilon^{-2} = 0{\cdot}1353$].

3. A voltage wave represented by

$$75 \sin \omega t + 35 \sin 7 \omega t$$

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 (1) the current in each circuit that would be indicated on a hot-wire ammeter, (2) the power supplied to the circuit.

The fundamental frequency of the voltage multiplied by $2\pi = 300$.

4. Describe with the help of clear diagrams (1) star winding, (2) mesh winding, as used in three-phase alternating current work.

The speed of a 30 pole three-phase star connected alternator is 100 r.p.m., and the magnetic flux per pole

is 5×10^6 lines. The armature has two slots per pole per phase, and each slot contains 20 conductors, all the coils per phase being joined in series. Find the terminal pressure of the machine.

5. In three-phase transformer work would you employ a three-phase transformer or three single-phase transformers properly connected? Give reasons for your answer, and state your opinion concerning the use of silicon iron for transformer cores.

A transformer having a ratio 20 : 1 takes 0·15 ampere at 2,000 volts and power factor = 0·32 on open circuit. With a full load current of 90 amperes in the short-circuited secondary coil, the primary voltage is 60 and power factor = 0·34. Find the maximum efficiency at power factor 0·8.

6. State and explain briefly the general types of work done by synchronous motors.

A three-phase synchronous motor of 120 K.W. has an efficiency of 88 per cent. and operates on a line voltage 1,000 at $\cos\theta = 1$, at a distance of 1,800 yards from the source of supply.

The power lost in transmission is 5 per cent. of the power generated. Find the weight of copper used in the lines. [Specific resistance of copper is 0.7×10^{-6} per inch cube; one cubic inch of copper = 0·32 lb.].

7. Describe, with the aid of sketches, the construction and action of a three-phase induction motor. Such a motor is direct coupled to a d.c. generator which gives 273 amperes at pressure 110 volts. The commercial efficiency of the generator is 88 per cent. The line pressure of the motor is 346 volts, and under full load conditions the commercial efficiency of the motor is 90 per cent. with power factor 0·8. Find (1) the supply line current, (2) the combined efficiency of the set.

8. Describe a rotary converter, and explain how it is used to supply direct current to a tramway system. A 10 K.W. converter has an efficiency of 90 per cent. at full load and operates at power factor 0·85; the d.c. voltage being 200 and the a.c. side operated three-phase. Find the direct current, and the a.c. line current and voltage.

9. Describe clearly with the help of diagrams, how you would measure, by means of suitable ammeters and voltmeters, the power transmitted in a three-phase circuit, when (*a*) star connected, (*b*) mesh connected, the load being non-inductive in each case.

10. A three-phase alternating current feeder supplies 220 K.W. of actual power, at power factor 0·75, the frequency being 50 and the 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 arranged star.