



1934

Applied Mechanics and Heat Engines (4th Year): Technical School Examinations 1934

Department of Education: Technical Instruction Branch

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COURSES IN MECHANICAL ENGINEERING.

(66)

AN ROINN OIDEACHAIS.

(Department of Education.)

BRAINSE AN CHEARD-OIDEACHAIS.

(Technical Instruction Branch.)

TECHNICAL SCHOOL EXAMINATIONS.

1934.

APPLIED MECHANICS AND HEAT ENGINES. (Fourth Year.)

Tuesday, May 29th—7 p.m. to 10 p.m.

Examiner—P. CORMACK, ESQ., F.R.C.S.C.I., M.R.I.A.

Co-Examiner—PEADAR A. MACCIONNAITH, M.SC., A.C.S.C.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 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.

9+2.75 *Read the General Instructions on page 1.*

(a) Seven questions only may be attempted, not more than Four being taken from either Section A or Section B.

(b) Equal values are attached to the questions.

(c) Answers must be written in ink; diagrams may be drawn in pencil.

(d) Write the number of the question distinctly in the margin of the paper before the answer.

(e) Slide-rules and drawing instruments, may be used.

(f) Abridged Callendar Steam Tables (Centigrade units) may be used.

SECTION A.

(Not more than four of the seven questions you may attempt may be taken from this section.)

1. A steel hydraulic press 13" internal diameter is 3" thick. What is the greatest tensile stress when there is a fluid pressure of 2.75 tons per sq. inch in the cylinder?

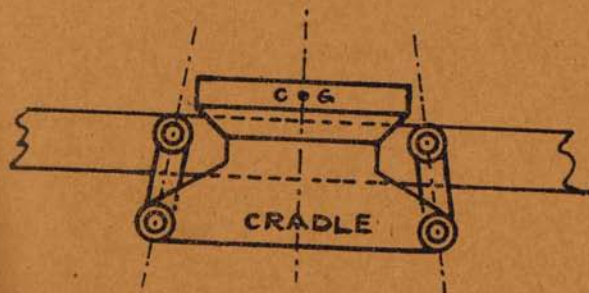
2. A coal conveyor has a lift of 80 feet. The conveyor consists of an endless chain of buckets which run over sprocket wheels 2' 6" diameter. The capacity of the conveyor is 45 tons per hour and the driving sprocket makes 5 revolutions per minute.

Find the torque on the sprocket shaft and calculate a suitable diameter.

3. A riveting machine needs 3 horsepower for its operation. A flywheel on the machine fluctuates in speed between 80 and 120 r.p.m. An operation occurs every two seconds and requires seven-eighths of all the energy supply for two seconds. Find the moment of inertia of the flywheel.

4. The weight of the reciprocating parts of a steam engine is 3 lbs. per sq. inch of the area of the piston. If the crank be 9" long and the r.p.m. 70, find how much the initial effective pressure is reduced by inertia, the obliquity of the rod being neglected.

5. The figure shows to scale the swing bolster for a four-wheel bogie truck. Bolster cradle piece carrying the load is supported from the cross frame by the swing links. The cradle load is 60,000 lbs. The cradle is deflected to the right until the swing link on the left is vertical. Find the horizontal force necessary. The centre of gravity of the load is marked c.g. on the diagram.



6. The slide valve of a double-acting steam engine is dismantled. Explain how to assemble the valve and to set it to give equal cut off on instroke and outstroke with a given lead at one end.

SECTION B.

(Not more than four of the seven questions you may attempt may be taken from this section.)

7. Show that when steam is throttled its Total Heat remains constant.

Superheated steam at 250 lbs. per sq. inch and 410° C. is throttled to 165 lbs. per sq. inch. What is its final temperature?

(Specific heat of superheated steam=0.5.)

8. A chain grate stoker is 20 feet wide and the fire is 8 inches thick. The grate speed is 6 inches per minute. Find the coal burned per hour if 1 ton occupies 40 cubic feet.

The boiler evaporation is 100,000 lbs. per hour, feed temperature 65° C., steam at stop valve 250 lbs. per sq. inch and 410° C. Find the thermal efficiency of the boiler.

(Net calorific value of coal=6,100 C.H.U. per lb.)

9. A 25,000 k.w. turbo-generator takes 9 lbs. of steam per kilowatt hour. The supply steam is at 400 lbs. per sq. inch and 426°C . The condenser pressure is 0.75 lb per sq. inch.

Find the quality of the exhaust steam.

What should be the cooling surface of the condenser tubes if the heat transmitted per sq. foot of surface be 4,200 C.H.U. per sq. foot per hour?

10. Sketch the Indicator Diagram for the Rankine Engine. In what respects does the Rankine Cycle differ from the Carnot Cycle? Show from the temperature-entropy diagram for the Rankine Cycle that its efficiency is less than $(T_2 - T_1)/T_2$ where T_2 is the boiler temperature and T_1 the condenser temperature.

11. In a compound turbine, the first stage is a two-row Curtis wheel which brings the pressure down from 250 to 45 lbs. per sq. inch. This is followed by three impulse stages and the expansion is completed by two reaction stages.

Explain the principles involved in the three types of turbine wheels in this compound turbine.

12. Discuss the economic value of increased steam pressure and of superheated steam for the different types of steam power plants.