



1933

# Machine Design (4th Year): Technical School Examinations 1933

Department of Education: Technical Instruction Branch

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# COURSES IN MECHANICAL ENGINEERING.

(65.)

AN ROINN OIDEACHAIS.  
(Department of Education.)

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

TECHNICAL SCHOOL EXAMINATIONS.  
1933.

MACHINE DESIGN.  
(Fourth Year.)

Monday, May 29th—6 p.m. to 10 p.m.

Examiner—ERNEST E. JOYNT, ESQ., M.I.MECH.E.

Co-Examiner—J. P. HACKETT, ESQ., B.E., A.R.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 are provided with a book of Mathematical Tables.

You may also use slide rules, drawing instruments, manuscript note books, and the following pocket books:—

Fowler's Mechanical Engineer's Pocket Book.

D. A. Low's Pocket Book for Mechanical Engineers.

Molesworth's Pocket Book of Engineering Formulæ.

The "Mechanical World" Pocket Book.

Machinery's Handbook.

Lett's Engineer's Diary.

"Practical Engineer" Pocket Book and Diary.

Messrs. Dorman, Long & Co's. Handbook for Constructional Engineers.

*The use of books, other than those mentioned, is prohibited.*

*Write on the first page of the answer book the names of the pocket books you have brought into the Examination.*

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.

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

#### INSTRUCTIONS.

##### Read the General Instructions.

(a) You may attempt not more than one of the first three questions (Nos. 1, 2, and 3), and not more than four of the remaining seven questions (Nos. 4 to 10).

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

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

1. Find the diameter of a shaft and design a cast iron pulley with arms of elliptical cross-section to transmit 12 H.P. at 200 revs. per minute. The diameter of the pulley is 32 inches and the angle of lap  $175^\circ$ . The co-efficient of friction is to be taken as 0.4. The belt is  $\frac{3}{16}$ -inch thick with a maximum stress of 320 lbs. per square inch. Make a working drawing of the pulley, one-quarter full-size.

[40 marks.]

2. Design a steel overhung crank with shaft end, journal and crank pin for a steam engine with cylinder 12 inches diameter, and a piston stroke of 20 inches. The steam chest pressure is 80 lbs. per square inch. Assume suitable stresses and bearing pressures. Make a dimensioned scale drawing of the design, giving full information as to the method of securing the crank pin and the allowances to be provided for the fit.

[40 marks.]

3. Design a steam stop valve six inches diameter for a pressure of 200 lbs. per square inch. The body is to be cast iron with gunmetal seating and valve. The valve body is to be 19 inches overall with flanges 12 inches diameter. The actuating screw is to work in a bridge piece supported on two pillars. Draw a longitudinal section of the design to scale, half full-size. Bolts and nuts may be omitted, but the number and diameter are to be stated. It is not necessary to show the hand wheel.

[40 marks.]

4. Determine the thickness of the shell plates and the proportions of the longitudinal riveted joint for a steam boiler seven feet diameter and a pressure of 120 lbs. per square inch. Make a dimensioned sketch of a portion of the joint.

[15 marks.]

5. A rolled steel joist 15 feet span is required to sustain a uniformly distributed load of ten tons. Calculate the bending moment and select, from a table of the properties of standard manufactured sections, a suitable joist for the purpose.

[15 marks.]

6. State the difficulties likely to arise in designing a machine-cut pinion with 15 or less teeth to engage with a straight-tooth rack. Describe with the aid of sketches how these difficulties are dealt with.

[15 marks.]

7. Determine the thickness of the material of a cast iron hydraulic cylinder nine inches internal diameter for a pressure of 800 lbs. per square inch. The safe stress is limited to 2,000 lbs. per square inch. If the cover is  $2\frac{1}{2}$  inches thick and the plunger  $6\frac{1}{2}$  inches diameter, design and sketch a suitable packing.

[15 marks.]

8. The travel of a simple slide valve is  $4\frac{1}{2}$  inches, the lap is  $1\frac{1}{8}$ -inch and the lead  $\frac{1}{8}$ -inch. Determine the angle of advance and the cut-off and show diagrammatically the relative positions of the crank and eccentric.

[15 marks.]

9. Determine the overall length, the number of full coils and the size of the square cross-sectional steel for a helical spring,  $3\frac{1}{2}$  inches mean diameter for a relief valve

three inches diameter, to open at a pressure of 100 lbs. per square inch.

[15 marks.]

10. Make sketches of a suitable wooden pattern for an iron casting of the type illustrated in the sketch, and show by a further sketch how the holes are cored in the mould.

[15 marks.]

