



1934

# Machine Construction and Design (3rd Year): Technical School Examinations 1934

Department of Education: Technical Instruction Branch

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# COURSES IN MECHANICAL ENGINEERING.

(61.)

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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MACHINE CONSTRUCTION AND DESIGN.  
(Third Year.)

*Wednesday, May 23rd—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.

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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 books, notes, or scribbling paper, except the book of logarithms supplied to you.

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 in your place 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.

*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 on page 1.

(a) You must attempt *one*, and *one only* of the first three questions (Nos. 1, 2 and 3) and you may also attempt 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.

(d) Slide rules, drawing instruments and tables may be used.

1. Design and make a sectional view of a simple screw jack with cast iron base. The screw is to be actuated by a lever, 18 inches long,  $\frac{1}{2}$ -inch diameter. The screw is to be  $1\frac{1}{2}$  inches diameter, 5 inches long, mild steel. Assuming a pull of 20 lbs. at the end of the lever, determine the pitch for a load of one ton, disregarding loss of efficiency through friction of the screw.

[52 marks.]

2. The following are the main dimensions of an eccentric sheave made in two separate parts jointed together:—Outside diameter,  $10\frac{3}{4}$  inches; breadth, 2 inches; throw, 2 inches; diameter of shaft,  $4\frac{1}{2}$  inches; diameter of boss, 6 inches; width of boss,  $2\frac{3}{4}$  inches. Design and make dimensioned drawings of the complete sheave.

[52 marks.]

3. Design and make dimensioned scale drawings of a hand lever to be keyed to a shaft  $1\frac{1}{4}$  inch diameter. The lever is to be 3 feet long to the base of the handle, and the actuating force is to be taken as 90 lbs. Assume a safe stress in the lever of 9,000 lbs. per sq. inch.

[52 marks.]

4. Show by means of a clear diagram the arrangement of either (a) the Walschaerts, or (b) the Stephenson link motion. Explain the effect on the cut-off and the lead of the valve caused by altering the position of the sliding block in the curved link.

[16 marks.]

5. Describe in proper sequence the various phases of the 4-stroke Diesel engine cycle. Illustrate these phases by a diagram such as you would expect from the use of an indicator, stating the maximum pressure developed.

[16 marks.]

6. A steam driven pump delivers water to an overhead tank. The source of supply is a pond to which the pump is connected by a cast iron pipe 100 yards long. Describe by the aid of a sketch the arrangement of a non-return valve for the end of the pipe where it enters the water.

[16 marks.]

7. Sketch the arrangement of a rope brake for an engine fly-wheel. In a brake test the fly-wheel of a steam engine was 4 feet 9 inches diameter, making 240 revolutions per minute. The dead load was 85 lbs. and the pull on the spring 15 lbs. Calculate the B.H.P. developed. If the I.H.P. was 8.9, what was the efficiency and the loss of energy in foot-lbs. per minute used in overcoming the friction of the engine?

[16 marks.]

8. A vertical donkey boiler is 2 feet 9 inches internal diameter, and 6 feet 6 inches high. Show by the aid of a diagrammatic sketch the arrangement of the shell, furnace and chimney. If the stress in the shell plates is limited to 5 tons per square inch and the efficiency of the joint is 55 per cent., find the thickness of the plates for a steam pressure of 120 lbs. per square inch.

[16 marks.]

9. The driving headstock of a lathe is provided with a coned pulley in 4 steps, 8, 7, 6 and  $5\frac{1}{4}$  inches diameter, respectively, driven by a similar cone pulley on the countershaft. It is also arranged with single-reduction gearing as follows:—wheel on lathe spindle, 50 teeth gearing with a pinion of 16 teeth on side shaft; wheels at end of cone and side shaft 44 teeth each. If the speed of the countershaft is 260 revs. per minute, calculate the highest and the lowest speed of the lathe spindle.

[16 marks.]

10. Describe with the aid of sketches, either (a) the construction of a steam trap, or (b) the arrangement and method of attachment to the boiler of any type of steam pressure gauge with which you are familiar.

[16 marks.]