

1928

Mechanical Engineering: Prospectus of Courses 1928-29

City of Dublin Vocational Education Committee

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1928-29.

inneallóireacht.

clár na scúrsaí.

sráid bóltón.

MECHANICAL ENGINEERING.

Prospectus of Courses.

BOLTON STREET.

City of Dublin Municipal Technical Schools.

BOLTON STREET TECHNICAL INSTITUTE.

SCHOOL OF MECHANICAL AND MOTOR CAR ENGINEERING.
SCHOOL OF ARCHITECTURE AND BUILDING TRADES.
SCHOOL OF BOOK PRODUCTION AND PRINTING TRADES.

KEVIN STREET TECHNICAL INSTITUTE.

SCHOOL OF ELECTRICAL ENGINEERING.
CHEMISTRY, PHYSICS, AND WIRELESS TELEGRAPHY.
ART, ART CRAFTS AND MISCELLANEOUS TRADES.
SCHOOL OF DOMESTIC SCIENCE.

PARNELL SQUARE TECHNICAL INSTITUTE.

SCHOOL OF COMMERCE.
SCHOOL OF DOMESTIC SCIENCE.

CHATHAM ROW.

MUNICIPAL SCHOOL OF MUSIC.

NOTE.—The General Prospectus of the Technical Schools is divided into eight parts, issued separately in booklet form. Each booklet is complete as regards the arrangements, Time Tables, Syllabuses, etc., of the particular Department and classes dealt with. The following is a list of the booklets :—

- No. 1. MECHANICAL AND MOTOR CAR ENGINEERING AND ALLIED TRADES.
- No. 2. ELECTRICAL ENGINEERING, WIRELESS TELEGRAPHY, PHYSICS AND CHEMISTRY.
- No. 3. ARCHITECTURE AND BUILDING TRADES.
- No. 4. BOOK PRODUCTION AND PRINTING TRADES.
- No. 5. COMMERCE.
- No. 6. DOMESTIC SCIENCE.
- No. 7. ART AND ART CRAFTS AND MISCELLANEOUS TRADES.
- No. 8. SCHOOL OF MUSIC.

Copies of any of the booklets may be had at any of the Technical Institutes, at the Public Libraries of the Corporation, or by post (2d.) from the Offices of the Technical Schools.

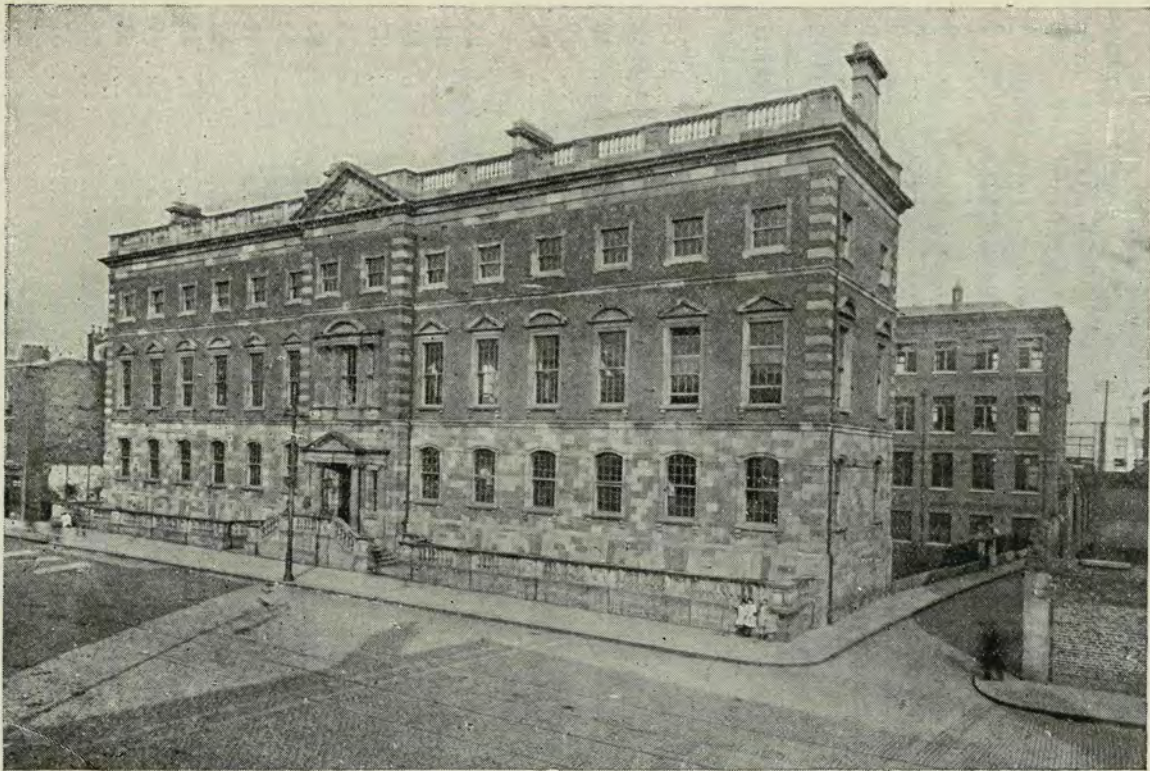
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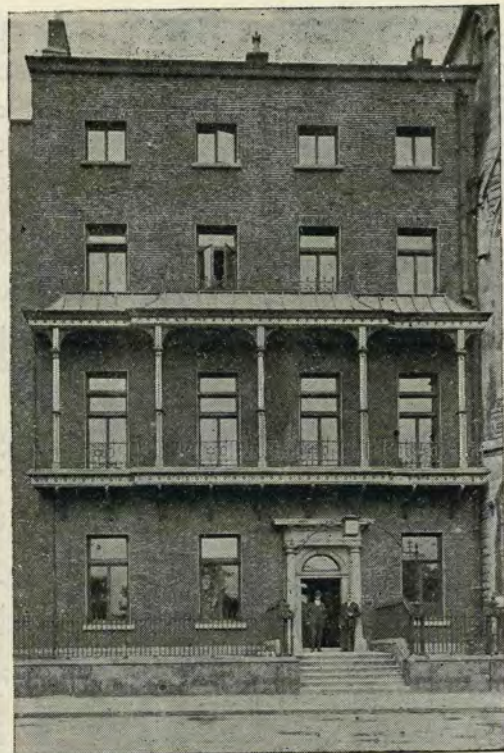


BOLTON STREET TECHNICAL INSTITUTE.

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KEVIN STREET TECHNICAL INSTITUTE.



PARNELL SQUARE TECHNICAL INSTITUTE.

Sgoileanna Ceárra agus Ealaídan,
Baile Átha Cliath.

CITY OF DUBLIN MUNICIPAL TECHNICAL SCHOOLS.



LOUIS ELY O'CARROLL, B.A., B.L.,
Principal Executive Officer.

EDWARD MORTON, A.R.C.SC.I., A.I.C.,
*Head Teacher of the School of
Physics, Electrical Engineering and
Chemistry.*

JOHN C. MACGUIGAN, B. COMM.
(N.U.I.); *Headmaster of the Parnell
Square Technical Institute, and
Head of the School of Commerce.*

WILLIAM DAVIDSON, F.B.I.C.C.,
*Head Teacher of the School of
Architecture, Building and
Furnishing Trades.*

ERNEST E. JOYNT, M.I.M.E.,
*Head Teacher of the School of
Mechanical and Motor Car
Engineering.*

WILLIAM H. JOHNSON,
*Acting Head Teacher of the School
of Book Production and Printing
Trades.*

MISS KATHLEEN O'SULLIVAN,
*Head Teacher of the School of
Domestic Science.*

W. L. WHELAN, Headmaster of Arts and Crafts.

ARTHUR DARLEY, Director, School of Music.

COUNCIL OF STUDIES.

The Council of Studies will consist of the Principal Executive Officer and the Heads of the several departments. For Examinations, representatives of the Part-time Teaching Staff, Employers' Associations and Trade Unions will be included.

All enquiries or communications should be addressed to the Principal Executive Officer, Technical Institute, Bolton Street.

SESSION 1928-29.

CALENDAR and MEMORANDA.

1928

- Mon., 3rd Sept.** Day Apprentice School resumes.
- Wed., 5th Sept.** First Term, School of Music, begins.
- Mon., 17th Sept.** Entrance Examinations and Enrolment of Students for Day and Evening Technical Classes begin.
- Mon., 24th Sept.** Instruction in all Technical Classes begins during this week.
- Thurs., 20th Dec.** Final Meeting of Classes before Christmas.

1929

- Wed., 2nd Jan.** Classes resume after Christmas.
- Mon., 14th Jan.** Second Term, School of Music, begins.
- FEBRUARY** Entries for Public Examinations are made about the end of this month. Exact dates will be notified to the Classes.
- Wed., 27th March** Final Meeting of Classes before Easter.
- Mon., 8th April** Classes resume.
- Fri., 10th May** All Evening Classes close except Special Classes preparing for Examinations.
- Sat., 11th May** School of Music closes.
- Fri., 26th July** Day Apprentice School closes.

The City of Dublin Municipal Technical Schools were founded in October, 1887, as an outcome of the Artisans' Exhibition held in the City in 1885. The Schools were originally housed in a historic but unpretentious building in Kevin Street. From the foundation, and practically without interruption, the record of progress and expansion has been continuous, and now the Schools occupy three very large Technical Institutes at Bolton Street, Kevin Street and Parnell Square, and several classes are accommodated in other buildings throughout the City, affording in all accommodation for upwards of 5,000 students.

CURRICULUM.

The present curriculum of the Schools provide complete Courses of Instruction in

Mechanical Engineering and Allied Trades.

Electrical Engineering and Allied Trades.

Radio Communication.

Motor Car Engineering.

Locomotive Engineering.

Naval Architecture.

Architecture, Building Trades and Furniture Trades.

Book Production and Printing Trades.

Applied Chemistry.

Botany, Materia Medica, and Pharmacy.

Art and Art Crafts.

Music.

Commerce.

Domestic Science

Catering Industries.

and numerous Miscellaneous Trades.

EVENING COURSES.

Evening Courses are provided in all the subjects outlined above, and enable those engaged in the day-time to acquire an intimate knowledge of the principles that underlie the processes carried out in their daily work.

DAY COURSES.

Day Courses and Classes are arranged in most of the Departments of the Schools. The DAY APPRENTICE SCHOOL provides whole-time two years' Courses in selected trades for boys who have just left school. The Day Trade Dressmaking Course provides similar training for girls, and Day School of Commerce a whole-time training to boys and girls.

Special Day Courses are provided for those actually engaged in trades—arrangements being made with employers whereby their apprentices can attend the Schools during part of several days each week. At present it has only been possible to arrange such Courses in a few cases—notably Painters and Decorators and the Printing Trades—but it is hoped, with the co-operation of the employers, to gradually extend this system to all trades.

ARRANGEMENT OF COURSES.

The Courses in all Departments, both Evening and Day, are arranged progressively to cover from two to five Sessions, according to the nature of the subject. The Courses in general include two or more subjects bearing on the main subject, and the instruction is given in such a manner as to illustrate the application of the principles of Science and Art to the daily work of the students.

ADVANCED WORK.

The Laboratories and Workshops of the Schools are very completely equipped with the best and latest apparatus and machinery, and senior students are given every facility for advanced or research work.

NEW CLASSES.

If it can be shown that there is a demand for a new class, the teacher and requisite equipment will be provided.

LECTURES.

Special lectures of a popular nature will be given during the Session.

CINEMA.

A complete cinema installation has been provided in the Technical Institute, Bolton Street, and films of an educational nature will be shown from time to time. These displays will be duly notified to students in their classes.

DEBATING SOCIETY.

Students of the Technical Schools are eligible for membership of the Debating Society. Annual subscription, one shilling.

ENTRANCE EXAMINATIONS.

In the present year Entrance Examinations will be held at the Bolton Street, Kevin Street, and Parnell Square Technical Institutes, every evening during the week commencing 17th September, and on as many evenings afterwards as may be necessary. All new Students are advised to attend at 7.0 p.m. Those who can produce the Junior or any Higher Grade Certificate of the Intermediate Education Board, or the Higher Grade Certificate of the National Board, or some equivalent Certificate, need not sit for the Entrance Examination, and should make application for admission early in the Session.

The Entrance Examination consists of easy papers in English, Arithmetic, and Elementary Drawing, and First and Second Class Passes will be awarded. Those who pass in the First Class are eligible to take any Specialised Course.

These Examinations are not obligatory for trades' students.

SPECIALISED COURSES.

The Official Specialised Technical Courses are open to all Students who pass the Entrance Examination in the First Class, or are otherwise qualified. Each one is to take up, under advice or approval, the particular Course which most nearly meets his requirements, and is to adhere to this definite programme without any subsequent variation. If he ceases to attend any component subject of this Course he is liable to forfeit his entire Ticket.

No Student may attend for more than two Sessions in any one stage of the same subject.

Teachers, Pupil Teachers, and Monitors may enter for Special Courses that suit their needs, apart from the Official Courses. Such a Course will be regarded as an Official Technical Course. The same privileges will apply to Students whose needs are not met by the Official Courses. In their case the Course Subjects must be arranged and sanctioned by the Head Teacher.

The stage of any subsidiary subject may be changed to fit the Student's particular grade of knowledge, the special evening allotted to Laboratory or other work may be altered, and a Student may be drafted from one class to an equivalent one. Any such changes must be sanctioned by the Head Teacher.

PREPARATORY COURSES.

Those who pass the Entrance Examination in the SECOND CLASS, or who have spent one year in the Sixth Standard of a National or Secondary School, may enter one of the "Introductory" Courses. Those who pass in the Third Class, or have not passed the Sixth Standard, are only at liberty to join one of the "Preliminary" Courses.

The Introductory Course Classes are of such a nature as to fit students to take up a Specialised Course of Technical Instruction in the following School Session. The subjects of instruction are:

- (a) English.
- (b) Elementary Mathematics and Arithmetic.
- (c) Drawing or Elementary Science or Elementary Domestic Economy.

The Preliminary Courses are similar to the Introductory, but of a more elementary character.

Any Trade Student who is taking an Introductory Course may attend the First Year Practical Class in his particular trade.

A class in Irish may be added to the Introductory or Preliminary Courses if desired, without extra fee.

FEES.

The fee for a full course or for a single class in Technological or Science subjects is usually 7s. 6d., Commercial or Domestic Economy subjects 10s. Special fees are: Wireless Telegraphy, £3 for Day Course; £2 for Evening Course; Day Commercial Course, £2; Motor Car Driving, £2; Practical Chemistry, 15s.; Practical Pharmacy, 15s.; Pharmaceutical Chemistry, £1 10s.; Materia Medica, 7s. 6d.; Botany, 7s. 6d.; Day Classes in Domestic Science, £1.

Holders of the Higher Grade Certificate will be admitted free on production of the Certificate.

If a student wishes to take up a class in addition to those of the Course, an extra fee must be paid except in the case of Irish.

All fees are payable in advance and cover the full Session or Term. Fees are not returnable.

GENERAL NOTICES.

The general enrolment of Students commences on Monday, 17th September, 1928.

Applicants for admission to Courses or Classes must be at least fourteen years of age.

Pupils actually in attendance at a Day National School or Day Secondary School are not eligible for admission to Evening Courses or Classes.

Teachers may be consulted on their class nights as shown in the Time Tables.

If any Student is absent from three consecutive meetings of any Class, unless for valid cause shown before the third meeting, his Ticket for the Class, or for the whole Course of which it is part, is liable to be cancelled without further warning.

The Trade classes are intended for those engaged in the several trades. Others will not be admitted before November 7th, and then only if there be room, and on payment of a quadruple fee.

A laboratory or workshop class can only be taken in conjunction with an approved lecture or drawing class. No Student will be allowed to remain in a laboratory or workshop class if his attendance at the lecture or drawing class proves unsatisfactory.

A class may be discontinued in the event of an insufficient number of Students joining or attending; and the number of evenings allotted weekly to any class may be reduced if there be a falling off in the attendance of Students. The right is reserved to close classes for any other reason whatever.

Students are to make good any damage done by them.

Strict order must be observed at all times within the precincts of the Schools.

Day Apprentice School.

The Scheme for a Day Apprentice School was adopted by the Conference on the Industrial Training of Apprentices, by the Technical Education Committee, by the Department of Agriculture and Technical Instruction, and by the Corporation of Dublin.

The object of the Scheme is to link technical education closely with industry by giving a specialised training from the outset of a boy's industrial career.

Apprenticeship Scholarships—approximately one hundred—may be awarded annually, on the results of examinations, to boys between the ages of fourteen and sixteen years. The Scholarships entitle the holders to a free training for two years in the Apprentice School, together with a payment of six shillings weekly for the first year, and eight shillings weekly for the second year; books and instruments will be supplied.

The Scholarships and Free Places are *strictly confined* to boys whose parents or guardians are resident in rate-paying houses within the boundaries either of the City of Dublin or the Urban Districts of Rathmines and Rathgar.

The course of instruction is altogether in the daytime; it covers 30 hours weekly for 46 weeks in each year; approximately one-third of the time in first year and two-thirds in the second year are devoted to a thoroughly practical and theoretical training in the trade for which the boy is preparing.

Pupils are allowed to select as far as possible the trades they desire to follow, and on the conclusion of the two years' course the Employers' and Trades Associations will allocate the boys to existing vacancies for apprentices.

An attendance of not less than eight hours weekly at the Technical School will be required during the terms of apprenticeship (*i.e.*, after the boy has left the Apprentice School).

The courses at present in operation are:—(1) *Plumbers*; (2) *Carpenters*; (3) *Printers*; (4) *Mechanical Engineering*; (5) *Electrical Engineering*; (6) *Sheet Metal Plate Work*; (7) *Cabinetmaking*; and (8) *Painting and Decorating, Brass-finishing, Motor Car Engineering, Brick-laying, Quantity Surveying*. The date and full particulars of Entrance Examinations will be duly announced in the Schools and in the Dublin Press from time to time.

Shorter Courses varying slightly from the above terms are conducted for the Catering Industry (training of Chefs, Waiters, and Waitresses).

SCHOLARSHIPS.

UNIVERSITY SCHOLARSHIPS.

The Corporation of Dublin provide Sixteen Scholarships and reserve four of these "for Students who have attended the City of Dublin Technical Schools," each of the annual value of £60, tenable for three years. Candidates must have attended the City of Dublin Technical Schools during at least one Session as a condition of eligibility for admission to the Scholarship Examination, and such candidates must have been in (*bona fide*) regular daily employment.

SPECIAL TRAINING FOR DIPLOMAS.

1. Courses of training will be instituted in the autumn session with a special view to the requirements of students preparing for admission to the recognised engineering institutions.

2. For the present the course will be confined to candidates for the Institution of Electrical Engineers and the Institution of Automobile Engineers.

3. The courses will be open to students between the ages of 17 and 25 selected on the results of an entrance examination which will be a test of general educational and of elementary technical attainments.

4. The courses may comprise both day-time and evening classes; they will be of a progressive nature covering a total period of approximately three years.

SCHOLARSHIPS.

1. The Technical Education Authority offers seven Scholarships each in Electrical Engineering and Automobile Engineering. Four of these Scholarships in each subject will be reserved for students of the Day Apprentice School; three in each subject will be open for competition to other students of the Schools or to applicants from elsewhere.

2. The award of the Scholarships will be made on the results of an examination.

3. The value of each Scholarship will be:—

1st Year	...	...	£5
2nd Year	...	...	£7
3rd Year	...	...	£10

4. The Technical Education Authority reserves the right to cancel a Scholarship in the case of faulty attendance, want of progress, indiscipline, or other unsatisfactory conduct.

Note.—For the current year the number of Scholarships in Electrical Engineering will be five, two of which will be reserved for students of the Electrical Engineering Section in the Day Apprentice School.

THE FOY SCHOLARSHIP.

A former student of the City of Dublin Municipal Technical Schools, Mr. W. P. Armstrong, has established a Scholarship in Chemistry, to be called the "Foy Scholarship." The annual value of the Scholarship is about £20, being the proceeds of an investment of £500 in Dublin Corporation Stock.

The Scholarship is awarded each session on the result of an examination in Chemistry, usually held in May. All students who have attended regularly during two sessions in the Chemistry Department are eligible to compete, and the student to whom the Scholarship is awarded must pursue his studies in the Chemistry Department during the following session.

THE DUBLIN MECHANICS' INSTITUTE SCHOLARSHIPS.

The above Scholarships are provided for by the Dublin Mechanics' Institute Residuary Fund, which has been made available for Industrial Scholarships.

Three Scholarships will be awarded annually—one in the Mechanical Engineering Group, one in the Electrical Engineering and Physics Group, and one in the Building Trades Group. The Scholarships are tenable for three years, and are value about £3 each per year.

Candidates must be engaged in an Operative Trade as Apprentices or Learners. They must be between the ages of 16 and 19, and must have attended a Technical Course during the preceding School Session and made 80 per cent. of the possible attendances in two of the subjects of the Course in which they are entered.

THE MULLIGAN SCHOLARSHIPS.

As a result of a bequest, Sixteen Scholarships of £1 each will be awarded on the results of the second year examination of the Department of Education.

DAY APPRENTICE SCHOOL SCHOLARSHIPS.

(See page 10.)

P R I Z E S .**SCHOOL PRIZES.**

First and Second Prizes are awarded in each year of each subject on the results of the Sessional Examination to Students who have obtained not less than 70 per cent. marks and have at least 60 per cent. attendance of the actual class meetings.

SPECIAL PRIZES.

Numerous prizes are offered by Employers and Trade Unions; chiefly the Dublin Building Trade Employers' Association, the Irish Quantity Surveyors' Association, the Dublin Guild of Building Workers' Union, the United Operative Plumbers' Association, Dublin Brick and Stonelayers' Trade Union, Operative Plasterers' Society, Master Drapers' Association, Armstrong Siddeley Motors, Ltd., etc.

PROGRAMME and TIME TABLE

OF THE

School of Mechanical and
Motor Car Engineering and
Allied Trades

FOR THE

SESSION 1928-29.

SCHOOL OF MECHANICAL AND MOTOR CAR ENGINEERING.

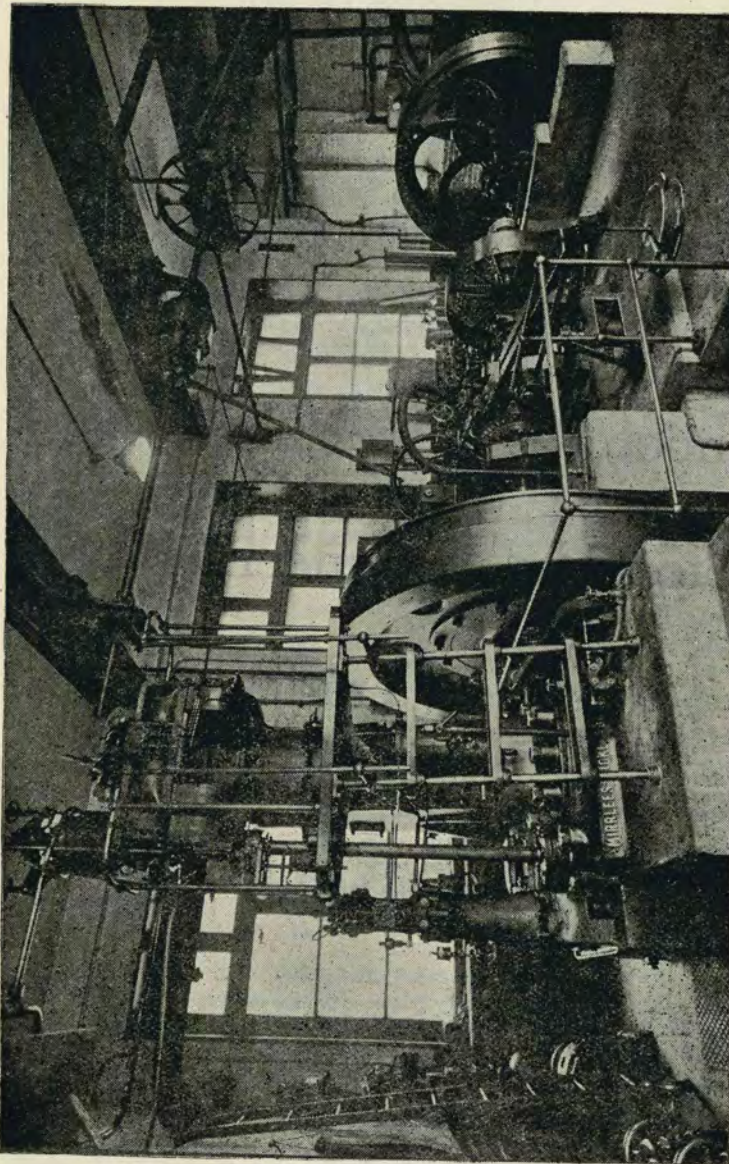
STAFF.

ERNEST E. JOYNT, M.I.MECH.E.	...	...	<i>Head of Department.</i>
A. M. MACLOUGHLIN, B.A., A.R.C.SC.I.	...	...	<i>Mechanical Engineering.</i>
W. D. PILE, A.M.I.M.E., M.I.A.E.	...	...	<i>Motor Car Engineering.</i>
H. C. CLIFTON, B.A.	...	...	<i>Mathematics.</i>
W. D. HORGAN, B.A.	...	...	<i>Physics and Chemistry.</i>
J. J. MCCORMICK, B.A.	...	...	<i>English, Irish, etc.</i>
W. L. WHELAN	...	...	<i>Design.</i>
R. BENT	...	...	<i>Engineering Workshop.</i>

PART-TIME LECTURERS AND DEMONSTRATORS.

R. J. DOWLING, A.M.I.M.E., A.M.I.C.E.I.	...	...	<i>Mechanical Engineering.</i>
P. CORMACK, F.C.SC.I., M.R.I.A.	...	...	<i>Mechanical and Motor Car Engineering.</i>
M. BURNS, B.E.	...	...	<i>Applied Mechanics, etc.</i>
J. HUMPHREYS	...	...	<i>Naval Architecture.</i>
W. J. ASH	...	...	<i>Locomotive and Mechanical Engineering.</i>
B. E. FEE	...	...	<i>Machine Drawing, etc.</i>
M. J. DOYLE, A.M.I.C.E.I.	...	...	<i>Motor Car Engineering.</i>
H. HOLOHAN	...	...	<i>Mathematics.</i>
J. KELLY	...	...	<i>Engineering Workshop Practice.</i>
A. BASSETT	...	...	<i>Engineering Workshop Practice.</i>
E. J. KENNEDY	...	...	<i>Patternmakers' Work.</i>
F. CONDRON	...	...	<i>Foundry Work.</i>
R. BRYAN	...	...	<i>Boilermakers' Work.</i>
H. W. TAYLOR	...	...	<i>Smithwork and Art Ironwork.</i>
J. W. STACK	...	...	<i>Brassfinishers' Work.</i>
M. LAWLER	...	...	<i>Brassfinishers' Work.</i>
J. DOOLEY	...	...	<i>Metal Plate Work.</i>
T. J. RYAN	...	...	<i>Oxy-Acetylene Welding, Metal Plate Work.</i>
J. NOLAN	...	...	<i>Heating Engineering.</i>
J. STUART	...	...	<i>Metal Plate Work.</i>
W. H. MEGAHEY	...	...	<i>Design.</i>
J. MCNAMEE	...	...	<i>English, etc.</i>
D. MACEOIN	...	...	<i>Irish.</i>
T. MACFIRBISIGH	...	...	<i>Irish.</i>
J. BERTIN	...	...	<i>French.</i>
L. DE CLERCQ	...	...	<i>Kinema Operator.</i>

J. MORGAN *Engine Driver (whole time).*



MECHANICAL ENGINEERING—ENGINE ROOM.

EXPLANATORY STATEMENT.

EQUIPMENT AND COURSES.

The School is equipped, and courses of study are arranged, to provide instruction in Mechanical, Marine, and Motor Car Engineering in their various grades and stages. The syllabus is designed to meet the requirements of all classes of students, from those leaving a primary school to those preparing for a university degree. The subjects will be treated on thoroughly practical lines, free from tendencies of a purely academic character.

THE MECHANICS AND HEAT LABORATORIES.

Are provided with a very complete selection of apparatus for training students in practical experimental work directly bearing on the subjects of the lectures.

THE MACHINE CONSTRUCTION AND DRAWING.

Class rooms contain a carefully considered selection of models, machine and engine details, and valves. In the higher stages this subject is dealt with in view of the requirements of present-day drawing office practice.

THE ENGINE ROOM.

Is equipped with a Marshall 8" x 12" horizontal steam engine ; a Kirke gas-fired boiler ; a 50 B.H.P. Diesel engine, connected to a Froude dynamometer ; a 10 B.H.P. National oil engine ; a 28 B.H.P. Crossley gas engine, arranged to work with either town or suction producer gas. Every provision is supplied for making indicator and brake tests, for measuring the quantity of fuel used, and for carrying out experiments in working under varying conditions.

THE HYDRAULIC PLANT

Comprises a series of turbines of the Thompson, Girard, Pelton and mixed-flow types, mounted on a concrete channel, and provided with the necessary gauges, break gear, tachometers and valves. The channel is fitted with a gun-metal weir at the end, and a measuring tank and sump are arranged to enable students to calculate the quantity of water passing through. Further hydraulic details comprise Venturi meters, apparatus for estimating the loss of head due to friction in pipe bends and in pipes of varied diameters, for experiments on the discharge of water from various orifices, and on the reaction of jets on vanes of different shapes.

THE ENGINEERING WORKSHOP

Is provided with a selection of modern lathes by the best American, German, and British makers ; a universal grinding

machine ; tool and twist-drill grinders ; drilling, slotting, planing, shaping and milling machines, with the necessary fittings and small tools.

THE FOUNDRY

Is equipped with melting furnaces for cast iron, brass and gun-metal, in addition to the necessary provision for instructing students in green and dry sand moulding and coremaking.

The other engineering and allied trades, SMITHWORK, PATTERN-MAKING, MOULDING, BRASSFINISHING, METAL PLATE WORK and OXY-ACETYLENE WELDING are dealt with in workshops fully provided with the machines and appliances necessary for teaching the principles underlying the practical work of these trades and processes.

Drawing, mathematics, mechanics, and geometry, where listed, form essential parts of the trades courses. These subjects will be taught in their direct co-relation with the practical work, and the courses of study are conceived not only with a view to the special needs of apprentices, but also to the interests of improvers and tradesmen desirous of gaining a thorough practical and theoretical knowledge of their craft.

THE MOTOR CAR ENGINEERING WORKSHOP AND GARAGE EQUIPMENT

Comprises a 14 h.p. Armstrong-Siddeley and a Ford motor car for running lessons and demonstrations ; Chevrolet, Overland, Riley and other complete chassis for lessons in assembly and repairs ; Wolseley and Ford sectioned models ; Crossley-Overland, Chevrolet, Galloway, Leyland, Ford, and Fordson tractor complete engines ; Trojan engine model ; a representative selection of gear-boxes, axle assemblies, carburettors and other important details by the best makers ; electric dynamos, ignition and lighting sets ; lathe, drilling machine, brazing hearth and vulcaniser ; complete sets of garage tools and appliances. The laboratory and lecture room equipment includes a 4-cylinder Wolseley engine for horse-power, fuel consumption, timing and tuning experiments ; flowmeter ; binaural apparatus for detecting faults by sound ; viscometer ; flash point tester ; magnetos and magneto tester ; autovac ; sectioned carburettors ; electric batteries, dynamos, instruments, etc., differential gear and other lecture models.

The above equipment is continually being added to, and arrangements are made for the temporary inspection and use of cars of various types loaned to the Schools.

NEW CLASSES AND COURSES

Are in contemplation, and a class will be added at any time in a specific subject for which there are a sufficient number of applicants.

KINEMATOGRAPH THEATRE.

At regular intervals throughout the Session the class work will be amplified by kinematograph displays of particular interest to students and others engaged in mechanical engineering and allied trades and pursuits. The dates of these displays will be set forth in a special programme, and the list of films, which is continually being added to, will comprise :

MECHANICAL ENGINEERING :

The Manufacture of Turbo-alternators.
The Manufacture of Fabroil Pinions.
"The Age of Speed."
The Manufacture of Files.
The Rolling of steel Railway Tyres.
Skefko Ball Bearings.

METALLURGY, METAL-PLATE WORK, etc.

The Manufacture of Tinplate.
Modern Forging Plant.
Electricity in an Iron Ore Mine.
Electricity in Steel Works.
Applications of Dissolved Acetylene.

MOTOR CAR ENGINEERING.

Mechanism of the Motor Car. (12-reel).
The new Ford Car.
Motor Transport.

RAILWAY AND GENERAL ENGINEERING.

"Iron Trail around the World."
The Construction of the Panama Canal.
"The Age of Oil."
Past and Present Forms of Traction.

In addition to the above, special lectures will be delivered in the Kinema Theatre by experts, as follows :

"Progress in Steel," by Mr. H. E. Kershaw, A.Met., (Technical representative of Messrs. Edgar Allen and Co., Imperial Steel Works, Sheffield.)

"Petroleum and its Products," by Mr. W. E. Gooday (Technical representative of the Vacuum Oil Co., Ltd.)

The dates of these lectures will be duly announced by notices exhibited in the various institutes.

COURSES AND TIME TABLES.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
INTRODUCTORY (ENGINEERS)—Fee, 7s. 6d. per Course.					
1 ^B	Arithmetic ...	Mon.	7.30-8.30	C1	M. Burns.
	English ...	Mon.	8.30-9.30	C1	M. Burns.
	Practical Drawing ...	Wed.	7.30-9.30	C1	B. E. Fee.
	Do. (Metal Plate Wk.)	Tues.	7.30-9.30	D5	J. Dooley.
MECHANICAL ENGINEERING COURSE—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
3 ^B	Machine Drawing—I. ...	Mon.	7.30-9.30	A5	W. J. Ash, B. E. Fee.
	Mathematics—I.B. ...	Fri.	7.30-9.30	C4	H. Holahan.
	Geometry—I. or ...	Tues.	7.30-9.30	C4	W. J. Ash.
	Workshop Practice—I.B. ...	Thurs.	7.30-9.30	D7, D9	J. Kelly, R. Bent.
SECOND YEAR.					
4 ^B	Machine Drawing—II. ...	Tues.	7.30-10.0	A5	R. J. Dowling, B. E. Fee.
	Mathematics—II. ...	Wed.	7.30-9.30	C5	H. Holahan.
	Geometry—II. ...	Fri.	7.30-10.0	A5	R. J. Dowling.
THIRD YEAR.					
5 ^B	Machine Construction—III. ...	Thurs.	7.30-10.0	A5	E. E. Joynt, B. E. Fee.
	Mathematics—III. ...	Wed.	7.30-9.30	C4	H. C. Clifton.
	Applied Mechanics—I. ...	Tues.	7.30-10.0	C6	A. M. McLoughlin.
FOURTH YEAR.					
6 ^B	Machine Construction and Design—IV. ...	Tues.	7.30-10.0	C5	E. E. Joynt.
	Mathematics—IV. ...	Mon.	7.30-9.30	C4	H. C. Clifton.
	Applied Mechanics—II. ...	Fri.	7.30-10.0	C6	A. M. McLoughlin.
	Heat Engines—I. ...	Wed.	7.30-10.0	A6	R. J. Dowling.
FIFTH YEAR.					
8 ^B	Engine and Machine Design—V. ...	Tues.	7.30-10.0	C5	E. E. Joynt.
	Mathematics—V. ...	Mon.	7.30-9.30	C4	H. C. Clifton.
	Applied Mechanics—III. or ...	Fri.	7.30-10.0	C6	A. M. McLoughlin.
	Heat Engines—II. ...	Fri.	7.30-10.0	A6, A8	P. Cormack.
SIXTH YEAR.					
9 ^B	Theory of Machines ...	Wed.	7.30-10.0	C6	P. Cormack.
	Economics of Engineering ...	Fri.	7.30-8.30	Parnell Square.	J. C. MacGuigaa.
	Physics and Chemistry ...	Tue.	7.30-9.30	A6	W. D. Horgan.
MECHANICAL ENGINEERING TRADES COURSES.					
ENGINEERING WORKSHOP PRACTICE—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
10 ^B	Fitting and Turning, Pract. I. ...	Wed.	7.30-9.30	D7 D9	J. Kelly, A. Bassett.
	Machine Drawing—I. ...	Mon.	7.30-9.30	A5	W. J. Ash, B. E. Fee.
	Mechanics and Calculations ...	Thurs.	7.30-9.30	C3	W. J. Ash.
SECOND YEAR.					
11 ^B	Fitting and Turning, Pract. II. ...	Fri.	7.30-9.30	D7, D9	J. Kelly, R. Bent.
	Machine Drawing—II. ...	Tue.	7.30-10.0	A5	R. J. Dowling, B. E. Fee.
	Mathematics—II. ...	Wed.	7.30-9.30	C5	H. Holahan.
THIRD YEAR.					
12 ^B	Fitting and Turning, Pract. III. ...	Tu., Fri.	7.30-9.30	D7, D9	J. Kelly, R. Bent.
	Machine Construction—III. ...	Thurs.	7.30-10.0	A5	E. E. Joynt, B. E. Fee.
	Mathematics—III. or ...	Wed.	7.30-9.30	C4	H. C. Clifton.
	Applied Mechanics—I. ...	Tue.	7.30-10.0	C6	A. M. McLoughlin, M. Burns.
FOURTH YEAR.					
13 ^B	Fitting and Turning, Pract. IV. ...	Tu., Fri.	7.30-9.30	D7, D9	J. Kelly, R. Bent.
	Machine Construction and Design—IV. ...	Tue.	7.30-10.0	C5	E. E. Joynt.
	or Applied Mechanics—II. or ...	Fri.	7.30-10.0	C6	A. M. McLoughlin.
	Mathematics—IV. ...	Mon.	7.30-9.30	C4	H. C. Clifton.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
PATTERNMAKING—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
14 ^B	Patternmaking—I. ...	Mon.	7.30-9.30	D4	E. J. Kennedy.
	Workshop Drawing and Calculations ...	Tues.	7.30-9.30	D4	E. J. Kennedy.
SECOND YEAR.					
15 ^B	Patternmaking—II. ...	Fri.	7.30-9.30	D4	E. J. Kennedy.
	Machine Drawing—II. ...	Tues.	7.30-10.0	A5	R. J. Dowling, B. E. Fee.
	Mechanics and Calculations ...	Thurs.	7.30-9.30	B8	W. J. Ash.
THIRD YEAR.					
16 ^B	Patternmaking—III. ...	Fri.	7.30-9.30	D4	E. J. Kennedy.
	Machine Construction—III. ...	Thurs.	7.30-10.0	A5	E. E. Joynt, B. E. Fee.
	Mathematics—III. ...	Wed.	7.30-9.30	C5	H. C. Clifton.
FOUNDRY WORK—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
18 ^B	Foundry Work—I. ...	W., Th.	7.30-9.30	D4	F. Condron.
	Workshop Drawing and Calculations ...	Tues.	7.30-9.30	D4	E. J. Kennedy.
SECOND YEAR.					
19 ^B	Foundry Work—II. ...	Thurs.	7.30-9.30	D4	F. Condron.
	Mathematics—I. ...	Fri.	7.30-9.30	C4	H. Holohan.
BRASSFINISHING—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
22 ^B	Brassfinishing, Pract.—I. ...	Fri.	7.30-9.30	D2	J. W. Stack.
	Lectures and Calculations—I. ...	Thurs.	7.30-9.30	D2	J. W. Stack.
	Machine Drawing—I. ...	Mon.	7.30-9.30	A5	W. J. Ash, B. E. Fee.
SECOND YEAR.					
23 ^B	Brassfinishing, Pract.—II. ...	Mon.	7.30-9.30	D2	J. W. Stack.
	Lectures and Calculations—II. ...	Thurs.	7.30-9.30	D2	J. W. Stack.
	Machine Drawing—II. or Design ...	Tues.	7.30-10.0	A5	R. J. Dowling, B. E. Fee.
		Tues.	7.30-9.30	C2	W. L. Whelan.
(A suitable class in Mathematics may be added.)					
BOILERMAKERS' WORK—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
26 ^B	Boilermaking—Drawing—I. ...	Thurs.	7.30-9.30	C1	R. Bryan.
	Geometry—I. ...	Tues.	7.30-9.30	C4	W. J. Ash.
SECOND YEAR.					
27 ^B	Boilermaking—Lecture and Drawing—II. ...	Tues.	7.30-9.30	C1	R. Bryan.
	Workshop Practice ...	Mon.	7.30-9.30	D9	R. Bryan.
(Students are recommended to add a suitable class in Mathematics or Geometry.)					
SMITHWORK—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
30 ^B	Smithwork, Practical—I. ...	Fri.	7.30-9.30	D9	H. W. Taylor.
	Machine Drawing—I. ...	Mon.	7.30-9.30	A5	W. J. Ash, B. E. Fee.
SECOND YEAR.					
31 ^B	Smithwork, Practical—II. ...	Fri.	7.30-9.30	D9	H. W. Taylor.
	Machine Drawing—II. ...	Tues.	7.30-10.0	A5	R. J. Dowling, B. E. Fee.
(A suitable class in Mathematics may be added.)					

No. of Course	SUBJECT	DAY	HOUR	ROOM	TEACHER
ART IRONWORK—Fee, 7s. 6d. for each Year of Course.					
34 ^B	FIRST YEAR. Art Ironwork, Practical—I. ...	Thurs.	7.30-9.30	D9	H. W. Taylor.
	Design—I. ...	...	7.30-9.30	Kevin St.	
SECOND YEAR.					
35 ^B	Art Ironwork, Practical—II. ...	Wed.	7.30-9.30	D9	H. W. Taylor.
	Design—II. ...	...	7.30-9.30	Kevin St.	
METAL PLATE WORK—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
38 ^B	Metal Plate Work, Lecture and Drawing—I. ...	Tues.	7.30-9.30	D5	J. Dooley.
	Metal Plate Work, Practical—I. ...	Thurs.	7.30-10.0	D5	J. Dooley, T. J. Ryan.
SECOND YEAR.					
39 ^B	Metal Plate Work, Lecture and Drawing—II. ...	Mon.	7.30-9.30	D5	J. Dooley.
	Metal Plate Work, Practical—II. Design ...	Wed.	7.30-10.0	D5	J. Dooley, T. J. Ryan.
		...	7.30-9.30		
THIRD YEAR.					
40 ^B	Metal Plate Work, Lecture and Drawing—III. ...	Mon.	7.30-10.0	D5	J. Dooley.
	Metal Plate Work, Pract.—III. Design—III. ...	Wed.	7.30-10.0	D5	J. Dooley, T. J. Ryan.
		...	7.30-9.30		
OXY-ACETYLENE WELDING—Fee, 7s. 6d. for Course.					
41 ^B	Oxy-Acetylene Welding, Pract.	Fri.	7.30-9.30	D5	T. J. Ryan.
HEATING ENGINEERING—Fee, 7s. 6d. for Course.					
FIRST YEAR.					
60 ^B	Heating Engineering, Lecture	Fri.	7.30-9.30	—	J. Nolan.
	Physics and Chemistry ...	Thurs.	7.30-9.30	A6	W. D. Horgan.
	Plan Drawing and Reading—I. ...	Mon.	7.30-9.30	B10	J. F. Cleary.
MOTOR CAR ENGINEERING.					
Course for Chauffeurs—Fee, 7s. 6d. for Course.					
42 ^B	Motor Car Engineering, Lecture and Demonstration—A ...	Mon.	7.30-9.30	B8	W. D. Pile.
	Motor Car Engineering, Lecture and Demonstration—B ...	Wed.	7.30-9.30	B8	—
MOTOR CAR ENGINEERING COURSE—Fee, 7s. 6d. for each Year of Course.					
FIRST YEAR.					
43 ^B	Motor Car Engineering, Lecture—I. ...	Tues.	7.30-9.30	B8	—
	Elementary Science—I. ...	Mon.	7.30-8.30	A8	W. D. Horgan.
	Elementary Mechanics—I. ...	Mon.	8.35-9.35	C6	R. J. Dowling.
	Garage Practice—I. ...	Thurs.	7.30-9.30	D8	—
SECOND YEAR.					
44 ^B	Motor Car Engineering, Lecture—II. ...	Fri.	7.30-9.30	B8	W. D. Pile.
	Mechanics—II. ...	Mon.	7.30-8.30	C6	R. J. Dowling.
	Science and Electricity—II. ...	Mon.	8.35-9.35	A8	W. D. Horgan.
	Garage Practice—II. ...	Tue.	7.30-9.30	D8	—
THIRD YEAR.					
45 ^B	Motor Car Engineering, Lecture—III. ...	Thurs.	7.30-10.0	A8	P. Cormack.
	Motor Car Electricity—III. ...	Wed.	7.30-9.0	C6	W. D. Pile.
	Motor Car Mechanics—III. ...	Wed.	9.5-10.5	C6	A. MacLoughlin.
	Garage Practice—III. ...	Fri.	7.30-9.30	D8	M. J. Doyle.
COURSE FOR MOTOR CAR SALESMEN—Fee, 7s. 6d. for Course.					
52 ^B	Motor Car Engineering, Lecture	Tue.	7.30-9.30	A8	W. D. Pile.

No. of Course	SUBJECT	DAY	HOUR	ROOM	TEA-HER
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DAYTIME COURSE FOR MOTOR CAR APPRENTICES AND IMPROVERS—Fee, 7/6 for Course.

Motor Car Electricity	...	Tue.	2.0-3.30	C6	W. D. Pile.
Motor Car Technology	...	Tue.	3.30-4.30	C6	A. MacLoughlin.
		Wed.	2.0-3.0	C6	
Motor Car Engineering	...	Tues.	4.30-6.0	C6	W. D. Pile.
		Wed.	4.30-6.0	C5	
Drawing and Sketching	...	Wed.	3.0-4.30	A5	E. E. Joynt.

MOTOR CAR DRIVING.

(Strictly confined to Students in regular attendance at the classes of either of the Motor Car Engineering Courses listed above).

Fee, £2 Os. 0d. for Course of eight Lessons.

Motor Car Driving	Sat.	2.0-5.30	—	M. J. Doyle.
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LOCOMOTIVE ENGINEERING—Fee, 7s. 6d. for each Year of Course.

51 ^B Locomotive Engineering	...	Wed.	7.30-9.30	C1	W. J. Ash.
Machine Drawing—I. or	...	Mon.	7.30-9.30	A5	W. J. Ash, B. E. Fee.
Mathematics—I.	...	Fri.	7.30-9.30	C4	H. Holohan.

NAVAL ARCHITECTURE.**Fee, 7s. 6d. for each Year of Course.****FIRST YEAR.**

47 ^B Naval Architecture, Lecture—I.	Tue.	7.30-9.30	B11	J. Humphreys.
Naval Architecture, Drawing—I.	Fri.	7.30-9.30	C5	J. Humphreys.
48 ^B Naval Architecture, Lecture—II.	Tue.	7.30-9.30	B11	J. Humphreys.
Naval Architecture, Drawing—II.	Fri.	7.30-9.30	C5	J. Humphreys.

GAS ENGINEERING.**GAS MANUFACTURE—Fee, 7s. 6d. for Course.**

53 ^B Gas Manufacture	...	Mon.	7.30-9.30	C5	—
Chemistry	...	Tue.	7.30-10.0	Kevin St.	P. B. Foy.
Mathematics—I.	...	Fri.	7.30-9.30	C4	H. Holohan.

GAS SUPPLY—Fee, 7s. 6d. for Course.

54 ^B Gas Supply	...	Thurs.	7.30-9.30	C5	—
General Physics, or	...	Mon.	7.30-10.0	Kevin St.	P. O'Callaghan.
Chemistry	...	Tue.	7.30-10.0	Kevin St.	P. B. Foy.
Mathematics—I.	...	Fri.	7.30-9.30	C4	H. Holohan.

LAND SURVEYING—Fee, 15s. for Course.

Land Surveying and Levelling	—	7.30-9.30	—	P. Cormack.
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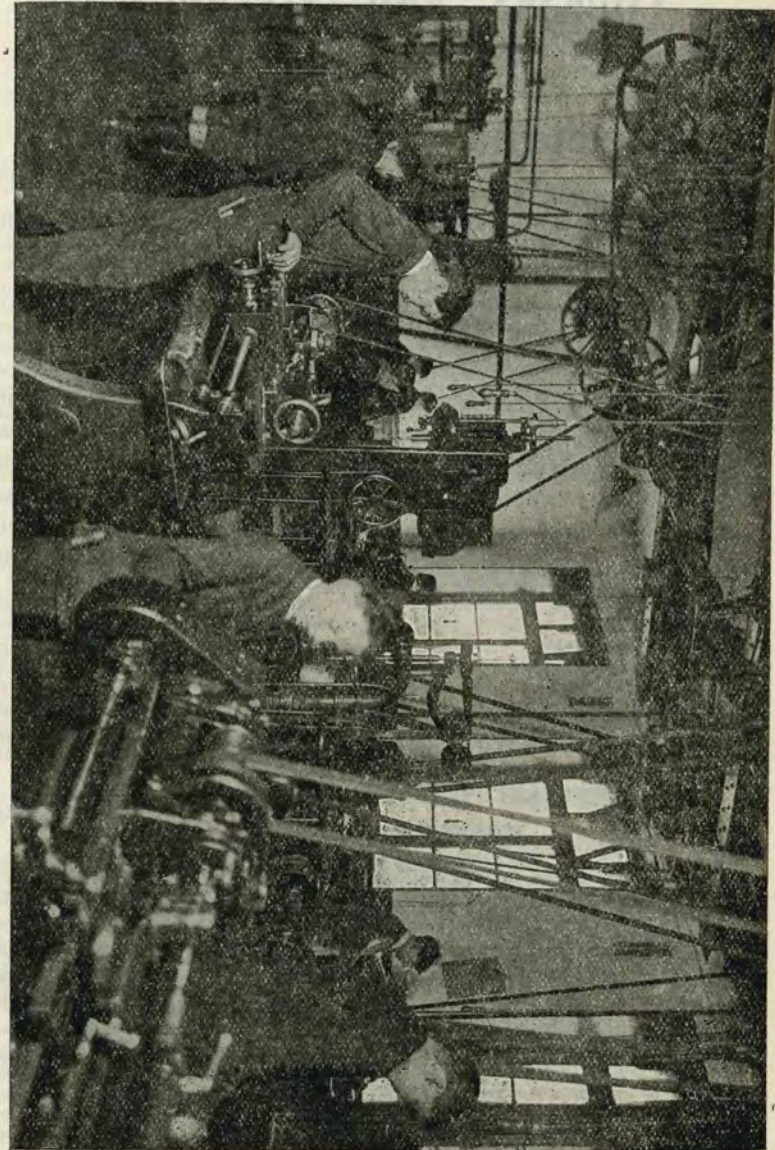
(Field Work will be arranged for Saturday afternoons.)

SPECIAL CLASSES IN IRISH.

Irish I.A.	...	Mon.	7.30-9.30	C2	D. S. MacEoin.
Irish I.B.	...	Thurs.	7.30-9.30	C2	D. S. MacEoin.

PRELIMINARY COURSE—Fee, 7s. 6d. for Course.

Arithmetic	...	Tues.	7.30-8.30	—	J. MacNamee.
English	...	Tues.	8.30-9.30	—	J. MacNamee.
Drawing	...	Wed.	7.30-9.30	—	J. MacNamee.

MECHANICAL ENGINEERING—FITTING AND TURNING.

COURSES AND SYLLABUSES.

Mechanical Engineering.

INTRODUCTORY COURSE (ENGINEERS).

Subjects :

ENGLISH.
WORKSHOP ARITHMETIC.
PRACTICAL DRAWING.

This course forms an introduction to the specialised courses in Mechanical and Motor Car Engineering and Engineering Trades. Students who attend regularly throughout the session and sit for the examination at the end will be qualified to take one of the higher courses in the succeeding session. Students are permitted to add a class in their trade subject by arrangement with the Head of the Department.

ENGLISH.

Grammar—parts of speech—punctuation—methods of note-taking and rules for essay-writing—dictation and reading exercises from technical journals—lectures on simple machines—letter and essay-writing.

WORKSHOP ARITHMETIC.

Signs and symbols—factors and powers—greatest common measure and lowest common multiple—fractions, their simplifications and conversion to decimals—decimals and the metric system—percentages—ratio and proportion—units of length—simple rules for mensuration of rectangles, parallelograms, triangles, circles, cylinders and cones—practical methods of calculating areas and volumes—units of weight and specific gravity—evaluation of simple formulae as used in engineering practice.

PRACTICAL DRAWING.

Use and care of instruments—lettering and simple geometrical exercises on lines and circles—scales—projections of solids—free-hand sketching and measurement of models—methods of making finished drawings of hexagonal and square nuts and bolts, screw-threads, rivets and riveted joints, simple bearings, shaft couplings, cranks and other simple machine details.

FIRST YEAR OF COURSE IN MECHANICAL ENGINEERING.

Subjects :

MECHANICAL DRAWING.
PRACTICAL MATHEMATICS.
WORKSHOP PRACTICE, *or*
PRACTICAL GEOMETRY.

MACHINE DRAWING.

FIRST YEAR.

Machine drawing methods and requirements as compared with those of other kinds of drawing—orthographic projection ; relation of various views to each other—proper use of drawing instruments, squares and scales—arrangement of the drawing on the paper—commencing a scale drawing—parallel lines and lines at various angles—joining curves to one another and to straight lines—application of simple geometrical principles to machine drawing—precision exercises—use of sketch book—dimensioned free-hand sketches of simple machine parts—scale drawings from dimensioned sketches of following details, etc.: simple angle brackets, simple bearings, shafts, couplings, overhung cranks, crank shafts, footstep bearing, knuckle joint, bolts and nuts, screws, and screw threads, screw jack, pedestals, piston and piston rod, connecting rod ends, crosshead, lathe tools, machine handles, simple cocks. Explanation of features of importance such as fillets, machining strips, stiffening webs, cores and pockets in castings—simple casting and forging operations involved in the manufacture of the parts.

PRACTICAL MATHEMATICS.

FIRST YEAR.

Arithmetic : Simple and compound rules—calculation of prices and costs by unitary method—decimal notation—decimals—fractions—contracted methods and approximations—weights and measures—metric system—percentages by fractional method—Square root. *Mensuration* : square, rectangle, triangle and circle—calculations of surface areas—rectangular volumes—sectional areas—applications of geometry to problems. *Algebra* : Description and use of symbols—evaluation—the four simple rules—simple equations ; their use in mensuration—transformation in formulae—factors ; their use in shortening work—elementary graphs.

ENGINEERING WORKSHOP PRACTICE.

FIRST YEAR.

Turning : Use of slide lathe in turning, boring, and surfacing—method of finding wheels required to cut screws of various pitches—cutting of screw threads, external and internal—cutting speeds for various metals—correct forms of tools—methods of chucking work ; precautions necessary to produce accurate cylindrical work. *Machine Tools* : Use of planing, shaping, slotting, and drilling machines—methods of fixing work to be operated upon by these machines—forms of the tools required and manner of grinding them—proper formation of cutting tools and their edges.

Fitting : Use of the hammer, chisel, and file in preparation of flat and other surfaces—making of keys and keyways for shafts and pulleys—use of gauges and templets in fitting work—use of file and scraper in preparation of plane surfaces, such as straight edges and surface plates—use of compasses, scribing blocks, square, etc., in marking out work preparatory to its being machined—use of stocks and dies, taps and reamers.

PRACTICAL GEOMETRY.

FIRST YEAR.

Plane Geometry : Use of instruments, squares and protractors—setting out of angles, with and without protractor—division of lines into proportional parts—construction and use of ordinary and diagonal scales—parallel, straight

and curved lines—construction of various plane figures—areas of figures and their reduction to equal squares—special properties of triangle and parallelogram and application in practice to link work—Loc. *Solid Geometry*: Objects of the subject—application to machine drawing and to practical work—isometric and oblique perspectives—orthographic projection—planes of projection—projections of the more familiar solids—sectional and extra views obtained by the use of additional planes—developments; cylinders, prisms, cone, etc.

SECOND YEAR OF COURSE IN MECHANICAL ENGINEERING.

Subjects:

MACHINE CONSTRUCTION AND DRAWING.

PRACTICAL MATHEMATICS.

PRACTICAL GEOMETRY.

MACHINE CONSTRUCTION AND DRAWING.

SECOND YEAR.

Fastenings: Bolts, studs and nuts—Whitworth screw threads—square threaded screws—cotted connections—pins—knuckle joints. *Bearings*: Simple line shaft, crank shaft, footstep, swivel and thrust bearings—pedestals, brackets, hangers, wall boxes—methods of lubrication. *Shafting*: Provision for alignment, couplings, keys and keyways. *Toothed Gearing*: Cast and machine-cut gears—proportions and shape of teeth—spur and bevel wheels—ratchet wheels—cams. *Pulleys*: Belt and rope gearing—open and crossed belts—shifting gear for countershafts. *Pipes*: Steam and water pipes—unions. *Engine Details*: Cylinders, covers, stuffing-boxes and packing—steam engine and gas engine pistons—piston rods, crossheads and slide bars—connecting rods, cranks, slide valves, eccentrics. *Boilers*: Boiler shells, gusset and longitudinal stays—rivets and riveted joints—stop valves, safety valves, cocks. *Machine Tools*: Simple details of lathes, drilling machines and shaping machines—forms of tools, drills and cutters. Detailed and assembly drawings—dimensioning—lettering, etc.

PRACTICAL MATHEMATICS.

SECOND YEAR.

Arithmetic: Contracted multiplication and division of decimals—square and cube root—ratio and variation. *Geometry and Mensuration*: Geometry of the line and circle—geometrical proportion—areas of plane figures—approximations to areas—Simpson's rules—volumes and surfaces of cone, cylinder and sphere. *Algebra and Graphs*: Fractions and partial fractions—simple and simultaneous equations—simple quadratics—indices—logarithms—use of tables—conversion of common to hyperbolic logarithms—calculations by logarithms—the slide rule. *Plotting equations*: the line, determination of mean lines—analysis of quadratic functions—solution and determination of maximum and minimum values. *Trigonometry*: Radian measurement—functions of angles less than 90 degrees—simple formulae—use of tables—solution of right-angled triangles—relation between sides and functions of angles of any triangle. *General*: mass, force, weight, velocity and acceleration—simple vectors and vector laws—centre of gravity. *Guldin's theorems*. Specific gravity, work, power, and horse-power. Forces acting on a point—resultant equilibrium—triangle and polygon of forces—couples levers.

PRACTICAL GEOMETRY.

SECOND YEAR.

Plane Geometry: Proportionals—construction of angles—trigonometrical functions of angles—circular measure of angles—scales, construction and use—location of points by rectangular co-ordinates—problems on lines and circles—construction and properties of similar figures—construction of circles from

specified data—tangents—angles in a segment—ellipse and its properties—cycloidal and involute curves—triangles, polygons and curved figures—vectors and vector quantities—problems on uniplanar forces. *Solid Geometry*: Points and lines—projections and methods of defining positions in space of points, lines and planes—horizontal and vertical traces—inclinations of lines and planes to planes of projection—views of solids in simple positions—alterations of ground line—inclined and vertical planes and plane figures—elevations, plans and sections of prisms, pyramids, the regular tetrahedron, sphere, right circular cylinder and cone—interpenetrations and developments.

THIRD YEAR OF COURSE IN MECHANICAL ENGINEERING.

Subjects:

MACHINE CONSTRUCTION AND DRAWING.

PRACTICAL MATHEMATICS.

APPLIED MECHANICS.

MACHINE CONSTRUCTION AND DRAWING.

THIRD YEAR.

Bearings: Crank shaft, dynamo and propeller shaft bearings—Michell thrust bearings—lubrication, continuous and forced—Babbit and other bearing metals—ball journal and thrust bearings—roller bearings. *Shafting*: Clutches—special couplings—universal joints. *Toothed Gearing*: Machine cut gears—involute teeth, standard proportions and contour—stub gear teeth—gear cutting methods. *Pulleys*: Size and strength of belting—angle of contact—sizing of pulleys—chain gearing. *Engines*: Slide valves—piston valves—eccentrics and eccentric rods—details of expansion and reversing gears—connecting rods for high speed and internal combustion engines—lubrication systems—crank shafts—governors—internal combustion engine details—valves, cams, spindles and pistons—manufacture and fitting of piston rings—metallic packings. *Boilers*: Various types—riveting—shell-connections—manholes—seatings—crown stays—steam valves—double-beat valves—feed valves, safety valves—blow-off cocks—locomotive regulator valves—steam and water gauges. *Hydraulic Details*: Pumps—pump valves—pipes—cylinders, accumulators—packing—hydraulic ram—ranks and tank joints—arrangement of pumping plant—supply and delivery pipes—non-return and sluice valves. *Machine Tools and Details*: Lathes—slotting, planing and milling machines—drilling machines—forms of tools, drills and milling cutters—jigs, limit gauges and measuring instruments. *Tracings*: Preparation of tracings for blue photo prints.

THIRD YEAR.

PRACTICAL MATHEMATICS.

Simultaneous equations solved algebraically and by graphs—solution of quadratic equations by method of fractions and by graph—graphical solution of equations of degree higher than the second—maximum and minimum values of quadratic and cubic expressions—logarithmic solution of equations. Application of Simpson's trapezoidal rules to determination of distance travelled by moving body—velocity gained with varying acceleration. Work done by a variable force or expanding gas. General solution of triangles—formulae for sine, cosine and tangent of sum or difference of two angles—formulae for sum or difference of sines or cosines of two angles—application of the formulae for compound angles to problems on valve displacement, etc.—formulae for the functions of $\frac{1}{2}A$ and $2A$ in terms of A . Linear graph law and the reduction thereto of other laws—graphs of the form $y=ax^n$. Trigonometrical and logarithmic functions. Slope of a curve at a point and its interpretation—rate of increase—velocity and acceleration—area of a curve and its interpretation—area of $y=\sin x$ and $y=\sin^2 x$ —the "root mean square" value of the ordinate.

APPLIED MECHANICS.**FIRST YEAR.**

Unit of force—force measured by its straining action—stretching of wires and springs—stress, strain, and elasticity. Composition, resolution, and equilibrium of forces. Moments of forces—couples—centres of gravity. Work, energy and power—diagrams of work—horse-power. Friction. Velocity ratio and efficiency of simple machines. Velocity and acceleration—uniformly accelerated rectilinear motion—force, mass, and acceleration. Elementary hydrostatics.

FOURTH YEAR OF COURSE IN MECHANICAL ENGINEERING.*Subjects :*

MACHINE CONSTRUCTION AND DESIGN.
PRACTICAL MATHEMATICS.
APPLIED MECHANICS.
HEAT ENGINES.

In addition to the subjects set forth for Machine Construction and Drawing, Third Year, problems involved in the practical design of the following will be more particularly dealt with :—

MACHINE CONSTRUCTION AND DESIGN.**FOURTH YEAR.**

Bolts and studs subjected to tensile and shearing stresses—pins and cotters. Simple bearings—journals—ball and roller bearings—thrust bearings. Shafting to withstand straining action due to torsion and bending—solid and hollow shafts—couplings, clutches and keys—knuckle joints—Hooke's coupling—levers. Boiler joints, proportions, efficiency of riveting and details of connections—strength of boiler and other cylindrical shells. Engine cylinders, flanges and covers. Toothed and belt gearing to transmit stated powers. Pistons, piston rods, crossheads, connecting rods and eccentrics—slide valves—valve gear to produce a given steam distribution. Cranks, crank pins and crank shafts. Stop valves—lever and spring loaded safety valves and cocks. Strength of materials used—stress, strain and elasticity—varying nature of straining action—factors of safety.

PRACTICAL MATHEMATICS.**FOURTH YEAR.**

Binomial expansions and approximations. Exponential and logarithmic theorems. Calculations of logarithms to the exponential base and their transformation to a decimal or other base. Tabular study, of the "rate of increase," and graphical study of the "slope of curve" of simple functions of a varying quantity, *i.e.*, powers, trigonometrical, logarithmic and exponential functions. Differentials of such simple functions; of their sum, difference of product, and of the function of a function. Successive differentiation and determination of the maximum and minimum values of a function. Integration as a process of summation, and as the inverse of differentiation. Further study of curves: conics, cycloids, trochoids, catenary. Discussion of the properties of curves from their cartesian equations. Simple harmonic motion.

APPLIED MECHANICS.**SECOND YEAR.**

Manufacture and properties of iron and steel—copper and its alloys—co-efficients of elasticity and rigidity—machines and instruments for testing the strength and elastic properties of materials—stress-strain diagrams—

effect of suddenly applied load—resilience. Resultant of a system of coplanar forces—the link polygon—forces in members of framed structures. Bending moment and shearing force diagrams—second moment of area—moment of resistance of a beam section. Friction and lubrication—Beauchamp Towers' and subsequent experiments—ball and roller bearings—efficiency of machines and overhauling—friction of ropes and belts on pulleys. Composition of velocities—relative velocities—motion in a circle—simple harmonic vibrations. Rate of change of momentum—time and space average of forces—energy of rotation—flywheels—governors. Hydraulics—total pressure and centre of pressure of immersed surface—simple pressure machines—total energy of water streams—Bernoulli's theorem—discharge through orifices and notches—pressure of jets—Pelton wheel.

HEAT ENGINES.**FIRST YEAR.**

General types of heat engines—thermometry—measurement of quantity of heat—latent and specific heat—energy in its various forms—mechanical equivalent of heat—first law of thermodynamics—properties of steam—temperature—pressure relation of saturated steam—steam tables—heat energy contained in a given weight of dry saturated steam, of wet steam and of superheated steam—determination of degree of wetness and degree of superheat. The steam engine cylinder—cylinder condensation; drainage—advantages of superheated steam—indicator and indicator diagrams—steam distribution, cut-off, release, compression and admission—mean effective pressure—clearance volume—indicated and brake horse-power—work done per cubic foot of steam—effect of back pressure—compound and multiple expansion engines—condensers—problems on the simple slide valve—valve setting. Steam engine details; piston, piston rod, packing, crosshead, slidebars, connecting rod, crank—flat and piston slide valves—drop valves—Corless valves—eccentrics—reversing gears. Production of steam—steam-boilers of various types—water tube boilers—transmission of heat from furnace to water—pounds of fuel required in practice to produce one pound of dry saturated steam—natural and forced draught—calorific value of boiler fuels—air supply required per pound of coal—products of combustion—feed water heaters—economisers—superheaters. Boiler mountings: steam valves and main supply pipes, safety valves, injectors, gauges, cocks, and vleaning arrangements. *Internal combustion engines*—the Otto cycle—gas engine indicator diagrams—calculation of horse-power, mechanical efficiency, etc.—properties and calorific values of gases and oils—gas producers—working and testing of gas, oil and Diesel engines.

FIFTH YEAR OF COURSE IN MECHANICAL ENGINEERING.*Subjects :*

ENGINE AND MACHINE DESIGN.
PRACTICAL MATHEMATICS.
APPLIED MECHANICS.
HEAT ENGINES.

ENGINE AND MACHINE DESIGN.**FIFTH YEAR.**

Shafting: Simple torque—torque combined with bending moment, torsional rigidity—hollow shafts—various types of couplings and clutches, cottred connections, suspension links, screws and screwed connections. *Riveted Joints*: Various forms, strength and efficiency—strength of boiler shells, flues and stays. *Steam Pipes*: Pipe connections—expansion joints. *Bearings*: Hangers and brackets—journals and pivots—use of anti-friction metals—lubrication—ball and roller journal and thrust

bearings—Michell thrust bearing—axle boxes. *Toothed Gearing*: Proportions of cast and machine cut gears—strength of arms, rims and bosses—involute teeth; angle of pressure, path of contact, interference, phases of action—stepped gears, double helical gears—spiral gears—bevel wheels—worm gearing. *Pulley and Belt Gearing*: Strength of belting—effective tension—design of arms, rims and bosses—splitland special pulleys. *Rope Gearing*: Grooves in pulley—horse-power transmitted—chain gearing. *Cylinders*: Thickness of barrel, flanges, covers—size and strength of bolts and studs—steam ports and passages. *Pistons and Piston Rings*—piston rods, attachment to piston and crosshead—determination of stresses in piston rods and connecting rods—design of connecting rod large and small ends—gudgeon pins—coupling rods. *Cranks*: Crank shafts and crank pins—built-up crank shafts—stresses in cranks, crank shafts and axles—flywheels. *Valves*: Slide valves, piston valves, drop valves—valve diagrams for simple and variable expansion—eccentrics, eccentric and valve rods—link motions. *Engine and Machine Frames*—main bearings for engines. Hydraulic cylinders, accumulators, pipes, pistons and plungers. *Cranes*: Design of simple wall and pillar cranes—stresses in members—use of tables in choosing suitable sections—strength of ties and pins—bearings for crane pillars—crane hooks—chains—wire ropes—crabs, gearing barrel, brake and attachments. *Steam Valves* of various types—design of casings, valve seatings, screws and covers—safety valves for given grate area of boiler—springs for safety valves—“Pop” safety valves—hydraulic stop valves. Miscellaneous engine and machine parts—hints on design—construction in the workshop—features to be observed or avoided—economy of manufacture—facility of machining and erecting—drawing office practice. Choice of materials—special steels and non-ferrous alloys—heat treatment of steels, case-hardening—specifications for engineering materials—inspection and tests.

PRACTICAL MATHEMATICS.

FIFTH YEAR.

Definite integrals. Applications of the calculus, and of approximate methods, to the determination of centres of gravity—surfaces and volumes of solids of revolution (Guldinus' Theorems)—moments of inertia—bending moments and deflection of beams—energy of a rotating mass—centre of pressure, etc. Integration by partial fractions and integration by parts—Fourier series—harmonic analysis. Important differential equations. Applications to beams and struts, to the pendulum, to simple and damped vibrations. Symbolic use of $\sqrt{-1}$ in connection with rotating vectors, and in the solution of differential equations.

APPLIED MECHANICS.

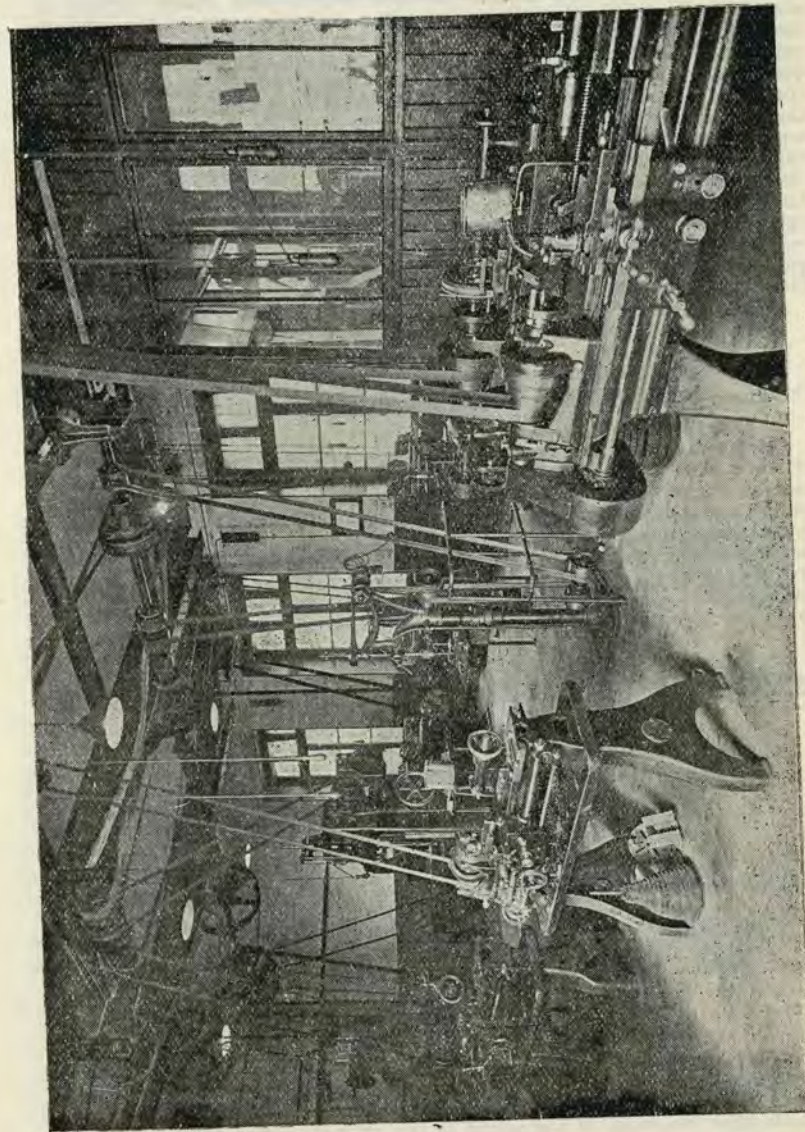
THIRD YEAR.

Strength of materials—types of testing machines—impact and hardness tests—effect of form of test piece on ultimate strength—repetition and reversal of loads—principal stresses. Strength and deflection of beams. Columns and struts. Euler, Rankine and other formulae. Strength and stiffness of shafts—combined twisting and bending. Working loads—travelling loads. Link mechanisms—piston velocity and acceleration—correction of indicator diagram for inertia of reciprocating parts—crank-effort diagrams—flywheels. Governors. Balancing of engines. Friction of bearings—lubrication—qualities and testing of lubricants. Hydraulics—flow in pipes—Venturi and other meters—effect of sudden contractions and bends—impulse and reaction turbines—centrifugal pumps and other hydraulic machines.

HEAT ENGINES.

SECOND YEAR.

Laws of thermodynamics and application to engineering problems—the working substance in a heat engine—physical properties of gases—Carnot's cycle of operations—efficiency of engine working on cycle—reversible engine—



MECHANICAL ENGINEERING WORKSHOP—MACHINE SHOP.

Carnot's principle—properties of saturated and superheated vapours—steam tables—wet steam—the dryness fraction—superheated steam—drying of steam by throttling—throttling calorimeter—entropy—entropy-temperature diagrams—the Carnot cycle, with steam for working substance—the steam engine and Rankine cycle—typical actual diagram—condensation and re- evaporation—wetness of the working steam—thermodynamic loss due to initial condensation—action of steam-jacket, superheating, compounding, drainage. Compound steam-engines—highspeed steam-engines. Condensers and auxiliaries—cooling towers. Flow of steam through orifices and nozzles— calculation of steam velocity—steam velocity from Mollier diagram—the impulse-turbine—the impulse and reaction-turbine—types of turbines: de Laval, Rateau Curtis, and Parsons. Internal-combustion engines—the Otto cycle—ideal cycles—air-standard cycle—typical internal-combustion engines—gas engine—oil engine—petrol motor—Diesel motor engine fuels—ignition, governing, lubrication—cylinder cooling—distribution of calorific value of fuel—power output and characteristic curves of various engines.

The Course is illustrated throughout by experimental work in the Heat Engineering Laboratories. The practical work includes:—

Determinations of the dynamical equivalent of heat—thermal properties of water and steam—measurement of wetness of steam—calorific value of peat, coal, petrol, alcohol, coal-gas—calibration of pressure and vacuum gauges, and indicator springs—use of indicators and recorders—use of friction-brakes of various types—the Froude water-brake—measurement of the mechanical efficiency of engines—power output of gas, oil, petrol and Diesel engines—torque and horse-power tests—fuel consumption tests—exhaust gas analysis—effect of fuel-air ratio on composition of exhaust gases, on mean effective pressure and on efficiency—power and economy tests.

SIXTH YEAR OF COURSE IN MECHANICAL ENGINEERING.

Subjects :

THEORY OF MACHINES.

ECONOMICS OF ENGINEERING.

PHYSICS AND CHEMISTRY.

This Course is arranged to suit the requirements of students who have completed five years of the Mechanical Engineering Course and are desirous of qualifying for entrance to the Institution of Mechanical Engineers or of otherwise extending their studies.

THEORY OF MACHINES.

Lower and higher pairing. Kinematic chains. Skew mechanism such as Hooke's joint. Methods of determining the relative velocity of different parts in a machine, by calculation and by graphic methods. Velocity and acceleration diagrams of the piston in the ordinary steam-engine. Theory of the teeth of wheels. Wheels in trains. Application of wheel trains in screw-cutting machinery and change-speed gearing for machine-tools. Ratchet mechanism. Theory of cams. Self-feeding for machine tools. Return motions. Method of effecting different velocity ratio with belts. Anti-friction devices of various kinds.

ECONOMICS OF ENGINEERING.

Simple economic terms and principles; Wealth, national and private; Capital; income; profit; value; price. General laws of supply and demand and their effect on prices. Theory of money; coinage. Foreign Exchanges: causes and effects of normal variations. Banking: general principles, chief operations and terms used. Fluctuations and cycles in trade and credit. National and Local Taxation: general principles in relation to premises, equipment, and finance of an engineering business. Division of labour. General history of trade unions. Purposes of Employers' Associations. Present-day activities in Mechanical Engineering Associations. Joint Stock Companies: their various kinds of capital obligations and liabilities. Method of marketing and advertisement: exhibitions. Forms of insurance. Outline of early manufacturing industries; reasons for lack of development: effect of making of roads, bridges, canals, railways, etc. Growth of factory system: history of difficulties encountered; reasons for industries being established in localities. Work of early pioneers in mechanical engineering. Natural resources of supply of raw materials for engineering; natural resources of the home country; association of these resources with specific manufactures. Relations of industries with each other. Growth of towns and decline of rural industries consequent on factory system.

PHYSICS AND CHEMISTRY.

Properties of mirrors and lenses. Simple telescopes and microscopes. Photometry. Properties of magnets. Magnetic fields. The earth's magnetism. The Compass. Properties and measurement of electric currents. Production of electric currents by voltaic and storage cells and by motion of conductors in magnetic fields. Force acting on a conductor carrying current in a magnetic field. Magnetization of iron. The properties of electrostatic charges. Sound and its propagation.

Chemistry.—Elements; compounds, laws of chemical combination.

Gas laws. Changes in volume accompanying reactions between gases.

The non-metallic elements, their occurrence, properties and chief compounds. Attention will be paid more particularly to (A elements) hydrogen, oxygen, nitrogen, carbon, chlorine, sulphur and silicon; (B compounds) water (soft and hard water), ammonia, nitric acid, the oxides of carbon, methane and the paraffins, ethylene, acetylene, hydrochloric acid, the oxides of sulphur, sulphuric acid and silica.

Energy changes involved in chemical combination; combustion.

General properties of the metals. Copper, zinc, aluminium, tin, lead and iron, their oxides and principal alloys. Behaviour of metals specified towards oxygen, steam, commoner acids and sulphur.

The theory of electrolysis and the chemistry of primary and secondary batteries. Principles governing applications of electrical methods in preparation of metals and commoner inorganic materials.

MECHANICAL ENGINEERING TRADES.

FIRST YEAR OF COURSE IN ENGINEERING WORKSHOP PRACTICE.

Subjects :

FITTING AND TURNING.
MACHINE DRAWING.
MECHANICS AND CALCULATIONS.

The Course in practical work in this subject is designed to meet the requirements of apprentices, young journeymen and improvers.

FITTING AND TURNING.

FIRST YEAR.

Measuring appliances : Use of calipers, micrometer and vernier—standard plug, taper and screw gauges—limit gauges—allowances for running, driving and shrinking fits. *Marking off and Machine work :* Marking off and setting up of work for machining—operations in the planing, shaping, slotting and milling machines—drilling, tapping and screwing—making of tools and cutters for use on various metals—use of reamers and broaches. *Lathe work :* Turning, boring and facing—tapered work—screw-cutting of external and internal single and multiple threads. *Fitting :* Making of gauges, templates, keys and feathers.

All work will be done to drawings prepared in connection with the classes in Machine Construction and Design. Patterns and castings made in the Institute will be utilised as far as possible.

MECHANICS AND CALCULATIONS.

FIRST YEAR.

The rule and its sub-divisions—fractional and decimal notation—measuring instruments—calipers—vernier—micrometer. Limit gauges—setting out angles and bevels. Machine tools ; operation of planing, shaping, slotting, drilling and milling machines—tools and their cutting angles—correct shape of twist drills—milling cutters. Hobbing and broaching operations. Screw thread, single and multiple—cutting screws in the lathe—change wheels. Wedges, cotters, cams. Grinding machines and operations. Force—work—power—horse-power transmitted by belting and toothed gearing. Engineering materials—properties and uses—strength. Heat treatment of metals—hardening—tempering—annealing—case-hardening.

MACHINE DRAWING.

FIRST YEAR.

See Syllabus under First Year of Course in Mechanical Engineering.

SECOND YEAR OF COURSE IN ENGINEERING WORKSHOP PRACTICE.

Subjects :

FITTING AND TURNING.
MACHINE DRAWING.
MATHEMATICS.

FITTING AND TURNING.

SECOND YEAR.

Lathe Work : Advanced exercises in screw-cutting—turning cranks and crankshafts, bushes, pistons, engine and general machine details. *Machine Work :* Machining operations on engine and machine details—milling straight and contour work—use of dividing head in cutting ratchets and gear teeth. Drilling machine methods and operations—simple exercises in grinding. *Fitting :* Angle and bevel gauges—squares, calipers, and other bench tools, etc. Fitting and assembling of machine parts. Simple exercises in hardening, tempering and annealing of tools, pins, bushes, etc.

MACHINE DRAWING.

SECOND YEAR.

See Syllabus under Second Year of Course in Mechanical Engineering.

MATHEMATICS.

SECOND YEAR.

See Syllabus under Second Year of Course in Mechanical Engineering.

THIRD YEAR OF COURSE IN ENGINEERING WORKSHOP PRACTICE.

Subjects :

FITTING AND TURNING.
MACHINE CONSTRUCTION.
MATHEMATICS.
APPLIED MECHANICS.

FITTING AND TURNING.

THIRD YEAR.

In addition to more advanced work on Syllabus under Second Year of Course the following will be particularly dealt with :

Lathe Work : Advanced exercises in turning, boring and screw-cutting on engine details involving precision and accurate finish to fine limits. *Grinding :* Various operations on the universal grinding machine. *Machine Work :* Operations on engine cylinders and frames, pumps, special machines, etc. Milling operations—connecting rods, links, knuckle joints, cutting of involute gear wheel teeth, etc. *Fitting :* Assembly of engines and machines. Steam engine repairs, disassembly and reassembly of motion and of boiler mountings, slide valve setting.

MACHINE CONSTRUCTION.

See Syllabus under Third Year of Course in Mechanical Engineering.

MATHEMATICS.

See Syllabus under Third Year of Course in Mechanical Engineering.

APPLIED MECHANICS.

THIRD YEAR.

See Syllabus under Third Year of Course in Mechanical Engineering.

FOURTH YEAR OF COURSE IN ENGINEERING WORKSHOP PRACTICE.

Subjects :

FITTING AND TURNING.
MACHINE CONSTRUCTION AND DESIGN.
APPLIED MECHANICS.
MATHEMATICS.

FITTING AND TURNING.

FOURTH YEAR.

Advanced work on Syllabus under Third Year of Course. Particular attention will be given to the use of modern measuring instruments; gauging systems; the production of accurate plane surfaces; turning of tapered work; special grinding operations; case-hardening and the heat-treatment of metals.

MACHINE CONSTRUCTION AND DESIGN.

FOURTH YEAR.

See Syllabus under Fourth Year of Course in Mechanical Engineering.

APPLIED MECHANICS.

FOURTH YEAR.

See Syllabus under Fourth Year of Course in Mechanical Engineering.

MATHEMATICS.

FOURTH YEAR.

See Syllabus under Fourth Year of Course in Mechanical Engineering.

FIRST YEAR OF COURSE IN PATTERNMAKING.

Subjects :

PATTERNMAKING.
WORKSHOP DRAWING AND CALCULATIONS.

PATTERNMAKING.

FIRST YEAR.

Timbers used: selection, defects, knots, shakes, warping, shrinkage, etc.—patternmaking tools and appliances—contraction, double contraction, and use of contraction rule—operation of wood turning lathe—securing of work to be operated on—construction of simple patterns to drawings—flanges, plain brackets, simple bearings—cores and core prints of various kinds—coreboxes—simple engine details—overhung and disc cranks—glands—eccentric sheaves—bearing brasses—valves and cocks.

WORKSHOP DRAWING AND CALCULATIONS.

FIRST YEAR.

Orthographic projection—plan, front elevation, end views—sectional views—drawings of simple castings; bearings, pedestals, brackets, hangers, wall boxes, moulding boxes, tank plates, pipes—cored work; valves, cocks, hollow castings, bushes and brasses. Engine parts—simple cylinder and steam chest—piston—eccentric—flywheel—frame—main bearings. Spur wheels and pinions—laying out bevel wheels—pitch, pitch diameter—tooth proportions. The correct reading of drawings and blue prints of simple and complex castings—calculations for patternmakers and moulders.

SECOND YEAR OF COURSE IN PATTERNMAKING.

Subjects :

PATTERNMAKING.
MACHINE DRAWING.
MECHANICS AND CALCULATIONS.

PATTERNMAKING.

SECOND YEAR.

Patterns of more advanced types—strickers—built up patterns, pulleys, frames, pedestals, columns, wall brackets, hangers—spur and bevel gearing—proportions, marking off and formation of teeth. Lathe and other machine tool details; chucks, vices, tool-holders, headstocks. Pipes, pipe bends and flanges—hydraulic details—stop and safety valves, cocks, pistons.

MACHINE DRAWING.

SECOND YEAR.

See Syllabus under Second Year of Course in Mechanical Engineering.

WORKSHOP MECHANICS AND CALCULATIONS.

SECOND YEAR.

See Syllabus under First Year of Course in Engineering Workshop Practice.

THIRD YEAR OF COURSE IN PATTERNMAKING.

Subjects :

PATTERNMAKING.
MACHINE CONSTRUCTION.
MATHEMATICS.

PATTERNMAKING.

THIRD YEAR.

In addition to advanced work on Syllabus under Second Year of Course, the following will be dealt with:—Cylinders for engines and pumps—coring of ports, passages, chambers, pockets and recesses—allowances for machining. Screw Propellers—development, lay-out, and formation of blade. Patterns for thin and ornamental castings in iron and brass.

MACHINE CONSTRUCTION.

THIRD YEAR.

See Syllabus under Third Year of Course in Mechanical Engineering.

MATHEMATICS.

THIRD YEAR.

See Syllabus under Third Year of Course in Mechanical Engineering.

FIRST YEAR OF COURSE IN FOUNDRY WORK.

Subjects :

FOUNDRY WORK.
TECHNICAL DRAWING AND CALCULATIONS.

FOUNDRY WORK.

FIRST YEAR.

Lectures : Materials used—varieties of sand, loam and graphite—manufacture, characteristics and properties of cast iron—mixing and properties of brasses, bronzes and other non-ferrous alloys. Aluminium, its properties and peculiarities. Arrangement, charging and firing of crucible furnaces—cupolas—arrangement of blast, charging, tapping, removal of impurities, etc., qualities of foundry coke—foundry tools and appliances—moulding in sand and loam—venting—coret, simple and built up—stickle work—moulding cylinders and intricate castings—chilled castings—moulding flat plates for thin and ornamental castings.

Practical Work: Moulding from simple patterns: flanges, glands, crank webs, faceplates, toothed pinions, etc.—valves, cocks and unions—cylinder covers, eccentrics, pistons and light engine details—moulding and coring a steam engine cylinder—castings in brass, gun-metal and aluminium.

Special attention will be given to preparation and consistency of the sand, venting of the moulds, securing of the moulding boxes, use of headers, precautions to be observed in pouring and other important features of foundry practice.

WORKSHOP DRAWING AND CALCULATIONS.

FIRST YEAR.

See Syllabus under First Year of Course in Patternmaking.

SECOND YEAR OF COURSE IN FOUNDRY WORK.

Subjects:

FOUNDRY WORK.

MATHEMATICS.

FOUNDRY WORK.

SECOND YEAR.

More advanced work in Syllabus given under First Year of Course.

MATHEMATICS.

SECOND YEAR.

See Syllabus under Second Year of Course in Mechanical Engineering.

FIRST YEAR OF COURSE IN BOILERMAKERS' WORK.

Subjects:

BOILERMAKING (LECTURE AND DRAWING).

GEOMETRY.

BOILERMAKERS' WORK.

FIRST YEAR.

Lectures: Elementary details of boiler construction—riveted joints—various forms of rivets and their applications—methods of closing rivets—caulking and fullering. Boiler shop processes—punching and drilling rivet holes—bending and flanging plates—plate welding.

Drawing: Use of drawing instruments—simple drawing and precision exercises—simple developments, cylindrical and coned shells—rivets—elementary riveted joints—boiler shell connections—angle rings—flanged and dished plates—spacing of holes for flue tubes, stays, plugs, etc.

GEOMETRY.

FIRST YEAR.

See Syllabus under First Year of Course in Mechanical Engineering.

SECOND YEAR OF COURSE IN BOILERMAKERS' WORK.

Subjects:

BOILERMAKING (LECTURES AND DRAWING).

BOILERMAKING (PRACTICAL).

BOILERMAKERS' WORK.

SECOND YEAR.

Lectures: Description of various types of boilers, land, marine, locomotive and watertube boilers—elements of boiler construction: shell, end plates, furnace tubes, fireboxes—riveted joints—types of rivets and reasons for selection—countersunk and partly countersunk rivets—punched and drilled holes—methods of closing rivets—hand and hydraulic riveting—lap and butt joints—pitch of rivets in relation to steam tightness at different pressures—arrangement of seams—intersecting joints—connection of end plates to shell—connection of parallel plates—caulking and fullering—flanged and dished plates—foundation and firehole rings—manholes, seatings and domes—boiler stays, gusset, longitudinal and diagonal—stiffening plates, rings, etc.—firebox crown and screw stays—boiler testing and inspection—pitting and grooving, incrustation, deposits, sediment, etc.—cleaning of boilers—watertight and oiltight riveted tank work—boiler shop processes: bending, flanging, drilling, punching, shearing, welding—materials used in boiler work and tank work: steel, iron, copper, galvanised plates, etc.

Drawing: Development and laying out of plates for cylindrical shells, drums and domes—coned shells and connections—riveted joints—lap, double and treble riveted butt joints—intersecting and overlapping joints—connection of end plates to shell—dished and flanged end plates—furnace tubes—fireboxes—combustion chambers—spacing of tube holes—circular and elliptical fireholes and manholes—riveted chimneys and uptakes—breaches connections—gusset, longitudinal and crown stays—general arrangement of boiler of simple type, etc.

BOILERMAKING (PRACTICAL)

SECOND YEAR.

Marking out, cutting and bending to required shape and dimensions of cylindrical and coned riveted bodies. Preparation of plates for boiler construction—levelling, squaring, cutting and drilling—simple riveted joints—caulking and fullering—gusset and screwed stays. Riveted tank work—watertight joints—corner connections—stiffening and staying. Boiler smithwork—heating of angle and channel bars in the fire—bending to required shape and size—welding and finishing—welding of plates for domes. Flanging of boiler end plates—allowance for contraction.

FIRST YEAR OF COURSE IN BRASSFINISHERS' WORK.

Subjects:

BRASSFINISHING (PRACTICAL).

BRASSFINISHING (LECTURES AND CALCULATIONS).

MACHINE DRAWING.

BRASSFINISHING (PRACTICAL).

FIRST YEAR.

Cocks, pumps, valves, lubricators, unions, injectors, steam whistles and horns—bushes, bearings, glands, screwed spindles, balls—Celtic crosses, shrines, candlesticks, electric and gas brackets and mountings—ornamental work—turning, screw-cutting, chasing, knurling, spinning—brazing, bronzing, polishing and lacquering.

BRASSFINISHING (LECTURES AND CALCULATIONS).**FIRST YEAR.**

Composition and qualities of different brasses and bronzes—workshop calculations—cutting speeds—pulleys and belts—simple and compound wheel trains—screws; Whitworth, gas, square, etc.—finding wheels to cut given screws in lathe—the rule and its sub-divisions—measuring instruments, calipers, micrometer and vernier—use of gauges—limit gauges—curved and contour gauges—useful workshop calculations—brazing; appliances and materials—lacquers and lacquering—brassfinishers' work as applied to pumps, injectors, steam and motor engines, electrical details, etc.—ecclesiastical and ornamental designs—brasswork in structural engineering.

FIRST YEAR. MACHINE DRAWING.

See Syllabus under Second Year of Course in Mechanical Engineering.

SECOND YEAR OF COURSE IN BRASSFINISHERS' WORK.

Subjects:

BRASSFINISHING (PRACTICAL).
BRASSFINISHING (LECTURES AND CALCULATIONS).
MACHINE DRAWING.
DESIGN.

BRASSFINISHING (PRACTICAL).**SECOND YEAR.**

More advanced work in Syllabus under First Year of Course.

BRASSFINISHING (LECTURES AND CALCULATIONS).**SECOND YEAR.**

Advanced work in Syllabus under First Year of Course.

MACHINE DRAWING.**SECOND YEAR.**

See Syllabus under First Year of Course in Mechanical Engineering.

SECOND YEAR. DESIGN.

See Syllabus under Second Year of Course in Metal Plate Work.

FIRST YEAR OF COURSE IN SMITHWORK.

Subjects:

SMITHWORK (PRACTICAL).
MACHINE DRAWING.

SMITHWORK (PRACTICAL).**FIRST YEAR.**

Making up and care of fire—fuels—smiths' tools—heating wrought iron, mild steel, carbon and other tool steels—qualities and grades of these materials—welding—forging of articles such as pins, bolts, nuts, hooks, cotters, keys, spanners, shackles, links, tongs, pincers, levers, straight and cranked—fire irons. Forging, dressing and tempering of steel punches, chisels, lathes, planing, and slotting tools, flat drills, etc. Simple engine and machine parts; cranks; plain and forked links, knuckle joints, etc. Thin forgings; spades, shovels, flattened bars, etc. Simple flat and coiled springs.

FIRST YEAR. MACHINE DRAWING.

See Syllabus under First Year of Course in Mechanical Engineering.

A suitable class in Mathematics is recommended.

SECOND YEAR OF COURSE IN SMITHWORK.

Subjects:

SMITHWORK (PRACTICAL).
MACHINE DRAWING.
MATHEMATICS (OPTIONAL).

SMITHWORK (PRACTICAL).**SECOND YEAR.**

More advanced work in Syllabus given under First Year of Course.

MACHINE CONSTRUCTION.**SECOND YEAR.**

See Syllabus under Second Year of Course in Mechanical Engineering.

MATHEMATICS.**SECOND YEAR.**

A suitable class in Mathematics is recommended.

FIRST YEAR OF COURSE IN ART IRONWORK.

Subjects:

ART IRONWORK (PRACTICAL).
DESIGN.

The Course is intended for those who have some practical knowledge of general smiths' work, but who are desirous of practising the more decorative sections of their trade.

ART IRONWORK (PRACTICAL).**FIRST YEAR.**

Iron, its nature and properties—various kinds of iron used by art ironworkers—tools, their applications and uses—treatment and manipulation of wrought-iron; forging, welding, jumping, bending and embossing—methods of joining ironwork—details used in art-smithing—riveting, intersecting, slitting, tenoning, shrinking on collars—twisting—spindle-shaped spiral twists—scrolls and volutes.

DESIGN.**FIRST YEAR.**

The students will attend the Art Department of the Technical Institute.

SECOND YEAR OF COURSE IN ART IRONWORK.

Subjects :

ART IRONWORK (PRACTICAL).

DESIGN.

ART IRONWORK (PRACTICAL).

SECOND YEAR.

Interlacings—plaiting—hammering—scrolling bars into volutes to given scale—beating scroll ends into forged or embossed leaves—construction of husks, flowers, rosettes, leaves and sprays, garlands and festoons—cartouches and shields—making of panels, grilles, balustrades, gates, hinges, hanging-signs, brackets, chandeliers, electroliers, lanterns, stands, and other objects in iron.

Special attention will be given to the treatment of metal work for use in electric light, gas and lamp fittings.

DESIGN.

SECOND YEAR.

The students will attend the Art Department of the Technical Institute.

FIRST YEAR OF COURSE IN METAL PLATE WORK.

Subjects :

METAL PLATE WORK (LECTURES AND DRAWING).

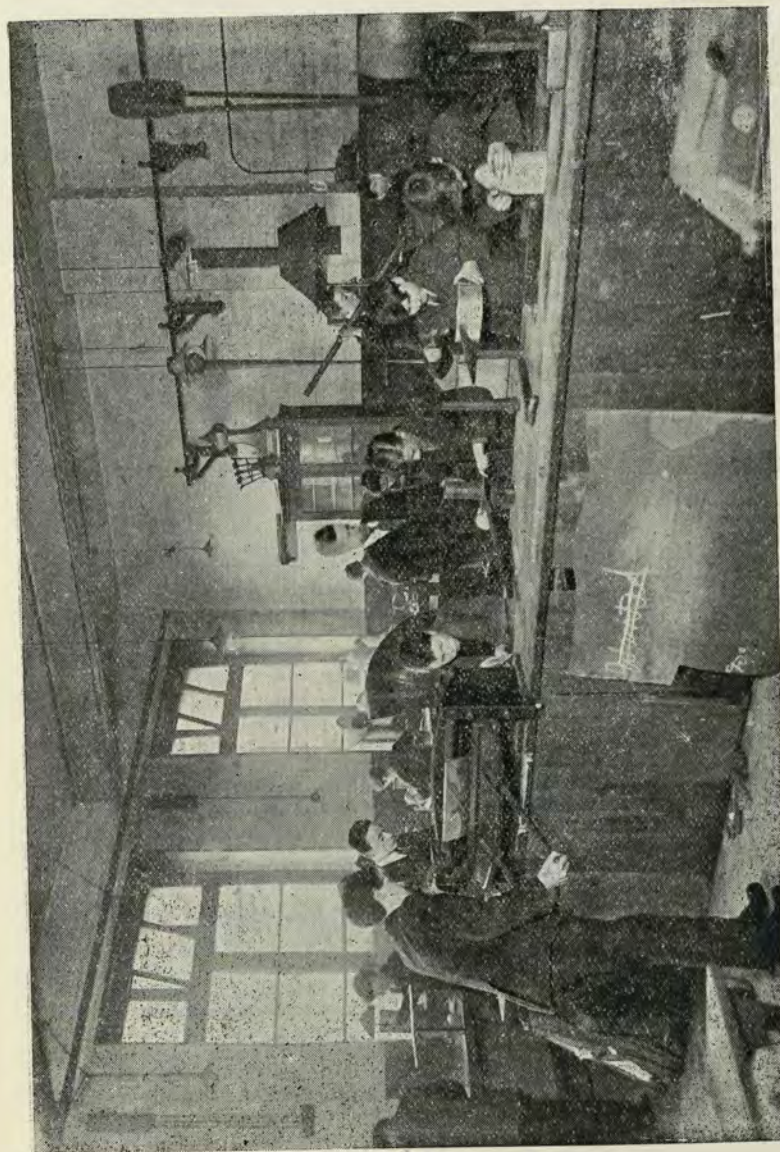
METAL PLATE WORK (PRACTICAL).

METAL PLATE WORK (LECTURES AND DRAWING).

FIRST YEAR.

Lectures : Fuels; composition, physical character and methods of application in metal plate work—metals; properties, specific gravities, melting points, etc.—iron and steel; physical and chemical properties—characteristics of lead, zinc, copper and tin—alloys, brasses and bronzes—solders, hard and soft—theory of soldering and brazing—use of fluxes—galvanising, tinning and retinning processes—manufacture of tinplate—calculations of dimensions of vessels of stated capacities.

Drawing : Geometrical problems for metal plate workers—angles, circles, polygons, ellipses, ovals, cylinder, prisms, etc.—intersections, interpenetrations and developments—stove and ventilator main and branch pipes—patterns, plans and elevations of simple articles of equal taper—development of right cones and patterns in two or more pieces—patterns for equal tapering bodies, round, oval and oblong, in two or more pieces, for large and small work—patterns for unequal tapering articles, hoods, hoppers, etc., and combined flat and curved surface such as an oblong body with rounded corners—patterns for Tee pipes, equal and unequal, meeting at different angles—bends in two or more pieces or in circular segments—lobster back patterns—V and Y pipes and branches—ventilators—articles with square or oblong bases and curved tops—patterns for compound bent surfaces such as vases, moulded bases, ornamental covers, etc.—inclined and raking mouldings, gutters, roof work, etc.—setting out of patterns for finials in copper and zinc, for lamps, boxes, baths and general toilet ware—ships' ventilators, hoods and lamps—motor car hoods, splashers and sheet metal body panelling.



METAL PLATE WORKSHOP—PRACTICAL INSTRUCTION.

METAL PLATE WORK (PRACTICAL).**FIRST YEAR.**

Use and care of hand and machine tools—use of cutting and bending appliances for light and heavy materials—use of pipe bending appliances, including bath beading machines—cutting of sheet metal and flattening by rolling, hammering, etc.—cutting of notches, allowances for lap—wiring and making of seams of various kinds—methods of joining sheet metal by soft soldering, rivetting, grooving, and use of suitable fluxes—methods of joining various articles by brazing, such as Tee pipes, branches, bends, spouts, piping, cylinders, etc., in iron, copper, or brass—annealing, stretching, raising, planishing and general principles of working up sheet copper, brass, and zinc—iron, plain and coated—tinning and retinning of various articles—making of flue and ventilating pipes, branches, Y pieces and various classes of ventilators, plain and ornamental—making of revolving and fixed chimney cowls in copper, zinc, and galvanised iron—construction of seams and flashings used in covering roofs, domes, etc., with copper, zinc or galvanised iron—making of gutters, hopper heads, rain-water pipes, mouldings, etc., to suit various angles and positions—making up of ships' lamps, ventilators, etc., in iron, copper, or brass—making up of kitchen utensils and toilet ware, boxes, trunks, etc.—making of plain and ornamental gas, oil and electric lamps—use of acetylene for welding and cutting sheet metal.

SECOND AND THIRD YEARS OF COURSE IN METAL PLATE WORK.*Subjects :*

METAL PLATE WORK (LECTURES AND DRAWING).
 METAL PLATE WORK (PRACTICAL).
 DESIGN.

METAL PLATE WORK (LECTURES AND DRAWING).**SECOND AND THIRD YEARS.**

The subjects listed for the First Year will be dealt with in their more advanced stages. The following will be the principal:—

Physical and chemical properties of metals and alloys—tin plate, galvanised iron, lead, coated iron—tinning—fuels, solid and gaseous, and their methods of application—oxy-acetylene methods applied to cutting and welding sheet metal bodies—preparation of drawings and patterns of an advanced character.

METAL PLATE WORK (PRACTICAL).**SECOND AND THIRD YEARS.**

More advanced work in Syllabus given under First Year of Course, with special attention to oxy-acetylene methods.

DESIGN.

The course is arranged so that students may become acquainted with the use of instruments, T square, set squares, compass, scales, etc., and the principles of construction of ordinary geometrical figures, with special reference to the application of geometry to industrial art. The exercises worked in class will include the drawing of geometrical patterns—spacing of surfaces for decorative purposes—bands and borders—units of pattern—diapers—the construction of arch-forms—tracery and mouldings. In addition, exercises will be given in the projection of simple solids.

Free drawing of ornamental details—corner ornaments, bands, borders and centre pieces. Pencil drawings—the use of coloured chalks and crayons on white, brown and tinted papers. Drawings from casts of foliage and ornaments in relief.

OXY-ACETYLENE WELDING.

Low pressure acetylene generator—use and care of apparatus—precautions and regulations to be observed in preparation and use of the gas,—back pressure valves—ventilation—storage and preservation of calcium carbide. The use of dissolved acetylene—high pressure storage of acetylene and oxygen—cylinders, valves and connections—method of coupling up—commencing work. Blow pipes for various processes—accessories. Cutting and welding methods—practical exercises on iron and steel plates, flat, angle and other sectioned bars—welding together of framed structures—use of welding rods, fluxes, etc. Oxy-acetylene processes applied to cast iron, aluminium, aluminium alloys and other non-ferrous metals. Welding of sheet metal bodies.

HEATING ENGINEERING.*Subjects :*

HEATING ENGINEERING (LECTURES).
 PHYSICS AND CHEMISTRY.
 PLAN DRAWING AND READING.

HEATING ENGINEERING.**FIRST YEAR.**

Steam and hot-water heating boilers—valves—traps—pressure gauges—water level indicators. Boiler feeders—tanks and fittings—storage tanks, cisterns and cylinders. Radiators, coils and their fittings. Pipe connections and fittings—provision for expansion and flexibility—tees and branch pipes—riser connections—special fittings. Air inlets and outlet registers, their operation and regulation—valves, dampers and other fittings. *Calculations :* Decimal fractions, proportions and per-centages—weights and measures—areas of rectangles, triangles, and circles—volumes of simple solids. Weights of water, air, steam, metals. Cubic capacities of rooms, etc.

PHYSICS AND CHEMISTRY.**FIRST YEAR.**

General Properties of Matter : measurement of length, area and volume—determination of density—measurement of force—centres of gravity—the lever—the principle of work. *Fluid Pressure :* nature and modes of measurement of pressure of liquids and gases—variation of pressure with depth in liquids—atmospheric pressure—the barometer—Boyle's Law—the principles of physics in connection with water supply, pumps and syphonic action. *Heat :* expansion of solids, liquids and gases—temperature and thermometers—heat as a quantity—the caloric and the therm—thermal capacity and specific heat—change of state—melting and boiling points—latent heats of fusion and vaporisation—change of volume resulting from change of state—the spheroidal condition and the physics of fluxes—convection, conduction and radiation. *Chemistry :* oxidation—reduction—composition of water and its action on metals—acids and salts—hydrochloric acid and "killed spirit"—elementary chemistry of lead, iron, zinc, tin and copper—composition and properties of red lead, litharge, white lead, etc., and cements made from them.

PLAN DRAWING AND READING.**FIRST YEAR.**

Use of drawing instruments—construction and use of scales—lettering in simple form—use of protractor. Construction of triangles and quadrilateral figures. Calculations of areas, volumes, etc.—relation of diameter to circumference of circle—area of circle. Segmental and elliptical curves. Simple scale drawings—drawing to scale of plans of small buildings—simple elevation of surfaces—drawings of plans, elevations and sections.

MOTOR CAR ENGINEERING.

COURSE FOR CHAUFFEURS.

This Course is arranged to suit the requirements of Chauffeurs desirous of gaining a thorough general knowledge of the construction, details and operation of petrol-driven vehicles. The instruction will consist partly of lectures and partly of practical demonstrations in the garage.

MOTOR CAR ENGINEERING (LECTURES AND DEMONSTRATIONS).

General principles and operation of the petrol engine types of engine in general use—valve systems—engine cooling systems—lubrication. Carburettors—principle of operation—various types. Fuel supply—gravitation pressure and "autovac" systems. Ignition—elementary electrical principles—coil and battery ignition—magnetos—wiring—sparking plugs—power starting arrangements. Dynamos—lighting and other electrical equipment of motor cars. Transmission gear—clutches—flywheel, gearboxes—Ford epicyclic gears—propellor shafts—universal joints—couplings—differential gear—chain drives—worm gearing—rear axle types—torque tube—bearings. Car controls—throttle—clutch—brake—gear change lever, etc. Brakes—operation and types. Front axle—principles of steering action—steering gears. Chassis—springs—shock absorbers. Wheels and tyres—construction, upkeep and repair—vulcanising. Body work details—miscellaneous parts, accessories, garage tools, appliances, etc.

Demonstrations in the garage on the subjects of the lectures; on location of faults, care of carburettors, defects in wiring and ignition, care of batteries, magnetos and dynamos, removal of defective or damaged parts, general care of motor-driven vehicles, cleaning, running difficulties, etc.

METAL PLATE WORKSHOP—OXY-ACETYLENE WELDING.



FIRST YEAR OF COURSE IN MOTOR CAR ENGINEERING.*Subjects :*

MOTOR CAR ENGINEERING (LECTURES).
 MOTOR CAR MECHANICS AND MATHEMATICS.
 ELEMENTARY SCIENCE.
 GARAGE PRACTICE.

MOTOR CAR ENGINEERING (LECTURES).**FIRST YEAR.**

Chassis arrangement—the internal combustion engine in its simplest form—construction of the power system—the Otto cycle—valves and valve operating mechanism—valve timing. Petrol feed systems—the carburettor—description of popular carburettors. Simple lubricating systems. Cooling. Construction of common types of clutch—change speed mechanisms. The rear axle—chassis suspension. Brakes—steering mechanisms and front axles. Elementary discussion of the properties and treatment of materials used in motor car construction. Sources and manufacture of petrol—physical properties of liquid fuels.

MOTOR CAR MECHANICS AND MATHEMATICS.**FIRST YEAR.**

Arithmetic : Simplification of fractions and conversion to decimals—averages and per centages—ratio proportion—square root—limits of accuracy—signification figures. *Algebra :* Notation—brackets—evaluation and transformation of formulae—simple factors and their use in shortening calculations—indices. *Mensuration :* Simple areas and solids—use of squared paper—illustration of varying quantities by a curve—the straight line graph. *Elementary Mechanics :* Mass, force, weight—velocity and acceleration—the lever—graphical representation of forces—centre of gravity, effect on stability of car—simple laws of the spring.

ELEMENTARY SCIENCE.**FIRST YEAR.**

General Physics : Units of length, area, volume and mass. Specific gravity. Pressure of liquids and gases. Viscosity. *Heat :* Temperature, thermometers, measurement of moderate and high temperatures. Expansion, laws of Boyle and Charles. Change of state, melting point, boiling point, evaporation, condensation, latent heat, conduction, convection and radiation. *Chemistry :* Combustion; oxidation, burning, explosion. The atmosphere: brief study of oxygen, hydrogen and nitrogen; bases, acids and salts. Carbon and its oxides. Physical properties of petrol, products of complete and incomplete combustion.

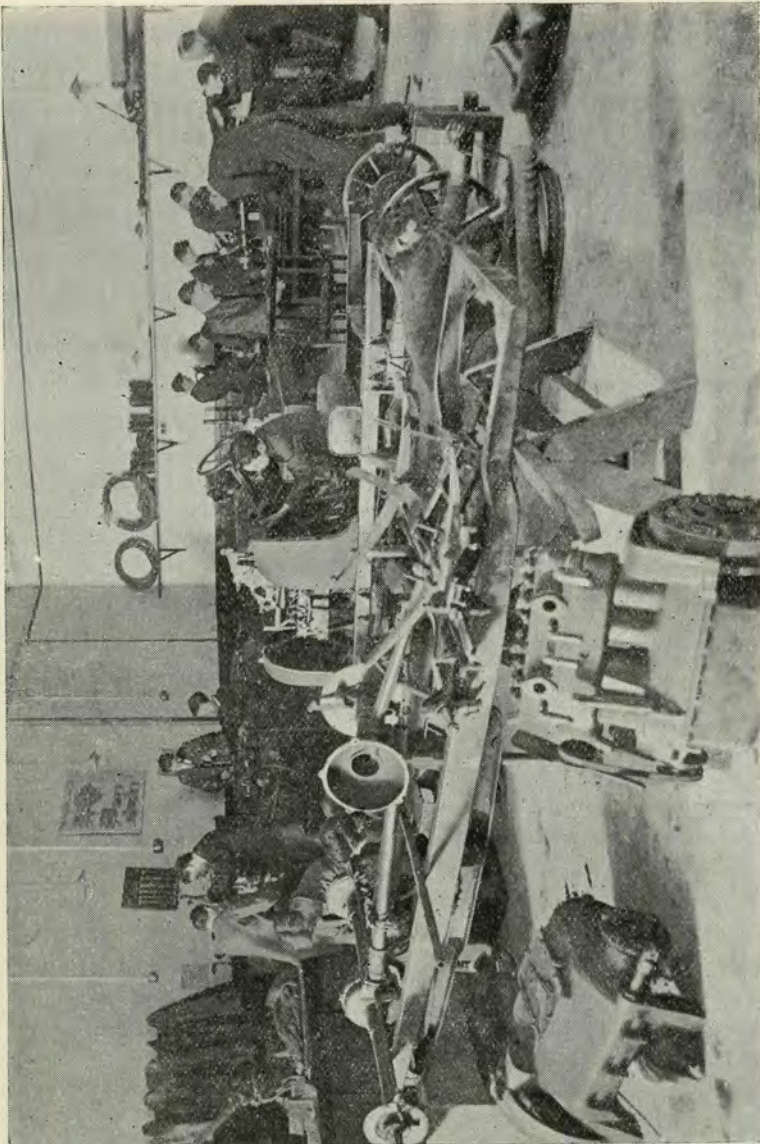
GARAGE PRACTICE.

(Class strictly reserved for actual apprentices in the Motor Trade).

FIRST YEAR.

Use of spanners, pliers, screwdriver, hand brace, files and other small tools. Soldering—brazing—screwing and tapping—hardening, tempering and casehardening—annealing and bending pipes. Use of bolts and nuts—removal of stubborn nuts and studs—cutting sheet material—key fitting. Disassembly of units, examination and marking of parts—common repair jobs will be demonstrated, including:—decarbonising and valve grinding, brake re-lining, fitting piston rings, valve and ignition timing, remetalting and fitting bearings, adjustment of ball and roller bearings, etc.

MOTOR CAR ENGINEERING—GARAGE PRACTICE.



SECOND YEAR OF COURSE IN MOTOR CAR ENGINEERING.*Subjects :*

MOTOR CAR ENGINEERING (LECTURES).
 MOTOR CAR MECHANICS.
 ELECTRICITY.
 GARAGE PRACTICE.

MOTOR CAR ENGINEERING (LECTURES).**SECOND YEAR.**

Cylinder types—piston and piston ring maintenance—oil rings—requirements in gudgeon pins, connecting rods, big and small end bearings—crankshaft arrangements and main bearing adjustment—overhead valve mechanism—sleeve valves—valve and ignition timing—further consideration of carburettors and carburettor adjustments—engine operating—temperatures and the cooling system—engine lubrication practice—details of clutch construction—sliding gear and epicyclic change speed mechanisms—universal joints—rear axle stresses and designs—the suspension system—front axle construction in relation to steering—steering columns—further types of brakes.

MOTOR CAR MECHANICS.**SECOND YEAR.**

Use of vernier micrometer—simple technical calculations—areas of irregular figures by squared paper—mid-ordinate and other rules—use of logarithms and trigonometrical tables. Graphical representation of forces—resultant of two forces—triangle of forces. Study of simple machines in their relation to motor car problems—mechanical advantage—velocity ratio—efficiency. Gearing—wheel trains—gearing efficiencies. Friction—power—indicated and brake horse power—rating formulae—power required to propel car against road and wind resistances and on gradients.

ELECTRICITY.**SECOND YEAR.**

Magnetism—lines of force—magnetic field—induction—permeability—reluctance. Static electricity—electric potential—current—resistance—conductors—electric circuits. Practical electrical quantities—generation of electric current. Ignition—Ruhmhorff coil—Ford ignition system—primary batteries—accumulators—production and distribution of spark-magnetos.

GARAGE PRACTICE.**SECOND YEAR.**

More advanced exercises in disassembling and reassembling—bushing and reaming—alignment of frames, axles, and wheels—adjustment of taper-roller bearings—assembly and adjustment of gear-boxes and rear axles—adjustment of clutches—fitting gudgeon pins, piston rings, and big end bearings—truing, facing and reseating valves—decarbonising—relining and adjusting brakes—valve and ignition timing—ignition wiring—battery testing and servicing—lamp wiring—carburettor overhauls.

THIRD YEAR OF COURSE IN MOTOR CAR ENGINEERING.*Subjects :*

MOTOR CAR ENGINEERING (LECTURES).
 MOTOR CAR ELECTRICITY.
 MOTOR CAR MECHANICS.
 GARAGE PRACTICE.

MOTOR CAR ENGINEERING (LECTURES).**THIRD YEAR.**

Cylinder dimensions and pressures—working efficiencies—mixture requirements for effective explosion—Clerk's experiment—effect of and control by turbulence—effect of mixture strength on engine power—piston operating conditions—special piston designs—offset engines—engine balancing—inertia forces—valve operating conditions—cam types—the mixture in the induction system—pinking—cylinder temperatures—properties and tests of lubricants—exhaust system requirements—modern four-wheel brakes.

MOTOR CAR ELECTRICITY.**THIRD YEAR.**

The construction, operation and regulation of lighting generators—care, maintenance, testing and repair of the lighting system—lamps and wiring—current and voltage regulators and meters—construction, operation, maintenance, testing and repairing of starter motors.

MOTOR CAR MECHANICS.**THIRD YEAR.**

Boyle's and Charles' laws—adiabatic and isothermal expansion—quantity of heat—B.Th.U. and C.H.U.—mechanical equivalent of heat—latent heat—calorific values of fuels—transmission of heat. Triangle and polygon of forces—application to determination of forces acting in various parts of motor car engine and mechanism. Torque couples—turning effort diagrams—mechanical and thermal efficiencies. Potential and Kinetic energy—the flywheel—inertia—force—mass—acceleration—acceleration on falling gradient. Stress—strain—elasticity—properties and treatment of cast iron, wrought iron—steels—aluminium and aluminium alloys, bronzes and bearing metals. Testing of materials.

GARAGE PRACTICE.**THIRD YEAR.**

More advanced work on Syllabus of Second Year of Course.

COURSE FOR MOTOR CAR SALESMEN.

This Course is designed for the use of Salesmen and Service Engineers in the Automobile Trade, the object being to enable them to become acquainted with matters of a purely technical nature directly bearing on their business. It will consist of a series of twenty lectures and demonstrations, illustrated by means of sectional and other models, lantern slides and kinema films. Time will be allotted at the close of each lecture for a brief discussion on the particular subject considered, during which questions suggested by daily experience will be dealt with.

MOTOR CAR ENGINEERING LECTURES.

Amongst others, the following subjects will be specially considered:—
The side-by-side compared with the overhead valve engine—aluminium and magnesium alloys and cast iron for pistons—modern braking systems; four-wheel, servo-hydraulic and vacuum brakes—engine lubrication and wear of bearings—three-speed gearboxes—carburettors and carburation—the generation of the explosion—engine working temperatures, thermostatic controls and steam cooling—"pinking" and "dopes"—magneto, and battery and coil ignition—the Diesel engine principle—free-wheel clutches—sleeve-valve engines—steering in relation to four-wheel brakes, balloon tyres, etc.—electrical equipment of the modern car.

COURSE FOR MOTOR CAR APPRENTICES AND IMPROVERS.

Subjects:

MOTOR CAR ENGINEERING (LECTURES).
MOTOR CAR ELECTRICITY.
MOTOR CAR TECHNOLOGY.
DRAWING AND SKETCHING.

This afternoon Course is reserved for apprentices and improvers in the motor car industry as selected by their employers. Classes will be conducted on two days each week during the term which will extend from November, 1928, to the end of March, 1929.

MOTOR CAR ENGINEERING.

Working principle of the petrol engine—functions and conditions for efficient operation of cylinders, pistons, bearings, valves, valve operating mechanisms—fuel feed systems—operation, maintenance and adjustment of various popular makes of carburettor—lubricating systems commonly met—operation and care of water cooling systems—construction and operation of common types of clutch—mechanisms of sliding change speed gears—construction, adjustment and maintenance of gear drive rear axles—function and operation of differential gears—operation and requirements of steering mechanism—steering gear maintenance—construction, operation, arrangement and maintenance of usual types of brake mechanism.

ELECTRICITY.

Electrical circuits, voltage distribution and testing of motor car wiring systems—magnetism and its application in the car—induction—the generation of high tension currents and their application in the ignition system—battery and coil ignition—magneto ignition—construction and care of storage batteries—principles and descriptions of typical starter motors—care and maintenance of starters—principles and description of the more common types of generator—care, testing and adjustment of generators—typical lamps, bulbs and systems of wiring.

MOTOR CAR TECHNOLOGY.

Precise measurements—vernier and micrometer calipers—areas and volumes—conversion of British to metric units and *vice-versa*—density and specific gravity—floating bodies and hydrometers—gaseous pressure—atmospheric pressure—Boyle's Law—physical effects of heat on solids liquids and gases—temperature—thermometers—Centigrade and Fahrenheit scales—expansion of solids, liquids and gases—Charles' Law—quantity

of heat—B. Th. U. and C.H.U.—mechanical equivalent of heat—latent heat—transmission of heat—boiling points and evaporation—mass and weight—force and its measurement—moments, torque, levers, couples—work energy—power—I.H.P. and B.H.P.—mechanical efficiency—simple machines—transmission of power—types of gearing—friction—composition and resolution of forces—motion, velocity and acceleration—inertia—kinetic energy—the flywheel—elements, mixtures and compounds—atoms and molecules—chemical symbols and formulae—composition of the atmosphere by weight and by volume—oxygen—combustion—oxidation—explosion—calorific values—hydrogen—carbon and its oxides—physical and chemical properties of petrol.

DRAWING AND SKETCHING.

Machine drawing methods—precision exercises—orthographic projection. Dimensioned freehand sketches of bolts, workshop tools, brackets, bearings, machine parts, links and levers, and preparation of scale drawings from such sketches. Motor car details—valves—pistons, connecting rods—crankshafts—clutches, etc. Toothed gearing—elementary principles—spur and bevel gears—differential gear—gearboxes. Axles—steering gear—brake drums and connections—springs, etc.

MOTOR CAR DRIVING.

During the Session a limited series of lessons will be arranged on Saturday afternoons, or at other suitable times, in motor car driving, practical management and cleaning. Admission to these lessons will be strictly reserved for students in regular attendance at all the classes of one of the Motor Car Engineering Courses. When the classes are being formed, preference will be given to students in attendance at the more advanced years of the Course. Students must provide their own licences and have them in their possession at each lesson.

LOCOMOTIVE ENGINEERING.*Subjects :*

LOCOMOTIVE ENGINEERING.

MACHINE DRAWING.

MATHEMATICS.

The Course is designed to meet the requirements of cleaners, firemen and others engaged in the practical operation of locomotive engines.

LOCOMOTIVE ENGINEERING.

The simple steam engine: its operation, cylinder, piston, piston rod, crosshead, slidebars, connecting rod, crank. Simple slide valve—eccentric and distribution of steam. The locomotive—comparison with stationary engine—inside and outside cylinders—crank axles. Valve motion—reversing and expansion gears—Stephenson, Walschaerts and other link motions. Simple and balanced flat valves—piston valves—outside and inside admission—valve setting. Steam boilers—general construction and essential parts. The locomotive boiler—construction—peculiarities—firebox—tubes—stays—provision for expansion. Boiler feed water—deposits. Boiler maintenance—cleaning—corrosion—priming. Boiler mountings—safety valves—Rams-bottam and “pop” valves—regulators—internal and external steam pipes—small valves—cocks—gauges—injectors—fusible plugs—wash-out plugs. Brake gear—screw brake—steam brake—automatic vacuum brake—ejector—vacuum cylinders—ball valves—hose couplings. Framing and wheels—coupled wheels—tyres—coupling rods—coupling rod crank pins—axles—axleboxes—spring mounting. Adhesion—sanding gear. Bogies—pony trucks radial axleboxes. Draw gear. Lubrication and lubricators. Locomotive superheating—types of superheaters—smoke and steam tubes—sniffing valves—pyrometers. Tenders—tanks—water valves and hose connections | water level indicators—coal bunkers.

MACHINE DRAWING.

See Syllabus under First Year of Course in Mechanical Engineering

MATHEMATICS.

See Syllabus under First Year of Course in Mechanical Engineering.

FIRST YEAR OF COURSE IN NAVAL ARCHITECTURE.*Subjects :*

NAVAL ARCHITECTURE (LECTURES).

NAVAL ARCHITECTURE, DRAWING.

LECTURES.**FIRST YEAR.**

Practical : Materials used in shipbuilding, their characteristics and strength—steel and iron plates—angles, sections and rivets and their proper application in the construction of ships—connection of plates and angles—riveting and caulking—lap, butt and strap joints—counter-sinking—keel blocks for building berths and docks—preparation of plans and models. Classification Rules, moulding loft and scribe boards—elements of ship's construction, keel, stem, stern frame, rudder, centre and side keelsons and girders, floors, inner bottom margin plate, frames, beams, decks, bulkheads, stringers, web frames, shell plating, pillars—construction of composite vessels—reasons for variations in rivet spacing at different parts of a vessel—punching, drilling and countersinking, principles of watertight work, construction and functions of component parts of iron and steel vessels generally, without reference to type—watertight flats, longitudinal bulkheads, open and double bottom, hatch coamings, ventilators, etc.

Theoretical : Simple areas and solids—specific gravities of principle shipbuilding materials—estimation of weights of simple parts—plates, sections, pillars, etc. Trapezoidal and Simson's first rule for determining areas and volumes—displacement of vessels, volume and weight in fresh and salt water. Block and prismatic co-efficients of water plane area, midship section and displacement. “Tons per inch immersion,” simple examples of sinkage caused by bilging—principles of moments, centre of gravity of plain figures.

DRAWING.

Use of instruments and squares—tests for accuracy—construction and use of scales—precision exercises—location of a point by rectangular co-ordinates—paper models of co-location of a point by rectangular co-ordinates—paper models of co-ordinate planes, cube and cone. Orthographic projection—intersection by inclined planes—screw threads—bolts and nuts of various types—rivets and riveting—sections of double riveted landing, elevation of landing with rivets—butt straps, horizontal and vertical sections—overlapped butts on outside and inside strakes—liners, and scarped types of butt joints—horizontal sections clear of, and in way of landing—doublings and tack riveting—right-angled plate connections—sections through gunwhale bar, sheer strake and stringer between frames, beam ends, lower deck stringer side framing—ordinary bottom framing—keels and keelsons.

MATHEMATICS.

See Syllabus under First Year of Course in Mechanical Engineering.

SECOND YEAR OF COURSE IN NAVAL ARCHITECTURE.

Subjects :

NAVAL ARCHITECTURE (LECTURES).

NAVAL ARCHITECTURE, DRAWING.

LECTURES.

SECOND YEAR.

Practical : More extended explanation of the construction and functions of the component parts of iron and steel vessels—open (skelton) floors, solid, built and hollow pillars—securing of pillars at their ends, box and semi-box beams—watertight flats and bulkheads passed through hatchways, shaft tunnels, panting and arrangements to prevent panting—deep tanks, skylights, Capstan beds, longitudinal girders—masts—deck erections—strengthening of shell and decks at ends of erections and corners of openings—riveting—spacing in various positions for watertight and oiltight work—rules of Lloyds and other registration bodies. Method and rules for testing—oil fuel compartments—oil carrying vessels—launching arrangements—explanation of working plans—template work and moulds—block model, construction and use—mould loft and scribe board work—frame bending and bevelling—fairing a set of lines on paper and on the mould loft floor—tracing keelsons, longitudinal, plate, edges, tank margins, etc., on floor—transference of lines to scribe boards, template work.

Theoretical : Simpson's second and five-eight rules—Tchebycheff's Rule—application to shipbuilding problems—curves of displacement—tons per inch immersion, principle of moments, centre of gravity, centre of buoyancy, conditions of equilibrium, stable and unstable—transverse metacentres—use of planimeter. Rudder area and size for given speed—ordinary and balanced rudders. Strength and testing of materials in tension, compression and shear—working strength and working load.

DRAWING.

Use of pictorial views—oblique planes—determination of real angle between traces of oblique planes—angles of inclination of oblique plane to three co-ordinate planes—parallel oblique planes—more difficult examples of cube in orthographical and pictorial views—development of surface of cone, pyramid, etc. Intersections and interpenetrations—double bottom framing, centre girder, margin plate, bilges, deck framing, pillars and plating—details of watertight and oiltight bulkheads and flats—panting arrangements—stern framing—cants—masts, spars and derricks. Castings, forgings and fittings—hawse pipes, chain pipes, fairleads, watertight doors, etc.—wood-work details.

MATHEMATICS.

See Syllabus under Second Year of Course in Mechanical Engineering.

GAS ENGINEERING.

Subjects :

GAS MANUFACTURE.

CHEMISTRY.

MATHEMATICS.

The Courses in Gas Engineering and Gas Supply are designed to suit the needs of students preparing for admission to the Institution of Gas Engineers. For the present Session the First Year only of the respective Courses will be dealt with, and the complete syllabuses of the principal technical subjects are those of the Ordinary Grade of the Institution.

GAS MANUFACTURE.

FIRST YEAR.

Carbonization : Retort settings, furnaces, producers, regenerators. Mouth-pieces, ascension, arch and dip pipes. Hydraulic mains, foul mains, method of tar removal. Retort house governors. Principles, action and practical management of regenerative retort furnaces. *Coal and Coke Handling Plant* : Tipping wagons, breakers, elevators and conveyors. Storage of coal. Hot coke conveyors and transporters. Methods of quenching, screening, grading and loading of coke. *Charging and Discharging Machines* : Types of machines in use. Size of coal suitable, regulation of quantity per charge. *Carburetted Water Gas* : Arrangements and construction of plant, cycle of working, method of coking. Temperatures, effect of quality of coke and oil on working results. *Blue Water Gas* : Arrangement and construction of plant, waste heat boilers, cycle of working, method of coking. Comparison with carburetted gas plant. *Gas Purification* : Condensers, exhausters, tar washers, tower and mechanically operated scrubbers. *Purifiers* : construction and arrangement, practical operation of purifying plant. *Gas Measurement and Storage* : Station meter, gasholders, tanks, inlet and outlet connections. *Gas Testing* : Water pressure gauges, recording instruments, gas analyses, tests for ammonia, sulphur compounds and purifier oxide. *Regulation of Pressure* : Types of station governors, principles of working and connections.

CHEMISTRY.

FIRST YEAR.

Lectures : General properties of matter—elements and compounds—chemical and physical changes—conservation of matter—water; action on water; quantitative composition, metals, electrolysis, hydrogen—solubility in water, other solvents, crystallization—oxygen; acid forming oxides—oxygen; basic oxides—atmosphere, Boyle's law and Charles' law—equivalent weight—laws of chemical combination—Gay Lussac's law. Avogadro's hypothesis, atomic theory—chlorine; preparation and properties—hydrochloric acid, chlorides—molecular weights—acids, bases, and salts—nitric acid: fixation of atmospheric nitrogen, nitrates—nitric oxide; preparation and properties—nitrogen peroxide, nitrous acid, nitrites nitrous oxide—law of multiples proportions—allotropy; sulphur, phosphorus and carbon—sulphuretted hydrogen; preparation and properties—sulphides—systems of analysis of salts—oxides of sulphur, sulphites and sulphates—manufacture of sulphuric acid; contact and chamber methods—carbon monoxide; preparation and properties—carbon dioxide and carbonates—combustion, flame, gas burners—general properties of common metals. *Practical Work* : Glass-working, cork boring and fitting up apparatus—action of heat, water, on

substances and mixtures—solubility—preparation and properties of hydrogen, oxygen, chlorine, hydrochloric acid, nitric acid, ammonia, nitric oxide, sulphur dioxide, sulphuretted hydrogen and carbon dioxide—action of acids on metals—measurement of volumes and density of gases and reduction to N.T.P.—alkalies, properties and reactions with acids—indicators—preparation and crystallization of simple salts—simple determinations of equivalents—recognition of chlorides, sulphates, sulphites, sulphides, carbonates, nitrates and nitrites.

PRACTICAL MATHEMATICS.

FIRST YEAR.

Arithmetic: Simple and compound rules—calculation of prices and costs by unitary method—decimal notation—decimals—fractions—contracted methods and approximations—weights and measures—metric system—percentages by fractional method—square root. *Mensuration*: Square, rectangle, triangle and circle—calculations of surface areas—rectangular volumes—sectional areas—applications of geometry to problems. *Algebra*: Description and use of symbols—evaluation—the four simple rules—simple equations; their use in mensuration—transformation in formulae—factors, their use in shortening work—elementary graphs.

GAS SUPPLY.

Subjects:

GAS SUPPLY.
GENERAL PHYSICS.
CHEMISTRY.
MATHEMATICS.

GAS SUPPLY.

Gas and its properties—calorific values—reactions of combustion—physical properties. *Gas pressure*: Units of pressure—flow through pipes—pressure measuring and recording instruments—governors. *Mains and Services*: Pipes and pipe fittings—materials—method of laying—joints and jointing methods—causes and prevention of corrosion—connections and repairs to existing mains—testing for leakage. *Flames*: Luminous and bunsen flames—temperatures and calorific values—high and low temperature flames—preheating. *Gas Measurements*: Meters—testing—maintenance—capacities—common defects. *Tools and Materials*: Gasfitters' tools—materials used for pipes and fittings—solders. *Interior Fittings*: Various kinds—determination of sizes—testing and location of faults. *Lighting Appliances*: burners—indoor and outdoor lanterns—supports—maintenance—efficiency of lamps and burners—mantles—candle power—diffusion, reflection and refraction of light. *Cooking and Heating*: Cookers—water heaters—radiators—construction, fixing, testing and upkeep. *Gas Engines*: Construction—fixing—management—adjustment. *Industrial Applications*: Low- and high-pressure gas—air blast—temperatures—blowpipes, soldering and heating irons, etc. *Flues*: Action of fluepipes—accessories—cowls, bafflers and hoods. Hygiene in relation to the use of gas.

GENERAL PHYSICS.

FIRST YEAR.

Measurement of length, area, volume—motion—mass—force—Newton's laws—measurement of force—gravitation—principles of statics—moments—principles of dynamics—rotation, elementary ideas on moments of inertia—elasticity and strength of materials—stretching, bending, twisting—simple periodic motion—vibration—principles of fluid pressure and applications—

principles of Archimedes and applications—density determination—flotation—atmospheric pressure—Boyle's law—thermometry—measurements of high and low temperatures—expansion of solids, liquids, gases—measurement of heat quantities—specific heats—fusion—latent heat—vaporisation—vapour pressure—study of steam, hygrometry—mechanical theory of heat—convection, conduction, radiation—propagation of light—elementary theory, photometry—formation of images by reflection from plane and spherical mirrors—refraction—prisms, lenses, dispersion—optical systems—lenses and combinations, telescope and microscope—spectrum analysis and theory of colours—wave motion—interference, diffraction, polarisation—velocity of sound—vibration of strings—resonance—vibration of air columns and rods.

CHEMISTRY.

FIRST YEAR.

See Syllabus under First Year of Course in Gas Engineering.

PRACTICAL MATHEMATICS.

FIRST YEAR.

See Syllabus under First Year of Course in Gas Engineering.

COURSE IN LAND SURVEYING AND LEVELLING.

The Course is intended to give a sound theoretical and practical knowledge of Surveying, to give facility in the use of the various instruments, in plotting surveys, and in making finished plans. It will be found of service to students preparing for the examinations of the Institution of Civil Engineers, etc. It also covers much of the work required for the various foreign examinations for Surveyors.

The course will comprise *eighteen* lectures and *ten* practical demonstrations—some devoted to field work, and some to office work. The dates and places for the field work will be announced in class as the course proceeds.

All apparatus and instruments for field work are provided by the Schools, but students must provide their own plotting scales, survey book, level book, drawing instruments, and materials.

SYLLABUS.

Surveying with the Chain: object in making a survey—apparatus used: chain, arrows, rods, etc.—testing chain for length—measures of length and area. *Simple Surveying Operations*: ranging a line, fixing position of a point relative to a line, setting out a perpendicular to a line, connecting points invisible from one another—optical square. *Chaining*: Duties of leader and follower—chaining on slopes—stepping—clinometer. *Simple Surveys*: stations—main lines—triangles, well and ill conditioned—offsets—offset rod—methods of dealing with fields, town plots and small estates of regular or irregular outline, obstacles, such as buildings, lakes, rivers. *Booking the Survey*: forms of field book—methods of entering the notes—conventional signs. *Magnetic Compass and Magnetic Bearings*: variations of the compass—prismatic compass. *Traversing with Chain*: setting out curves. *Levelling*: instruments employed; level—construction of telescope—level staff—Abney level—clinometer—aneroid barometer. *Simple and Compound Levelling*: bench marks—datum line—curvature of earth—refraction. *Methods of Booking Levels*: rise and fall methods—collimation method—reduction of levels and method of checking—check levels. *Sections*: cross sections and longitudinal sections—working sections. *Plotting Sections*: horizontal and vertical scales—information required on the plotted section. *Principles of Contouring, Permanent Adjustment of Level*: office work—scales,—meaning of representative fraction—scales used on ordnance plans—plotting scales. *Materials* required, such as brushes, colours, instruments—plotting the field notes—mode of procedure—styles of writing and printing—north points—colouring—ornament generally—preparation of finished plans. *Copying Plans*: Tracing—heliography—enlarging and reducing—pantograph. *Mensuration of Areas*—method of triangles—method of ordinates—Simpson's rule—planimeter—computing scale.

An examination in the theory and practice of surveying will be held at the close of the course, and certificates will be awarded to successful students

Special Classes.

IRISH LANGUAGE.

All Students of the Schools are entitled to attend a class in Irish if they so desire, without extra charge. Classes in the First Year only are held in the Bolton Street Institute, but more advanced students will be provided with instruction in any stage at the Technical Institute, Parnell Square, or Kevin Street.

IRISH.

FIRST YEAR.

Oval: Conversation lessons (questions, answers and general remarks) to afford each student the necessary practice to attain reasonable fluency in conversing on simple matters such as the following:—name and home or residence—salutations on meeting and parting—the clock—days of the week—months and seasons—the weather—money—easy counting—colours and other ordinary properties of common objects—location of objects in the classroom and immediate neighbourhood—parts of the body and clothing—giving and carrying out simple orders. With the conversational lessons, the student will be familiarised with the ordinary constructions in regard to the use of *is*, *seadh*, *ni headh*, *an eadh*, *nach eadh*, *gurb eadh*, *sé*, *ni hé*, *an é*, *nach é*, *gurb é*, *cad é*, *an bhfuil*, *nil*, *tá*, *go bhfuil*, *nach bhfuil*, *an raibh*, *ni raibh*, *bhí*, *go raibh*, *nach raibh*; and of some of the more commonly used verbal nouns such as *suidhe*, *seasamh*, *teacht*, *siubhal*, etc.

Written Work: Each student will keep a note-book to record the salutations, simple phrases, his own name and address, etc., in correct Irish. Rough notes may also be written according to English phonetics or otherwise to aid in the memorising and pronunciation of words and phrases.

Cultural: Students will be taught to memorise simple songs, rhymes, stories, recitations, etc., so as to be able to repeat them with correct *blas*. Verses, etc., will be according to Gaelic metres, and stories or recitations by Gaelic authors.

PRELIMINARY COURSE.

Subjects :

ENGLISH.

ARITHMETIC.

DRAWING.

This Course is arranged for junior trade students who have had to leave school while still in the lower standards, in order to provide them with the opportunity of qualifying for the Introductory and Specialised Courses. Students are permitted to take a practical class in their trade subject by arrangement with the Head Teacher, provided there is room for their admission.

ENGLISH.

Spelling, correct pronunciation and grammar—formation of sentences—use of verbs, adverbs, prepositions, etc.—simple descriptive compositions.

ARITHMETIC.

Multiplication tables—simple multiplication and division—easy compound addition, subtraction, multiplication and division—simple mental arithmetic.

DRAWING.

Simple geometrical exercises—exercises with compass and set squares—precision exercises—angles, squares, rectangles, circles, etc. Freehand sketches and simple drawings to scale of familiar workshop objects and elementary machine parts.

