1934

Mechanical Engineering: Prospectus of Courses Session 1934-35

City of Dublin Vocational Education Committee

City of Dublin
Vocational Education Committee

Scoileanna Ceárd-Oideachais
City of Dublin Technical Schools

Seirsiún
1934-35
1933

Session
1934-35

2½

MECHANICAL ENGINEERING
PROSPECTUS OF COURSES

BOLTON STREET AND RINGSEND

CALENDAR

SESSION 1934-35

1934.	
Sept. 3, Monday.	Whole-time Day Schools open for enrolment. Day Apprentice School resumes work.
„ 10, „	Whole-time Day Schools commence work, and Part-time Day Classes open for enrolment.
„ 17, „	Evening Classes open for enrolment, and Part-time Day Classes commence work.
„ 24, „	Evening Classes commence work.
Nov. 1, Thursday.	*All Saints Day.* Whole-time Day Schools, excepting Day Apprentice School, closed.
Dec. 8, Saturday.	*Feast of Immaculate Conception.* Whole-time Day Schools, excepting Day Apprentice School, closed.
„ 15, Saturday.	Last meeting before Christmas of all Day and Evening Classes, except Day Apprentice School and special classes.
„ 18, Tuesday.	Last meeting before Christmas of Day Apprentice School and special classes.
1935.	
Jan. 2, Wednesday.	All classes resume work after Christmas vacation.
„ 3, Thursday.	New Course Lectures, Materia Medica and Botany commence work.
„ 6, Sunday.	*Feast of the Epiphany.*
Mar. 2, Saturday.	Land Surveying and Levelling Course begins.
„ 2, „	Motor Car Driving Lessons begin.
„ 17, Sunday.	*St. Patrick's Day*
„ 23, Saturday.	Land Surveying Field work begins.
Apr. 16, Tuesday.	Last meeting of classes before Easter vacation.
„ 24, Wednesday.	All classes resume work after Easter vacation.
May 3, Friday.	Evening Classes close (excepting special classes).
„ 30, Thursday.	*Ascension Day.* Whole-time Day Schools, excepting Day Apprentice School, closed.
June 4, Tuesday.	New Course Lectures, Materia Medica and Botany commence work.
„ 10, Monday.	*Whit-Monday.* Schools closed.
„ 20, Thursday.	*Feast of Corpus Christi.* Whole-time Day Schools, excepting Day Apprentice School, closed.
„ 28, Friday.	Whole-time Day Schools and Part-time Day Classes (excepting special classes and Day Apprentice School), closed for the Session.
July 19, Friday.	Day Apprentice School closes. Schools closed on all Bank Holidays not specified in above Calendar.

CITY OF DUBLIN VOCATIONAL EDUCATION COMMITTEE

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Offices :—

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BOLTON STREET,
DUBLIN.

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Chief Executive Officer.

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MR. SLEATOR.

MASTER TAILORS.

MR. E. J. MCWILLIAM.
MR. W. O'CONNOR.
MR. W. SCOTT.
MR. R. BOYD.

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GENERAL NOTICES

ENTRANCE EXAMINATIONS, FEES, REGULATIONS.

Entrance Examinations will be held at Technical Institutes, Bolton Street and Ringsend, every evening during the week commencing 17th September, and on such subsequent evenings as may be arranged. Students who produce satisfactory evidence of education may be exempted from examination. Introductory Courses are provided for those who fail to obtain sufficiently high marks in the examination.

Fees: per Session.

Courses in Mechanical Engineering and Motor Car Engineering	7/6 for Course.
Introductory Course	2/6 for Course.
Additional Course subjects	2/6 each.
Single subjects	7/6 each.

Technical students may take a class in Irish and in Physical Training for an additional fee of 2/6 per class.

Students who through obtaining employment are unable to continue in attendance at the Whole-time Day School Courses of the City of Dublin Vocational Education Committee will be admitted to approved Evening School Courses, without fees, up to the value of the Day School Fees paid.

The same concession may be extended to other students who have left the Day School Courses, if the reasons for their non-attendance at the Day School Classes are considered by the Principal to be adequate.

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

The Trade Classes are primarily intended for those engaged in the several trades. Others will not be admitted before November 5th, 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 continue in a Laboratory or Workshop Class if his attendance at the Lecture or Drawing Class is unsatisfactory.

A Class may be discontinued if an insufficient number of students join or attend; the number of evenings allotted weekly to a Class may be reduced if there be a falling off in the attendance. The right is reserved to close Classes for any other reason whatever.

Students must make good any damage done by them.

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

A complete course of study in any section generally occupies about three years.

Where possible, separate Classes for journeymen will be arranged in Trade subjects.

The Courses as set out are not to be considered as arbitrary, the subjects may be varied with the sanction of the Principal.

PROGRAMME and TIME TABLE

OF THE

Schools of Mechanical and Motor Car Engineering and Allied Trades

AT

Technical Institutes: Bolton Street and Ringsend

MECHANICAL ENGINEERING DEPARTMENT

Technical Institute, Bolton Street

TEACHING STAFF.

ERNEST E. JOYNT, M.I.MECH.E.—*Principal.*

A. M. McLOUGHLIN, B.A., A.R.C.SC.I.	R. B. CLARK.
W. D. PILE, A.M.I.M.E., M.I.A.E.	J. LENIHAN.
H. C. CLIFTON, B.A.	H. HOLOHAN, B.A.
W. D. HORGAN, B.A.	J. J. HUGHES.
H. C. FITZGERALD.	
M. NIALL, M.SC.	J. KELLY.
R. BENT.	J. J. REDMOND.
R. J. DOWLING, A.M.I.M.E., A.M.I.C.E.I.	E. J. KENNEDY.
P. CORMACK, F.C.SC.I., M.R.I.A.	R. BRYAN.
A. O'M. BURKE.	W. MURTAGH.
M. J. DOYLE.	J. DOOLEY.
M. BURNS, B.E.	T. J. RYAN.
W. J. ASH.	H. LYNCH.
B. E. FEE.	D. MacEOIN.

COURSES AND TIME TABLES

Bolton Street

No. of Course	Subject	Day	Hour	Room	Teacher	No. of Syllabus
	MECHANICAL ENGINEERING.					
	INTRODUCTORY					
1B	Arithmetic	Mon.	7.30–8.30	B 20	M. Burns	2
	English	Mon.	8.30–9.30	B 20	M. Burns	1
	Practical Drawing	Thurs.	7.30–9.30	A 5	B. E. Fee	3
	Practical Drawing (Metal Plate Work)	Tues.	7.30–9.30	D 2	J. Dooley	35
	FIRST YEAR.					
3B	Machine Drawing—1A ..	Mon ,Wed.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	4
	Mathematics	Fri.	7.30–9.30	C 7	J. J. Hughes	11
	Geometry or	Thurs.	7.30–9.30	B 1	R. J. Dowling	9
	Engineering Workshop—I. ..	Tue.,Thur.	7.30–9.30	D 7	J. Kelly, J. J. Redmond	22
	SECOND YEAR.					
4B	Machine Drawing—II. ..	Tues.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	5
	Mathematics II.	Wed.	7.30–9.30	B 1	H. Holohan	12
	Geometry	Thurs.	7.30–9.30	B 1	R. J. Dowling	9
	THIRD YEAR.					
5B	Machine Drawing—III. ..	Tues.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	6
	Mathematics III.	Wed.	7.30–9.30	C 7	H. C. Clifton	13
	Applied Mechanics—I. ..	Thurs.	7.30–9.30	C 8	A. McLoughlin	17
	FOURTH YEAR.					
6B	Machine Construction—IV ..	Thurs.	7.30–9.30	B 27	E. E. Joynt	7
	Mathematics—IV	Mon.	7.30–9.30	C 7	H. C. Clifton	14
	Applied Mechanics—II. ..	Tues.	7.30–9.30	C 8	A. McLoughlin	18
	Heat Engines—I.	Wed.	7.30–9.30	B 27	R. J. Dowling	20
	FIFTH YEAR.					
7B	Machine Design—V.	Thurs.	7.30–9.30	B 27	E. E. Joynt	8
	Mathematics—V.	Mon.	7.30–9.30	C 7	H. C. Clifton	15
	Applied Mechanics—III ..	Tues.	7.30–9.30	C 8	A. McLoughlin	19
	Heat Engines—II.	Wed.	7.30–9.30	A 8	P. Cormack	21
	MECHANICAL ENGINEERING TRADES.—ENGINEERING WORKSHOP PRACTICE.					
	FIRST YEAR.					
10B	Engineering Workshop—I. ..	Thurs.	7.30–9.30	D 7	J. Kelly, J. J. Redmond	22
	Machine Drawing—I.	Wed.,Mon.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	4
	Mechanics and Calculations ..	Tues.	7.30–9.30	B 20	M. Burns	16
	SECOND YEAR.					
11B	Engineering Workshop—II. ..	Wed.	7.30–9.30	D 7	J. Kelly, J. J. Redmond	23
	Machine Drawing—II. ..	Tues.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	5
	Mathematics—I.	Fri.	7.30–9.30	C 7	J. J. Hughes	11
	THIRD YEAR.					
12B	Engineering Workshop—III. ..	Fri.	7.30–9.30	D 7	J. Kelly, R. Bent	24
	Machine Drawing—III.. ..	Tues.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	6
	Mathematics—II.	Wed.	7.30–9.30	B 1	H. Holohan	12

No. of Course	Subject	Day	Hour	Room	Teacher	No. of Syllabus
	FOURTH YEAR.					
13B	Engineering Workshop—IV. ..	Fri.	7.30–9.30	D 7	J. Kelly, R. Bent	25
	Machine Construction—IV. ..	Thurs.	7.30–9.30	B 27	E. E. Joynt	7
	Mathematics—III.	Wed.	7.30–9.30	C 7	H. C. Clifton	13
	PATTERNMAKING.					
	FIRST YEAR.					
14B	Patternmaking—I.	Mon.	7.30–9.30	D 4	E. J. Kennedy	26
	Workshop Drawing and Calculations	Tues.	7.30–9.30	D 4	E. J. Kennedy	30
	SECOND YEAR.					
15B	Patternmaking—II.	Fri.	7.30–9.30	D 4	E. J. Kennedy	27
	Machine Drawing—IA. ..	Wed.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	4
	Mechanics and Calculations ..	Tues.	7.30–9.30	B 20	M. Burns	16
	THIRD YEAR.					
16B	Patternmaking—III.	Fri.	7.30–9.30	D 4	E. J. Kennedy	28
	Machine Drawing—II. ..	Tues.	7.30–9.30	A 5	W. J. Ash, B. E. Fee	5
	Mathematics—II	Wed.	7.30–9.30	B 1	H. Holohan	12
	FOUNDRY WORK.					
18B	Foundry Work—I.	Wed.	7.30–9.30	D 4	H. Lynch	29
	Workshop Drawing and Calculations	Tues.	7.30–9.30	D 4	E. J. Kennedy	30
	BRASSFINISHING.					
22B	Brassfinishing, Practical ..	Mon. Fri.	7.30–9.30	D 5	W. Murtagh	31
	Mechanics and Calculations—I.	Tues.	7.30–9.30	B 20	M. Burns	16
	Machine Drawing—IA. ..	Wed.	7.30–9.30	A 5	W. J. Ash, B. E Fee	4
	BOILERMAKING.					
26B	Boilermaking, Lectures and Drawing	Tues.	7.30–9.30	B 27	R. Bryan	32
	Boilermaking, Practical ..	Mon.	7.30–9.30	D 9	R. Bryan	33
	SMITHWORK.					
30B	Smithwork, Practical	Tue., Wed.	7.30–9.30	D 9	——	34
	Machine Drawing—IB. ..	Mon.	7.30–9.30	A 5	W. J. Ash H. C. FitzGerald	4
	ART IRONWORK.					
34B	Art Ironwork, Practical—I. ..	—	7.30–9.30	D 9	——	64
	Design—I.	—	7.30–9.30	—	——	—
	METAL PLATE WORK.					
	FIRST YEAR.					
38B	Metal Plate Work, Lecture and Drawing—I.	Tues.	7.30–9.30	D 2	J. Dooley	35
	Metal Plate Work, Practical—I.	Thurs.	7.30–10.0	D 2	J. Dooley, T. J. Ryan	36

No. of Course	Subject	Day	Hour	Room	Teacher	No. of Syllabus
	SECOND YEAR.					
39B	Metal Plate Work, Lecture and Drawing—II.	Mon.	7.30-9.30	D 2	J. Dooley	37
	Metal Plate Work, Practical—II.	Wed.	7.30-10.0	D 2	J. Dooley, T. J. Ryan	38
	THIRD YEAR.					
40B	Metal Plate Work, Lecture and Drawing—III.	Mon.	7.30-9.30	D 2	J. Dooley	37
	Metal Plate Work, Practical —III.	Wed.	7.30-10.0	D 2	J. Dooley, T. J. Ryan	38

Students are recommended to add a class in Design.

OXY-ACETYLENE WELDING.

41B	Oxy - Acetylene Welding, Practical	Fri.	7.30-9.30	D 2	T. J. Ryan	39

MOTOR CAR ENGINEERING.—COURSE FOR MOTOR CAR DRIVERS.

42B	Motor Car Engineering ..	Mon.	7.30-9.30	B 15	A. O'M. Burke	41

MOTOR CAR ENGINEERING COURSE.

	FIRST YEAR, A					
43B	Motor Car Engineering—I. ..	Tues.	7.30-8.30	B 15	A. O'M. Burke	43A
	Motor Car Electricity—I. ..	Tues.	8.35-9.35	A 6	W. D. Horgan	53
	Science—I.	Wed.	7.30-9.30	A 6	J. J. Hughes	58
	Motor Workshop Practice—I.	Thurs.	7.30-9.30	D 8	A. O'M. Burke	47
	Machine Drawing—IB. ..	Mon.	7.30-9.30	A 5	W. J. Ash H. C. FitzGerald	4
	FIRST YEAR, B					
	Motor Car Engineering—I. ..	Tues.	8.35-9.35	B 15	A. O'M. Burke	43A
	Motor Car Electricity—I. ..	Tues.	7.30-8.30	A 6	W. D. Horgan	53
	Science—I.	Fri.	7.30-9.30	A 6	M. Niall	58
	Motor Workshop Practice—I. ..	Wed.	7.30-9.30	D 8	A. O'M. Burke	47
	Machine Drawing—IB. ..	Mon.	7.30-9.30	A 5	W. J. Ash H. C. FitzGerald	4
	SECOND YEAR.					
44B	Motor Car Engineering—II. ..	Wed.	7.30-8.30	B 15	W. D. Pile	44A
	Motor Car Electricity—II. ..	Wed.	8.35-9.35	B 15	W. D. Pile	54
	Mechanics—I.	Mon.	7.30-8.30	B 27	W. D. Pile	60
	Science—II.	Mon.	8.35-9.35	A 6	W. D. Horgan	59
	Motor Workshop Practice—II., or	Fri.	7.30-9.30	D 8	A. O'M. Burke	48
	Machine Drawing—II. ..	Tues.	7.30-9.30	A 5	W. J. Ash, B. E. Fee	5

Students are recommended to add a class in Mathematics.

	THIRD YEAR, A.					
45B	Motor Car Engineering—III. A.	Thurs.	7.30-9.30	A 8	P. Cormack	45B
	Electricity—III.	Mon.	8.35-9.35	C 8	W. D. Pile	55
	Mechanics—II.	Mon.	7.30-8.30	C 8	A. McLoughlin	61
	Motor Workshop Practice—III, or	Fri.	7.30-9.30	D 8	A. O'M. Burke	49, 50
	Machine Drawing—III., or	Tues.	7.30-9.30	A 5	W. J. Ash, B. E. Fee	6
	Mathematics—II.	Wed.	7.30-9.30	B 1	H. Holohan	12

No. of Course	Subject	Day	Hour	Room	Teacher	No. of Syllabus
	FOURTH YEAR.					
46B	Motor Car Design—IV. ..	Fri.	7.30-9.30	C7	W. D. Pile.	46B
	Applied Mechanics—II. ..	Tues.	7.30-9.30	C8	A. McLoughlin ..	18
	Mathematics—III.	Wed.	7.30-9.30	C7	H. C. Clifton ..	14

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 0s. 0d. for Course of Eight Lessons.

Motor Car Driving	Sat.	*2.30-6.0	—	M. J. Doyle.. ..	—

*or other afternoons as may be arranged.

GAS ENGINEERING.

The Courses in Gas Engineering, Gas Supply, and Gas Fitting have been arranged in compliance with the requirements of the Institution of Gas Engineers for Students preparing for the Examinations prescribed by that Body.

GAS ENGINEERING.

	FIRST YEAR.					
46K	Physics	Mon.	7.30-10.0	Kevin St.	P. O'Callaghan ..	62
	Inorganic Chemistry	Tue., Wed.	7.30-10.0	Kevin St.	P. B. Foy	63
	Mathematics—I.	Fri.	7.30-9.30	C7	J. J. Hughes ..	11

GAS SUPPLY.

	FIRST YEAR.					
47K	Physics	Mon.	7.30-10.0	Kevin St.	P. O'Callaghan ..	62
	Inorganic Chemistry	Tue., Wed.	7.30-10.0	Kevin St.	P. B. Foy	63
	Mathematics—I.	Fri.	7.30-9.30	C7	J. J. Hughes ..	11

GAS FITTING.

	FIRST YEAR.					
50B	Lectures and Calculations—I...	Thurs.	7.30-9.30	B20	R. B. Clark ..	65
	Gas Fitting, Practical—IA. ..	Mon.	7.30-9.30	B21	J. Lenihan	68
	Gas Fitting, Practical—IB. ..	Wed.	7.30-9.30	B21	J. Lenihan	68
51B	SECOND YEAR					
	Lectures and Calculations—II.	Tue.	7.30-9.30	B20	R. B. Clark ..	66
	Gas Fitting, Practical—II. ..	Fri.	7.30-9.30	B21	J. Lenihan	69
	THIRD YEAR					
52B	Lectures and Calculations—III.	Tues.	7.30-9.30	B20	R. B. Clark... ...	67
	Gas Fitting, Practical—III.	Thurs.	7.30-9.30	B21	J. Lenihan	70
	Machine Drawing—I	Mon. Wed.	7.30-9.30	A5	W. J. Ash	4

IRISH.

Irish—IA.	Mon.	7.30-9.30	C2	D. S. MacEoin ..	71
Irish—IB.	Thurs.	7.30-9.30	C2	D. S. MacEoin ..	71

TECHNICAL SCHOOL RINGSEND

MARTIN KEADY, A.R.C.SC.I., B.SC. (ENG.), LOND.—*Principal.*

TEACHING STAFF

THE PRINCIPAL.

S. O. EVANS.

D. R. HARTE, B.A., B.E., A.R.C.SC.I.

I. LAMBERT, B.SC. (HONS.), H.DIP.ED.

B. DEVLIN, B.E., A.R.C.SC.I.

P. J. O'HAGAN.

J. R. EVANS.

A. MCNEIL SHAW.

J. COLEMAN.

D. FLYNN.

Time Table and Courses

INTRODUCTORY.

Subject	Section	Day	Hour	Teacher	Syllabus No.
Arithmetic	—	Monday & Friday	8.30–9.30	P. J. O'Hagan ..	2
English	—	Monday	7. 0–8.30	P. J. O'Hagan ..	1
Practical Drawing	—	Friday	7. 0–8.30	P. J. O'Hagan ..	3

MECHANICAL ENGINEERING COURSE.

FIRST YEAR.					
Machine Drawing	—	Friday	7.30–9.30	B. Devlin ..	4
Mathematics	—	Wednesday ..	7.30–9.30	P. J. O'Hagan ..	11
Geometry	—	Thursday ..	7.30–9.30	P. J. O'Hagan ..	9
Workshop Practice (Optional) ..	—	Monday	8. 0–10.0	S. O. Evans ..	22
SECOND YEAR.					
Machine Drawing	—	Friday	7.30–9.30	B. Devlin ..	5
Mathematics	—	Tuesday	7.30–9.30	P. J. O'Hagan ..	12
Mechanics	—	Monday	7.30–9.30	I. Lambert ..	18
Workshop Practice (Optional) ..	—	Monday	8. 0–10.0	S. O. Evans ..	23

MECHANICAL ENGINEERING (TRADES) COURSES.

ENGINEERING WORKSHOP PRACTICE.

FIRST YEAR.					
Fitting and Turning	—	Monday	8. 0–10.0	S. O. Evans ..	22
Machine Drawing	—	Friday	7.30–9.30	B. Devlin ..	4
Mathematics	—	Wednesday ..	7.30–9.30	P. J. O'Hagan ..	11
SECOND YEAR.					
Fitting and Turning	—	Monday	8. 0–10.0	S. O. Evans ..	23
Machine Drawing	—	Friday	7.30–9.30	B. Devlin ..	5
Mathematics	—	Tuesday	7.30–9.30	P. J. O'Hagan ..	12

SMITHWORK.

Smithwork (Practical)	—	Monday	8. 0–10.0	S. O. Evans ..	34
Machine Drawing	—	Friday	7.30–9.30	B. Devlin ..	4

OXY-ACETYLENE WELDING.

Oxy-Acetylene Welding	—	Monday or Friday	8. 0–10.0	A. McNeil Shaw ..	39
Welding Science	—	Tuesday	7.30–9.30	B. Devlin ..	40
Sketching and Drawing		Friday	7.30–9.30	B. Devlin ..	40

SYLLABUSES

SUBJECTS.

1—English.

Grammar, parts of speech, punctuation. Reading exercises from technical publications, dictation, letter and essay writing, notetaking. Lectures on simple machines.

2—Workshop Arithmetic.

Signs and symbols, factors, greatest common measure, least common multiple, fractions, decimals. Percentages, ratio and proportion, units of length, area, volume and weight. Simple mensuration.

3—Practical Drawing.

Use of instruments, lettering, simple geometrical exercises, orthographic projection. Freehand sketches of models and machine parts. Scale drawings of nuts, bolts, screw threads, bearings, brackets, couplings and other simple machine details.

4—Machine Drawing, I.

Use of drawing instruments and materials, precision exercises, orthographic projection. Use of sketch book, dimensioned freehand sketches of simple parts. Scale drawings of brackets, bearings, couplings, bolts, nuts, screws, simple engine details, valves and cocks. Explanation of features of importance in machine and engine parts, and of operations involved in their manufacture.

5—Machine Drawing, II.

Bolts, studs, screw threads, nuts, cottered connections, pins, knuckle joints. Simple journal and other bearings. Pedestals, brackets, hangers and wall boxes. Methods of lubrication. Couplings, keys and keyways. Pulleys and belt gearing. Steam and water pipes. Cylinders, covers, stuffing-boxes, pistons, piston rods, crossheads, slidebars, connecting rods, cranks, slide valves, eccentrics. Boiler construction, riveted connections, stays. Stop and safety valves, cocks. Simple details of lathes and other machine tools. Detailed and assembly drawings, dimensioning, lettering, etc.

6—Machine Drawing, III.

Crank shaft, propeller shaft, dynamo and thrust bearings. Bearing metals, lubrication. Ball and roller bearings. Couplings, clutches, universal joints. Elements of toothed gearing. Pulleys and belt gearing. Slide and piston valves, eccentrics, connecting rods, crank shafts, governors. Cylinders, pistons, packing, crossheads. Internal-combustion engine details. Pumps, hydraulic fittings and details. Boiler types, shell connections, riveting, manholes, seatings, stays. Safety and stop valves, cocks, gauges. Details of lathes, planing, shaping and drilling machines; forms of tools, drills and milling cutters. Measuring instruments, limit gauges.

7—Machine Construction, IV.

Advanced exercises in Machine Drawing, also problems involved in the design of the simpler details of machines and steam engines.

Drawing: Steam and internal-combustion engine and pump details and assemblies; valve gears, link motions, condensers, injectors, governors. Boiler arrangements, details and mountings. Toothed, belt and chain gearing. Workshop appliances, details of machine tools. Preparation of finished drawings, colouring. *Design*: Screwed connections, pins, cottered and knuckle joints, shafts, couplings, spur gearing, simple stop valves, cams, levers. Preparation of tracings for photo prints.

8—Machine Design, V.

Shafting, couplings, clutches. Screwed and cottered connections, links. Riveted joints and connections, boiler shells, flues and stays. Journals and bearings; anti-friction metal, lubrication systems. Ball and roller, pivot and thrust bearings. Spur, bevel and worm gearing. Pulley and belt gearing. Steam engine cylinders, thick cylinders. Pistons, piston rods, crossheads, connecting rods and cranks. Coupling rods, valves and valve motions, eccentrics. Flywheels and governors. Stop valves, safety and relief valves. Pumps and details. Helical springs, cams, miscellaneous machine and engine details. Simple cranes and crabs. Manufacturing operations; design applied to economy and facility of production, choice and use of materials. Drawing office methods; specifications, inspection and tests of materials.

9—Practical Geometry.

Use of instruments, setting out of angles, proportional parts; scales. Exercises on straight lines and curves. Construction of plane figures, areas of figures, and reduction of areas to equal squares, properties of the triangle and parallelogram; application to link work. Construction of angles; circular measure and trigonometrical functions of angles. Proportionals, construction and use of scales. Location of points by rectangular co-ordinates, problems on lines and circles, construction of circles from specified data, tangents, angles in segment. The ellipse; cycloidal and involute curves. Triangles, polygons and curved figures. Vectors and vector quantities, problems on uniplanar forces. Projections and methods of defining positions of points and lines in space, horizontal and vertical traces. Views of solids in various positions, alterations of ground line, inclined and vertical planes. Elevations, plans and sections of prisms, pyramids, cylinders, and cone. Interpenetrations and developments.

11—Practical Mathematics, I.

Arithmetic: Simple and compound rules, calculations of prices and costs, fractions, decimals, contracted methods, percentages, ratio and proportion, square root. *Mensuration*: Square, rectangle, triangle and circle, areas, volumes; applications of geometry to problems. *Algebra*: Symbols, the four simple rules, simple equations, evaluation and transformation of formulae, factors. Elementary graphs.

12—Practical Mathematics, II.

Arithmetic: Multiplication and division of decimals, square and cube root, ratio and variation. *Mensuration*: Areas of plane figures, Simpson's rules, area and volume of cone, cylinder and sphere. *Algebra*: Fractions and partial fractions; simple, simultaneous and quadratic equations; indices, logarithms, use of slide rule. The straight line and other simple graphs. *Trigonometry*: Radian measurement, functions of angles, simple formulae, use of tables, solution of triangles, vectors. *General*: Mass, weight, centre of gravity, work, power, velocity and acceleration.

13—Practical Mathematics, III.

Simultaneous and quadratic equations, graphical solution of equations of degree higher than the second; maximum and minimum values of quadratic and cubic expressions, logarithmic solution of equations. Applications of Simpson's trapezoidal rules. 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 $y = \sin^2 x$ and $y = \sin x$. The "root mean square" value of the ordinate.

14—Practical Mathematics, IV.

Binominal 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 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.

15—Practical Mathematics, V.

Definite integrals. Application of the calculus and of approximate methods to the determination of centres of gravity. Surfaces and volumes of solids. Guldinus' Theorems. Moments of inertia, bending moments and deflection of beams. Energy of a rotating mass, centre of pressure. 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.

16—Workshop Mechanics and Calculations.

Systems of linear, superficial and volumetric measurement. Fractions, decimals, contracted methods. Measuring instruments; fits, limits and gauges. Simple mensuration applied to workshop problems. Engineering materials; properties, applications, production and methods of working. Force, work, power. Strength of simple structures. Machine tools; types and uses. Power transmission; pulley and belt gearing, toothed gearing, wheels in train, use of change wheels in screw-cutting.

17—Applied Mechanics, I.

Force measured by its straining action; stretching of wires and springs. Stress, strain, elasticity. Moments of forces, couples, centres of gravity. Work, energy, power; diagrams of work, horse power. Friction. Simple machines, velocity ratio and efficiency. Composition, resolution and equilibrium of forces. Velocity and acceleration. Elementary hydrostatics.

18—Applied Mechanics, II.

Engineering materials, their manufacture, properties and testing. Elasticity, strain, energy, resilience, co-planar forces, stresses in framed structures. Bending moment and shearing force; moment of resistance of a beam. Strength of shafts. Friction on an incline, screw friction, mechanical efficiency. Linear and angular accelerations; their relations to mass, force and torque. Kinetic energy, flywheels. Centrifugal force, governors. Simple harmonic motion. Simple mechanisms.

19—Applied Mechanics, III.

Further treatment of testing of materials; alloy steels, heat treatment; fatigue of metals. Principal stresses. Strength and deflection of beams, distribution of shear stress. Strength and stiffness of

shafts. Combined bending and twisting. Flat and coiled springs. Struts. Coil friction. Crank effort diagrams and design of fly-wheels. Balancing of engines. Governors.

20—Heat Engines, I.

The steam engine cylinder, steam distribution, mean effective pressure, calculation of indicated, and of brake horse power. Problems on the simple slide valve. Work done per cubic foot of steam. Effects of superheating. Steam boilers; heat transmission, heating surface; boiler types. Mechanical stokers, economisers, feed-water heaters, feed pumps and injectors, superheaters; boiler efficiency. Boiler valves, mountings and fittings. Fuels, calorific value, air supply per pound of fuel, products of combustion. Transmission of heat from furnace to water, evaporation, air supply to furnace, natural and forced draught.

21—Heat Engines and Power Plants, II.

Fuels: Gas, oil and coal; commercial tests for composition and calorific value. Oil burners, stokers, pulverised fuel. Combustion; composition of fuel gases. Boilers and auxiliaries; condensers. Treatment of feed water. *Reciprocating Engines*: Steam, gas, oil and petrol. Tests and adjustments for maximum economy and efficiency. *Steam Turbines*: Modern types, principles of action. Layout of power stations. *Water Turbines*: Impulse and reaction types; tests of discharge, power, efficiency and characteristics. Speeds of modern types.

22—Engineering Workshop, I.

Fitting: Use of the hammer, chisel and file in preparation of flat surfaces. Making of templets and keys, cutting keyways. Use of compass, surface gauge and try-square in marking out work. Use of stocks and dies, and taps. Preparation of plane surfaces by use of scraper. *Turning and Machine Work*: Simple exercises in turning of pins, bolts and spindles; use of chucks and face-plates. Operations in drilling, shaping, planing and slotting machines. Forms, use and grinding of drills and cutting tools. Use of calipers, micrometer and gauges in working to precise dimensions. *Smithwork*: Simple exercises in preparing, dressing and tempering chisels and other small tools.

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.

23—Engineering Workshop, II.

Fitting: Angle and bevel gauges, squares, calipers, clamps and other bench tools. Fitting and assembling of simple machine parts. *Lathe and Machine Work*: Advanced exercises in screw-cutting; turning of bushes, brasses, engine and machine parts. Operations in milling, planing, shaping, and drilling machines. Simple exercises in grinding to fine dimensions.

24—Engineering Workshop, III.

Lathe Work: Advanced exercises in turning, boring and screw-cutting involving the assembly of component and interchangeable parts. *Machine Work*: Planing, milling and grinding operations on cylinders, pumps, connecting rods, links and various machine details. *Fitting*: Assembly of engine and machine parts. Disassembly and re-assembly of engine motion and of boiler mountings.

25—Engineering Workshop, IV.

Advanced work on Syllabus of earlier years, involving the complete turning, machine, fitting and assembly of machine and engine details requiring a high degree of accuracy and finish. The application and use of modern high-grade measuring instruments and gauges. Fine grinding operations on hardened surfaces. Production of spur and ratchet wheels; tapered work; cottered connections, screw jacks and other workshop accessories.

26—Patternmaking, I.

Selection, qualities and application of timbers and other materials used. Use of patternmaking tools and appliances, the contraction rule. Operation of wood-turning lathe. Construction of simple patterns of flanges, brackets, bearings, brasses and crocks. Corebox making; use of core prints.

27—Patternmaking, II.

Patterns of more advanced type; built-up patterns, pedestals, wall brackets, hangers, toothed wheels, pulleys, clutches, pipe bends, valves, cocks, pistons. Use of strickles and loam board.

28—Patternmaking, III.

Cylinders and connections for engines and pumps, hydraulic details. Patterns of complex nature, involving coring of passages, chambers and recesses. Patterns for ornamental castings in iron, brass and bronze.

29—Foundry Work.

Materials used; sand, loam and graphite. Foundry appliances and tools. Characteristics and properties of cast iron, brasses and bronzes. Castings in aluminium. Arrangement and management of furnaces for melting metals. Miscellaneous exercises in moulding and casting from patterns of a simple nature. Preparation and use of cores. Moulding by use of strickle.

30—Workshop Drawing and Calculations.

Orthographic projection. Simple exercises in drawing as applied to patternmaking and foundry work. Interpretation of prints and drawings of castings. Elementary calculations required for foundry work.

31—Brassfinishing.

Bench and lathe operations involved in finishing and assembly of cocks, valves, lubricators, injectors, gauges, steam whistles. Turning of screwed spindles and of balls. Preparation of small switches and other simple electrical fittings. Ecclesiastical and ornamental brasswork requiring a high degree of finish. Chasing, knurling, spinning, brazing, polishing and lacquering operations.

32—Boilermaking, Drawing.

Lectures: Elementary details of boiler construction; rivets and riveted joints; methods of closing rivets; steam tight seams; caulking and fullering. Boiler domes and manholes; furnace tubes; dished plates. Boilermaking materials. *Drawing*: Simple drawing and precision exercises. Developments of cylindrical and coned shells, riveted seams and boiler shell connections. Spacing of holes for flue tubes, stays, manholes.

33—Boilermaking, Practical.

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. 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. Flanging of boiler end plates. Oxy-acetylene processes applied to boilermakers' work.

34—Smithwork.

Making up and care of fire, varieties and qualities of fuels, smiths' tools and appliances. Forging in wrought iron, mild steel and tool steel. Welding. Forging of pins, bolts, keys, hooks, cotters, spanners, shackles, links, tongs, pincers, levers. Forging, dressing and tempering of chisels, centre punches and lathe tools. Thin, flattened and pointed forgings.

35—Metal Plate Work, Drawing and Theory, I.

Lectures: Fuels used in metal plate work. Metals: characteristics and applications of tinplate, zinc, copper and iron. Solders and brazing materials. Galvanising, tinning and re-tinning processes. Calculations of dimensions, capacities and weights of vessels of various designs.

Drawing: Geometrical problems involved in metal plate work; intersections and penetrations. Development of patterns for vessels and other objects of simple form such as:—Cylindrical pipes and branches, coned articles in two or more pieces, equal tapering bodies, baking pans; objects with combined flat and coned surfaces, tee pipes, bends in two or more pieces, V and Y pipes. Patterns for finials, simple mouldings, gutters and other roofwork details. Principal joints used in metal plate work practice.

36—Metal Plate Work, Practical, I.

Use of hand tools, cutting and bending appliances. Cutting, rolling, hammering, bending and flattening operations. Preparation of notches, allowances for lap, wiring and joining of seams and intersecting parts. Jointing, soldering, brazing, riveting and grooving

processes. Brazing in iron, copper and brass. Annealing, stretching, raising and planishing. Tinning and retinning methods. Preparation of flue and ventilating pipes and branches, hoods, ventilators, T and Y pipes, household utensils, toilet ware, baking pans and cake tins. Preparation of roof flashings, mouldings, chimney pipes and cowls, ventilators and tallboys. Plain and ornamental lamps, vases, boxes and caskets.

37—Metal Plate Work, Drawing and Theory, II., III.

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

Metals and alloys : their physical and chemical properties. Special uses of tinplate, galvanised and lead-coated iron. Fuels, solid and gaseous; their methods of application. Oxy-acetylene processes. Development of patterns of an advanced type involving triangulation methods. Development of complex patterns and mouldings, and of those required for articles to be welded, brazed, and specially treated.

38—Metal Plate Work, Practical, II., III.

In addition to advanced work on the Syllabus for the First Year, special attention will be given to the following :—Oxy-acetylene processes applied to the cutting and welding of sheet-metal objects; the choice and proper use of blowpipes, welding rods and fluxes. Oxy-acetylene methods in the treatment of sheet copper, aluminium, brass, and stainless steel. Sifbronze welding. Welding, bending and treatment of light panels. Preparation and repair of motor car wings, bonnets and radiators. Domes, finials, ships' ventilators. Lamps, vases, caskets and other ornamental work involving a high degree of finish. Flashings for domes, spires and special roof forms. Kettles, urns, boilerettes, mirrors and other domestic articles of importance.

39—Oxy-Acetylene Welding.

Low pressure acetylene generator : precautions to be observed in the preparation and use of the gas. Storage and preservation of calcium carbide. Dissolved acetylene; care of high pressure acetylene and oxygen cylinders, valves, gauges and other fittings. Choice and use of blow-pipes for various purposes. Cutting and welding processes.

Practical exercises in cutting and welding plates, angle and other sectional bars. Welding of framed structures of different designs. Oxy-acetylene methods applied to cast iron, aluminium alloys, brasses; bronzes and copper. Use of welding rods and fluxes for different metals.

40—Welding Science.

Simple chemistry of the atmosphere; oxidation and combustion. Some of the simpler elements, in particular carbon, hydrogen, iron, copper, aluminium; oxidation of these elements.

Measurement of temperature; quantities of heat; specific heat Thermal expansion and contraction. Conduction of heat.

Three states of matter—solids, liquids, gases. Melting points; conversion of liquids into gases. Solutions of solids in liquids and solids; solutions of gases in liquids and solids. Crystallisation. Changes of state in solids, recalescene, quenching, hardening, softening and tempering.

Force and fluid pressure; elementary ideas of stress and strain.

Metallurgy :—Composition and properties of the principal ferrous metals; effects of carbon, manganese, silicon, sulphur, phosphorus, oxygen and nitrogen on the strength, hardness, ductility, plasticity and malleability of steels. The effect of metallic additions made for the improvement of physical or chemical properties.

Heat treatment of metals. Normalising, annealing, hardening, tempering and case hardening.

Changes in the structure of metals due to welding and their recognition by macrographical and microscopic methods. Crystalisation. Effects of chilled casting metal. Grain, growth, overheating. Oxidising; "burning." Diffusion of carbon into weld metal.

Types of electrodes and welding rods, and their compositions. Slags and Fluxes.

Expansion and contraction; stresses resulting therefrom in welds.

Modes of testing welds, destructive and non-destructive.

Cast iron and alloy steels.

Composition and properties of the non-ferrous metals, principally copper, aluminium and some of their alloys.

Sketching and Drawing :—Freehand sketching, and drawing to scale of simple elements of machines and structures. The dimensioning and reading of drawings. Sketches showing assembling of elements and methods of holding them in place during welding.

41—Motor Car Engineering (Lecture).

Chassis arrangement. Simple petrol engine, construction and operation; the power system, valve mechanism, engine types. Cooling and lubrication systems. Principles and operation of carburettor; description of typical carburettors. Gravity and vacuum petrol feeds. Elementary electrical principles; battery and coil ignition, magnetos. Transmission arrangements; clutches, change speed mechanisms, propeller shafts, universal joints. The final drive; differential, back axles. The front axle; steering action, principles and mechanism. Brakes, types and methods of operation. Springs, types, and method of action. Torque reaction; thrust systems, chassis lubrication, care of tyres. Construction and upkeep of secondary batteries.

42—Motor Car Engineering (Lecture).

Cylinder types, pistons, piston and oil rings, gudgeon pins, connecting rod and bearings. Crankshaft arrangements, main bearing adjustment. Valves and valve mechanisms, valve and ignition timing. More advanced construction of carburettors, their adjustment and operation. Engine temperatures, the cooling system, lubrication. Clutches, their construction, various types. Sliding gear and epicyclic change speed mechanisms, universal joints. Rear axles, arrangement and stresses. The suspension system. Front axle and construction in relation to steering, steering columns and mechanism. Various types of brakes.

43a—Motor Car Engineering.

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 carburetter; description of popular carburettors. Ignition systems.

Simple lubricating systems. Cooling. Construction of common types of clutch; change speed mechanisms. The rear axle; chassis suspension. Brakes. Steering mechanisms and front axles.

43b.

Preparation of engine for starting, preparation of car for starting, car manœuvring. Simple maintenance work, including chassis lubrication, brake adjustment, detachable wheel work and tyre manipulation. Exercises worked by students on the four stroke cycle, four stroke engine and exercises to make clear the principles of operation of clutch, gears, etc.

44a—Motor Car Engineering, 2nd Year.

Four and six cylinder engines, general description, construction and operation of the various forms of clutches and change speed gears in common use, the steering mechanism, brakes and braking, universal joints and transmission to road driving wheels, fuel and ignition systems, operation, maintenance and location of simple faults in the complete power unit, car manœuvring.

44b.

General maintenance work such as outlined in car makers' instruction books. Lubrication of complete chassis. Checking of units and parts for loose assemblies, rigging, etc. Study of the behaviour of the running engine under various conditions. Systematic location of simple engine faults.

45a—Motor Car Engineering, 3rd Year.

Systematic location of engine faults arising under the various headings, engine and chassis maintenance in detail including periodic attentions to fuel and ignition systems, locating and practical treatment of troubles arising in clutches, gears, steering and braking systems.

45b—Motor Car Engineering (Lecture), 3rd Year.

More advanced treatment of the subject matter of the Second Year of the Course.

Petrol; commercial tests, comparison with other fuels, carburation, weak and rich mixtures, maximum power and maximum economy mixtures. Carburettors and petrol feed systems. Otto and Diesel cycles. Torque-speed and power-speed curves. Engines, stresses in parts, balance, vibration. Gears and gear-cutting. Transmission and control systems, calculation of stress. Lubricants: viscosity, determination of flash point.

46A—Motor Car Engineering, 4th Year.

The subject matter of the earlier Years of the Course will be dealt with in its higher stages, with particular reference to advanced maintenance work and the systematic location of the more obscure engine faults.

46B—Motor Car Design, 4th Year.

The application of the fundamental laws of mechanics and geometry to elementary problems in motor car design. Proportioned drawings and sketches of details of engine power and valve systems, clutches, gear boxes, rear axles and other important details. Calculations of gas and inertia pressures, crank pin bearing areas, frictional torque in clutches, dimensions of shafts, strength of gear teeth, bearing loads, brake leverages, etc.

47—Motor Workshop Practice, 1st Year.

Vicework and simple fitting work involving the use of hand and bench tools and including filing, chipping, marking out, use of tools for measuring and testing, drilling, reaming, scraping, tapping and screwing, punching, drifting, riveting, grinding, soldering, brazing, simple pipework in copper and the working of sheet metal by hand methods. Making of simple hand tools and appliances for use in the garage.

48—Motor Workshop Practice, 2nd Year.

More advanced bench and fitting work. Simple forging operations, including drawing out, bending, straightening and truing of bent and deformed parts. Simple exercises involving the use of the lathe and drilling machine. Pipework in copper and steel. Spring making and wire working. Annealing, hardening, tempering and case-hardening.

49—Motor Workshop and Garage Practice, 3rd Year.

Forging, bench and vicework, lathework, including screw-cutting, boring and taper turning, drilling, planing, milling. Treatment of problems requiring special tools, materials and equipment. More advanced operations in decarbonising and valve re-seating. Fitting of gudgeon pins, piston-rings, and big end bearings. Bushing and reaming. Installation of ball and roller bearings. Re-lining brakes and clutches.

50—Motor Workshop and Garage Practice, 4th Year.

Various practical forging, fitting, turning, drilling and other machine tools operations. Toolmaking; oxy-acetylene processes. Advanced engine fitting work including re-metalling bearings, aligning and bedding in crankshaft, lapping and grinding operations, scraping, taper and parellel reaming. Chassis frame and unit alignment and setting. Axle straightening. Spring setting.

51A—Garage Practice, 1st Year.

Use of spanners, pliers, screwdrivers, hand brace, files and other small tools. Use of bolts and nuts, removal of stubborn nuts and studs. 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, fitting bearings, adjustment of ball and roller bearings.

51B.

Preparation of engine for starting. Preparation of car for starting. Car manœuvring. Simple maintenance work including chassis lubrication, brake adjustment, detachable wheelwork and tyre manipulation. Exercises worked by students on the four stroke cycle (four cylinder engine). Exercises to make clear the principles of operation of clutch, gear, etc. Systematic location of the simpler engine faults.

52A—Garage Practice, 2nd Year.

More advanced exercises in disassembling and re-assembling. Adjustment of taper and roller bearings. Decarbonising. Truing, facing and re-seating valves. Adjustment of clutches. Valve and

ignition timing. Carburettor overhauls. Maintenance work on electrical equipment such as truing of points, brush races, fitting and bedding of brushes, skimming of commutators, etc.

52B.

General maintenance and servicing work. Lubrication of complete chassis. Checking of units and parts for loose assemblies, rigging, etc. Study of the behaviour of the running engine under various conditions. Systematic location of faults in the power unit arising under the various headings.

53—Motor Car Electricity, I.

General effects of the electric current. Applications of these effects. Control of the current. General circuit considerations. Idea of resistance. Series and parallel circuits. Switches and switching devices. Current strength and unit. Electrical pressure. Ohms law. Power and power measurement. Sources of electrical energy. Primary cells. Principles and action of lead accumulator. Battery charging. Magnetism; electro magnetism; electro magnets; factors governing their strength. Applications of the electro magnet. Electromagnetic induction. Simple qualitative treatment of the dynamo. The car charging circuit.

54—Motor Car Electricity, II.

Revision of electromagnetic induction. The induction coil, simple and multicylinder ignition. Multi-trembler, master trembler, synchronised trembler; coil ignition. Modern form of battery and coil ignition for four and six cylinder engines. Principle and use of condenser. Ignition timing. Automatic advance and retard mechanism.

Practical care, maintenance and testing of car batteries. Principle and action of the magneto. L.T. and H.T. magneto. Rotating armature, rotating magnet and polar inductor magnetos. Practical dismantling and re-assembling of magnetos.

Principle and action of dynamo. Study of the shunt machine characteristics. Battery charging circuit on car. Necessity for the "cut out." Examination of various types of "cut out." Third brush regulation.

Principle of the electric motor. Motor starters. The Bendix drive.

55—Motor Car Electricity, III.

More detailed study of the dynamo. Practical determination. Dynamo characteristics for separately excited, series, shunt and compound wound machines. Practical examination of behaviour of the third brush dynamo. Other methods of car dynamo voltage and output regulation. Constant current, constant potential vibrating regulators. Thermostatic control. Reversed series control. Armature reaction control methods. Further work on "cut-outs." Cases where "cut out" may be dispensed with. Freewheel dynamo drives. Examination of car switchboards. Practical wiring of complete lighting and charging circuits for typical car equipments, *e.g.*, Lucas, Rotax, C.A.V., etc.

Car starter types and circuits. The dynamotor.

56—Motor Car Electricity, IV.

Practical wiring on the cars of typical lighting and starting sets. Dynamo construction, armature windings. Testing of dynamo armatures and fields. Location and remedy of dynamo defects. Location and remedy of faults in ignition circuits, coil and magnetos. Dual and duplex ignition circuits. Use of the electrical test bench. Battery testing and repairs.

Study of the electric motor. Series, shunt and compound H.P. output and torque. Types of electric motor starters. The Bosch equipment. The Bendix drive. Starter relay switches. Car wiring of starter circuits. Examination of the dynamotor. Delco circuits.

57—Automobile Electrical Equipment, Testing and Repair.

Testing, repair, and adjustments of car electrical equipment, such as dynamos, starters, magnetos, ignition coils, "cut outs," batteries, horns, general wiring, etc.

58—Science, I. (Motor Car Engineering).

General Physics: British and metric units of length and mass. Density. Pressure of liquids and gases, atmospheric pressure, Boyle's law, the Principle of Archimedes.

Heat: Temperature, expansion, thermometers, the units of quantity. Change of state, melting and boiling points, vaporisation, condensation. Conduction, convection, radiation.

Chemistry: Chemical change, the meaning of combustion, oxides, the air, brief study of oxygen, nitrogen, sulphuric acid and hydrogen.

59—Science, II. (Motor Car Engineering).

Heat: Expansion of solids, liquids and gases, with arithmetical treatment. Calorimetry, specific and latent heats.

Properties of vapours, diffusion of gases, kinetic theory of gases.

Chemistry: Molecules and atoms, elements and compounds, chemical symbols, the atomic theory, atomic weights, quantitative notation, valency.

Water, carbon, carbon dioxide; carbon monoxide; carbides; combustion; ignition point; flame; the Bunsen burner. Hydrochloric acid, zinc chloride. Lead, its oxide and sulphate, brief treatment of iron, aluminium, tin and zinc. The paraffin group.

60—Mechanics, I. (Motor Car Engineering).

Use of vernier and micrometer. Computation of areas by mid-ordinate and other rules. Force, moments of forces, levers, wheel and axle, screw jack, wheel trains. Speed, mechanical advantage and efficiency of machines. Work, power, horse power. Heat and power. Graphical representation of forces. Applications of mechanical principles to motor car problems.

61—Mechanics, II. (Motor Car Engineering).

Gearing; velocity ratio of wheel trains. Work and energy. Indicated and brake horse power; analysis of indicator diagrams; R.A.C. rating; mechanical efficiency. Mechanical equivalent of heat, calorific value of a fuel; thermal efficiency. Torque, couples; tractive effort deduced from engine torque; variation of torque in crankshaft; relation between horse power and torque; strength of shafts. Friction. Force, motion and inertia; centrifugal force. Balancing of rotating masses; inertia of reciprocating parts. Composition, treatment and testing of steels and other materials of construction.

62—General Physics (Gas Engineering).

Measurement of length, area and volume. Motion, mass, force. Newton's laws, 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 determinations, flotation, atmospheric pressure, Boyle's law. Thermometry, measurement of temperatures, expansion of solids, liquids, and gases. Measurement of heat quantities, specific heats, fusion, latent heat, vaporisation, vapour pressure. Study of steam, hygrometry, mechanical theory of heat, convection, conduction, radition. 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.

63—Inorganic Chemistry (Gas Engineering).

Lectures: General properties of matter, elements and compounds, chemical and physical changes, conservation of matter. Water, quantitive composition. Metals, electrolysis, hydrogen, solubility in water, other solvents. Crystallization, oxygen, acid forming oxides, basic oxides. Atmosphere, Boyle's and Charles' laws. 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, nitrogen peroxide, nitrous acid, nitrites, nitrous oxide. Law of multiple 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. Carbon monoxide, 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 and 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 of N.T.P. Alkalies; properties and reactions with acids, indicators, preparation and crystallisation of simple salts, simple determinations of equivalents. Recognition of chlorides, sulphates, sulphites, sulphides, carbonates, nitrates and nitrites.

64—Art Ironwork.

Iron, its nature and properties, various kinds of iron used by art ironworkers; tools, their application and uses. Treatment and manipulation of wrought-iron; forging, welding, jumping, bending and embossing. Methods of joining ironwork, operations in art-smithing; riveting, intersecting, slitting, tenoning, shrinking on collars. Twisting scrolls and volutes.

65—Gas Fitting, Lectures and Calculations, I.

Gas fitting tools, design, use and maintenance. Gas piping; pipe fitting materials and their applications. Joints, jointing materials, solders and fluxes. Gas fitting screw threads. Meters, description; use and fixing. Gas burners, cookers, grillers, radiators, boilers and other gas-fired familiar domestic appliances.

Simple calculations of areas and volumes; cubic contents of tanks, vessels, apartments, etc. Meter reading; units employed in gas measurements; elementary treatment of pressure gauges and recorders.

66—Gas Fitting Lectures, II.

Blown, screwed and flanged joints; testing and precautions against accidents. Meters; types, connections, reading of indices. Gauges; burners for lighting, heating and cooking appliances; burner governors. Description and fixing of domestic cookers, grillers, gas fires, radiators, geysers, etc.

Physical properties of materials used for gas pipes and fittings; their reaction to stretching, compression, bending and twisting; effects of heat on materials.

Gauges; gauge pressures; pressure required for various gas appliances. Volumetric and pressure governors.

67—Gas Fitting Lectures III.

Internal gas pipes and fittings: joints, pipe laying, lighting fittings; testing for soundness; detection and correction of faults. Relation between loss of pressure, bore and length of pipe and capacity; other circumstances affecting pressure. More advanced treatment of meters, governors and gauges. Illumination; lighting schemes; burners; shades; reflectors and chimneys. Domestic cookers and heaters; water heating: principles of hot water circulation; appliances and fittings; thermostats. Principles of ventilation. Physical effects of heat: temperature, British Thermal Unit. Precautions to be observed in working with gas; method of dealing with gassing.

68—Gas Fitting, Practical, I.

Gas fitting tools, use, care and upkeep. Cutting and screwing iron, brass and copper tubing. Formation of parallel and taper screw threads; use of stocks, dies and taps. Drilling operations. Simple exercises in joint blowing, pipe fitting, bending and jointing.

69—Gas Fitting, Practical, II.

More advanced work on the Syllabus of the First Year and, in addition—

Examination and practical study of L.P. lighting burners and lamps; ventilation arrangements; gas and air controls. Burners and castings of small cooking stoves; oven ventilation; spacing of hot plate burners; small gas circulators, burners, waterways and flues. Domestic gas irons; radiators; flueless heaters; thermostatic control arrangements. Gas connections to lighting fittings, burners and gas fires; regulating devices. Pipe-work testing for soundness with gauge; fixing of small type meters. The use of U tubes for ascertaining pressures.

70—Gas Fitting, Practical, III.

Joint making in larger sized pipes; saddle joints; large screwed connections. Bending larger lead and iron pipes. Use of pressure gauge for locating stoppages. More advanced work on lighting fixtures, gas fires, radiators, cookers, geysers and hot water circulating arrangements, adjustment of thermostats. Practical study of recent improvements.

71—IRISH.

Conversation lessons on simple matters such as the name, home or residence, salutations, the clock, days of the week, months and seasons, the weather, money, easy counting, colours, etc. Location of objects in the classroom and neighbourhood, parts of the body and clothing, giving and carrying out simple orders. With the conversational lessons the student will be familiarised with the use of *is* and *tá,* and of verbal nouns.

Memorising of simple songs, rhymes, stories, etc., so as to be able to repeat them with correct *blas*. Short stories and recitations.

Each student will keep a note-book to record the salutations phrases, etc., in correct Irish.