
Prospectus: Kevin Street

Kevin Street College

1941

Technical Institute, Kevin Street : Prospectus, 1941- 42

City of Dublin Vocational Education Committee

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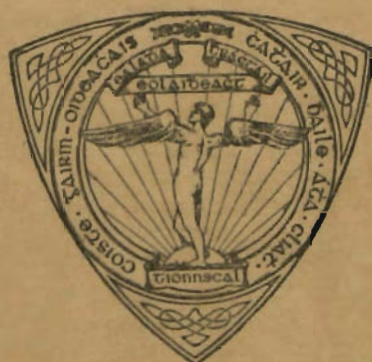


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City of Dublin
Vocational Education Committee

SCOILEANNA CEÁRD-OIDEACÁIS
Cátrac Áta Cliač

seisiún
1941-42



Session
1941-42

Schools of Science and Technology
The Technical Institute, Kevin St.

PROSPECTUS

CALENDAR—SESSION 1941-42.

1941—SEPT. 1, MONDAY	Whole-time Day Schools open for enrolment, and Day Apprentice School resumes work.
SEPT. 8, MONDAY	Part-time Day Classes open for enrolment and Whole-time Day Schools commence work.
SEPT. 15, MONDAY	Evening classes open for enrolment and Part-time Day classes commence work.
SEPT. 22, MONDAY	Evening classes commence work.
NOV. 1, SATURDAY	<i>All Saints Day.</i> Whole-time Day Schools excepting Day Apprentice School and Special classes closed.
DEC. 8, MONDAY	<i>Feast of Immaculate Conception.</i> Whole-time Day Schools excepting Day Apprentice School and Special classes closed.
DEC. 13, SATURDAY	Teaching work in Whole-time Day Schools ceases—excepting Day Apprentice School and Special classes.
DEC. 15, MONDAY	Term Examinations in Whole-time Day Schools commence.
DEC. 20, SATURDAY	Last meeting of classes before Christmas Vacation.
1942—JAN. 5, MONDAY	All classes resume work after Christmas Vacation.
JAN. 6, TUESDAY	<i>Feast of the Epiphany.</i> Whole-time Day Schools excepting Day Apprentice School and Special classes closed.
MAR. 17, TUESDAY	<i>St. Patrick's Day.</i> Schools closed.
MAR. 31, TUESDAY	Last meeting of Day and Evening classes before Easter Vacation.
APR. 8, WEDNESDAY	All classes resume work after Easter Vacation.
MAY 1, FRIDAY	Evening classes close—excepting where otherwise arranged.
MAY 14, THURSDAY	<i>Ascension Day.</i> Whole-time Day Schools—excepting Day Apprentice School and Special classes—closed.
MAY 25, MONDAY	<i>Whit-Monday.</i> Schools closed.
JUNE 4, THURSDAY	<i>Feast of Corpus Christi.</i> Whole-time Day Schools—excepting Day Apprentice School and Special classes closed.
JUNE 20, SATURDAY	Teaching work ceases in Whole-time Day Schools excepting Day Apprentice School and Special classes.
JUNE 22, MONDAY	Seasonal Examinations commence in Whole-time Day Schools excepting Day Apprentice School and Special classes.
JUNE 27, SATURDAY	Whole-time Day Schools and Part-time Day Domestic Economy classes close—excepting Day Apprentice School and Special classes.
JUNE 29, MONDAY	<i>Feast of Saints Peter and Paul.</i>
JULY 11, SATURDAY	Day Apprentice School and other classes close excepting where otherwise arranged

Schools closed on all Bank Holidays not specified in above Calendar

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THE CITY OF DUBLIN VOCATIONAL EDUCATION COMMITTEE

COMMITTEE

Alderman C. BREATHNACH, LL.D., T.D. (Chairman), 384 Clontarf Road.
Councillor M. O'SULLIVAN, P.C. (Vice-Chairman), 74 Ballymun Road,
Glasnevin.
Councillor Mrs. K. CLARKE, Baymount, 95 Clontarf Road.
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" P. BELTON, T.D., Bellevue Park, Killiney.
" J. J. BYRNE, B.A., B.L., 60 Talbot Street.
" FINTAN BURKE, 4 Wilfield Road, Ballsbridge.
Miss HELENA MOLONY, 48 Fleet Street.
MICHAEL O'FOGHLUDHA, 5 Cabra Road.
Mr. M. P. ROWAN, 52 Capel Street.
Dr. LORCAN G. SHERLOCK, 18 Kildare Street.
Mr. W. J. WHELAN, 35 Lower Gardiner Street.
Mr. M. L. COLGAN, 6 Gardiner's Row.

Head Offices :—
Technical Institute,
Bolton Street,
Dublin.

L. E. O'CARROLL, B.A., B.L.,
Chief Executive Officer.

Tel. No. 43553.

TECHNICAL INSTITUTE, KEVIN STREET LOCAL COMMITTEE

Alderman C. BREATHNACH, LL.D., T.D., 384 Clontarf Road (*ex-officio*).
Rev. M. GERAGHTY, C.C., The Presbytery, High Street.
Senator D. D. HEALY, T.C., P.C., 40 Usher's Quay.
Dr. LORCAN G. SHERLOCK, 18 Kildare Street.
Mr. W. J. WHELAN, 35 Lower Gardiner Street.
Mr. J. W. KELLY, 16 St. Joseph's Parade, Nelson Street.
Mr. J. ANDREWS, B.Sc., Messrs. A. Guinness, Son and Co., James's Street.

E. MORTON, B.Sc., A.R.C.Sc.I.,
Hon. Secretary.

Technical Institute,
Kevin Street.
Tel. No. 51801.

ADVISORY SUB-COMMITTEE

BAKERY AND CONFECTIONERY TRADES

Mr. J. SWIFT; Mr. P. McDARBY; Mr. M. CONROY; Mr. P. O'NEILL;
Mr. G. DALY; Mr. J. KELLY; Mr. L. KENNEDY and
Mr. H. E. O'DONOHUE.

GENERAL REGULATIONS

DAY AND EVENING COURSES AND CLASSES

ADMISSION.

In general applicants for admission to classes must not be under fourteen years of age.

ENTRANCE EXAMINATION.

Intending students may be required to pass an entrance test, or give evidence of a satisfactory standard of education. Introductory Courses are provided for those who fail to reach the entrance test standard.

ENROLMENT.

Whole-time Day Courses Week commencing 1st September.

Part-time Day Courses Week commencing 8th September.

Evening Courses Week commencing 15th September.

COURSES.

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

TRADE CLASSES.

The Trade Classes are primarily intended for those engaged in the several trades ; where possible separate classes for journeymen will be arranged in trade subjects.

ATTENDANCE.

Punctual and regular attendance of students will be insisted upon. Those who are absent from more than two consecutive class meetings, without assigning a satisfactory reason, may have their names removed from the Class Roll. When this has been done, students can be restored to their places only by the special permission of the Principal.

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 is a falling-off in the attendance. The right is reserved to those classes for any other reason whatever.

DISCIPLINE.

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

DAMAGE TO SCHOOL PROPERTY.

Students wilfully damaging School property may be required, on order of the Committee, to pay for such repairs or replacements as may be necessary.

CLOAKROOM AND BICYCLE HOUSES.

The authorities of the School do not accept responsibility for articles left in any part of the School premises.

BOOKS, STATIONERY AND EQUIPMENT.

Students are expected to provide themselves with such books, stationery and equipment as may be required.

SCHOOL CHOIRS AND DRAMATIC CLASSES.

The Committee is prepared to facilitate the organisation of Choral and Dramatic Societies and similar activities. Students interested are invited to communicate with the Principal.

REGULATIONS IN REGARD TO FEES

All fees must be paid on enrolment.

Where a student elects to enrol in any particular Institute for certain classes, a transfer to one of the other Technical Institutes for similar classes without payment of the full enrolment-fee, can only be made by special permission.

Students who, through obtaining employment or other valid reason, are unable to continue in attendance at current Whole-time Day Courses, may be admitted to approved Evening School Courses in the current Session with a remission of fees up to the value of the Day School Fees paid.

FEES

DAY COURSES.	£	s.	d.
Applied Science (Whole-time) per Session	6	0	0
Bakery Practice (Part-time) do.	0	7	6
Certificate Course in Breadmaking (Part-time) do.	0	15	0
Certificate Course in Flour Confectionery do.	0	15	0
Cinema Projection Technology (Part-time) do.	0	10	0
Electrotechnology and Engineering Science (Whole-time)			
per Session	1	0	0
Electrical Installation Work (Whole-time) do.	1	0	0
Radio Engineering (Whole-time) do.	3	0	0
 Wireless Telegraphy :—			
*Marine Operators' Certificate Course	12	0	0
*Aircraft Operators' Certificate Course	12	0	0
*Combined Course	16	0	0
Radiotechnology (Part Course)	2	0	0
Direction-Finding (Part Course) per Month	1	0	0
Morse Practice (Part Course)..... per Month	0	7	6

EVENING COURSES : ART, SCIENCE, TECHNOLOGY,
TRADES.

			£	s.	d.
Applied Chemistry	.....	per Session	0	15	0
Medical Chemistry	.....	do.	1	10	0
Pharmaceutical Chemistry (Lectures)		do.	1	10	0
Ditto, ditto (Lab. 120 hours)	.....	do.	0	15	0
Ditto, ditto (Practice)	.....	do.	0	10	0
Pharmacy (Practical)	.....	do.	0	15	0
Specialised Technical Analysis	.....	do.	0	15	0

Wireless Telegraphy :—

*Marine Operators' Certificate Course	.....		4	0	0
*Aircraft Operators' Certificate Course	.....		4	0	0
*Combined Course	.....		5	0	0
Radiotechnology (Part Course)	.....		1	0	0
Direction-Finding (Part Course)		per Month	0	7	6
Introductory Courses	.....	per Session	0	2	6

All other Courses in this section—7/6 for each year of Course.

Students of Evening Technical Courses may take a class in Irish at a fee of 2/6.

(* Fees for Certificate Courses in Wireless Telegraphy are inclusive for the full period of training up to certification.)

SCHOOLS OF SCIENCE AND TECHNOLOGY TECHNICAL INSTITUTE, KEVIN STREET.

(Telephone 51801)

STAFF :

E. MORTON, B.S.C., A.R.C.S.C.I. *Principal and Head of the Schools of Physics, Electrical Engineering and Chemistry.*

MATHEMATICS, PHYSICS.

HENRY C. CLIFTON, B.A.; FRANCIS NOLAN, M.S.C.; P. J. O'CALLAGHAN, B.S.C., A.R.C.S.C.I.; M. HENDERSON, B.E.; E. HYNES, B.E.; J. M. FORDE, B.E.; H. FLOOD, B.S.C., A.R.C.S.C.I.; E. MOYNIHAN, B.S.C., A.R.C.S.C.I.; P. WHELAN, B.S.C., A.R.C.S.C.I.; B. J. DIXON, B.S.C., A.R.C.S.C.I.; D. W. MORRISSEY, B.S.C.

APPLIED CHEMISTRY AND BIOLOGY.

W. J. LOOBY, B.S.C., A.R.C.S.C.I., H.DIP.ED.; B. G. FAGAN, B.A., B.S.C., F.I.C., A.R.C.S.C.I.; P. J. HURLEY, M.S.C.; H. D; THORNTON, B.S.C., A.R.C.S.C.I.; F. J. BARRAGRY, M.P.S.I.; G. A. WATSON, B.S.C., A.R.C.S.C.I.; M. J. GORMAN, B.S.C., A.R.C.S.C.I.; J. H. FERGUSON, Tech. Dip. (Milling); JOHN SHIEL, M.D., B.L., PH.C.; D. W. MORRISSEY, B.S.C.

ELECTROTECHNOLOGY, TELECOMMUNICATIONS.

W. FEGAN, A.M.I.E.E.; GEO. K. RING, B.E., A.R.C.S.C.I., B.S.C.; HAROLD A. HODGENS, R.O., Tech. Dip.; J. J. O'DOHERTY, B.S.C., B.E., A.M.I.E.E.; B. MANGAN, B.E.; W. O'CONNOR, B.E.; T. J. CARROLL, R.O., Tech. Dip.; E. HYNES, B.E.; H. DE LACY, B.E.; J. HONAN, R.O.; P. CONLON, Tech. Dip.; P. SULLIVAN, Tech. Dip.; H. J. BARRISCALE, B.E.; A. D. WHELAN, B.E.; J. WILLIAMS.

TRADES and HANDICRAFTS

MICHAEL LAMBERT	.....	.....	Instrument Making.
W. J. BRADY, TECH.DIP.	.....	.....	Glass Blowing.
E. J. McNAMARA	.....	.....	Electrical Installation Work.
J. RYAN	—	—	Do.
J. O'TOOLE	.....	.....	Electric Welding.
M. O'KEEFE	.....	.....	Electric Cable Jointing.
A. MULVANEY, TECH.DIP.	.....	.....	Do.
P. J. CASEY	.....	.....	Boot Manufacture.
S. ANTHONY, TECH.DIP.	.....	.....	Breadmaking and Flour Confectionery.

LANGUAGES : 'INTRODUCTORY COURSES

W. O'BRIEN, DIP.ING.	.....	.....	Technical German.
F. NOLAN, M.SC.	.....	.....	Do.
P. O RIAIN	.....	.....	Irish.
S. E. MAC CORMAIC	.....	.....	Continuation Subjects.
J. MOYNIHAN	—	—	Continuation Subjects and Irish.

ART and ARTISTIC CRAFTS

WILLIAM L. WHELAN, Art Master's Certificates, Board of Education, London, Silver and Bronze Medalist, National Competition, South Kensington; Medalist, Irish National Art Competition—*Head of the Arts and Crafts Department.*

JAMES J. BURKE, Certificated Art Teacher, London, Medalist.

MISS MARGARET WHELAN, Certificated Art Teacher, Medalist.

SCHOOLS OF ELECTRICAL ENGINEERING, RADIO TECH-
NOLOGY, PHYSICS AND APPLIED CHEMISTRY

PROGRAMME AND TIME-TABLE

OF THE COURSES IN

Electrical Engineering Practice and Technology

Electrical Trades and Crafts

Instrument Making and Allied Crafts

Radiotelegraphy

Physics and Mathematics

Pure and Applied Chemistry

Industrial Chemistry—Specialised Courses

Bacteriology and Botany

Pharmacy and Allied Subjects

Languages for Students of Technology

SESSION 1941-42

SCHOOLS OF ELECTRICAL ENGINEERING, RADIO TECHNOLOGY, PHYSICS AND APPLIED CHEMISTRY

DAY COURSES

Full-time Course—Electrotechnology and Engineering Science

(Session—October to July)

The Course provides a pre-apprenticeship training of a high standard suitable for those who intend to enter Electrical Trades or the offices of Consultant Engineers or Electrical Contractors.

The Course is designed to cover two Sessions and provides approximately 25 hours of instruction per week in Mathematics, Physics, Chemistry, Mechanics, Electrical Technology and Workshop Practice, and in Irish, English and Physical Training.

Intending students should not be over sixteen years of age and should have attained a minimum standard of general education equivalent to that of the Second Year of the Intermediate Course in Secondary Schools.

Sessional Fee, £1.

Full-time Courses for the Training and Certification of Radio Officers (Mercantile Marine and Aircraft)

See pages 22-42 relative to Time Tables, Syllabuses and Conditions of Admission to Courses.

Full-time Course—Radio Engineering and Radio Service.

(Session—October to May).

The Course is designed to be of practical service to those who desire a fundamental understanding of the principles of Radio Communication and of Service Work in connection with the installation and maintenance of Radio Apparatus and Equipment.

The Syllabuses of Instruction are based on those of the City and Guilds of London Institute. Students are expected to sit for the examinations of the Institute in both Radio Service and Radio Communication.

Intending students should not be under 16 years of age and should have, at least, a knowledge of Direct Current Electricity up to the standard of the Elementary Grade Examination of the Department of Education.

The Course provides approximately 20 hours of instruction per week in Technical Electricity, Radio Communication, Radio Service and in the related Mathematics and Physics. Students of the course may take related Evening Classes on two evenings per week.

Inclusive Sessional Fee, £6.

Full-time Course—Applied Science and Mathematics

(Session—October to July)

The Course provides a thorough general scientific training suited to the requirements of students who intend to enter scientific occupations as Pharmaceutical Chemists, Opticians, Radiologists, etc., or who desire to train for entrance to some branch of Chemical or Engineering Industry having a scientific basis.

The subjects of instruction include Mathematics (Geometry, Co-ordinate Geometry, Algebra, Trigonometry, Calculus Elements); Applied Mathematics; Physics, Chemistry; Botany; Biology.

The Syllabuses of instruction generally conform with those of the Department of Education (T.I.B.) and also approximate to those for the Matriculation Examination of the National University.

The requirements of the student for specialised instruction in any particular branch of Applied Science or Industrial Technology are provided in Evening Classes; students attending the Day Course may take specialised Evening Classes on two evenings per week.

Inclusive Sessional Fee, £6.

Part-time Courses—Science and Technology

(Session—October to July)

Classes of established Courses in one or more of the specialised subjects listed hereunder may be taken on payment of the appropriate fees.

<i>Subject</i>	<i>Day</i>	<i>Hour</i>	<i>Fee per Session</i>
{ Chemistry (Lectures)	Thurs., Fri.	9.30-10.30	£1
	Do. (Lab.)	Thurs., Fri.		10.30-12.30
Special Laboratory Course	Tuesday	9.30-12.30	£1
{ Physics (Lectures)	Mon., Wed.	9.30-10.30	£1
	Do. (Lab.)	Mon., Wed.		10.30-12.30
Biology (Lec. & Pract.)	Tues.	5.30-7.0	
	Thurs.	5.0-6.30	£1
Mathematics	Mon., Wed., Fri.	2.0-3.30	£1
Applied Mathematics	Tues., Thurs.	2.0-4.0	£1
Electrical Technology (D.C.; A.C.)	(6 Hours per week)		£1
Electrical Installation Technology	(6 Hours per week)		£1
Technical Drawing	(6 Hours per week)		£1

Part-time Courses—Practical Pharmacy

The Courses are intended for Pharmaceutical students preparing for the Final Examinations of the Pharmaceutical Society of Ireland.

Three Courses are conducted in each session, *viz.*, one Course in each of the three School terms, *viz.*, Winter, Lent and Summer terms.

There are approximately twelve class meetings to each course. Classes meet on Wednesday and Thursday afternoons from 3 to 6 p.m.

Course Fee, 15/-.

DAY COURSES FOR TRADE APPRENTICES

Full-time Courses—Electrical Installation Work and Electrotechnology

These Courses are conducted under special schemes making provision for the full technical training of Electrical Apprentices during the five-year period of Apprenticeship. The schemes have the co-operation of Trade Unions and Employers.

Courses provide 33 hours of instruction per week in Electrical Theory and Experimental Work, Engineering Science, Mathematics, English (Précis and Report Writing), Technical Drawing, Electrical Installation and Fitting Work.

The syllabuses of instruction are based on those for the Department of Education Examinations in Electrical Installation Work and in Electrical Engineering Practice. By arrangement with the Department of Education, students sit for the Junior and Senior Trade Tests and for the Technological Examinations at appropriate stages in the instruction.

The duration of the Courses, depending on the particular scheme, varies between 3 months and 6 months in each year of Apprenticeship.

Fee for each Course, £1.

Part-time Courses—Projection Science and Technology (Cinema Apprentices)

The Courses are designed to provide for the technical training of Cinema Apprentices employed in the Dublin Area, and are organised in co-operation with the Trade Union and the Irish Cinema and Theatre Managers' Association.

The Courses extend over three Sessions and provide a minimum of four hours of instruction per week in Mathematics, Elementary Science, Light and Sound, Technical Electricity, Electrical Reproduction of Sound, and Sound Head Amplifier Equipment.

The Session extends from October to mid-June in each year.

Fee for each Course, 10/-.

SCHOOLS OF ELECTRICAL ENGINEERING, RADIO TECHNOLOGY, PHYSICS AND APPLIED CHEMISTRY
EVENING DEPARTMENT.

CERTIFICATE COURSES AND EXTERNAL EXAMINATIONS.

The attention of Students is directed to the Examinations in Art, Engineering and Chemical Technology, and Craft subjects conducted under the auspices of the Department of Education, the City and Guilds of London Institute, and Professional Institutions, such as the Institution of Electrical Engineers, the Institute of Gas Engineers, etc.

When deciding on a Course of Study the intending student should consult the Principal or a Lecturer. It is important that the Course prescribed should meet not only the educational requirements of the student, but also lead to his or her acquirement of a Technical Qualification of high standing in Industry. Such qualifications are of definite value to the holders when seeking employment or betterment of position.

Established Courses as listed hereunder are conducted in relation to the examination requirements of the several authorities named.

COURSE	EXAMINATION SYLLABUSES
Breadmaking and Flour Confectionery.	City and Guilds (Lond.)
Brewing	City and Guilds (Lond.)
Electrical Engineering Practice	{ City and Guilds (Lond.) Department of Education Institution of Electrical Engineers
Electrical Installation Work	

COURSE	EXAMINATION SYLLABUSES
Flour Milling	City and Guilds (Lond.)
Gas Engineering and Supply	{ City and Guilds (Lond.) Institution of Gas Engineers.
Line Telegraphy, Telephony	{ Department of Education City and Guilds (Lond.)
Milk Processing	City and Guilds (Lond.-)
Oils, Fats and Waxes	City and Guilds (Lond.)
Paints and Varnishes	City and Guilds (Lond.)
Petroleum Products	City and Guilds (Lond.)
Physics and Applied Chemistry	Department of Education
Pharmaceutical Chemistry and Allied Subjects.	Pharmaceutical Society of Ireland
Radio-Communication	{ City and Guilds (Lond.) Institute of Electrical Engineers
Radio Service Work	City and Guilds (Lond.)
Radio-Telegraphy, -Telephony (Aircraft and Marine Radio Officers).	Department of Posts and Telegraphs.

Further information in regard to Schemes of External Examinations may be had on request to the Principal.

Schools of Electrical Engineering, Radio Technology, Physics and Applied Chemistry

Evening Courses and Time Table

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
SPECIAL CLASSES IN IRISH.					
	Irish—L.C.	Monday	7.30-9.30		P. O. Riain.
	Irish—I.D.	Friday	7.30-9.30		Do.
INTRODUCTORY COURSES					
4K	English—F	Tuesday	7.30-8.30	13	S. E. MacCormaic.
	Elementary Mathematics—F	Tuesday	8.30-9.30	13	S. E. MacCormaic.
	Elementary Science—A	Friday	7.30-9.30	8	E. Moynihan.
5K	English—G	Thursday	7.30-8.30	16	S. E. MacCormaic.
	Elementary Mathematics—G	Thursday	8.30-9.30	16	S. E. MacCormaic.
	Drawing—F	Wednesday	7.30-9.30	14	Miss M. Whelan.
ELECTRICAL TRADES					
ELECTRICAL INSTALLATION WORK.					
FIRST YEAR.					
6K	Electrical Wiring—Pract. I	Mon. or Fri.	7.30-10.0	1	E. J. McNamara
	Electrical Engineering—Lect. I	Wednesday	7.30-8.30	12	E. Moynihan.
	Electrical Laboratory—I	Wednesday	8.35-10.0	8	E. Moynihan; H. Flood.
	Physics for Electricians	Tuesday	7.30-10.0	8	H. Flood; M. Henderson.
SECOND YEAR.					
7K	Electrical Wiring—Pract. II	Thursday	7.30-10.0	1	E. J. McNamara.
	Electric Installation—Lect. II	Tuesday	7.30-8.30	4	W. Fegan.
	Electrical Engineering—II	Monday	7.30-10.0	6	H. De Lacy; A. D. Whelan.
ELECTRICAL FITTING.					
THIRD YEAR.					
8K	Electrical Fitting—Pract.	Wednesday	7.30-10.0	1	E. J. MacNamara.
	Electrical Engineering—(D.C. and A.C.)	Thursday	7.30-10.0	6	W. Fegan.
	Technical Drawing	Friday	7.30-10.0	14	J. Williams.
CABLE JOINTING.					
9K	Cable Jointing	Mon. & Wed. Tues. & Thurs.	8.0-10.0	18	P. O'Keefe.
ELECTRIC WELDING.					
10K	Electric Welding	Mon. Tu. Wed. Thurs. Fri.	8.0-10.0	5	J. O'Toole.

No. of Courses	SUBJECT	Day	Hour	Room	TEACHER
ELECTROTECHNOLOGY					
ELECTRICAL ENGINEERING PRACTICE.					
FIRST YEAR.					
11K	Electrical Engineering—I.A. Physics for Electricians—I.A.	Thursday ... Monday ...	7.30-10.0 7.30-10.0	12-10-8 8	H. Flood; E. Moynihan. H. Flood; M. Henderson.
12K	Electrical Engineering—I.B. Physics for Electricians—I.B.	Wednesday Tuesday ...	7.30-10.0 7.30-10.0	12-10-8 8	E. Moynihan; H. Flood. H. Flood; M. Henderson.
SECOND YEAR.					
13K	Electrical Engineering—II ... Mathematics—II. C. ... Technical Drawing—II. ...	Monday ... Friday ... Wednesday ...	7.30-10.0 7.30-9.30 7.30-10.0	11-4-6 4 14	G. Ring; H. De Lacy. A. D. Whelan. A. D. Whelan. H. J. Barriscale.
THIRD YEAR.					
14K	Electrical Engineering—III ... Applied Mechanics—I ... Mathematics ...	Wednesday Friday ... Thursday ...	7.30-10.0 7.30-10.0 7.30-10.0	4-6 9 8	G. Ring; W. Fegan. F. Nolan. D. W. Morrissey.
FOURTH YEAR.					
15K	Electrical Engineering—A.C. Practical Mathematics ...	Tuesday ... Thursday ...	7.30-10.0 7.30-9.30	4-6 11	G. Ring. D. W. Morrissey.
FIFTH YEAR.					
16K	Electrical Engineering—IV ... Power Plants and Producers	Tues., Thurs. Wednesday	7.30-10.0 7.30-10.0	4-6 AS*	G. Ring; W. Fegan.
SIXTH YEAR.					
17K	Electrical Engineering—V ... *Mathematics ...	Tues., Thurs. Mon. or Fri.	7.30-9.30 7.30-9.30	28-8 B2*	J. J. O'Doherty. H. C. Clifton.
POST OFFICE ENGINEERING COURSES					
TECHNICAL TELEGRAPHY.					
FIRST YEAR.					
18K	Technical Telegraphy—I ... Magnetism and Electricity ...	Thursday ... Friday ...	8. 0-10.0 7.30-10.0	26 12-8	P. Sullivan. P. O'Callaghan.
SECOND YEAR.					
19K	Technical Telegraphy—II ...	Tuesday ...	8. 0-10.0	16	P. Conlon.
TECHNICAL TELEPHONY.					
FIRST YEAR.					
20K	Technical Telephony—I ... Magnetism and Electricity ...	Wednesday Friday ...	8. 0-10.0 7.30-10.0	8 12-8	P. Sullivan. P. O'Callaghan.
SECOND YEAR.					
21K	Technical Telephony—II ...	Tuesday ...	8. 0-10.0	11	B. Mangan.
POST OFFICE ENGINEERING.					
22K	Post Office Engineering—I ... Instrument and Wiring (Pr.)	Monday ... Friday ...	8. 0-10.0 8. 0-10.0	5 11 & 6	H. J. Barriscale. H. J. Barriscale.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
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RADIO TECHNOLOGY**RADIO COMMUNICATION.**

FIRST YEAR.					
23K	Radio Communication—I	Tuesday	8. 0-10.0	8	J. Carroll.
	Magnetism and Electricity—I	Friday	7.30-10.0	12 & 10	P. J. O'Callaghan.
SECOND YEAR.					
24K	Radio Communication—II	Tuesday	8. 0-10.0	9	H. De Lacy.
	Electrical Engineering (A.C.)	Thursday	7.30-10.0	4 & 6	G. Ring.

RADIO-SERVICE.

FIRST YEAR.					
25K	Radio Service—I	Monday	8. 0-10.0	9	J. Carroll.
	Magnetism and Electricity—I	Friday	7.30-10.0	12 & 10	P. J. O'Callaghan.
SECOND YEAR.					
26K	Radio Service—II	Thursday	8. 0-10.0	9	H. Hodgens.
	Radio Communication—I	Tuesday	8. 0-10.0	9	F. Nolan.

MORSE PRACTICE.

27K	Telegraphy Practice	Mon., W., Th.	7.30-9.30	13	J. V. Honan.
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TRAINING COURSES FOR RADIO OFFICERS

(See Page 43)

INSTRUMENT MAKING AND GLASS BLOWING**INSTRUMENT MAKING.**

FIRST YEAR.					
28K	Instrument Making—I	Tuesday	7.30-10.0	2	M. Lambert.
	Elementary Science	Friday	7.30-9.30	8	E. Moynihan.
SECOND YEAR.					
29K	Instrument Making—II	Friday	7.30-10.0	2	M. Lambert.
	Electrical Engineering—I, or	Tuesday	7.30-10.0	12-10-8	E. Moynihan.
	Physics—I	Monday	7.30-10.0	12 & 10	P. J. O'Callaghan.

GLASS BLOWING OF SCIENTIFIC APPARATUS.

30K	Glass Blowing	Mon., W., Fri.	7.30-10.0	27	W. G. Brady.
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PHYSICS AND MATHEMATICS**GENERAL PHYSICS.**

31K	*Physics I (General and Heat)	Monday	7.30-10.0	10 & 12	P. J. O'Callaghan; P. Whelan.
32K	*Physics II (Light and Sound)	Wednesday	7.30-10.0	9 & 10	P. J. O'Callaghan; P. Whelan.
33K	*Physics III (Magnetism and Electricity)	Friday	7.30-10.0	12 & 8	P. J. O'Callaghan; B. Dixon; P. Whelan M. Henderson.
34K	Mechanics I (Elements)	Thursday	7.30-9.30	8-15	F. Nolan.
35K	Mechanics II	Tuesday	7.30-10.0	25	J. M. Forde.

(*A Class in Mathematics may be taken in addition).

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
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SPECIAL COURSES

- * ELECTRICITY FOR RADIOLOGISTS.
- * PHYSICAL OPTICS.
- * OPTICAL INSTRUMENTS.

* The Special Courses listed above may be organised in the Session 1941-41. Intending students should consult the Principal.

MATHEMATICS.

39K	Mathematics—I	Friday	7.30-9.30	4	A. D. Whelan.
40K	Mathematics—II	Friday	7.30-9.30	11	D. W. Morrissey.
41K	Mathematics—III	Monday	7.30-9.30	B 2	H. C. Clifton.
42K	Mathematics (Tutorial Class).	Friday	7.30-9.30	28	H. C. Clifton.

(MATHEMATICS.—Students should consult the Principal before enrolling).

PURE AND APPLIED CHEMISTRY

APPLIED CHEMISTRY (GENERAL).

FIRST YEAR.					
43K	Inorganic Chemistry, Lecture	Tuesday	7.30-8.30	25	G. A. Watson; H. Thornton.
	Laboratory—I	Tuesday	8.35-10.5	21	G. A. Watson; H. Thornton.
	Do.	Wednesday	7.30-10.0	21	G. A. Watson; H. Thornton.
	Physics—I	Monday	7.30-10.0	10	P. O'Callaghan.
SECOND YEAR.					
44K	Inorganic Chemistry, Lecture	Monday	9. 5-10.5	25	G. A. Watson.
	Chemical Analysis—II	Tuesday	7.30-10.0	22	G. A. Watson.
		Monday	7.30-9. 0	22	G. A. Watson.
	Physics—II. A.	Wednesday	7.30-10.0	9 & 10	P. J. O'Callaghan.
THIRD YEAR.					
45K	Inorganic Chemistry, Lecture	Thursday	7.30-8.30	25	H. Thornton; B. G. Fagan.
	Chemical Analysis—III	Friday	7.30-10.0	22	H. Thornton; B. G. Fagan.
		Thursday	8.35-10.5	22	H. Thornton; B. G. Fagan.
	Physics II. B.	Wed.	7.30-10.0	10	P. J. O'Callaghan.
FOURTH YEAR.					
46K	Organic Chemistry and	Thursday	7.30-10.0	22	B. G. Fagan; H. Thornton.
	Technical Analysis—IV	Friday	7.30-10.0	22	B. G. Fagan; H. Thornton.
FIFTH YEAR.					
47K	Organic Chemistry and	Thurs., Fri.	7.30-10.0	22	B. G. Fagan; H. Thornton.
	Analysis—V	Thurs., Fri.	7.30-10.0	22	B. G. Fagan; H. Thornton.

PHYSICAL CHEMISTRY.

48K	Physical Chemistry—Lecture	Thursday	7.30-10.0	23	P. O'Callaghan.
	Physical Chemistry—Laboratory	Thursday	7.30-10.0	23	P. O'Callaghan.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
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INDUSTRIAL CHEMISTRY

SPECIALISED COURSES IN TECHNICAL ANALYSIS.

FOOD AND DRUGS.

49K | Technical Analysis ... | Thurs. & Fri. | 7.30-10.0 | 22 | B. G. Fagan; H. Thornton

OILS AND FATS.

50K | Technical Analysis ... | Thurs. & Fri. | 7.30-10.0 | 22 | B. G. Fagan; H. Thornton

GAS MANUFACTURE.

51K | Technical Analysis ... | Thurs. & Fri. | 7.30-10.0 | 22 | B. G. Fagan; H. Thornton.

COURSE FOR DIPLOMA OF VETERINARY STATE MEDICINE EXAMINATION.

52K | Technical Analysis ... | Thurs. & Fri. | 7.30-10.0 | 22 | B. G. Fagan; H. Thornton.

TESTING OF PETROLEUM PRODUCTS (FUEL OILS AND LUBRICANTS).

53K | Technical Analysis ... | Thurs. & Fri. | 7.30-10.0 | 22 | B. G. Fagan; H. Thornton.

TECHNOLOGY OF MANUFACTURES

BREWING SCIENCE AND CHEMISTRY OF FERMENTATION.

54K | Lecture and Laboratory ... | Friday ... | 6.0-8.0 | 23 | W. J. Looby.

BAKERY AND MILLING SCIENCE.

55K | Lecture and Laboratory ... | Thursday ... | 7.30-10.0 | 10 | P. Whelan.

INDUSTRIAL BACTERIOLOGY AND ENZYME CHEMISTRY.

56K | Lecture and Laboratory ... | Tuesday ... | 7.30-10.0 | 23 | W. J. Looby.

MILK PROCESSING AND MILK PRODUCTS MANUFACTURE.

57K | Lecture and Laboratory ... | Fri., Wed. ... | 8.0-10.0 | 23 | M. J. Gorman.

CEREAL CHEMISTRY AND FLOUR MILLING TECHNOLOGY.

INTERMEDIATE COURSE—Stages I & II

58K | Flour Milling Principles ... | Monday ... | 7.30-10.0 | 28 | J. H. Ferguson.

| Milling Science ... | Thursday ... | 7.30-10.0 | 10 | P. Whelan.

FINAL COURSE—Stages III & IV

59K | Milling Technology ... | Wednesday ... | 7.30-10.0 | 28 | J. H. Ferguson.

| Cereal Science ... | Monday ... | 7.30-10.0 | 23

TECHNOLOGY OF PAINT AND VARNISH MANUFACTURE.

60K | Lecture and Laboratory ... | Wednesday ... | 7.30-10.0 | 21 | G. A. Watson.

CHEMISTRY FOR PHOTOGRAPHY, PHOTO-MECHANICAL PROCESS WORK, LITHOGRAPHY, ETC.

61K | Lecture and Laboratory ... | Thursday ... | 7.30-9.30 | 22 | P. Nolan.

CHEMISTRY AND BOTANY FOR SEEDSMEN.

62K | Lecture and Laboratory ... | Thursday ... | 7.30-9.30 | 23 | W. J. Looby.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
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MEDICAL CHEMISTRY

63K	Medical Chemistry—Lect.	Wed., Fri.	7.30-8.30	25	P. J. Hurley ; D. W. Morrissey.
	Do. Lab.	Monday	7.30-10.0	21	P. J. Hurley ; D. W. Morrissey.
	Do. Lab.	Friday	8.30-10.0	21	P. J. Hurley ; D. W. Morrissey.

COURSES FOR PHARMACEUTICAL CHEMISTS

* LECTURE CERTIFICATE COURSE IN PHARMACEUTICAL CHEMISTRY.

(September to May).

64K	Chemistry and Physics, Lect.	Mon. & Fri.	7.30-8.30	25	P. J. Hurley.
	Do. do. Lab.	Mon. & Fri.	8.30-10.0	21	P. J. Hurley.
	(Optional)				

* POST-LECTURE CERTIFICATE COURSES IN PRACTICAL CHEMISTRY.

(September to February ; February to May ; May to August).

65K	Chemical Laboratory (120 hours)	Mon., Wed., Thursday.	7. 0-10.0	21	P. J. Hurley.
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PRACTICE COURSES IN PHARMACEUTICAL CHEMISTRY.

(September to January ; January to April ; May to August).

66K	Chemical Laboratory	Wed. & Thurs.	7. 0-10.0	21	P. J. Hurley.
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* BOTANY.

(September to May).

67K	Botany	Thursday	7. 0-8.30	23	W. J. Looby.
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* MATERIA MEDICA.

(September to May).

68K	Materia Medica	Thursday	8.30-9.30	23	Dr. J. Shiel.
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** Courses recognised by the Pharmaceutical Society of Ireland.*

PRACTICAL PHARMACY.

(September to January ; January to May ; May to August).

69K	Lecture and Practical	Mon., Tues., Thurs., Fri.	7.30-10.0	24	P. J. Barragry.
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LANGUAGE COURSES

IRISH FOR STUDENTS OF SCIENCE AND TECHNOLOGY.

70K	Irish	Wednesday	8. 0-10.0	24	
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GERMAN FOR STUDENTS OF SCIENCE AND TECHNOLOGY.

71K	German—I	Wednesday	8. 0-10.0	11	W. O'Brien.
	German—II	Thursday	8. 0-10.0	28	W. O'Brien.

School of Radio Telegraphy

DAY AND EVENING COURSES FOR THE TRAINING
AND CERTIFICATION OF RADIO OFFICERS FOR THE
MERCANTILE MARINE AND AIR SERVICES.

DAY COURSE.

SUBJECT	Section	Day	Time	Room	TEACHER
Radio Technology	A.	Mon., Wed., Thurs.	10.30-11.30	11	H. Hodgens.
" "	B.	Tues., Wed., Fri.	3.0-4.0	11	H. Hodgens.
Practical Radio	A.	Mon., Wed., Thurs.	11.30-12.30	11	H. Hodgens.
" "	B.	Tues., Wed., Fri.	2.0-3.0	11	H. Hodgens.
Direction Finding	A.	Tuesday	10.30-11.30	11	H. Hodgens.
Aircraft Radio	A.	Friday	10.30-11.30	11	H. Hodgens.
Electricity and Magnetism	A.	Tuesday, Friday	11.30-12.30	9	W. Fegan.
" " "	B.	Monday	2.0-4.0	4	W. Fegan.
" " "	B.	Thursday	10.30-12.30	9	W. Fegan.
" " "	C.	Wednesday	10.30-12.30	9	F. Nolan.
" " "	C.	Thursday	2.0-4.0	10	F. Nolan.
Rules and Regulations	A.	Tuesday, Friday	2.30-3.0	13	J. Honan.
" " "	B.	Thursday	3.0-4.0	13	J. Honan.
" " "	C.	Monday	3.0-4.0	13	J. Honan.
Aircraft Procedure and Regulations.	A.	Wednesday	3.0-4.0	13	J. Honan.
Morse Code Practice and Traffic Working	A. B. C.	Daily	10.0-12.30 2.0-4.0	13	J. Honan.

EVENING COURSE.

SUBJECT	Day	Hour	Room	TEACHER
Telegraphy Practice (including handling of radio-telegrams).	Monday	7.30-9.30	13	J. V. Honan.
	Wednesday	7.30-9.30	13	J. V. Honan.
	Thursday	7.30-9.30	13	J. V. Honan.
	Friday	7.30-9.30	13	J. V. Honan.
*Technical and Practical Radio Direction Finding.	Tues., Wed.	8.0-10.0	11	H. Hodgens.
Electricity and Magnetism	Friday	7.30-9.30	8	P. O'Callaghan.
*Alternate Current Lecture and Laboratory (May to July).	Wednesday	7.30-10.30	6	G. Ring.

*Students of Day and Evening Courses in Radiotelegraphy may attend the Course in Alternate Current.

Courses and Syllabuses

ELECTRICAL ENGINEERING, RADIO TELEGRAPHY, APPLIED PHYSICS AND CHEMISTRY.

INTRODUCTORY COURSE (ELECTRICAL).

Subjects.

ENGLISH.

WORKSHOP ARITHMETIC.

ELEMENTARY SCIENCE, *or*

PRACTICAL DRAWING.

ENGLISH.

Grammar : parts of speech, punctuation, letter and essay writing, notetaking, dictation and reading from technical journals, lectures on simple electrical apparatus and machinery.

WORKSHOP ARITHMETIC.

Signs and symbols, factors and powers, G.C.M. and L.C.M. fractions, simplification and conversion to decimals ; decimals and metric system, percentages, ratio and proportion, units of length, 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 use in electrical engineering.

ELEMENTARY SCIENCE.

Units : length, area, volume and mass. Force and moment of a force ; lever ; balance. Density. States of matter and change of state. Pressure. Heat and temperature. Centigrade and Fahrenheit scales. Demonstration of effect of heating solids,

liquids and gases; expansion, conduction, convection and radiation. Evaporation and boiling. The Calorie-specific heat. Distinction between chemical and physical changes. Study of nature and action of air. Heating of metals in air; change of appearance and weight; rusting of iron; meaning of burning or combustion. Inactive and active constituents of air. Preparation of oxygen and examination of its properties. Preparation of hydrogen and examination of properties. Oxidation of hydrogen. Action of metals on acids; sulphuric, nitric and hydrochloric acids. Elementary ideas on formation of salts with mention of copper sulphate, ammonium chloride, silver nitrate, and zinc chloride. Decomposition of water by the electric current and identification of the products of decomposition; relative amounts of oxygen and hydrogen evolved. Production of an electric current; using any two dissimilar metals and a mineral acid. Necessary elements of a primary cell. Magnetism; properties of a magnet; lines of force; magnetic field. Magnetisation of iron. Comparison of magnetic properties of soft iron and hard steel. Magnetic field around a straight current-carrying conductor; circular conductor; solenoid. Polarity of solenoid. Electromagnet and electric bell. Leclanche and Daniell cells; examination of; determination of positive and negative poles; conventional direction of current; polarisation. Potential; analogy of "head of water" and "current strength" of water flow with electrical potential and current. Chemical effect of current; revision; passage of current through acidulated water; anode and cathode. Copper voltameter (expt.). General effect of electrolysis; electrolytes; Definition of ampere in terms of electro-deposition of copper (silver). Conductors and insulators. Resistance; ohm defined. Potential; volt defined assuming Ohm's law). Electric circuit; use of ammeter and voltmeter; general statement of Ohm's law. Application of Ohm's law to whole or part of circuit. The "Polarisation Effect" in cells. Secondary cells. Elementary ideas of "capacity" of an accumulator. Construction of the commercial storage cell. Resistances in series and in parallel. Resistance of a cell. Calibration of an ammeter (copper voltameter). Calibration of a voltmeter (using standard resistance and ammeter). Measurement of resistance by the ammeter; voltmeter method. Heating effect of a current. Electrical

heating apparatus. Variation of resistance with change of temperature of pure metals, alloys, carbon and electrolytes. Use of Nichrome, Manganese, etc., in making resistance coils. Joule's Law; Joule defined; relation between the Calorie and the Joule. Glow lamps and arc lamps. Electromagnetism and electromagnetic induction; Lenz's law.

PRACTICAL DRAWING.

Use and care of instruments; scales; lettering and simple geometrical exercises on lines and circles; projections of solids; freehand sketching and measurement of models; methods of making drawings of simple parts of machines and apparatus.

FIRST YEAR COURSE IN ELECTRICAL ENGINEERING PRACTICE.

Subjects.

ELECTRICAL ENGINEERING.

MATHEMATICS, MECHANICS AND DRAWING.

(PHYSICS FOR ELECTRICIANS).

ELECTRICAL ENGINEERING.

FIRST YEAR.

Phenomena of electric charges and currents; lines of force; types of magnetic fields; electro magnets, permanent magnets, and their applications; conductors and insulators; difference of potential; primary cells; volts, amperes and ohms; Ohm's law; galvanometers; ammeters and voltmeters; resistance and methods of measurement; specific resistance; temperature co-efficient; thermal effects of currents; incandescent lamps; attainment of steady temperature; simple photometry; fuses; heaters and radiators; Joule's, Watt's, and B.O.T. units; Coulombs; potential and other factors governing size of cables; description and grading of cables; electric arc-switches; chemical effects of a current; electro-deposition; secondary cells and batteries; internal resistance; divided circuits and currents; grouping of cells; electro-magnetic induction; spark coil; simple action of the dynamo.

SCIENCE, MATHEMATICS, AND DRAWING.

(Physics for Electricians).

Units; ; length, area, volume and mass. Force and moment of a force lever balance; weighing density. States of matter and change of state. Properties of materials. Strength, hardness, tenacity, divisibility, ductility, elasticity, porosity. Liquids; capillarity, absorption of water by various materials. Exclusion of water by impregnation and protective coverings. Solvents and solutions. Pressure. Heat and temperature. Centigrade and Fahrenheit scales. Demonstration of effect of heating solids, liquids and gases. Expansions. Transfer of heat by conduction, connection and radiation. Evaporation and boiling. Calorie-specific heat. Distinction between chemical and physical changes. Study of nature and action of air. Heating of metals in air; rusting of iron; meaning of burning and combustion. Inactive and active constituents of air. Preparation of oxygen and examination of its properties; oxidation; oxides. Preparation of hydrogen and examination of its properties. Oxidation of hydrogen. Action of metals on acids; sulphuric, nitric, and hydrochloric-acids; salt formation. Decomposition of water by the electric current; identification of products of decomposition. Production of electric current using any two dissimilar metals and a mineral acid. Revision. Force. Work done by a force. Transformation of Work into Heat. energy. Various forms of energy. Conservation of energy. Transformation of chemical into electrical energy. Transformation of electrical energy into various forms. *Mechanics*.—Concrete illustrations of electrical and mechanical forces; parallelogram of forces; resolving forces; triangle and polygon of forces. Moments, parallel forces, centres of gravity, loaded beam. Couples. Electrical and mechanical examples. *Mathematics*.—Fractions and decimals; curtailment of unnecessary figures. Measurement and calculation of perimeters, cross-sectional areas, surfaces volumes, and weights of simple details of apparatus in metric and British systems. The triangle, rectangle, circle, cylinder, cone and frustum. Square root. Percentage. Sine, cosine, and values for 0, 30, 45, 60 and 90 degrees. Use of tables. *Drawing*.—Simple geometrical figures and hexagons, ellipses and polygons to scale from specified dimensions to illustrate distributing networks.

SECOND YEAR COURSE IN ELECTRICAL ENGINEERING PRACTICE.

Subjects.

ELECTRICAL ENGINEERING.

MATHEMATICS.

MACHINE DRAWING.

ELECTRICAL ENGINEERING.

SECOND YEAR.

Practical units for current, voltage, resistance power and energy; Ohm's law; resistances in series and parallel; measurement of resistances; Wheatstone bridge; use of megger; ohmmeter and generator, and voltmeter for measuring instruments; electrical and mechanical properties of conductors and insulators; magnetic induction; simple theory of the dynamo; construction and functions of different parts of direct current dynamo; shunt series and compound windings; deduction of the formulae for generated volts; motors, general principles of action; starters and regulators; reversal rotation in series; shunt and compound wound motors; commonly occurring faults and wrong connections; secondary cells, installation and maintenance, direct current transmission and distribution circuits; simple calculations thereon; types of electric lamps; illumination tests and calculations; alternating currents; single phase; elementary theory of construction of alternator; frequency; effect of self-induction and capacity; lag and lead; choking coil; resistance and impedance; power in single-phase circuits, inductive and non-inductive; principle of action of the transformer; A.C. motors; elementary treatment of the production of a rotating magnetic field by two and three-phase currents in order to explain the action of induction motors.

MATHEMATICS.

SECOND YEAR.

Arithmetic.—Fractions and decimals. Contracted methods. Use of logarithms and slide rule. Calculations based on electrical and physical data.

Algebra.—Simple equations in one or two unknowns and their graphical solution. Indices. Factors. Straight-line law. Use of formulae.

Trigonometry.—Trigonometrical ratios. Circular measure. Solution of rightangled triangles.

Applications to Mechanics.

The lever, pulley-block, screw-jack, hydraulic press ; mechanical advantage ; resultant pull of field-magnet poles upon armature core ; velocity and acceleration ; lineal and angular ; law connecting force, mass and acceleration ; work, energy and power ; calculation of brake-horse-power ; efficiency ; friction ; calculation of brush friction loss.

MACHINE DRAWING.

SECOND YEAR.

Freehand diagrammatic sketches of electrical apparatus, and the conventional drawing of circuits and connections, such as those associated with measuring instruments, storage batteries and direct current machines. Freehand and scale drawings of bearings, shaft, armature core, field-magnets, brush holders, switches, and other simple parts of direct current machines.

THIRD YEAR COURSE IN ELECTRICAL ENGINEERING COURSE.

Subjects.

ELECTRICAL ENGINEERING.

APPLIED MECHANICS.

POWER PLANTS AND PRODUCERS.

ELECTRICAL ENGINEERING.—THIRD YEAR.

Materials.—Conductors ; electrical and mechanical properties, resistivity, conductivity, temperature effects ; insulators, properties, temperature and moisture effects. *Electrical Circuits :* Units ; Ohm's law ; parallel and series circuits ; energy ; drop in P.D. in feeders ; Kirchoff's laws. *Magnetic Materials.*—Properties of iron and steel ; hysteresis and permeability ; laws of and calculations on magnetic circuits. *Instruments.*—Principles of types of ammeters, voltmeters, wattmeters and watt-hour-meters ; calibration and tests ; measurement of resistances ; test sets.

Generators.—Principles of armature windings; armature reaction and commutation; shunt and series and compound dynamos; losses, operation, tests and characteristics. *Motors.*—Principles, force, torque, B.H.P.; series shunt and compound motors; losses, characteristic curves, efficiencies and tests; motor starters, controllers, speed control; parallel running of machines; batteries: types, maintenance and uses; transmission of power; boosters, balancers, etc. *Electrical Lighting.*—Lamps; types used, construction and efficiencies; principles of photometry and of illumination. *Traction.*—Motors used; control, speed-time curves, etc.

II.—MECHANICS.—SECOND YEAR.

Displacement, velocity and acceleration; motion of a body with constant acceleration; resolution and composition of velocities, accelerations, etc.; mass and momentum; force as measured by the rate of change of momentum; Newton's laws of motion; kinetic energy and work; units of force and measurement; balances of forces; torques and moments; condition for the equilibrium of three parallel forces; resolution and composition of co-planar parallel forces; centre of gravity; stable, unstable, and neutral equilibrium; equilibrium of three forces not parallel triangle and parallelogram of forces; moments; polygon of forces; work, energy, power, friction; simple machines, velocity ratio, mechanical advantage, efficiency, principle of work; pressure in liquids, variations with depth; transmission of liquid pressure, hydraulic press; pressure on immersed and floating bodies; density, methods of determining relative densities; relation between volume and pressure in gases; atmospheric pressure.

MATHEMATICS III.—THIRD YEAR.

Indices, logarithms and slide rule; Napierian logs; simple equations, simultaneous equations, quadratic equations; use of formulae; miscellaneous problems in solution of triangles; plotting of functions. Graphic solutions of equations; determination of mean values and areas. Deduction of laws between two variables from observed data. Trigonometrical ratios of angles of any magnitude. Addition formulae. Slope of straight line and of a curve. Vectors and elementary applications of Vector algebra to alternate current theory.

FOURTH AND HIGHER YEARS' COURSES IN ELECTRICAL ENGINEERING PRACTICE.

Subjects.

ELECTRICAL ENGINEERING.

MATHEMATICS.

POWER PLANTS AND PRODUCERS.

ELECTRICAL ENGINEERING.—FOURTH AND HIGHER YEARS.

General consideration of alternating E.M.F. and current; maximum R.M.S. and average values; inductance, reactance, and impedance; capacity and condensers; vectors and their application to A.C. circuits; power and power factor; iron, properties and measurement of losses in iron; wave forms and harmonics production of polyphase currents, three-phase circuits; power in polyphase circuits, methods of measurement of power; rotating fields; transformer; construction, types, principles, performance, tests; auto-transformer; principle and uses; transformer connections, phase-transformations; alternators; construction, principles, performance and tests; armature windings, common types; synchronous motors, principles, performance and tests; methods of starting and synchronising; induction motor; construction, types, principles and performance; vector and circle diagrams, tests; rotary converter; principle, voltage, ratios, performance and uses; commutator motors; general principles of operation; repulsion motors; principles of operation; motor converters; principles of operation; transmission; voltage drop due to resistance capacity and inductance; comparison of efficiency of methods of transmission.

MATHEMATICS.—FOURTH AND HIGHER YEARS.

Simultaneous equations of three unknowns; simple cases of the binomial theorem; values of $\sin 2A$ and $\cos 2A$ in terms of $\sin A$ and $\cos A$; value of $\tan (A \pm B)$ in terms of $\tan A$ and $\tan B$; values of $\sin A \pm \sin B$ and $\cos A \pm \cos B$ in terms of the sines and cosines of half the sum and difference of A and B ; solution of triangles; sum of the series $\sin a + \sin (a+d) + \sin (a+2d) \dots$ to n terms; calculation of hysteric co-efficient from hysteresis curve of sample of iron; graph of $I = Ae^{mt} + \sin mt$; t being time

and I current ; measurement of slope at a point on sine and other curves such as those representing $y=e^x$ and $y=e^{ax}$; simple differentiation with respect to x , of forms such as ax^n and ax^n ; n being 1, 2, 3, or 4 ; $a \sin x$, $a \cos x$, $a \tan x$; $a \sin bx$, $a \cos bx$, $a \tan bx$; $\log x$ —simple integration of forms such as ax^n and ax^n in which $n=1, 2, 3$, or 4 ; $a \sin bx$, $a \cos bx$, $a \sin^2 x$, $a \cos^2 x$ —integration between limits such as is involved in determining area of a half sine wave, strength of the magnetic field outside a straight conductor carrying a current, insulation resistance of a cable, temperature rise in machine parts.

POWER PLANTS AND PRODUCERS.—FOURTH YEAR.

Steam.—Fuels, solid and oil ; calorific power ; heat transmission in steam boilers ; effects of deposits and incrustation ; types of land boilers ; choice of boiler to suit character of fuel, restrictions of space and required output ; boiler mountings ; superheaters, economisers, feed water-heaters boiler feed pumps of different makes, injectors ; hand stoking, mechanical stokers ; natural and forced draught ; testing, examination and upkeep of boilers ; lay-out of a boiler house. *Reciprocating Steam Engines.*—Description of present-day types ; peculiarities of high-speed engines used in electrical plants ; forced lubrication ; valve gears, and valve setting ; governors ; governing for special and fluctuating loads ; fly-wheels ; jet and surface condensers ; air and circulating pumps ; maintenance of vacuum ; cooling towers ; pipe lines, lagging, provision for expansion and drainage ; water hammer ; steam traps and separators ; connection of boiler and engine house ; lay-out of an electrical generating station ; indicators, calculations, I.H.P. and B.H.P. ; measurement of feed and condensing water ; steam consumption per I.H.P., B.H.P., and kilowatt hour. *Locomotive Engine.*—Conditions affecting the design of locomotives ; train resistance on the level, on curves and on inclines ; tractive power and draw-bar power ; adhesion on dry and wet rails ; distribution of weight, centre of gravity and wheel arrangements ; balancing for revolving and reciprocating masses ; valves and valve gears ; locomotive boilers ; superheaters and feed water-heaters ; special valves, fittings, lubricators, etc. ; vacuum and air brakes. *Steam Turbines.*—Types, operation and care of steam turbines ; lubrication,

governing, etc. *Internal Combustion Engines*.—Description, starting, operation and care of gas oil engines; indicator diagrams, calculations of power, gas and oil consumption per brake horse-power hour; calorific powers of oils and gases; Diesel engines; the Still and other special engine types. *Water Turbines*.—Choice of a particular type; lay-out of hydro-electric plant.

Arrangements will be made at suitable times for visits to power-houses and important engineering works in the city and vicinity.

FIRST YEAR COURSE IN ELECTRICAL INSTALLATION WORK.

Subjects.

ELECTRICAL WIRING (LECTURES).

ELECTRICAL WIRING (PRACTICAL WORK).

ELECTRICAL ENGINEERING.

PHYSICS FOR ELECTRICIANS.

ELECTRICAL WIRING (LECTURES).—FIRST YEAR.

Electricity.—Elementary principles of electricity and magnetism as applicable to installation work. *Condensers*.—The standard wire gauge; simple problems relating to current-carrying capacity and voltage drop in copper wires and cables. *Resistance Wires*.—Properties of resistance materials in common use, methods of winding and connecting resistance spirals and installation of resistances. *Fuse Wires*.—Properties of materials in common use; precautions in installing. Insulators: Porcelain, pure and vulcanised rubber, paper, slate, marble, fibre, etc.; insulation of single and twin wires on rubber and paper cables up to $\frac{1}{2}$ square inch size, or its equivalent. *Wiring Systems*.—Cleats, insulators, wood casing, surface wiring, metal piping, and conduits; details of handling material, fixing in position, running of wires; return systems. *Connections* to distribution boards cut-outs, ceiling roses, lamp holders, switches (including two-way and two-way intermediate switches), fuses; wiring of fittings and other consuming devices. *Testing*.—Use of test lamp and detector for sorting out circuits; pole finding. *Bells*.—Installation of electric bells and simple indicators. *Lamps*.—Carbon and metal filament lamps; currents and voltages required. *Electrical Ma-*

chinery.—Principles of the action of C.C. dynamos and motors.
Buildings.—Precautions when cutting away for installation work in buildings. *Plans*.—Plotting out runs of wires and cables on plan provided.

ELECTRICAL WIRING (PRACTICAL WORK).

FIRST YEAR.

Methods of handling wire and cable ; soldering iron and blow lamp ; methods of tinning and heating fluxes ; sweating and preparing thimbles and lugs ; making the following joints : Running, end to end, T and Y in 1-18, 3/22, 7/16, 19/16 ; connecting to ceiling roses, switches, sockets, and other accessories ; methods of connecting flexibles ; insulating joints ; preparation of ends ; looping in ; cutting, screwing, and bending metal pipes and conduits ; bending and connecting up metal-sheathed wires.

ELECTRICAL ENGINEERING AND PHYSICS FOR ELECTRICIANS.—FIRST YEAR.

See Syllabuses under First Year Course in Electrical Engineering.

SECOND AND THIRD YEAR COURSES IN ELECTRICAL INSTALLATION WORK.

Subjects.

ELECTRICAL WIRING (LECTURES).

ELECTRICAL WIRING (PRACTICAL WORK).

ELECTRICAL ENGINEERING.

MACHINE DRAWING.

ELECTRICAL WIRING (LECTURES).

SECOND AND THIRD YEARS.

In addition to the subjects of First Year the following will be dealt with : Wiring Rules of the Institution of Electrical Engineers and Regulations of the Home Office ; insulation testing with ohm-meter and generator, or other testing instruments ; location and repair of faults ; details of cables, switches and cut-outs in general use and carrying capacities ; rating of fuses ;

connecting-up motors and dynamos and methods of altering speed and rotation; three-wire system and lamp and power connections thereon; care and maintenance of secondary batteries; more extended knowledge of principles governing earthing of metal portions of installations; precautions to be taken against; unsuitable switches, fittings, etc.; insufficient earthing of iron piping, motors, etc.; dampness in exposed cables or outside wiring; vulcanising concentric and other special systems; drawing up wiring schedule for small installation; erection and running of small isolated plants, including oil or gas engine, dynamo, and secondary battery; principles and connections of electrical cooking and heating apparatus, signs and flashers, time switches, and small motor-driven appliances; energy consumed by electric cooking and heating apparatus and advantages or disadvantages compared with other means of heating and cooking—wiring up and connecting simple telephones and inter-communication systems. *Drawing*.—Plans, elevations, sections and dimensioned sketches roughly to scale.

ELECTRICAL WIRING (PRACTICAL WORK)

SECOND AND THIRD YEARS.

More advanced work on the matters included in the Syllabus for the First Year, and in addition: Joints on cables up to $\frac{1}{2}$ square inch sectional area; jointing and connecting lead-covered cables, including V.R. or paper insulated concentrics; making and installing fuses of various capacities; wiring of more complex circuits; working and connecting up of metal-sheathed wires, and cables; making of working sketches from diagrams.

ELECTRICAL ENGINEERING.—SECOND YEAR.

See Syllabus under Second Year Course in Electrical Engineering.

CABLE JOINTING.

FIRST AND HIGHER YEARS.

Low tension, high tension and extra high tension cables. Concentric cables. Preparation of ends for jointing. Straight through joints on L.T. single core, twin core, 3-core and 4-core cables. Tee-joints on above. Making of sleeves for joints. Correct method of filling sleeves with insulating compound. Joints on single core,

twin core, 3-core, and 4-core concentric cables. Joints on H.T. and E.H.T. cables.

ELECTRIC WELDING.

FIRST AND HIGHER YEARS.

Details of equipment: care and maintenance of plant; precautions in use. Correct sizes of electrodes and current density for various purposes. Electric arc travel for various kinds of work. Types of joints and their preparation for arc welding. Perpendicular line of welding and overhead welding. Cutting with the arc. Jointing of plates, bars and tubes.

FIRST YEAR COURSE IN TECHNICAL TELEGRAPHY.

Subjects.

TECHNICAL TELEGRAPHY.

MAGNETISM AND ELECTRICITY.

TECHNICAL TELEGRAPHY.—FIRST YEAR.

Preliminary. Fundamental principles of Magnetism and Electricity in their application to Telegraphy.

Batteries. Primary Batteries, wet and dry: their composition and chemistry. Simple calculations relating to special combinations of cells; potential drop in a battery, and the effect on circuits connected thereto; testing and maintenance of Leclanché primary batteries. Secondary batteries: construction and application to telegraph working.

Telegraph Instruments. The construction of permanent and electro-magnets; simple calculations relating to electro-magnets. The principles and construction of the following apparatus: Sounders (ordinary and polarised), keys, relays and simple switches; galvanometers: single current and differential; resistance coils, gauge and kind of wire used, methods of winding and insulating, and effect of temperature variation; shunts and their uses; condensers and their uses in the simpler telegraph systems. Inspection, testing and adjustment of telegraph instruments.

Telegraph Lines.—Overhead. Preservative treatment of poles and timber; pole fittings, brackets, insulators, various types

and their uses, erection of poles. Types of wire employed, properties and use of hard drawn copper, bronze and iron. Method of erecting wires; jointing wires. Aerial cables: types, their uses and methods of erecting. Insulated wires used in overhead construction. Methods of leading in.

Telegraph Lines.—Underground. Iron and earthenware single and multiple way conduits; pipe bends and couplings. Manhole and joint box construction. Types of cable used for main and local circuits; jointing wires, twisted and soldered joints; numbering wires and joints; drying joints; plumbing; pressure testing and desiccating.

Internal Wiring. Termination of internal cables on main frames. Classes of wire used and general wiring scheme of large telegraph offices.

Telegraph Systems. The simpler systems of manual telegraphy, including single and double current duplex, universal battery system and central battery working. Simple methods of cable telegraphy.

Testing Instruments. Detectors, galvanometers for testing purposes. Wheatstone bridge. Simple line tests for conductor resistance, insulation resistance, disconnections, earths and contacts. Localisation of faults on lines and apparatus.

Protective Devices. Methods of protecting lines, submarine cables and apparatus from (a) lightning, (b) power circuits.

MAGNETISM AND ELECTRICITY.

Magnets and magnetic substances. Action of magnets on one another. North and south poles, consequent poles and magnetic axis of a magnet. Laws of magnetic force.

Magnetic field. Lines of force; their delineation by iron filings or a small compass.

Magnetic induction. Magnetic qualities of hard steel and soft iron; permeability, retentivity, coercive force. Effects of the introduction of soft iron into a magnetic field.

Methods of magnetisation by permanent magnets. Distribution of magnetism in magnets. Effect of breaking or subdividing a magnet. Effect of the keeper of a magnet on the distribution of the lines of force.

Terrestrial magnetism ; declination ; dip. Earth's magnetic force ; horizontal and vertical components of the force. Magnetic poles and equator ; magnetic meridian. General explanation of the behaviour of the compass and dip needle on the assumption that the earth is a magnet.

Electrification by friction ; positive and negative electrification ; simultaneous developments of positive and negative charges in equal quantities. Attraction and repulsion. Electric charge or electric quantity. The gold leaf electroscope. Laws of electric attraction and repulsion.

Conductors. Non-conductors.

Distribution of electricity on conductors ; electric density ; action of points. Hollow conductors.

Difference of potential. Analogies with temperature, level and pressure. Work done by, or against, electric forces. Electric field. Electrostatic capacity.

Electrostatic induction. Leyden jar and plate condenser. Electrophorus. Frictional electric machine. Influence machines. Electric discharge.

Practical unit of capacity. Condensers in series and in parallel.

Electromotive force. Potential difference. Electric current. Simple voltaic cells. Local action and polarisation. Constant cells. General description of the chemical action taking place in the more common forms of cells.

The electric circuit, resistance ; simple analogies with hydraulics. Relation between the resistance of a wire and its physical dimensions. Ohm's law and its application to simple circuits. Units ; ampere, coulomb, volt, ohm. Ammeter ; voltmeter. Resistances in series and in parallel. Cells in series and in parallel.

Electrolysis. Copper and water voltameters.

Electrolysis. Copper and water voltameters. Electric power ; watt, joule. The heating effect of a current in a conductor ; calorie.

Magnetic field due to a current in a straight wire, circular coil and solenoid. Oersted's experiment. Ampere's and Maxwell's rules. Galvanometer. Forces acting on needle of galvanometer. Astatic needles. Moving coil instruments.

Electro-magnets. Ampere turns and permeability of core. Use of soft iron and hard steel. Elementary conception of magnetic circuit.

Electro-magnetic induction ; induction of electro-motive forces by moving conductors in magnetic fields ; induction of E.M.F. in secondary circuit by starting and stopping the current in a neighbouring primary circuit ; induction coil ; self-induction.

SECOND YEAR COURSE IN TECHNICAL TELEGRAPHY.

Subject.

TECHNICAL TELEGRAPHY.—SECOND YEAR.

Construction.—Testing of materials employed ; aerial lines ; factor of safety ; stresses on poles ; static and kinetic stresses on wires ; law connecting sag and stress ; regulation of wires ; underground lines ; modern practice, submarine lines ; manufacture, laying and repairing internal wiring of large telegraph offices. *Telegraph Instruments.*—Wheatstone apparatus, Creed, Hughes, Baudot, the siphon recorder, the undulator and cable relays ; general principles of construction. *Telegraph Systems.*—Wheatstone, quadruplex, type-printing telegraphs ; concentration ; inter-communication and common battery systems ; methods of working long submarine cables ; superimposed circuits ; simultaneous telegraphy and telephony. *Repeaters.*—Principles of, simplex and duplex ; forked and divided quadruplex. *Telegraphic Transmission.*—Effects of capacity and inductance in circuits ; method of reducing, compensating for, and eliminating same ; laws governing the speed of working on long aerial, underground and submarine lines. *Testing.*—Wheatstone bridge ; tangent, ballistic and reflecting galvanometers ; ammeters ; voltmeters ; bridge megger ; theory, construction and methods of use ; localisation of earths, contacts and disconnections on line wires ; capacity, resistance, inductance and insulation measurement ; measurement of resistance and E.M.F. of batteries. *Wireless (or Radio) Telegraphy.*—Theory ; principal systems in use ; construction of aerial gear ; transmitting and receiving apparatus ; wave measuring devices. *Miscellaneous.*—Variable period of a current ; Helmholtz's equations ; Kirchoff's and

Maxwell's laws; electro-magnet coils, simple formulae for; suitable illustrative diagrams will be systematically introduced.

FIRST YEAR COURSE IN TECHNICAL TELEPHONY.

Subject.

TECHNICAL TELEPHONY.

MAGNETISM AND ELECTRICITY.

TECHNICAL TELEPHONY.—FIRST YEAR.

Preliminary. Fundamental principles of Magnetism and Electricity in their application to Telephony.

Batteries. Primary batteries, wet and dry; their composition and chemistry. Simple calculations relating to special combinations of cells; potential drop in a battery, and the effect on circuits connected thereto; testing and maintenance of Leclanché primary batteries. Secondary batteries; construction and application to telephone working.

Telephone Instruments. The construction of permanent and electro-magnets; simple calculations relating to electro-magnets. The elementary theory of the electric transmission of sound. The various transmitters and receivers in common use; induction coils, repeating coils, transformers, impedance coils, keys, lamps, jacks, cords, plugs, indicators, condensers and other minor apparatus; magneto and trembler bells; magneto-generator and vibrator; magneto and C.B.S. subscribers' instruments; construction, principles, and application of the foregoing apparatus.

Telephone Lines.—Overhead. Preservative treatment of poles and timber; pole fittings, brackets, insulators, various types and their uses; erection of poles. Types of wire employed, properties and use of hard drawn copper and bronze. Method of erecting wires, jointing wires. Aerial cables; types, their uses and method of erecting. Insulated wires used in overhead construction, bridle wire, bronze parallel wire; distribution poles; fittings for house attachments. Tools and safety appliances.

Telephone Lines.—Underground. Iron and earthenware single and multiple way conduits; pipe bends and couplings; manhole and joint box construction; types of cable for trunk and local

working ; jointing wires, twisted and soldered joints ; numbering wires and joints ; drying joints, plumbing ; pressure testing and desiccating.

Telephone Systems. The simpler systems of telephony, including magneto and central battery signalling ; house telephones ; multiple jacks, branching and series arrangement ; operator's telephone circuits, cord circuits, junction circuits ; magneto and C.B.S. exchanges. The principles of central battery working ; the principles of trunk working. The use of main and intermediate distributing frames. Various types of small switchboards.

Testing Instruments. Detectors, galvanometers for testing purposes, Wheatstone bridge. Simple line tests for conductor resistance, insulation resistance, disconnections, earths and contacts. Localisation of faults on lines and apparatus.

Protective Devices. Methods of protecting lines, submarine cables and apparatus from (a) lightning, (b) power circuits.

MAGNETISM AND ELECTRICITY.

(See Syllabus for First Year Technical Telegraphy).

SECOND YEAR COURSE IN TECHNICAL TELEPHONY.

Subject.

TECHNICAL TELEPHONY.—SECOND YEAR.

Construction.—Testing of materials employed ; aerial lines ; modern practice ; stresses on poles ; static and kinetic stresses on wires, law connecting sag and stress, regulation of wires ; factors of safety ; underground and submarine lines, modern practice. **Telephone Apparatus.**—Construction and theory of telephonic apparatus generally, methods of use and maintenance, various forms of transmitters and receivers, tests for efficiency, subscribers' sets. **Telephone Systems.**—Manual Exchanges ; magneto and common battery, complete multiple, partial multiple, divided multiple, transfer, method of ringing, engaged tests ; lay-out of exchanges, equipment, including frames, racks, sections, desks, apparatus and power plant ; automatic exchanges, general principles of ; party line systems ; circuits exchange equipment,

subscribers' station equipment; private branch exchanges, "house" systems, pay stations, coin-collecting boxes; junction circuits; methods of working between local exchanges in same area and between trunk and local exchanges—trunk circuits; exchange equipment, circuits, methods of working, signalling, recording calls; super-imposed or multiplex circuits; simultaneous telegraphy and telephony on the same wires, practical systems and theory of. *Telephonic Transmission*.—Limiting factors; attenuation and distortion; loading; Pupin's and other formulae; effects of leakage; conductance; comparative efficiencies of wires of various materials and gauges, open, underground and submarine. *Testing*.—Wheatstone bridge; tangent; ballistic and reflecting galvanometers; ammeters; voltmeters; theory, construction and methods of use; localisation of earths, contacts and disconnections on line wires; capacity, resistance, inductance and insulation measurements; measurement of resistance and E.M.F. of batteries; Post Office Morning Test system (for long-distance lines). *Miscellaneous*.—Kirchoff's and Maxwell's laws; electro-magnet coils, simple formulae for telephone repeaters. Suitable illustrative diagrams will be systematically introduced.

TELEGRAPHY.—MORSE SOUNDER PRACTICE.

In this class instruction will be given in the manipulation of the Morse Sounder and the reception and transmission of messages, up to the speed required by the Post Office. Instruction will also be given in Post Office telegraphic regulations, signalling procedure, etc.

TELEGRAPHY.—BUZZER PRACTICE.

This Class provides training in the manipulation of the Morse Signalling Key and in the reception of the Morse Code using Headgear Telephones, and meets the requirements of Wireless Operators wishing to qualify for higher speeds in telegraphic working, and also those desiring to acquire the Amateur Radio-Experimental Transmitting Permit.

INSTRUMENT MAKING AND LABORATORY ARTS.

INSTRUMENT MAKING.—FIRST AND HIGHER YEARS.

Materials.—Metals, alloys, woods, insulating materials; mechanical properties of each and suitability for different purposes. *Tools.*—Varieties and uses; making and setting; defects and treatment. *Processes.*—Filing, bending, soldering, welding, polishing, lacquering, surface finishing, drilling, tapping, silvering. *Lathe Work.*—Turning, tapering, bevelling, mill-heading, screw-cutting. *Fine Work.*—Use of phosphor-bronze and quartz filaments; mounting of spider threads; silvering of glass. *Design and Construction of Instruments.*—General mechanical principles; levers, springs, screws, periodic and aperiodic, ballistic and dead-beat system; dimensions and proportions, workmanship and finish. *Weighing Scales.*—Considerations of range of reading; factors determining sensitivity; precision and accuracy; systems of control; gravity, tension, torsion, spring. *Special Work.*—Construction of fixed and variable inductances, condensers and other parts for wireless receiving sets; design and construction of panels and switchboards for such sets using two, three or more valves; general assembling of all component parts of wireless systems.

GLASS BLOWING OF TECHNICAL APPARATUS.

Preliminary Considerations.—Tools, blowpipe, files and knives, flame, cleaning of glass.

General Operations.—Cutting soft glass, cutting hard glass, concentric capillaries, constricting a tube, rotation of the tube, flanging, bending glass.

Elementary Services.—Joining tubing end to end (equal bore), joining two tubes (unequal bore), T-pieces and angle joints, bulb at end of tube, bulb in middle of tube.

More Advanced Exercises.—Spinning glass, thistle funnel, let-through joint, gas-washing tube, suction pump, capillary tubes, thermometers, joints in position, cross joints, joints on thin glass, or glasses of different hardness, U-tube.

Special Operations.—Condensers, spirals, cone-and-socket joint cylindrical dewar-vessels, silvering of glass, simple manipulations with hard glass in the oxygen flame, glass-to-metal seals and joints, electrodes, copper to glass joints.

SCHOOL OF RADIO TELEGRAPHY

EQUIPMENT.

The School is fully equipped with modern Marine and Aircraft Radio Apparatus, including a $1\frac{1}{2}$ K.W. I.C.W./C.W. Marine Transmitter, a Marconi Type AD41 Aircraft Transmitter, standard types of Marine and Aircraft valve receivers, and complete Direction Finding Apparatus.

INSTRUCTION.

The Course of Training is arranged to prepare students in the shortest possible time for the Examinations of Proficiency in Radio telegraphy and Radiotelephony. The instruction consists of Lectures and Practical Work in Technical Electricity, Technical Radiotelegraphy and Radiotelephony, and Direction Finding, with practice on the Marine and Aircraft Apparatus specified above, and includes training in sending and receiving in the Morse Code, operating procedure and the handling of traffic, and in the Rules and Regulations for Radio Operators including the Q-Code, and typewriting.

COURSES.

Day and Evening Courses are provided. Students of the Day Course attend each day from 10-12.30 and 2-4. Students of the Evening Course attend each evening from 7.30-9.30, except Saturday evening. See Time Tables, page 20.

FEES.

The Fees, which cover tuition in all subjects up to obtaining the State Certificate of Proficiency, are as follows :

DAY COURSES.

Marine Operators' Certificate Course	.....	.....	£12	0	0
Aircraft Operators' Certificate Course	.....	.....	12	0	0
Combined Course	.....	.....	16	0	0

EVENING COURSES.

Marine Operators' Certificate Course	.....	.....	£4	0	0
Aircraft Operators' Certificate Course	.....	.....	4	0	0
Combined Course	.....	.....	5	0	0

The payment of Fees may be made in advance or as follows :

Day Course Fees.—A payment of Four Pounds on Enrolment and thereafter of Four Pounds at the commencement of each subsequent term until the full fee is paid.

Evening Course Fees.—A payment of Two Pounds on Enrolment and thereafter of One Pound at the commencement of each subsequent term until the full fee is paid.

ADMISSION.

Students are expected to have a good general education, with special attention to handwriting, spelling, geography, arithmetic up to square root, algebra up to quadratic equations, elements of trigonometry.

SCHOOL SESSION.

The School of Wireless Telegraphy is conducted independently of the other classes in the Technical Schools, and is open all the year, with the usual holidays at Christmas, Easter and Summer. Students are admitted at all periods. The usual time taken to train for Examination is about 18 months in the Day School, and proportionately longer in the Evening Course.

**MARINE RADIOTELEGRAPHY AND
RADIOTELEPHONY.**
**SYLLABUSES OF THE STATE EXAMINATIONS FOR
THE CERTIFICATION OF MARINE RADIO OFFICERS.**

(1) It is necessary for persons operating wireless telegraph apparatus on board ships registered in Eire which are subject to the provisions of the Merchant Shipping (Wireless Telegraphy) Act, 1919, and the Merchant Shipping (Safety and Load Line Conventions) Act, 1933, to hold either a 1st or 2nd Class Certificate of proficiency issued by the Minister for Posts and

Telegraphs in accordance with the General Radiocommunication Regulations annexed to the International Telecommunication Convention, 1937.

The First Class Certificate states that the holder possesses the following qualifications :—

(a) Knowledge of the general principles of electricity, of the theory of radiotelegraphy and radiotelephony, and of the practical adjustment and operation of all apparatus (spark C.W., I.C.W., and D.F.) and accessory apparatus used in the ship's service.

(b) Transmitting and receiving by ear, messages in plain language at a speed of 25 words a minute, and in code groups at a speed of 20 groups a minute.

(c) Sending and Receiving spoken messages clearly by telephone apparatus.

(d) A detailed knowledge of the Regulations applying to the exchange of radiotelegraph traffic, of the documents relative to the charges for radiotelegrams, and of the radiotelegraph part of the Regulations for the Safety of Life at Sea.

(e) A knowledge of the principal maritime navigation routes and of the most important wire and wireless routes of the world.

(2) In order to qualify, candidates will be required :

(a) To send for each test on an ordinary Morse key for three consecutive minutes at not less than the prescribed speed five letters or characters counting as one word or group. The accuracy of signalling, the correct formation of the characters, and the correctness of spacing will be taken into account.

(b) To receive Morse signals for three consecutive minutes at the prescribed speeds from a double headgear telephone receiver ordinarily used for radio-telegraph reception, and to transcribe them legibly.

(c) To send and receive traffic by means of telephone apparatus.

(d) To have a theoretical and practical knowledge of the operation, adjustment and maintenance of spark C.W., I.C.W., and D.F. apparatus.

(e) To have a theoretical and practical knowledge of the operation, adjustment and maintenance of the accessory apparatus such as motor-generator sets, storage batteries, etc.

(f) To have the necessary knowledge to make, with the means that would be available on board a ship, the repairs of damaged apparatus.

(g) To know the principal wire and wireless routes of the world, as indicated in the relative publications issued by the International Office of the Telegraph Union, Berne, and the principal maritime navigation routes of the world.

(3) The practical examination on the apparatus specified in Section 2 (d) above will include :

- (a) Connecting-up apparatus.
- (b) Regulating and adjusting apparatus.
- (c) Tracing and clearing faults.
- (d) Repairing defective apparatus.
- (e) Using D.F. apparatus to obtain bearings.
- (f) Operating (sending and receiving).
- (g) A test on commercial working, exchanging traffic as between a ship and other ship stations, and between a ship and a shore station.

(4) The theoretical examination will consist of two papers. Two hours will be allowed for the first, and three hours for the second paper. These papers will consist of comprehensive questions under the following headings :—

Magnetism general electrical principles. Atmospheric electricity. Condensers. Primary and secondary cells. Direct alternating and oscillatory currents. Electro-magnets. Electro-magnetic induction. Measuring Instruments, transformers. Motors, dynamos, alternators and converters. Valves; characteristics; installation and operation of Spark, C.W. and I.C.W. transmitting installations : principles, apparatus, circuits, adjustments, maintenance. Receiving apparatus : principles, circuits, adjustments, maintenance. Emergency installations. Ether waves. Aerials. Radiotelephony, transmitting and receiving apparatus; principles, circuits, adjustments, maintenance. Direction finding apparatus : principles, circuits, adjustments, maintenance. Auto-alarm devices : principles, adjustments, maintenance. Wave-meters.

The standard of theoretical knowledge required from a candidate for a First Class Certificate calls for a sound grasp of the theoretical principles and of the practical methods of application thereof. The candidate's mathematical knowledge should include algebra up to simple equations, elementary graphs and the elements of trigonometry. Questions in the written tests dealing with the practical application of general principles will have reference to one or other of the commercial sets fitted in merchant ships.

(5) The examination in the Radiocommunication Regulations will be based upon the rules contained in the *Handbook for Wireless Telegraph Operators*.

The commercial working test will include the preparation of messages for transmission ; insertion of preambles, charges, routes ; order of transmission ; transmission and reception of messages at the prescribed speeds ; log keeping ; procedure signals.

(6) The Second Class Certificate.

The Examination Syllabus for the Second Class Certificate covers generally that for the First Class Certificate. The theoretical examination consists of one paper only, and lower standards in transmission and reception are prescribed, viz : Plain language, 20 words per minute ; code, 16 groups per minute.

CERTIFICATION OF AIRCRAFT RADIO OFFICERS. EXAMINATION SYLLABUSES.

MORSE RECEIVING.—The reception tests will be conducted on a valve oscillator circuit and will correspond to the following speeds :

Plain language	.....	20 words per minute.
Code	.....	16 groups per minute.
Cypher	.....	10 groups per minute.

PLAIN LANGUAGE.—This section of the receiving test will consist of a passage of 300 characters to be received in three minutes. Mixed punctuations and figures will be included (normally six of each), a figure or punctuation counting as *two* char-

acters. An interrupted signal will be superimposed on the actual Morse signal throughout this test in order to simulate "wireless interference." The note of the interfering signal will be of a different pitch and of half the intensity of the Morse signal.

CODE.—This section of the receiving test will consist of 48 five-letter groups to be received in 3 minutes.

CYPHER.—This section of the receiving test will consist of 15 five-figure groups to be received in 1½ minutes.

During the code and cypher sections of the receiving test the interfering signal will be suppressed, and a local motor generator set will be put into operation in order to simulate "engine noise interference."

MORSE SENDING.—The candidate will be required to *send* similar tests as detailed in the previous section (above). The interfering signal will be suppressed during the sending tests; but the local motor generator will be put into operation throughout the code and cypher sections of the tests.

PRACTICAL COMMUNICATION TESTS.

1. *By Radiotelephony.*

This test will be conducted on a line telephone circuit. The candidate will be supplied with a complete "Head-set," and a "Send-Receive" switch. He will be required to carry out an "imaginary flight" over a recognised civil air route and to make such calls as may be selected by the examining officer, who will take the part of the "Ground Stations." A local motor generator set will be in operation throughout this test in order to simulate engine noise. The speech quality and strength, local noises and general method of conducting the test will be so arranged as to somewhat represent actual working conditions. Typical examples of the calls to be made, and procedure to be carried out are as follows :

Reporting departure. Requesting D.F. assistance. Obtaining meteorological information. Position reports. Transmitting distress, urgency and safety signals. The international phonetic alphabet, etc.

2. *By Radiotelegraphy.*

This test will be similar to the Radiotelephony Communication test (above), except that all communications will be carried out by Morse code. The candidate will be expected to keep a detailed log of communications in this section. The test will be conducted on a valve oscillator circuit, and local "wireless" and "engine noise" interference will be superimposed on the Morse signals during part of the test.

PROCEDURE AND REGULATIONS.

Under this section candidates will be expected to have a good knowledge of the following :

A.P. 1529 (Q code) with special reference to General Operating Signals, Direction Finding, Meteorological and "QBI" Signals, and common abbreviations used in the Aircraft Radio Services. The P.M.G. Handbook for Wireless Operators (Sections applicable to Aircraft Radio Services). The main European Air Routes. The main European Aircraft Radio Stations and Call Signs. The main radio communication areas in the United Kingdom (precise boundaries *not* required). Correct procedure for establishing communication with short range stations situated in main communication areas. Principal wavelengths (or frequencies) to be used. Q.B.I. routine. Order of priority of communications. Procedure during distress traffic. Conditions justifying transmission of Distress, Urgency, or Safety Signals. Brevity of communications. Obligation to obtain all possible available information prior to departure. D.F. assistance available. Classification and types of D.F. bearings and positions. Reliability of D.F. assistance (Day and Night). Procedure if Receiver fails. Procedure if Transmitter fails. Relative responsibilities of Commander and Radio Operator. Licence requirements for installation and operation of radio apparatus on aircraft. General knowledge of communication regulations. Knowledge of the publications and notices giving details of most of the information required under this section, etc.

AIRCRAFT RADIO INSTALLATIONS.

(Practical and Oral Tests on Standard Aircraft Apparatus.)

The tests under this section will be framed with a view to

testing the candidate's ability to operate the apparatus. The candidate will be required to demonstrate the following :

1. Ability to tune the receiver to any required wavelength (or frequency, and adjust same for the correct reception of Radiotelegraphy (C.W. and I.C.W.) or Radiotelephony. Actual W/T and R/T transmissions must be tuned in by the candidates, particular attention being paid to the correct use of reaction where this is incorporated in the equipment.
2. Ability to tune the transmitter to any required wavelength (or frequency) and adjust same for the correct transmission of W/T R/T or I.C.W. Particular attention will be paid to the candidate's ability to make rapid correct alterations in wavelength. Normally these tests must be carried out without the use of a calibration chart.
3. Knowledge of switchboard operation and emergency working (where this is incorporated in the equipment).
4. Name the main components and explain briefly their function.
5. Detect and rectify simple faults in the apparatus and accessory equipment.
6. Correct method of connecting L.T. or H.T. to radio apparatus when necessary, etc.

NOTE.—The operation of the transmitter and receiver controls may be either by remote or direct control. Candidates should be familiar with both methods.

AIRCRAFT RADIO INSTALLATIONS.—ACCESSORY EQUIPMENT AND GENERAL RADIO THEORY.

(1) *Practical and Oral Tests.*

A practical knowledge of the following : Accessory aircraft radio equipment, including power plant accumulators, aerials (types and utility) and methods of changing over (necessity for retuning), aerial winches. Aerial loading coils. Fairleads. Earth connections. How to "earth" aerials. Routine in vicinity of electrostatic storms. Signs of approaching electrostatic storms. Bonding. Screening. Remote controls. Elementary tests of valves, batteries, condensers, etc. Use of voltmeter. Use of ammeter. Practical

idea of values of main components (*i.e.* tuning condensers, etc.). Practical methods of increasing or decreasing wavelength of aerial circuits. Telephones. Microphones (as used on aircraft). Adjustment of Direction Finding apparatus and the taking of bearings.

(2) *Written Test.*

The syllabus includes all the matters prescribed for the Theoretical Examination for the First Class Certificate (Marine), together with the following : Aircraft Radio Power Units ; simplified theoretical diagrams of Aircraft Transmitters and Receivers ; Master Oscillators (elementary principles) ; elementary theory of Direction and Position Finding ; general D.F. Assistance available for Aircraft ; Homing Devices ; Aircraft Radio Beacons ; Aircraft Approach and Landing Systems.

PHYSICS AND MATHEMATICS

FIRST YEAR COURSE IN GENERAL PHYSICS.

Subjects.

GENERAL PHYSICS

MATHEMATICS.

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 determinations ; flotation ; atmospheric pressure ; Boyle's law ; thermometry ; measurement 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.

PURE MATHEMATICS.—FIRST YEAR.

Arithmetic.—Fractions and decimals ; square root ; percentages ; interest, simple and compound ; estimates ; weights and measures ; metric system. *Geometry.*—Properties of lines, triangles, rectilinear figures, circles and polygons as treated in first four books of Euclid. *Algebra.*—Definitions and signs ; indices ; factors ; simple and quadratic equations ; involution and evolution ; surds ; ratio, proportion and variation. *Trigonometry.*—Definition ; measurement of angles by degrees and radians ; relations of functions and conversion of one into another ; ratios of sum and difference of angles and multiples and submultiples of angles ; curve of sines. *Logarithms.*—Definitions ; multiplication and division ; use of tables and slide rule.

SECOND AND HIGHER YEARS' COURSES IN GENERAL PHYSICS.

Subjects.

GENERAL PHYSICS.

MATHEMATICS.

GENERAL PHYSICS.—SECOND AND HIGHER YEARS.

The courses will consist for the main part of laboratory work, with frequent occasional lectures on special subjects. Each student will do a special course of experiments assigned to him in accordance with his capabilities and his own special requirements.

PURE MATHEMATICS.—SECOND YEAR.

Geometry.—Ratio and proportion with applications to geometry, so far as the subject is treated in the definitions of Euclid's Fifth Book, and in his Sixth Book. *Algebra.*—Permutations and com-

binations ; progressions ; complete theory of indices ; the Binomial theorem. *Plane Trigonometry*.—Formulae for finding the sine, cosine, etc., of the sum and difference of two angles, and of the multiples and sub-multiples of an angle ; diameters of circles inscribed in and circumscribed about a given circle ; area of a circle ; description and use of the vernier, theodolite and sextant. *Graphics*.—Plotting of observations on squared paper ; interpolation ; errors of observation ; average value, etc. ; the plotting of functions ; maximum and minimum values ; calculations and determinations by graphical methods.

PURE MATHEMATICS.—THIRD AND HIGHER YEARS.

Algebra.—Theory of indices ; summation of series ; tests of the convergence and divergence of series ; binomial, exponential, and logarithmic series ; partial fractions ; elementary determinants ; imaginary and complex quantities ; De Moivre's theorem. *Solid Geometry*.—Properties of straight lines and planes ; their intersections, inclinations, parallelism, perpendicularity ; properties of the sphere, and of cylinders and cones. *Spherical Trigonometry*.—Definitions of great and small circles, angles and sides of supplemental triangles ; fundamental relations between trigonometrical ratios of the sides and angles of spherical triangles. *Geometrical Conics*.—Properties of the parabola, ellipse, and hyperbola deduced by pure geometry from definition in *plano*. *Co-ordinate Geometry*.—Co-ordinates of a point ; rectangular, oblique, and polar ; transformation of co-ordinates ; equations of straight lines, and treatment of questions relative to intersection, concurrence, inclination, parallelism, perpendicularity, etc. ; equations of circles, their tangents and normals ; properties of their diameters, axes, foci, conjugate diameters, asymptotes, poles and polars and determination of circles satisfying given conditions of their tangents and normals ; discussion of the general equation of the second degree. *Differential Calculus*.—Definitions, limits, differential co-efficients ; differentiation of simple and inverse functions ; successive differentiation of functions of one variable ; Taylor's and Maclaurin's theorems and their simpler applications ; determination of values of functions when intermediate in form ; differentiation of a function and of implicit functions ; maxima and minima of functions of one independent variable ; differen-

tiation of functions of two or more independent variables ; applications of the preceding to the geometry of the plane curves referred to rectangular or to polar co-ordinates ; tangents, normals, sub-tangents, sub-normals, asymptotes ; singular points ; contact and curvature ; tracing of curves ; differential co-efficients of arcs and areas of plane curves, and of the surfaces and volumes of solids of revolution. *Integral Calculus*.—Meaning of definite and of indefinite integrals ; integration of the more frequently occurring functions ; integration by parts ; rational functions ; formulae of reduction ; applications to areas and lengths of curves, to volumes and areas of surfaces of revolution, to centres of gravity, and moments of inertia. *Elementary Differential Equations*.—Integration of differential equations of the second and higher orders with constant co-efficients.

FIRST YEAR COURSE IN RADIO COMMUNICATION.

Subjects.

RADIO COMMUNICATION.—I.

ELECTRICAL ENGINEERING.—I.

RADIO COMMUNICATION.—FIRST YEAR.

1. Construction of transmitting and receiving inductors.
2. Capacitance ; construction of fixed and variable condensers for low voltage, fixed condensers for high voltage.
3. Qualitative treatment of eddy current loss including skin effect in conductors, and of dielectric loss in condensers.
4. Construction of two electrode and three electrode thermionic valves ; principles of action and characteristic curves with application to non-reactive load.
5. Detecting devices for small alternating potentials ; contact rectifiers and valves.
6. Construction and action of telephone receivers and electro-magnetic loud speakers.
7. High frequency and low frequency thermionic amplifiers, essential principles of action. Causes of distortion.
8. Simple circuits of radio receivers including use of retroaction. Qualitative ideas of selectivity.
9. Use of a loop aerial for reception and direction finding.
10. Qualitative treatment of simple valve oscillator.
11. Simple wavemeter.
12. General principles of heterodyne reception.

ELECTRICAL ENGINEERING.—I.

*(See Syllabus for First Year Electrical Engineering)*SECOND YEAR COURSE IN RADIO
COMMUNICATION.*Subjects.*

RADIO COMMUNICATION.—II.

ELECTRICAL ENGINEERING.—(A.C.).

RADIO COMMUNICATION.

SECOND YEAR.

1. Elementary ideas of the radiation and propagation of electromagnetic waves and of the properties of transmitting and receiving antennae; simple computations neglecting absorption and reflexion. 2. The theory of coupled circuits and their application to the problem of selectivity. 3. The generation of oscillations in a valve circuit. Self-oscillating and master-controlled valve transmitters for C.W. and I.C.W. Neutralizing circuits; simple spark transmitter. 4. The modulation of valve transmitters by keying, tone and speech. Sidebands. Frequency bands necessary for various modulation systems. 5. Construction and action of devices for rectifying alternating current for H.T. supply. Smoothing circuits. 6. Transmitting valves including cooled anode and demountable type valves. 7. The reception of C.W. and I.C.W. telegraphy and of radio telephony signals. Superheterodyne and super-regenerative receivers. Methods of minimizing interference from atmospherics and unwanted stations. 8. Multi-electrode valves and their uses, including the cathode ray tube. 9. Schematic arrangements and principles of operation of radio telephone channels connected to land line circuits. 10. High frequency measurements of current, voltage, resistance, inductance, capacitance, frequency and field strength. 11. Decibel and neper. Simple computations, T and H type of attenuators and their applications, design of simple sections. 12. Interference with radio reception by industrial and domestic electric plant. Devices and circuits for preventing or minimizing such interference.

ELECTRICAL ENGINEERING.—(A.C.).

(See Syllabus for Fourth Year Course in Electrical Engineering).

RADIO COMMUNICATION.

THIRD YEAR.

Revision of the subject-matter of the Grades I and II Syllabuses in addition to the treatment of such subjects as the following :

1. General properties of electro-magnetic waves radiated from an antenna. Polarization. The effect of the earth and ionosphere on the propagation of radio waves.
2. Simple antennae and antenna arrays for long and short waves. Diversity reception.
3. Radio frequency transmission lines ; inductance, capacitance and characteristic impedance of such lines. Reflection. Standing waves. Impedance matching.
4. Direction finding systems for fixed and mobile stations. Causes of error and their elimination. Bellini Tosi, rotating loop and Adcock systems.
5. Simple treatment of electric wave filters. Image impedance and propagation constant of non-dissipative sections. Design of prototype sections from given formulae.
6. Constant frequency oscillators including piezoelectric and tuning-fork control. Thermostats. Long and short wave transmitters, employing frequency control.
7. The theory of detection, using non-linear devices. Distortion in detectors. Frequency changes. Power grid and diode detectors.
8. Intermodulation and distortion in amplifiers, Class A, B and C amplifier. Push pull amplifiers.
9. The balanced modulator. Suppressed carrier single side-band telephony on long waves. Appropriate transmitting and receiving circuits.
10. The connexion of radio telephone links to land line telephone circuits. Technical operation, position and equipment including monitoring, amplifier volume indicators, transmission measuring equipment and singing suppressors of electro-mechanical and thermionic types.
11. Overloading limiting and automatic gain control on receivers.
12. Attenuation equalizers on radio channels and tone control on radio receivers.
13. Electron valve oscillator (Barkhausen effect).
14. Underlying principles of design of high frequency and measurement purposes, including inductors, condensers, insulators, resistors, attenuators, etc. Special consideration in dealing with high power stations.

RADIO SERVICE.

I.—THEORY.

FIRST YEAR.

Electrolytic thermal, and magnetic effects of a current. Difference between d.c. and a.c. supplies. Conditions necessary for flow of electricity. Conductors and insulators.

Resistance e.m.f. and p.d. Units in which they are measured and the relations between them. Ohm's Law. Series and parallel circuits. Dependence of resistance upon dimensions and material of conductor.

Electrical Power and Energy.—Definition of the alternating ampere. Cost of running receiving sets.

Magnetic fields due to conductors and coils. Electro-magnets and permanent magnets, with special reference to speakers and pick-ups. Moving iron instruments.

Force on a conductor carrying a current in a magnetic field. E.m.f. due to relative motion of conductors and magnetic fields. Moving coil instruments.

Self and mutual inductance. Principles of the transformer. Energy stored in a magnetic field.

Electric charges ; electric fields and forces ; potential difference. Electrostatic voltmeters.

Condensers ; capacitance ; dielectrics ; types of condenser. Aerial and earth as a condenser.

Separate and combined effects of inductance and capacitance in a.c. circuits ; simple graphical treatment. Simple resonance and tuning. Atomic character of electric charges. The electron. Electron emission. The diode. Rectification by diode and metal rectifier. D.c. supply from a.c. mains. Rectifier instruments. The triode. Characteristics of diodes and trodes. Use of triode as amplifier.

I.—PRACTICAL WORK.

Measurement of resistance, inductance, capacitance, and characteristics of valves. Checking voltage and current ratings in receiver. Ganging of straight sets, i.f. amplifiers and signal frequency circuits. Installation of aerial systems. Continuity testing and simple tests on components.

RADIO SERVICE. THEORY.

SECOND YEAR.

Revision of First Year Syllabus and the following :

Use of triode as frequency converter or oscillator. Radiation from oscillating circuits. Effects of frequency and type of circuit. The test oscillator. Wave-length and frequency. Reception of constant amplitude. H.f. waves. H.f. amplification. Simple methods of rectification. Modulation and side-bands. Pre-selection and band-pass filters. Regeneration. Tetrode and h.f. and l.f. pentode valves ; directly and indirectly heated types. Variable mutual conductance valves.

Methods of coupling valve circuits ; instability and "decoupling." Methods of volume control. Battery receivers : simple typical circuits. Battery maintenance. Mains receivers. Mains transformers ; rectifiers ; smoothing circuits, automatic grid bias. Necessity for extra "decoupling."

Essential differences between a.c., d.c., and "Universal" type receivers. Limitations of "straight" sets. Heterodyne theory. Local oscillator ; frequency changer ; i.f. circuits. Simple super-heterodyne circuits.

Multi-electrode frequency changers. Image suppression ; the pre-selector stage.

Short-wave receivers. Automatic volume control ; delayed and full ; amplified a.v.c. Tuning indicators.

Aerial systems. Interference suppression.

Special output circuits ; push-pull, Class B, quiescent push-pull.

Loud speakers—types and performance. Acoustics of rooms. Tone control. High fidelity receivers. Contrast amplification.

Radio-gramophones ; turntable drives, record changes, pick-ups. Public address systems.

Car radio.

Testing—signal generator, cathode ray oscillograph, bridges. Service test gear—multi-range instruments, service oscillator, output meter. I.E.E. regulations relating to radio installations. Use and rating of fuses.

Business methods in relation to service work.

2. PRACTICAL WORK.

Simple repairs and adjustments to components, speakers, pick-ups, and gramophone mechanisms.

Tracing of faults in chassis :

(1) Simple faults disconnecting current circuits, such as :

(a) Broken mains or battery circuit, *e.g.* switch not closing or break in wire. (b) Heater circuit disconnected (not rectifier). (c) H.t. circuit disconnected between rectifier and branch circuits. (d) Disconnected anode or anode decoupling circuit, *e.g.* broken-down resistor. (e) Screen or oscillator anode circuit disconnected. (f) Cathode or bias circuit disconnected. (g) H.t. negative disconnected.

(2) Faults not materially affecting current circuits :

(a) Open circuit speech coil. (b) Disconnected intervalve coupling, *e.g.* open circuit condenser. (c) Tuning coil disconnected (badly adjusted switch contacts).

(3) Short circuits :

(a) Speech coil. (b) Bias resistor. (c) I.f. coil. (d) Grid circuits to chassis, *e.g.* trimmers, coil tags and screened leads breaking through installation. (e) A.v.c. line to chassis.

CALCULATIONS.

Revision of elementary arithmetic. Metric system : use of prefixes deci-, centi-, milli-, micro-, kilo-, mega. Simple ratio and proportion, with special reference to percentages. Simple mensuration. Arithmetical application of simple formulae, using electrical examples, such as Ohm's Law. Plotting on squared paper. Algebraic notation, angles and simple trigonometry. Indices, logarithms, and use of slide rule. The bel and decibel ; simple explanations.

APPLIED CHEMISTRY

FIRST YEAR COURSE IN APPLIED CHEMISTRY.

Subjects.

INORGANIC CHEMISTRY.

PHYSICS FOR CHEMISTRY.

INORGANIC CHEMISTRY.

FIRST YEAR.

Chemical and physical changes; elements, compounds and mixtures. General properties of solids, liquids and gases. Application of Boyle's Law and Charles's Law.

Hydrogen. Oxygen; basic and acid forming oxides. Water; gravimetric and volumetric composition; solvent properties, crystallization.

Chemical equivalents. Laws of chemical combination, Dalton's Atomic Theory. Gay Lussac's Law of Volumes. Avogadro's Hypothesis, molecular weights of gaseous compounds, atomic weights. Valency, formulae, equations. Calculations by means of equations.

Chlorine, hydrochloric acid.

Nitrogen, ammonia, nitric acid, nitrates, nitric oxide, nitrous oxide, nitrogen peroxide. Nitrous acid, nitrates.

Sulphur; allotropy; sulphuretted hydrogen; sulphur dioxide and trioxide; sulphurous acid and sulphites. Simple consideration of the contact and chamber processes for the production of sulphuric acid.

Carbon; allotropes. Carbon monoxide and dioxide. General properties of the carbonates.

Combustion; flame; Bunsen burners; oxidation and reduction. Acids, bases, salts.

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,

sulphurdioxide, sulphuretted hydrogen and carbon dioxide; action of acids on metals; measurement of volumes and density, of gases and reduction of N.T.P.; alkalis, 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.

PHYSICS FOR CHEMISTRY.

PHYSICS—FIRST YEAR.

Units of length, area and volume. Units of mass. Use of metre stick, vernier calipers and micrometer screw gauge. Use and limitations of graduated cylinder, pipette and burette.

Centre of gravity. The lever. Common balance. The Laboratory Balance. Sensibility of balance. Density of regular solids; estimation of possible error. Use of specific gravity bottle. Specific gravity of liquids and of powders insoluble and soluble in water.

Hydrostatic pressure. Principle of Archimedes. Specific Gravity of irregular solids heavier and lighter than water, insoluble and soluble in water. Specific gravity of liquids. Hydrometer. Atmospheric pressure. Simple barometer. Fortin barometer. Open manometer; simple pressure gauge. Siphon.

Boyle's Law. Exhaust pump.

Expansion of solids, liquids and gases. Thermometers. Determination of fixed points. Coefficients of expansion of a solid. Variation of density of a liquid with temperature. Real and apparent coefficients of expansion of liquid. Charles's Law. Absolute temperature. The Gas Equation. Simple gas thermometer.

Transmission of heat; conduction, convection and radiation.

Quantity of heat. Calorie. British Thermal Unit. Specific heat. Law of Dulong and Petit. Approximate determination of heat of solution, neutralization, reaction and combustion. Change of state. Cooling curve for pure substance. Melting point of pure substance. Latent heats of fusion and vaporization.

Vapour pressure. Properties of saturated and unsaturated vapours. Critical temperature. Dalton's Law of Partial Pressures. Influence of pressure on boiling point of pure liquid. Vacuum and steam distillation. Evaporation. Elementary Hygrometry.

The Lever as a machine. Work. Work equation for simple machines. Galileo's pendulum. Conservation of mechanical energy. Mechanical equivalent of heat.

Elementary treatment of electrostatics to develop the conception of quantity of electric charge. Joule, ampere coulomb, volt, ohm. Chemical effect of electric current. Faraday's Laws of Electrolysis. Ionic Theory.

SECOND YEAR COURSE IN APPLIED CHEMISTRY.

Subjects.

INORGANIC CHEMISTRY

CHEMICAL ANALYSIS.

PHYSICS.

INORGANIC CHEMISTRY.—SECOND YEAR.

A detailed study of water. Impurities met with in natural waters. Hard and soft waters. Chemical processes involved in the treatment of water to render it fit for industrial use.

Technical methods of softening water for industrial use, such as the lime and sodium carbonate process and the permutit process.

Technical methods of filtration.

Methods of determination and equivalents. Law of Dulong and Petit. Atomic weights. Simple methods of determining vapour density and the determination of the molecular weight from vapour density.

Law of mass action. Faraday's Laws of Electrolysis. Elements of the ionic theory and its application to analysis.

Hydrogen peroxide; preparation and uses. Ozone.

Diffusion of gases.

The halogens. Commercial preparation and uses of these elements and their hydracids. Bleaching powder, sodium hypo-

chlorite, potassium chlorate. General comparison of properties of halogen group.

Catalysts and their influence on the velocity of chemical change. Contact and chamber processes for the manufacture of sulphuric acid. Fuming sulphuric acid. Thiosulphuric acid and sodium thiosulphate. Sodium hydrosulphite. Potassium persulphate. Sulphur chloride.

Carbon; partial and total gasification of carbon and carbonaceous material. Manufacture of coal gas, producer gas, water gas, carburetted water gas, Mond gas. Thermo-chemistry. Exothermic and endothermic reactions. Carbon disulphide. The electric furnace and its application in the manufacture of metallic carbides.

Detailed study of the atmosphere. Liquefaction of gases. Higher oxides of nitrogen. Gaseous dissociation.

Manufacturing processes for the fixation of nitrogen. Oxidation of ammonia to nitric acid. Preparation and manufacture of common ammonium salts. Nitrification and denitrification.

Phosphorus. Its oxides, chlorides, hydrides and acids. Calcium phosphate and fertilisers. Use of grinding machines in chemical industry. Manufacture of matches.

Arsenic, antimony and bismuth. Their occurrence, preparation, properties and uses. The compounds they form with hydrogen, oxygen and chlorine, studied comparatively with those of nitrogen and phosphorus.

Boric acid, borax. Chemistry of the borax bead tests. Boron. Boron trioxide and boron fluoride.

Silica, its occurrence, properties and uses. Common natural silicates. Stoneware, glass, pottery and fused silica ware. Silicon, its chloride and fluoride. Etching on glass. Silicic and hydrofluosilicic acids.

Dialysis. Colloids.

CHEMICAL ANALYSIS.—SECOND YEAR.

Detection of the following metals in the pure state, in salts, simple mixtures of salts or alloys: Silver, lead, mercury, bismuth, copper, cadmium, arsenic, antimony, tin, iron, aluminium, chro-

mium, manganese, zinc, nickel, cobalt, calcium, strontium, barium, magnesium, potassium, sodium, and ammonium ; qualitative recognition of chlorides, bromides, iodides, hypochlorites, chlorates, fluorides, intrites, nitrates, phosphates, sulphates, sulphites, sulphides, thiosulphates, carbonates, bicarbonates, borates, silicates, arsenites and arsenates ; use and care of instruments employed in volumetric analysis, including the standardisation of pipette and burette ; use of standard alkali, alkali carbonate and acids, together with exercises arising from their use ; preparation and use of standard permanganate, ferrous iron, oxalic and silver nitrate solutions ; use of standard thiocyanate solution ; standard iodine, sodium thiasulphate and sodium arsenite solutions and exercises on their use ; preparation of salts and common substances in a state of purity.

PHYSICS FOR CHEMISTRY.

PHYSICS—SECOND YEAR.

Elementary surface tension and viscosity. Osmosis. Elementary Kinetic Theory of Gases.

Reflection and refraction at plane surfaces. Dispersion. Elementary theory of mirrors and lenses necessary for the understanding of optical instruments. Camera. The simple microscope. Telescope. Compound microscope. Refractometer.

The spectrum. Spectroscope and spectrometer. Elementary wave theory. Interference. Diffraction. Measurement of wavelength. Elementary treatment of polarization. The polarimeter.

Properties of a magnet. Magnetic fields. Molecular theory of magnetism.

Electrostatics. Quantity. Potential. Capacity. Electroscopes.

Magnetic effect of current. Electro dynamics—moving coil instruments. Electric motor.

Heating effect of current. Potential Difference. Electrical energy and power. Ohm's Law.

Decomposition potential. Conversion of electrical energy into chemical energy. Reversible cells. Storage battery. Electromotive Force.

Wheatstone Bridge. Potentiometer. Elementary thermo electricity. Electrical thermometers.

Electro-magnetic induction. Dynamo. Induction Coil. Transformer.

Elementary treatment of conduction through gases.

THIRD YEAR COURSE IN APPLIED CHEMISTRY.

Subjects.

INORGANIC CHEMISTRY.

CHEMICAL ANALYSIS.

INORGANIC CHEMISTRY.

THIRD YEAR.

Metals and the chief sources from which they are obtained. General methods used in the extraction of metals from their more important ores.

Preparation of alloys and their general properties. Freezing point curves and cooling curves.

Classification of the elements of the Periodic system. Law of Isomorphism. X-ray spectra and atomic members.

The more important compounds of the following metals :

(a) Sodium and potassium ; (b) copper and silver ; (c) calcium strontium and barium ; (d) magnesium, zinc, cadmium and mercury ; (e) aluminium ; (f) tin and lead ; (g) chromium and manganese ; (h) iron, cobalt and nickel.

Manufacture of sodium, zinc, aluminium, tin, lead, copper, cast-iron, wrought iron and steel. Hardening of steel. Influence of added elements on the properties of steel.

Technical production and uses of sodium peroxide, hydroxide, carbonate and bicarbonate ; potassium chloride and nitrate ; potash fertilisers ; lime, mortar ; plaster of Paris ; Portland cement ; magnesium sulphate ; zinc oxide and sulphide ; Lithophone alums ; thermit ; red lead ; white lead, potassium chromate, dichromate and permanganate ; ferrous sulphate.

Solutions : lowering of vapour pressure, osmotic pressure, determination of molecular weight by cryoscopic and ebullioscopic methods. Limitations of the methods. Equivalent conductivity. Degree of dissociation as found by conductivity compared with Van't Hoff's coefficient.

Relative strengths of acids. Hydrogen ion concentration. Hydrolysis of salts. Use of the spectroscope.

Colloidal solutions : preparation of typical solutions of a suspenoid and an emulsoid. Characteristic behaviour and influence of degree of dispersion.

CHEMICAL ANALYSIS.—THIRD YEAR.

Ordinary methods of gravimetric analysis, including the estimation of silver, lead, copper, tin, arsenic, antimony, iron aluminium, zinc, nickel, calcium, barium, magnesium, sodium, potassium, and ammonium, hydrochloric, sulphuric, phosphoric and carbonic acids; application of above, and also of volumetric methods to determination of the composition of simple alloys, and of simple mixtures; preparation of typical metals, oxides and salts, in a state of purity; analytical control of purity; revision of the volumetric work of the second year course; more extended use of standard iodine and thiosulphate; use of standard permanganate and dichromate solutions.

FOURTH AND FIFTH YEAR COURSES IN APPLIED CHEMISTRY.

Subjects.

ORGANIC CHEMISTRY.

TECHNICAL ANALYSIS.

ORGANIC CHEMISTRY.—FOURTH YEAR.

The province of organic chemistry. Reasons for separate study of carbon compounds. Detection and estimation of carbon, nitrogen, sulphur and halogens in organic substances.

Calculation of percentage composition from the results of analysis and deduction of empirical formulae. Molecular and constitutional formulae.

Methane and ethane considered as typical saturated hydrocarbons. Homologous series. Higher members of paraffin series. Isomerism. Petroleum and its products. Halogen derivatives. Chloroform, iodoform.

Ethylene and acetylene considered as typical unsaturated substances. Ethylene dibromide.

Methyl alcohol. Ethyl alcohol. Alcoholic fermentation. Higher alcohols considered briefly. Alkyl halides—methyl and ethyl iodides, ethyl chloride. Acetonitrile.

The oxidation products of alcohols. Formaldehyde, acetaldehyde and acetone. Formic and acetic acids. The chloroacetic acids as examples of substitution. Acetic anhydride and acetyl chloride and their use as reagents.

Ethyl acetate ; its preparation, properties and saponification.

Nature of common oils, fats and waxes ; their saponification.

Soap and Candles. Palmitic, stearic and oleic acids. Acetamide. Amines : primary, secondary and tertiary amines.

Glycollic and lactic acids. Optical isomerism. Oxalic, malonic, succinic, malic and tartaric acids. Ethyl malonate and ethyl acetoacetate and their use as synthetic reagents.

Keto-enolic desmotropy. Maleic and fumaric acids and geometrical isomerism. Glycol. Glycerol : Its manufacture and conversion into nitro-glycerine.

Mannitol and the carbohydrates. Sucrose and its technical production, dextrose, laevulose, maltose and lactose ; their occurrence, preparation, properties, and distinctive tests. Use of polarimeter.

Starch and the dextrines. Cellulose, nitrocelluloses, cellulose acetate and gun-cotton.

Cyanogen compounds. Cyanic and cyanuric acids. Thiocyanates. Potassium ferrocyanide and ferricyanide. Prussian blue. Preparation of hydrocyanic acid, potassium, sodium, silver and mercuric cyanides. Cyanogen. Urea.

Organo-metallic compounds of zinc and magnesium.

PRACTICAL ORGANIC CHEMISTRY.—FOURTH YEAR.

Elementary composition of carbon compounds : detection of carbon, hydrogen, nitrogen, sulphur, halogens, and metals. Physical properties of carbon compounds. Determination of melting point, boiling point, specific gravity, optical activity. Identification of simple organic compounds which may include methyl, ethyl and allyl alcohols, chloroform, iodoform, ethyl bromide, ethyl acetate, ethyl hydrogen sulphate, methyl oxalate, ethyl sulphuric acid, formaldehyde, acetaldehyde, acetone, acetic, chloroacetic, succinic, malic, tartaric and citric acids; ethylamine, acetamide, oxamide, acetonitrile, chloral hydrate, glycerol, urea, cane sugar, reducing sugars, starches. Prominent salts of above organic acids.

Preparation of the following aliphatic compounds :— potassium ethyl sulphate, ethyl bromide, methyl ether, ethylene bromide, amyl nitrate, acetone, chloroform, acetoxime, acetyl chloride, acetic anhydride, acetamide, ethyl acetate, oxalic acid, methyl oxalate, palmitic acid, urea.

FIFTH YEAR.

Benzene, toluene and their halogen derivatives. Nitrobenzenes; aniline; mono and di-methylanilines; toluidines, Diazobenzene. Phenol. Dihydroxybenzenes. Tannic acid, mordants, tanning. Benzoic and salicylic acids.

Higher homologues of benzene with their halogen, nitro, amino, hydroxy and sulphonie acid derivatives. Diazo, diazoamino and aminoazo compounds. Phenylhydrazine. Aromatic aldehydes

and ketones. Toluic and phthalic acids. Naphthalene, anthracene and their technically important derivatives. Thiophene, pyridine and quinoline. Brief consideration of the dyes of the di-phenylmethane and tri-phenylmethane series. Technically important organic compounds of arsenic.

PRACTICAL ORGANIC CHEMISTRY.—FIFTH YEAR.

Reactions for identification of characteristic groups occurring in organic compounds.

Identification of simple organic compounds and classification of those of more complex character. Determination of molecular weights of organic compounds. Use of combustion furnace in estimation of elements. Fractional distillation under atmospheric and reduced pressure.

Preparation of aromatic compounds including : Nitro-benzene, azo-benzene, aniline, sulphanilic acid, diphenyl carbinol (by Grignard re-agent), diazo-benzene, sulphate, iodobenzene, chlorobenzene (by Sandmeyer re-action), amino azo-benzene, phenol, nitro-phenol, benzoic acid, picric acid, anthra-quinone, B. naphthol, salicyl aldehyde and a typical azo-dye.

PHYSICAL CHEMISTRY, SPECIAL COURSE.

The Lectures will deal with the fundamental principles of Physical Chemistry and their bearing on, and application to, Systematic Chemical Analysis and Applied Chemistry generally.

The course of experimental work, arranged as far as possible to illustrate the Lectures, will include the determination of molecular weights by various methods : Victor Meyer, Hofmann, Beckman, Silver Salts, etc. Inversion Points, Rate of Inversion and Polarimetry, Pulfrich Refractometer, Spectroscope, Calorimetry, Heats of Solution and Neutralization, Flash Point, Bomb Calorimeter, Freezing and Boiling Points of Pure and Mixed Substances, Electrolysis, Rate of Migration, Conductivity of Solutions, p.h. Values.

INDUSTRIAL CHEMISTRY

ANALYSIS OF FOOD, DRUGS, AND WATER.

SALE OF FOOD AND DRUGS ACT.

Short history of adulteration and early legislation in regard to pure food. The present laws relative to food and drugs adulteration. Sections of the Acts that intimately concern the Public Analyst. Form of Analyst's certificate. Certificates as *prima facie* evidence and conditions governing the institution of proceedings. Regulations regarding standards of purity.

FOOD.

Milk.—Composition of milk and variation in composition ; milk of mammals other than the cow ; milk standards ; methods of calculating added water and fat deficiency ; fat of milk, its composition and methods of estimation ; methods of Gerber, Werner-Schmidt, and Rose-Gottlieb ; composition of non-fatty solids ; estimation of proteins, milk-sugar and ash ; changes in milk on souring ; analysis of sour milk ; preservatives in milk and methods of detection ; artificial colouring matter in milk ; composition and analysis of skimmed, separated, condensed and dried milk. *Butter and Margarine*.—Composition of butter fat, and its analysis ; Reichert-Wolff number ; Polenske number ; Kirschner number ; iodine and saponification values ; refractive index and Valenta test ; standards for butter ; general consideration of fats used in manufacture of margarine ; laws relating to sale of margarine. *Cheese*.—Various kinds of cheese and their comparison ; adulteration of cheese ; standards for cheese ; analysis. *Starch Food*.—Microscopical characters of the starches ; use of the microscope in their detection ; rice, sago, pearl barley, oatmeal, wheat potato and maize. *Wheat Flour*.—Wholemeal ; wheatmeal ; household flour ; analysis of flour ; bleaching of, and addition of "improvers" to, flour ; self-raising flour ; bread and its analysis ; baking powder. *Condiments and Spices*.—General consideration, and analysis of vinegar, pepper, mustard, ginger, etc. *Tea, Coffee, and Cocoa*.—Composition and analysis ; microscopical characteristics ; addition of chicory to coffee ; coffee extracts. *Sugar, Jams and Honey*.—Composition and analysis ; artificial

colours in jam ; glucose and honey. *Beer, Wine and Spirits.*— Analysis ; original gravity of beer ; standard for spirits. Preservatives and poisonous metals in food.

DRUGS.

Standards of the British Pharmacopoeia and the Department of Local Government ; methods of analysis of extracts, liquors, liniments, mixtures, powders, syrups, tinctures and ointments.

WATER AND WATER ANALYSIS.

Natural waters and source of impurities ; rain water ; surface water ; river water ; wells and springs ; waters used in brewing, distilling, and mineral water industries ; boiler-feed water ; sources, storage and distribution of waters used for drinking supply ; water treatment ; chemical analysis of water and interpretation of results.

THE CHEMISTRY OF OILS, FATS AND WAXES.

INTRODUCTION.

General method of producing and refining oils, fats and waxes. Occurrence of fatty oils, fats and waxes. Saponification products, Soap. Glycerine. Mono, di- and tri-glycerides. Naphthenes. Benzenes. Isomerism. Meaning of Hydrolysis. The fatty acids. The carbonyl group. Saturated and unsaturated compounds. Valency of carbon and structure of carbon compounds. The stearic, oleic, linoleic, linolenic and elupanodonic acid series.

TESTING AND ANALYSIS.

Physical methods. Specific gravity ; viscosity ; flash point ; refractive power ; melting point ; titer test.

Chemical methods. Bromine thermal value ; saponification value ; Reichert-Wollny value ; Polenske value ; Acetyl value ; Acid value ; Unsaponifiable value.

CLASSIFICATION.

Marine oils, including Menhaden ; cod-liver ; whale. Vegetable drying oils, including Linseed. Vegetable semi-drying oils, in-

cluding maize ; cottonseed, and sesame. Vegetable non-drying oils, including rape ; olive and castor. Animal oils, including Neats-foot. Vegetable fats, including cocoa-butter ; palm and cocoa-nut. Animal fats, including tallow ; butter-fat and lard.

THE WAXES.

Occurrence and properties of sperm oil ; carnauba wax ; bees-wax ; wool wax.

MINERAL OILS.

Occurrence and properties of petroleum ; shale oil ; coal-tar oil and lignite oil ; paraffin ; vaseline and ozokerite.

HARDENED FATS.—PRACTICAL COURSE.

INTRODUCTION.

Sampling and preliminary tests. Practical method for determining specific gravity ; melting point ; solidifying point of mixed fatty acids ; refractive index ; viscosity ; solubility ; iodine value ; saponification value ; Reichert-Wollny value ; acetyl value, etc.

Specific tests for certain oils and fats ; testing and analysis of mineral oils and waxes ; interpretation of results ; scheme for identification of an oil fat or wax.

TECHNICAL ANALYSIS—GAS MANUFACTURE.

(1) Coal (Approximate Analysis).

Moisture ; organic volatile matter ; ash ; fixed carbon, by difference ; sulphur ; calorific value ; evaporative power from calorific value.

(2) Gas (Partial and Complete).

Partial : Carbon-dioxide ; oxygen ; olefines ; carbon-monoxide.

Complete. As above, and methane and hydrogen by explosion ; nitrogen, by difference.

Sulphuretted hydrogen tested for by lead acetate paper, also estimated as grains per 100 cubic feet by iodine solution. Total sulphur in gas. Test for cyanogen compounds and for benzole vapour.

(3) Sulphate of Ammonia.

Moisture ; free acid or ammonia ; total ammonia ; sulphuric acid from fixed ammonia by calculation ; insoluble matter ; residue ; nitrogen calculated from total ammonia.

Colormetric test for copper and test for lead. Examination of B.Ov. for nitrates by Lunge Nitrometer.

(4) Bog-Iron Oxide.

Moisture ; $Fe_2 O_3$; $Fe_2 (OH)_6$.

(5) Spent Oxide.

Moisture ; pure sulphur ; tar. Test for cyanogen compounds.

(6) Liquor.

Ammonia content, free and fixed ; Tests for sulphur compounds, cyanogen and amount of gas given off on acidification.

(7) Tar.

Water content ; specific gravity ; distillation test ; estimate of tar acids ; estimation of basic compound.

(8) Oils.

Specific Gravities, viscosity, flash point and distillation test.

SPECIAL COURSE FOR DIPLOMA OF VETERINARY STATE MEDICINE.

Water Analysis.—Solids in solution, Ammonias, Nitrates, Chlorine, Oxygen absorbed and dissolved, hardness, interpretation of results.

Air.—Estimation of CO_2 .

Milk.—Specific gravity ; total solids ; fat ; solids not fat ; ash ; preservatives.

Feeding Stuffs.—Moisture ; oil ; albuminoids, fibre ; starch ; ash ; sand in ash ; food unit value ; albuminoids ratio.

Disinfectants.—Chemical valuation of bleaching powder ; permanganate of potash, formaldehyde ; sulphurous acid ; carbolic acid.

Tests for Common poisons ; mineral acids and alkalis ; arsenic ; antimony ; mercury ; lead ; barium ; cyanides ; phosphorus ; alkaloids, including strychnine, morphia.

TESTING OF PETROLEUM PRODUCTS.

(FUEL OILS AND LUBRICANTS.)

Specific Gravity ; Ash ; Acidity ; Alkalinity ; Flash Point distillation test ; viscosity ; carbon residue ; cloud and pour test ; demulsification number ; sulphur content ; saponification value ; iodine value ; water in oils.

Setting point of paraffin wax ; smoke point of kerosene ; estimation of colour ; consistency of greases ; drop and flow points of greases ; dilution in crankcase oils.

BREWING SCIENCE AND CHEMISTRY OF FERMENTATION.

FIRST AND HIGHER YEARS.

Preparation and properties of cellulose, starch from various sources, soluble starch, dextrose, cane and invert-sugar, and the products of the hydrolysis of starch.

The examination and valuation of barleys. Kiln-drying barleys, storing and screening.

Malting. The process of malting, including the so-called atmospheric systems. Conditions necessary for healthy germination.

The examination and comparative valuation of malts. Estimation of extract, proteins, ash constituents, etc.

Water. Analytical examination and test of fitness for brewing ales and stouts. Artificial softening and purification.

Mashing. Various methods of making the mash. Use of raw grain and other starch-containing material. Chemical changes effected during the mashing process, especially those attending the hydrolysis of starch. Influence of time and temperature on the result.

Use of sugar as a brewing material.

Boiling. Influence of boiling on the raw wort. Objects attained by the use of hops. Sulphured hops and their detection. The cold storage of hops.

Cooling. Influence of aeration on the cooling worts.

The various forms of the saccharometer, and the relation of their readings to each other and to specific gravity as ordinarily indicated.

Fermentation. The various systems of fermentation employed in the United Kingdom. The yeast organisms. Microscopical examinations of ferments, their modes of growth and reproduction. The chemical function of the ferments. Theories of fermentation.

Analysis of beer and worts. Determination of "original gravity." The "forcing tray" process as a test of the stability of a beer.

Preservative agents, and how applied to beer. The preparation and use of finings and caramel.

BACTERIOLOGY AND ENZYME CHEMISTRY.

Examination of plant cells as an introduction to the use of the microscope. Preparation of culture media. Study of the life histories of typical yeasts, bacteria and moulds, including their special cultural treatment in the laboratory. Experiments on enzyme chemistry. Bacterial analysis of water, milks, etc. Preservation of foods by sterilization, drying, salting, cold storage, etc.

MILK PROCESSING AND MILK PRODUCTS MANUFACTURE.

SCIENCE.

Chemistry.—Elements, compounds, mixtures, acids, bases, salts, quantitative estimation of acidity, alkalinity. The Atmosphere; water; hydrogen; oxygen; carbon; nitrogen; phosphorus; sulphur; common metals; elementary chemistry of the sugars; alcohols; formaldehyde; acetic acid; butyric acid; lactic acid; fats; proteins.

Chemical composition and physical properties of milk. Analysis of milk (fat, total solids, protein, lactose, chlorides and acidity). Elementary chemistry of milk constituents. Causes of variations in composition of milk. Effects of heat. Causes and prevention of

deterioration and taints. Adulteration of milk. Comparative nutritive value of milk. Water supply. Water softening. Detergents.

Physics.—Specific gravity. Viscosity. Surface tension. Hygrometry. Heat. Expansion. Thermometry. Latent heat. Specific heat. Conduction. Convection. Radiation. Evaporation. Principles of refrigeration. Fluid pressure. Barometers. Syphons. Pumps. Elementary machines.

Microbiology.—Microscope. Form, growth and classification of micro-organisms. Isolation. Culture media, staining and examination. Flora of milk and milk products. Effect of physical factors, including temperature, light, sterilization, pasteurization. Disinfectants, detergents, preservatives. Changes produced by micro-organisms, including acidity, alkalinity, oxidations, reductions, pigment formation and aroma. Enzymes.

MILK PROCESSING AND MILK PRODUCTS MANUFACTURE :

(Pasteurization, Sterilization, Ice Cream, Condensed and Dried Milk Products).

Pasteurisation and Sterilization.—Raw material. Bacterial flora and pre-pasteurization bacteriological standards. Pre-pasteurization treatment; bulking, pre-heating, straining, homogenizing. Principles of pasteurization and sterilization. Types and construction of pasteurizing and sterilizing apparatus. Precision control; thermometers and thermographs. Refrigeration. Faults, their detection and remedy. Cleansing of apparatus by hot water. Steam sterilization and use of detergents. Bottling and bottling equipment. Legal bacteriological and chemical standards. Water supplies. Methods of steam raising.

Ice Cream Manufacture.—Materials, Standards. Public Health requirements. Functions and quantities of components. Calculation of quantities and preparation of mixes. Mixing and refrigeration. Hardening. Types of refrigerating plants. Ageing vats and other equipment. Packing. Filling machines. Physical properties of ice cream. Faults, their detection and remedy.

Manufacture of Condensed and Dried Milk Products.—Raw materials. Legal standards.

Condensed milk; types of equipment; sugar addition; viscosities; cooling; canning, storage. Dried milk and dried whey; types of equipment, including spray, roller, vacuum band methods; grinding, packing, types of package, vacuum packing.

Keeping qualities of the above products; faults, their detection and remedy.

CEREAL CHEMISTRY AND FLOUR MILLING TECHNOLOGY.

THIRD AND FOURTH YEARS.

Cereal Science.

Elementary chemistry; constituents of air; combustion in air; oxides; combustion of coal and producer gas; constituents of water; hard and soft water; formation of rust; chalk and lime; carbon dioxide and monoxide; simple ideas of elements and compounds, of acids, bases and salts, and of metals and non-metals.

Sources of power; measurement of heat in B.Th.U.; specific and latent heat; hygrometry; properties of saturated and superheated steam; special applications to milling—*e.g.* moisture tests of wheat, wheat-feed and flour; effect on milling of moisture in wheat, in stocks and in the air.

Knowledge of pests in wheat and its products; reasons for heating, sweating and degeneration of wheat.

Elementary principles of breadmaking; effects of yeast, salt, temperature and time on breadmaking; gluten and the effect of quality and quantity on breadmaking; tests for nitrogen, gluten, ash and fibre; influence on bread-making of natural properties of flours and of bleachers and improvers; starch, sugar and enzymes.

Action of improvers; methods of improving flour quality.

Bleaching, natural and artificial.

FLOUR MILLING TECHNOLOGY.

FIRST YEAR.

Simple study of wheat, its structure and physical characteristics. Wheat growing countries, climate, harvest period, ports of shipment and shipping routes. Impurities of wheat, pests, and diseases. Simple study of types of wheat and the effect of soil and climate on wheat quality. Bushel test.

Brief history of milling, including early methods of grinding, dressing, etc., and the gradual development of present day, methods. Mechanical wheat intake plants, conveyors, elevators weighers and measurers. Preliminary cleaning machines and types of wheat storage silos.

Elementary study of construction of machinery employed in wheat cleaning separators, scourers, brushes, cockle and barley oats separators, spiral separators, aspirators, washers, whizzers, waterwheels, stoners, magnetic separators, effluent plants. Conditioners and driers. Grinders for screenings.

Elementary study of construction of machinery employed in Mill Rollermills. Plansifters, Centrifugals, Reels, Purifiers, Sieves, Study of construction of exhaust trunks, Fans, Dust Collectors. Study of construction of Elevators, Spouts, Conveyors for Mill stocks. Packing machinery, hoists, shorts, belt drives, pulley speeds.

SECOND YEAR.

Pneumatic Intake Plants. The objects of preliminary cleaning and drying. Attention to wheat during storage. The objects of wheat blending. Blending by weight, by volume. The principles of wheat cleaning; separation by size; shape, weight, specific gravity, magnetic separation, fractional cleaning, washing. Wheat conditioning, its objects and methods employed.

Disposal of screenings. Simple flow sheets of wheat cleaning plants.

Principles of grinding, including mill stones and impact machines; detailed study of rollermills and the objects of gradual breaking and gradual reduction.

Principles of scalping, grading and dusting. Principles of purification. Principles of flour dressing. Examples of sectional flow sheets. Flour bleaching and improver plants.

FLOUR MILLING TECHNOLOGY.

ADVANCED STUDY OF CONTROL OF MACHINERY AND PROCESSES.

THIRD YEAR.

Wheat cleaning machinery. Conditioners, the conditioning process and wheat drying. The design of wheat cleaning flow sheets. The break system and scalping. Grading and dusting. Purification. The reduction system and flour dressing. The scratch system. Flour divides. Flour bleaching and improving. Wheat-feed and Wheatmeal systems. Design of mill flow sheets.

Advanced study of wheat plant, germination, foliation, fertilization, propagation of new varieties. Quality of flour from different types of wheat. Strong or sponging flour. Medium strength flours. Soda bread flour. Self-raising flour. Biscuit flour. Wheat blending. Warehouse control. Work for stand periods and mill fumigation. Mill pests. Possible causes of complaints by customers.

FLOUR MILLING TECHNOLOGY.

MILL CONTROL AND MANAGEMENT.

FOURTH YEAR.

Choice of site and prime moves. Layout of mill premises. Organisation of staff and duties. Mill records and reports. Insurance against fire. Fire fighting equipment.

Wheat valuation ; calculations of the values of wheats, taking into account the impurities, moisture content and flour content. Planning economic grist, taking flour quality into account. Calculation of gain or loss of weight in screenroom and mill ; the effect on costs. Calculations of flour extraction ; its effects on costs. Divides ; how obtained and calculated and their effect on costs. Costs of manufacture and of selling distribution and administration. Effect of output on costs ; fixed and variable charges.

TECHNOLOGY OF THE MANUFACTURE OF PIGMENTS, PAINTS, AND VARNISHES.

This Course is designed to provide those engaged in these industries with a knowledge of the chemical nature of the materials used, and of the scientific basis underlying works operations.

Physics.—Measurement. Specific gravity. Hydrometers. Heat. Methods of transference. Expansion. Thermometers. Specific heat. Latent heat. Boiling and melting points. Hydrometry.

Chemistry.—A simple study of facts and theories.

Atmosphere, oxygen, hydrogen, carbon, carbon dioxide, carbonates. Hardness in water. Sulphur, oxides of sulphur. Sulphurous acid, sulphuric acid, hydrogen sulphide and sulphides. Chlorine and hydrochloric acid. Nitric acid, ammonia. Acids; alkalis and salts. Compounds of metals used in the industry.

Technology.—Oils and varnishes including methods of testing. Solvents, resins and gums. Pigments, including mixing and grinding. Drying and properties of films.

CHEMISTRY FOR PHOTOGRAPHY, PHOTO-MECHANICAL WORK, LITHOGRAPHY, Etc.

This class forms part of the Courses in Photography, Photo-Mechanical Work and Lithography (*see* Book Production and Printing Trades Booklet).

To understand the processes used in Photography, Photo-Mechanical Work, Lithography, etc., it is necessary to have some knowledge of chemistry and its general principles. Throughout the part of the syllabus devoted to General Chemistry, frequent reference is made to applications to these chemical processes.

General Chemistry.—Physical and chemical changes; mixtures and compounds; elements; chemical laws; elementary treatment of the atomic theory. *The Atmosphere*.—Constitution of the atmosphere; oxygen; nitrogen. *Acids*.—General study of the common acids, sulphuric, nitric, hydrochloric. *Alkalies*.—Lime, caustic soda, sodium carbonate, ammonia. *Salts*.—Methods of formation; water crystallisation. *Water*.—Hydrogen; carbon dioxide; natural waters. *Sulphur*.—Oxides, sulphites, sulphates,

thiosulphates. *Halogens*.—Detailed study of chlorine, bromine and iodine. *Oxidation and Reduction*.—Study of typical examples with particular reference to photographic operations. *Metallic Salts*.—Silver, gold, copper, iron, uranium.

Applied Chemistry.—Photo-chemistry of certain metallic salts ; photo-chemistry of silver salts ; theories concerning latent image ; sensitizers ; history of photographic processes ; collodion and gelatine emulsions ; ripening ; dry plates ; theory of developers, and restrainers ; acid and alkaline development ; fixing agents ; intensification and weakening of silver image ; printing processes ; toning processes ; platinotype ; chemistry of photo-mechanical processes.

BOTANY FOR SEEDSMEN.

FIRST YEAR.

Examination of a simple flowering plant ; its chief organs. Various forms of root, stems and leaf ; modifications of these organs for special purposes ; food storage ; vegetable propagation. The cell and cell contents in embryonic and adult structures, variations in type of cells of different organs. Tissues. Brief survey of the chemical nature of the principal components of plant bodies ; food, food storage and translocation.

Such of the minute structure of root, stem and leaf of herbaceous and of woody types as is necessary to explain the physiological processes connected with absorption, respiration, transpiration, assimilation, movement, growth in length and in thickness.

Buds and branching. Winter condition of some trees of different types. Forms of inflorescence. The flower ; variety of structure of floral organs. Detailed structure of stamen and of pistil ; Pollination and fertilization. Fruit. Seed dispersal. Germination.

Various forms of vegetative and of floral organs of plants as illustrated by reference to some members of the commoner families of flowering plants.

Carbohydrates ; proteins ; glucosides ; terpenes and camphors ; the principal alkaloids.

Physics.—Units of measurement, lengths, areas, volumes ; states of matter ; physical and chemical changes ; mass inertia, force, parallel forces ; weight ; Hooke's law ; energy and work ; densities of solids, liquids and gases ; Archimedes' principles and applications ; liquids and gases ; principle of flotation ; atmospheric pressure ; barometers ; Boyle's law ; kinetic energy and gases ; diffusion ; heat and its general effects ; thermometry ; melting and boiling points ; expansion of solids, liquids and gases ; specific heats ; Dulong and Petit's law ; change of state ; latent heat ; transference of heat ; methods.

PRACTICAL CHEMISTRY.

Qualitative analysis for bases and acids in solutions of simple salts, including the salts of common organic acids. Principles of organic analysis ; Detection of B.P. substances and the chief alkaloids. Standard solutions. Volumetric estimations of B.P. Water analysis ; ammonia ; nitrates ; nitrites ; chlorides ; total and permanent hardness. Urine analysis ; estimation of sugar.

BOTANY.

(September to May.)

The plant cell, tissues, and systems.

The structure and principal modifications of root, stem, and leaf in Angiosperms ; structure of typical flowers, fruits, and seeds.

The elements of plant Physiology and plant Biology, including the Ecology of native plants.

The special study of the following : *Bacillus subtilis*, *Spirogyra*, *Fucus*, *Mucor*, *Psalliota*, *Funaria*, *Aspidium*, *Pinus*, *Cheiranthus*.

The outlines of classification of Spermaphyta.

The Natural Orders : Liliaceae, Orchidaceae, Gramineae, Rosaceae, Ranunculaceae, Papaveraceae, Cruciferae, Leguminosae, Compositae, Solanaceae, Scrophulariaceae, Umbelliferae.

The following collection of slides : *Vicia Faba*—L.S. root apex, *Lilium*—L.S. root tip, *Helianthus*—T.S. stem, *Zea*—T.S. stem, *Helianthus*—T.S. root, *Ricinus*—T.S. seed, *Pinus*—L.S. ovule, *Ficus* T.S. leaf, *Horse-chestnut*—L.S. stem node, *Wheat*—L.S. seed, *Quereus*—T.S. stem (2nd year), *Circaea*—raphides, Typical Leaf—T.S. Sieve tubes, Lenticel.

MATERIA MEDICA.

(September to May).

I.

Identification ; description ; natural origin ; family ; geographical source ; chief constituents and pharmacopoeial requirements of the following :

Drugs of Vegetable and Animal Origin.

Acacia, aconitum, adeps, adeps lanae, agar, aloe, amyllum, anethum asafoetida, aurantii cortex, balsamum peruvianum, balsamum tolu tanum, belladonnae folium, belladonnae radix, benzionum, bichu calumba, capsicum, carum, caryophyllum, cascara sagrada, cassia, catechu, cera alba, cera flava, cinchona, cinnamomum, coccus, chlehcoci cormus, colchici semen, colocynthis, colophonium, copaiba, coriandum digitalis folium, ergota, filix mas, ipecacuanha, foeniculum, gelatinum, gentiana, glycyrrhiza, hamamelis, hyoscyamus, ipomoea, jalapa, krameria, limonis cortex, linum, lobelia, mel depuratum, morrhuae oleum, myrrha, nux vomica, olivae oleum, ricini oleum, abietis oleum, amygdalae oleum, anethi oleum, anisi oleum, arachis oleum, cadinum oleum, lavandulae oleum, limonis oleum, lini oleum, menthae piperates oleum, myristicae oleum, rosmarini oleum, santali oleum, santali australiensis oleum, sesami oleum, terebinthinae oleum, theobromatis oleum, opium, pix carbonis praeparata, pix liquida, podophylli resina, podophyllum, prunus serotina, quassia, quillaia, rheum, scammoniae resina, scilla, senega, sennae folium, sennae fructus, serpentaria, stramonium, strophanthus, styrax, tamarindus, thyroideum, tragacantha valeriana, zingiber.

II.

BACTERIOLOGY.

Definition of bacteria ; size ; reproduction ; motility ; structure ; spores ; effect of light ; effect of heat ; growth in gases ; identification ; classification ; preparation of sera and vaccines.

III.

Definition and storage of the following bacteriological preparations: antitoxinum diphthericum, antitoxinum tetanicum, antitoxinum welchicum, serum antidysentericum (shiga), toxinum diphthericum calefactum, toxinum diphthericum detoxicatum, toxinum diphthericum diagnosticum, tuberculinum pristinum, vaccinum typho-parathy-phosum (t.a.b.), vaccinum vaccinia.

IV.

VITAMINES.

Presence of vitamin bodies in vegetables, fruits, oils, wheat, and rice.

PRACTICAL PHARMACY.

Translation of latin prescriptions; detection of dangerous doses; compounding and dispensing; explanation of process of making non-chemical preparations of the Pharmacopoeia. Recognition of preparations of the Pharmacopoeia which are not of a definite chemical nature, such as extracts, tinctures and powders.

Demonstrations, as far as possible, will be made of the Pharmacopoeia operations; dispensing of physicians' prescriptions, prescription reading, calculation of percentages, and other quantities occurring in prescriptions.

SPECIAL CLASSES

IRISH LANGUAGE.

IRISH.

FIRST YEAR.

Oral.—Conversation lessons on simple matters such as the following: 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.

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

Cultural.—Memorising of simple songs, rhymes, stories, etc., so as to be able to repeat them with correct *blas*. Stories and recitations by Gaelic authors.

TECHNICAL GERMAN.

Readings.—Fiedler and Sandbach and Linguaphone Course.

Grammar.—Pronunciation ; the articles ; declensions of nouns ; declension of adjectives ; comparison of adjectives, adverbs, numerals, pronouns ; conjugation of verbs ; prepositions ; cases with verbs ; order of words ; omission of words. German words not to be translated ; subjunctive, infinitive ; formal subject ; comparative. Technical vocabulary. Abbreviations used in technical and scientific German. Commercial terms and correspondence. German technical journals. Sources. Bibliographies. Abstraction. German currency.

DAY AND EVENING COURSES
IN
SPECIAL TRADES

BAKERY PRACTICE and TECHNOLOGY:

BREADMAKING

FLOUR CONFECTIONERY

BOOT and SHOE MANUFACTURER:

HANDICRAFT

CLICKING and PATTERN CUTTING

FACTORY PRODUCTION

BAKERY PRACTICE AND TECHNOLOGY.

The Courses are organised to provide for the full technical training of Bakehouse Apprentices in the theory and practice of Breadmaking and Flour Confectionery, during the period of apprenticeship.

The work of the classes is under the supervision of an Advisory Committee representative of the Irish Bakers', Confectioners' and Allied Workers' Union and of the Association of Master Bakers.

The practical classes are conducted on each afternoon excepting Saturday, from 12.30 to 6.30 p.m. The ancillary instruction in Bakery Science and Calculations and in Art is given in Evening Classes.

Syllabuses.

BREADMAKING.

(THEORY).

FIRST YEAR.

Introduction. Comparison of scientific method of breadmaking and haphazard methods.

ELEMENTARY STUDY OF RAW MATERIALS.

1. *Wheat*.—Sources and varieties of wheats of the world—Spring Wheat, Winter Wheats, strong and soft Wheats, characteristics of the different varieties. Constituents of the Wheat berry : their functions and effects.

2. *Flour*.—Milling of Wheats, old and modern methods ; types of flour produced. The effects of different milling processes on the resultant flours. Grades of flour produced by modern milling methods.

Properties of flour produced from different wheats.

PRACTICAL BAKERY WORK.

Straight doughs made on long and short systems. Sponge methods using soft and stiff sponges. Characteristics of the bread produced by the different methods.

CONFECTIONERY.

Study of Raw Materials.—Types of flour used for Confectionery. Eggs, whites, yolks, different types of preserved eggs. Different types of aerating agents. Shortening agents. Sweetening agents. Colouring and Flavouring agents.

PRACTICAL WORK.

Chemically aerated goods of scones and bun type (Scones, Rocks, etc.). Chemically aerated goods of Batter method (Queens, Tottenham, etc.). Short paste goods (jams, fruit pies, etc.). Puff Paste. Different method of manufacture. English, Scotch, French.

SECOND YEAR. BREADMAKING.

Varieties of Meals.—Whole meals; germ meals; malted meals; proprietary brands.

Yeast.—Elementary study of yeast; use in bread-making; food necessary for its life, growth and reproduction. Storage of yeast; effects of temperature; possible contaminations.

Manipulation of different types of ovens. Use of Bread Improvers; types and effects of same.

PRACTICAL WORK.

Use of different bread improvers and enriching agents to show their effects on finished bread.

Times and temperatures; quantities of yeast and salt used in breadmaking. Manufacture of simple fancy breads.

CONFECTIONERY.

Cake Making.—Various methods of producing cakes of different varieties. Pound cakes, Slab cakes, Seasonal and Festival cakes.

Sponge Goods.—Sponge cakes, rolls, etc. Sweet pastes and short breads. *Biscuits.*—Pie pastes, hot and cold methods (meat pies). Preparations of royal icing; simple piping and coating top and sides of cakes.

THIRD YEAR. BREADMAKING.

More detailed work of the subjects of the 1st and 2nd years. Study of fermentation.

PRACTICAL WORK.—Fancy bread rolls ; malt, milk, brown, Vienna bread. *Small fermented foods.*—Dinner rolls ; bun goods ; tea cakes, bracks, baps, etc.

CONFECTIONERY.

Manufacture of bases for fancies, Genoese, etc. Afternoon tea fancies. Sweet pastes, frangipan, Petite four Glacé, etc. (decorated). *Gateau* and torten, flans, etc. *Choux Paste*, cream buns, éclairs, etc. *Meringue goods.*—Cold and boiled methods. *Dessert Biscuits.*—Petite macaroons. English and French Routs, etc. *Cake Decoration.*—Birthday, Christmas, bride cakes, etc.

FOURTH YEAR. BREADMAKING.

Deeper knowledge of materials used in bread-making, and a more detailed knowledge of the principles underlying the study of breadmaking.

Faults in Bread. Technical calculations. Diseases in yeast and bread.

PRACTICAL.—Manufacture of bread under different circumstances to produce faults. Use of different flours to show effect. Manufacture of richer types of fermented small goods. Hot plate goods. Festival and window display goods.

CONFECTIONERY.

Syrups ; fondants ; making simple sugar confectionery.

CHOCOLATE GOODS.

Use and treatment of chocolate in the bakery. Chocolate coating of biscuits and fancies. Perforation of moulds and making of Easter Eggs and Medallions. Simple centre dipping.

Buttercreams.—Various kinds. *Rich Fermented Goods.*—Babus, Danish Pating, etc. *Cake Decorations.*—Preparation of green pastes (soft and hard). Mould making (sulphur and plaster) Soft sugar work, etc. *Marzipan.*—Flower and fruit making.

Time Table.

BAKERY PRACTICE AND TECHNOLOGY.

FIRST YEAR.

Bakery Practice Ia Wed. 12.30-3.30 Room 20. S. Anthony

SECOND YEAR.

Bakery Practice IIa	Fri.	.....	3.30-6.30	Room 20.	S. Anthony
Bakery Practice IIb	Thurs.	3.30-6.30	Room 20.	S. Anthony

THIRD YEAR.

Bakery Practice III.	Mon.	3.30-6.30	Room 20.	S. Anthony
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FOURTH YEAR.

Bakery Practice IV.	Tues.	3.30-6.30	Room 20.	S. Anthony
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JOURNEYMEN CLASSES.

Section A.	Wed.	3.30-6.30	Room 20.	S. Anthony
Section B.	Thurs.	3.30-6.30	Room 20.	S. Anthony

WOMEN CONFECTIONERS.

Flour Confectionery I.	Tues.	7.30-10.0	Room 20.	S. Anthony
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CERTIFICATE COURSES IN BREADMAKING AND FLOUR CONFECTIONERY.

The Certificate Courses in both subjects follow the Syllabuses of the Examinations of the City and Guilds of London Institute. The requisite ancillary subjects to Bakery Practice include Physics, Chemistry, Cereal Science, Microbiology and Decorative Art.

The classes in ancillary subjects to be taken by the student in each year of a Course will be determined in consultation with the Principal.

BOOT AND SHOE MANUFACTURE.

HANDICRAFT AND FACTORY OPERATIVE COURSES.

The aim of these classes is to give a knowledge of the various branches of the trade to apprentices and improvers, who, owing to the increased use of machinery, are usually confined to one of the many branches of the Boot Trade.

Several machines have been added to the equipment.

FIRST, SECOND AND THIRD YEARS.

Determination of simple areas, as of skins; definition of terms; the action of water upon leather, metric system of measurement; differences between the bones of the infant and adult; how muscles act, effect of friction and pressure; formation of the foot and leg, with their characteristics and functions; methods of

obtaining shape and dimensions of the foot and leg ; measuring ; apparatus ; methods of recording measurements ; fitting up lasts for bespoke. *Pattern-cutting*.—Standards ; men's and boys', ladies' and girls' ; drafting standard pattern ; grading patterns into sets ; cutting patterns into working sets. *Clicking*.—Selection and description of various hides and skins and their adaptability ; economy in cutting up skins for mens' and ladies' boots ; upper fitting. *Closing*.—Action of parts of simple machines for uppers. *Rough stuff cutting*.—The hide and its divisions ; cutting and sorting bottom stuff. *Lasting*.—Hand-lasting for machine-sewn work ; machine-lasting for machine-sewn work with reference to various machines used. Methods of attaching soles to uppers, boots for malformed feet. *Finishing*.—Hand-finishing ; description of tools ; machine-finishing ; acids, stains, colouring substances, dyes and paints used in finishing boots and shoes. *Handsewn method*.—Preparing insole ; welt and lasting ; attaching welt and sole. *Raw Materials*. *Tanning*.

DAY APPRENTICE SCHOLARSHIP COURSE BOOTMAKING.

This Full-time Day Course extends over two Sessions, and is conducted under the terms of the Day Apprentice Scholarship Scheme. The Course provides 30 hours of instruction per week, of which approximately 20 hours are devoted to practical instruction in Bootmaking.

A full description of the Scheme appears on page 27 of the General Guide.

EVENING COURSES AND TIME TABLE. HANDICRAFT.

			Room	
Boot and Shoe Making—I.	M., W.	8.0-10.0	3	P. J. Casey.
Boot and Shoe Making—II.	Tu., W.	8.0-10.0	3	P. J. Casey.
Boot and Shoe Making—III	Tu., Th.	8.0-10.0	3	P. J. Casey.

BOOT FACTORY OPERATIVES' COURSE.

			Room	
Clicking & Pattern Cutting—I.	M.	8.0-10.0	14	P. J. Casey.
Factory Methods and Operations—I.	W.	8.0-10.0	14	P. J. Casey.

ART

AND

ARTISTIC CRAFTS

The Art Department is open on every evening in the week, except on a Saturday, and Art Students in courses above First Year Grade may work on any evening in the week when there happens to be room. Students will work under the guidance of the Art Master, who may change the night of work, or otherwise vary the courses to meet particular needs.

STAFF.

ART AND ART CRAFTS.

WILLIAM L. WHELAN, Art Master's Certificate, Board of Education, London, Silver and Bronze Medalist. National Competition, South Kensington; Medalist, Irish National Art Competition.—*Head of the Arts and Crafts Department.*

JAMES J. BURKE, Certificated Art Teacher, London, Medalist.

MISS MARGARET WHELAN, Certificated Art Teacher, Medalist.

Evening Courses and Time Table

GENERAL ART COURSES.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
80 K	FIRST YEAR :				
	Obj. and Mem. Drawing—I.	Thurs.	7.30-9.30	14	W. L. Whelan; Miss M. Whelan.
	Mechanical Drawing and Design—I.	Tues.	7.30-9.30	14	Miss M. Whelan.
	Extra Class in any Art subject	Tues.	7.30-9.30	11	W. L. Whelan.
81 K	SECOND YEAR :				
	Obj. and Mem. Drawing—II	Thurs.	7.30-9.30	14	W. L. Whelan.
	Design—II.	Tues.	7.30-9.30	14	W. L. Whelan; J. J. Burke.
	Drawing from Natural Forms—II.	Mon.	7.30-9.30	14	W. L. Whelan.
	Drawing from Casts—II.	—	—	—	—
82 K	THIRD YEAR :				
	Obj. and Mem. drawing—III.	Mon.	7.30-9.30	14	W. L. Whelan; Miss M. Whelan.
	Industrial Design—III.	Thurs.	7.30-9.30	14	W. L. Whelan; J. J. Burke.
	Drawing from Natural Forms—III.	Thurs.	7.30-9.30	14	W. L. Whelan.
	Drawing from Casts—III.	Thurs.	7.30-9.30	14	W. L. Whelan.
	Pictorial Composition	Mon.	7.30-9.30	14	W. L. Whelan.
83 K	FOURTH YEAR :				
	Obj. and Mem. Drawing—IV.	Mon.	7.30-9.30	14	W. L. Whelan.
	Industrial Design—IV.	Thurs.	7.30-9.30	14	W. L. Whelan.
	Pictorial Composition	Mon.	7.30-9.30	14	W. L. Whelan.
	Drawing and Painting from Natural Forms.	Mon.	7.30-9.30	14	W. L. Whelan.

APPLIED ART AND CRAFT COURSE.

No. of Course	SUBJECT	Day	Hour	Room	TEACHER
FIRST YEAR :					
84 K	Mechanical Drawing, Geometrical Design, etc.	Tues.	7.30-9.30	14	Miss M. Whelan.
	Freehand and Elementary Drawing from Casts, etc.	Thurs.	7.30-9.30	14	W. L. Whelan.
	Craftwork	Mon.	7.30-9.30	14	W. L. Whelan; Miss M. Whelan.
SECOND YEAR :					
85 K	Elementary Designs and General Handicrafts.	Mon.	7.30 9.30	14	W. L. Whelan.
	Drawing of Common Objects, etc.	Thurs.	7.30-9.30	14	W. L. Whelan.
	Craftwork	—	—	—	—
THIRD YEAR :					
86 K	Industrial Design	Thurs.	7.30-9.30	14	W. L. Whelan; J. J. Burke.
	Drawing in Light and Shade from Casts, etc.	Tues.	7.30-9.30	—	—
	Craftwork	—	—	—	—
FOURTH YEAR :					
87 K	Industrial Design and Historic Development of Styles.	Thurs.	7.30-9.30	14	W. L. Whelan.
	Craftwork	—	—	—	—

In the Third and Fourth Years a Class in Craftwork should be taken, and in the First and Second Years an appropriate Class in Art added.

SPECIAL ART AND CRAFT CLASSES.

SUBJECT	Day	Hour	Room	TEACHER
KEVIN STREET TECHNICAL SCHOOLS.				
Art Metalwork	Tues., Thurs.	7.30-9.30	—	J. J. Burke.
Enamelling on Metal	Tues., Thurs.	7.30-9.30	—	J. J. Burke.
Drawing and Design for Leatherwork and Leathercraft.	Mon. Wed. Thurs.	7.30-9.30	—	W. L. Whelan; Miss M. Whelan.
Leatherwork, Stencilling, etc.	Mon., Thurs.	7.30-9.30	—	W. L. Whelan; Miss M. Whelan.
Design for Art Ironwork	Mon., Thurs.	7.30-9.30	—	W. L. Whelan.
Commercial Art	Mon., Thurs.	7.30-9.30	—	W. L. Whelan.

GENERAL ART SYLLABUSES

MECHANICAL DRAWING, PATTERN CONSTRUCTION AND GEOMETRICAL 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; special reference will continually be made to the application of geometry to the different branches of industrial art, such as designing, etc. The exercises worked in class will include the drawing of geometrical patterns; spacing of wall and other 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.

FREEHAND DRAWING, ELEMENTARY DRAWING FROM CASTS AND NATURAL FORMS.

Materials and aim of study; methods of using pencil, pen, charcoal and brush; their suitability to express form in line or mass; blackboard demonstrations to show methods of construction, structural planning, guide, leading and controlling lines; proportion of masses, spaces, boundaries and details; drawing from large diagrams of construction or ornamental floral, foliated and animal forms, carefully selected and graduated to train the hand and lead the eye to appreciate beauty of form and proportion and to show in an elementary way the development of architecture and ornament; the principles of ornamentation; free-hand drawing on paper and blackboard; exercises to test the students' ability to apply the principles which have been already taught; exercises in the representation of form with flat washes of colour; direct drawing in silhouette; drawing from casts of simple ornament and simple sprays of natural foliage in high and low relief; drawing from shells, butterflies and birds; drawing from photographs of simple sprays of natural foliage, flowers and fruit; drawing from natural foliages, flowers and fruit; drawing from photographs, cases and large diagrams of typical examples of historic styles, patterns and schemes of decoration, including heraldry and lettering in use at different periods,

furniture, utensils, costume, armour, etc.; typical ornamental treatment of borders, medallions, panels, friezes and pilasters. Provision will be made during the lessons for practice in time-drawing; simple memory drawing.

ELEMENTARY DESIGN AND GENERAL HANDICRAFTS.

Materials used in designing, paper, tinted grounds, blackboard, chalk, charcoal, colours, stains and inks; methods of work; transferring, pouncing and stencilling, bilateral and radial patterns, working drawings; methods of delineation; outline, surface, massing or spacing, relief, modelling and carving; elements of ornament; geometry as the basis of ornament; geometric design; floral and natural forms, their adaptation to decoration; designing to fill given spaces: square, triangle, border, spandril, lunette, pilaster, panel; the designs may consist of: ornament composed of straight lines only; geometric ornament, interlacing ornament, scroll-work, and foliated or floral ornament; surface design and repeating patterns, composed of straight lines, geometric, interlacing, scroll-work, and floral ornament; diapers and "all-over" patterns; "drop," "sprig," and "trellis" patterns; simple designs in the Celtic style; practice in minor handicrafts not requiring special plant or apparatus will be carried on in the design rooms. The section includes: making of stencil plates, gesso-work, poker work, embroidery, leather work, wood-block making and printing, tile painting, lithographic drawing, book decoration, etc.

MODEL DRAWING, DRAWING OF COMMON OBJECTS, MEMORY DRAWING.

Experience to show by actual observation the effect of perspective in modifying the appearance of objects; position of points, meaning and illustration of varnishing; laws governing the appearance of objects, and how they should be drawn; drawing the circle in different positions, at the eye level, above and below the eye level; application to the drawing of familiar objects of circular section, such as cylinders, jars and cans; drawing of regular solids, with application to common objects: the cube, rectangular prism, triangular prism, hexagonal prism, cone and pyramid.

DRAWING IN LIGHT AND SHADE, FROM CASTS, COMMON OBJECTS, AND NATURAL FORMS.

Materials and how to use them ; simple exercises in rendering flat tones ; graded and flat tones by means of chalk, pencil, pen and brush ; meaning of terms : light, half-tone, shade, cast-shadow and their modifications ; natural and artificial lighting of objects ; plane surfaces and surfaces inclined to the source of light ; the cube, prism, and box ; shadows from straight lines and simple surfaces on plane and curved surfaces : the cylinder, cone and sphere ; exercises on these to show the effect of different backgrounds ; rings with concave and convex sections ; vase forms ; distribution of light and shade on vase forms ; true tone and relative tone ; exercises in rendering geometric solids ; relief ornament on flat grounds and on curved surfaces ; more advanced exercises from the cast, and from groups of objects ; application of the principles of light and shade to the drawing of architectural and natural forms ; details from the antique ; details from life ; drawing in light and shade from memory, and time drawings ; finished studies.

BRUSHWORK AND PAINTING ORNAMENT.

Brush forms resulting from single brush-impressions ; combined brush marks of different tones ; the rendering of ornamental forms by means of brush strokes ; drawing with the brush in silhouette, simple architectural and natural forms, leaves, flowers ; direct expression of plant and animal life by means of brushwork ; the mixing and harmonious juxtaposition of colour and the preparation of various grounds ; painting ornament in oil and tempera from the cast, from photographs and from examples of decorative painting to be found on vases or tiles ; copy from stained glass and other examples of historic art ; the importance and influence of the situation and surroundings on the painting of ornament.

THE PRINCIPLES OF ORNAMENT AND DESIGN : HISTORIC DEVELOPMENT OF STYLES.

Lectures for craftsmen and students of design ; the use of form and colour for decorative purposes in various periods ; architectural elements, general proportions of architectural forms ; principles and elements of ornament ; structure and growth of plants,

trees and shells ; analysis of form and design ; characteristics in typical ornaments, metal work, bronzes, porcelain, costume, textiles and embroideries ; furniture and wood work ; book-illustration ; animal forms in nature and their adaptation as ornaments ; human figure, griffins, dolphins, birds, etc. ; nemonic ornament ; symbolic ornament ; lettering ; architectural details as ornaments ; Egyptian, Assyrian and Greek art ; Etruscan and Roman art ; early Christian art in Ireland ; Gothic art ; Persian, Japanese and other Oriental styles ; Renaissance ; modern art ;

COMMERCIAL ART.

Lettering and its Applications.—Decorated initials ; printed notices ; name plates ; window tickets ; maps ; plans and architectural drawings. *Drawing for Reproduction.*—Book illustration ; process work ; colour printing. *Poster Design.*—Show cards ; catalogue covers ; calendars. *Fashion Drawing and Dress Design.*—Figure measurements, pose and gesture ; draping the figure ; drapery, colour and composition ; fashion technique.

ARTISTIC HANDICRAFTS.

Lamp and Candle Shades, Lanterns.—The making of wire frames ; the use of vellum and parchment, papers, silks, etc. ; the development of shapes and decoration of same. *Printing with Lino and Wood Blocks.*—Drawing, designing and cutting. *Decorative Painting of Whitewood Ware.*—Trays, boxes, bowls, frames and candlesticks.

ARTISTIC LEATHER WORK.

Materials ; tools—technical processes—types of leather craft. Constructive leather work—applied ornament—staining—polishing—blind and gold tooling, etc. (Mondays, Wednesdays, Thursdays, 7.30–9.30).

ART METALCRAFT AND JEWELLERY.

The necessary tools ; their correct use and application. Metals ; their qualities and preparation. Composition and preparation of pitch and pitch blocks. Repoussé ; the production of pattern and design resulting entirely from the combination and repetition of various toolmarks or impressions.

The embossing of simple forms. Simple sheet metal work ; The setting out and development of various forms on thick paper. Flat sheet metal construction ; trays and boxes, etc. The raising of metal from the flat sheet to the round.

Simple Jewellery : Wire drawing and twisting ; the making of rings, grains, discs, domes and scrolls. The decorative selection and arrangement of these units in the production of design. The process of hard soldering ; pickling and polishing. The setting of stones and enamel panels.

ART ENAMELLING.

Preliminary preparation of the metal—cutting, doming, and cleaning.

The enamel—its nature and qualities—the grinding, washing, application on metal surface, firing, annealing, and surface finishing of.

The various styles of—Champlevé, Cloisonné, etc.—their use in jewellery and in the decoration of flat and raised fans.

CRAFT CLASSES.

Mondays, Tuesdays, Wednesdays, Thursdays, 7.30–9.30.

ADVANCED DESIGN APPLIED TO CRAFTS.

In this class exercises will be arranged bearing upon the particular branch of design or handicraft the student desires to follow up.

Advanced designs adapted to special processes of execution : wood-carving, goldsmiths' work, enamelling, metal work, embossing, casting and ironwork ; book illustration ; process work ; wood-engraving ; colour printing ; furniture and plaster work ; designs for schemes of decoration with some important feature carried out in full sizes, or to as large a scale as the limits will allow ; designs for important competition to full size or to a large scale, with sketches to show the position the design is meant to occupy.

Lectures for those engaged in the various Art Industries and Crafts.

A short course of Lectures will probably be given by the Art Master, Mr. W. L. Whelan, the dates of which will be posted on the School Notice-board.

**GENERAL CURRICULUM OF THE SCHOOLS
UNDER THE CONTROL OF
THE CITY OF DUBLIN VOCATIONAL EDUCATION
COMMITTEE.**

BOLTON STREET TECHNICAL SCHOOL.

Mechanical Engineering.	Architecture
Motor Car Engineering.	Building Science.
Gas Engineering.	Building and Allied Trades.
Metal Plate Work.	Printing and Book Production.
Brass Finishing.	Watchmaking.
	Art and Art Crafts.
Day Apprentice and specialised Daytime Technical Courses.	
Day Junior Technical School.	

KEVIN STREET TECHNICAL INSTITUTE.

(Day and Evening Courses)

Pure and Applied Mathematics.	Electrical Engineering and Allied Trades.
Pure and Applied Physics.	Radio-Telegraphy.
Pure and Applied Chemistry.	Art and Art Crafts.
Bacteriology.	Bakery Science and Practice.
Pharmacy.	Bootmaking.

PARNELL SQUARE TECHNICAL INSTITUTE.

General Commercial Subjects.	Transport.
Accountancy and Allied Subjects.	Day Trade Classes :—
Local Government	Dressmaking.
Domestic Science and Housecraft.	Shirtmaking (Power).
Languages.	Clothing Manufacture (Power).
Retail Distribution.	Chef's Training Course.
Physical Training.	
Day School of Commerce.	
Day Technical Course (Girls).	

GENERAL CURRICULUM OF THE SCHOOLS
UNDER THE CONTROL OF
THE CITY OF DUBLIN VOCATIONAL EDUCATION
COMMITTEE.

PEMBROKE TECHNICAL INSTITUTE (Ringsend and Ballsbridge).

General Commercial Subjects.	Mechanical Engineering.
Retail Distribution.	Motor Car Engineering.
Languages.	Oxy-Acetylene and Electric
Domestic Science and Housecraft.	Welding.
Art and Art Crafts.	Woodworking Trades.
	Day School of Commerce.
	Day Junior Technical School (Boys).
	Day Technical Course (Girls).
	Special Apprentice Training Courses.

RATHMINES TECHNICAL INSTITUTE.

General Commercial Subjects.	Banking, Finance and Foreign Ex-
Accountancy, Auditing and Allied	change.
Subjects.	Company Secretaries.
Insurance.	Government Accountancy and
Advertising and Publicity.	Finance.
Physical Training.	Languages.
	Domestic Science and Housecraft.
	Day School of Commerce.
	Day Technical Course (Girls).

MARINO TECHNICAL INSTITUTE.

General Commercial Subjects.	Metalwork.
Languages.	Science.
Domestic Science and Housecraft.	Woodwork.
Physical Training.	
	Day Junior Technical School (Boys and Girls).
	Day School of Commerce.

CHATHAM ROW SCHOOL OF MUSIC (Day and Evening Classes.)

Pianoforte.	Wind Instruments (Wood and Brass).
Violincello.	Fifes.
Uilleann and Irish War Pipes.	Viola.
Elocution.	Orchestra.
Violin.	Drums and Flute.
Singing and Choir.	Traditional Music.
Organ.	Irish Harp.

Offices—

TECHNICAL INSTITUTE,
BOLTON STREET,
DUBLIN.

L. E. O'CARROLL, B.A., B.L.,
Chief Executive Officer.