COLLEGE OF
ENGINEERING & TECHNOLOGY,
BENGAL

SESSION 1934-1935.

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COLLEGE OF ENGINEERING & TECHNOLOGY,

BENGAL.

Historical Sketch.

The College of Engineering & Technology, Bengal, formerly known as the Bengal Technical Institute, was founded in the year 1906 by the Society for the Promotion of Tchnical Education in Bengal, with the object of training students for the Industrial persuits as well as to develop and utilize the material resources of the country.

Late Sir Rash Behari Ghosh, late Sir Taraknath Palit, Sir Nilratan Sirkar and Sreejut Satyananda Bose were the principal organisers of this Society and of the Bengal Technical Institute (now known as the College of Engineering and Technology, Bengal).

In the year 1910 the Society for the Promotion of Technical Education in Bengal was amalgamated with and merged in the National Council of Education, Bengal which was founded in the year 1906 with the object of imparting and promoting the imparting of Education—Literary and Scientific, as well as Technical and Professional—on National lines and exclusively under National Control—not in opposition to, but standing apart from, the existing systems of Primary, Secondary and Collegiate Education—attaching special importance to a knowledge of the Country, its Literature, History and Philosophy and designed to incorporate with the best Oriental ideals of life and thought, the best assimilable ideals of the West and to inspire students with a genuine love for and a real desire to serve the Country.

Late Sir Rash Behari Ghosh, late Sir A. Choudhury, late Sir Gooroodas Banerjee, late Mr. A. Rausul and Sreejut Hirendra Nath Datta were among others the principal organisers of the Council.

Late Mr. Subodh Chandra Mallik who made an endowment of Rs. 1,00,000/-, late Maharaja Surya Kanta Acharya Bahadur of Muktagacha, Mymensingh, who made an endowment of Rs. 2,50,000/- and Sreejut Brojendra Kishore Roy Choudhury of Gouripur who made an endowment of Rs. 5,00,000/- to the Council are the principal foundation donors. Late Sir Rash Behari Ghosh who was the first President of both National Council of Education and the Society for the Promotion of Technical Education in Bengal bequeathed to the Council the whole of the residue of his Estate valued at over sixteen lacs of rupees for the promotion of Technical Education. The princely gift of Sir Rash Behari Ghosh enabled the Council to erect buildings and workshops at Jadavpur and remove the Bengal Technical Institute (now known as the College of Engineering & Technology, Bengal) to its present site.

The College of Engineering & Technology, Bengal receives a recurring annual grant of Rs. 30,000/- from the Corporation of Calcutta.

Location.

The College is located in a fine piece of ground measuring 100 bighas at Jadavpur within five miles from Sealdah Railway Station (Calcutta) and in the immediate vicinity of Jadavpur Railway Station. This piece of ground was secured on 99 years lease from the Corporation of Calcutta. Another fine piece of ground measuring 92 bighas of land just contiguous to the former piece of ground has also been secured on the same terms and conditions from the Corporation of Calcutta for the future expansion and opening the proposed Agricultural Department.

Buildings.

The instructions are carried out in six spacious buildings located in the College Campus. The main building which is a two storied one occupies a floor space of 26,000 sq. feet. The Chemical Engineering Laboratory building has a total floor space of 15,000 sq. feet, and the Chemical Technology building covers a total floor space of 5,000 sq. feet. The Physics and the Electrical Engineering Laboratories are housed in a two storied building; the ground floor which has a total floor space of 12,000 sq. feet, is occupied by the Electrical Engineering Laboratory and the first floor where the Physics Laboratory is located has a floor space of 10,000 sq feet. The Mechanical Engineering Laboratory and the Power plant are located in the same building covering the floor space of 15,000 sq. feet. The workshops cover floor space of 30,000 sq. feet. besides there is a store shed.

There are also two hostels, one dining hall and five staff quarters at present in the campus.

FACILITIES FOR INSTRUCTIONS.

Library. The Library which is located in the Main College Building contains about 12,000 useful volumes. There is a well equipped reading room attached to the Library to enable the students to utilise their leisure hours in consulting reference books, current literatures etc.

Power plant & Laboratories & Work-shops. There is a Power Plant which supplies power and light for the Workshops, Laboratories, College buildings, Hostels and the Staff Quarters. It is also used as a Laboratory for the instruction of students in the Generation and Distribution of Power. Besides there are well equipped Physical, Chemical, Mechanical Engineering, Electrical Engineering and Chemical Technology Laboratories. The various workshops (Machineshop, Pattern shop, Foundry, Smithy &c.) are also well-equipped with modern machineries, instruments and apparatus for giving practical training to the students.

Physical Culture. The students are encouraged to take part in sports, such as Cricket, Football, Hockey etc. and athletics.

The College besides providing spacious grounds for sports such as Hockey, Foot-ball, Cricket &c., spends a sum of about Rs. 3,000/- per annum for promotion of Physical culture among the students.

A big *jheel* measuring 600 feet by 175 feet within the campus is open to the students for swimming.

GENERAL INFORMATION.

1. The Session lasts from 1st. of July to 30th of June.
2. College remains closed for the Summer Vacation during May and June.
3. Candidates seeking admission in the College for any of the Courses should apply to the Superintendent giving particulars required in the printed Admission sheet which is supplied with the prospectus and on request.
4. Applications for admission are entertained from the middle of June.
5. Admission to any class shall be regarded to be for one complete Session.
6. When a student has been admitted he shall not ordinarily be allowed to take transfer or withdraw his name except on payment of tuition fees for the unexpired portion of the session and arrears of tuition fees and other charges if any.
7. Remission of tuition fees for the unexpired portion of the session and other charges if any, may be made by the Managing Committee wholly or partly in special cases on good and sufficient grounds.

COURSES OF STUDY.

Following are the courses offered by the College :—

1. **Mechanical Engineering Course.**
   Five years' course leading to diploma in Mechanical Engineering.
2. **Electrical Engineering Course.**
   Five years' course leading to diploma in Electrical Engineering.
3. **Chemical Engineering Course.**
   Five years' course leading to diploma in Chemical Engineering.
4. **Junior Technical Course.**
   Three years' course.
5. **Survey & Draftsmanship Course.**
   Two years' course.

6. Agricultural Course ~~for~~ 2 years

FEES, DEPOSITS & PAYMENTS.

Admission fee. Admission fee is equal to one month's tuition fee and is payable at the time of admission.

Tuition fees. (*i*) For Engineering Courses the tuition fee for each complete session is Rs. 120/- and is payable in monthly instalments of Rs. 10/-.

(*ii*) For Junior Technical Course the tuition fee is Rs. 96/- for each complete session and is payable in monthly instalments of Rs. 8/-.

(*iii*) For other courses the tuition fee is Rs. 84/- for each complete session and is payable in monthly instalments of Rs. 7/-.

Other fees. Magazine fee Re. 1/-, Contingency fee Re. 1/- and Sporting fee Rs. 3/- per annum have to be paid each session in the month of January with the tuition fee for the month. Besides, these fees have to be paid at the time of admission.

Deposits Students working in the laboratories, workshops and other practical classes will have to purchase in each Session Laboratory Coupons worth about Rs. 10/- as a caution against breakage. This is refundable at the end of the session.

Payments. (*i*) Tuition fees must be paid on or before the 15th of every month.

(*ii*) Defaulters shall pay a fine of one pice for each day after 15th till the day on which their fees are paid and their names also are liable to be struck off at the end of the month in which default has been made.

(*iii*) Defaulters whose names have been struck off may be readmitted on payment of tuition fees of the session due up to and inclusive of the month of such re-admission and re-admission fee Re. 1/-.

(*iv*) Re-admission fee and fines may be remitted wholly or partly in special cases on good and sufficient grounds.

(*v*) No student shall be permitted except on special circumstances to appear at the Annual, First Engineering, Intermediate Engineering and Final Examinations unless he has paid his tuition fees and other dues for the whole session.

Other Essential Expenses.

Every First year student must be prepared to provide himself with a set of Drawing instruments and other requisites which will cost approximately Rs. 30 to Rs. 40. These instruments will serve the purpose throughout the course.

Stipends, Scholarships & Free Studentships.

Free studentships, stipends and scholarships are awarded to deserving poor and meritorious students and the continuance of the same depends on the good progress, regular attendance and good behaviour.

Free-students on leaving the College without sufficient and satisfactory reasons must pay fees for the full period they were allowed exemption from payment of fees.

Attendance.

The Class hours are from 10-30 A.M. to 5 P.M.

Students must attend 70 per cent. of the lectures in theoretical classes and 70 per cent. of the exercises in practical classes. Percentage of attendance will be strictly observed.

Students wishing to leave the College before the closing hours must apply to the Superintendent with the recommendation of their respective teachers.

Leave & Percentage.

Percentage rules being binding on all students, applications for leave from the students or from their guardians on their behalf are unnecessary, as a student failing to be present in his class on any account has necessarily to be marked 'absent' in the Attendance Registers, and no commutation is permissible under any circumstances without contravention of the Rules.

ADMISSION INTO THE COLLEGE HOSTEL.

1. The two Hostels at Jadavpur are according to the present arrangement reserved for Hindu students of the COLLEGE OF ENGINEERING & TECHNOLOGY.

2. Applications for admission from new students will only be considered after they have been admitted into the College.

Every admission shall be subject to the approval of the Superindendent of the COLLEGE OF ENGINEERING & TECHNOLOGY.

3. All admissions are understood to be for a complete session, and boarders are liable for all charges from the beginning of the session.

4. Caution money to the amount of Rs. 20/- is payable in advance with every application for admission. The sum will be refunded in case such admission is refused or when a boarder finally leaves the Hostel provided all dues have been paid up by him.

5. Admission fee of Rs. 2/- for a complete term shall be paid by every student on admission into the Hostel. Substitutes when permitted, may however be exempted from such fees.

6. Each boarder shall have to pay the following scale of rent including charges for light and medical attendance, by the 10th of every month. For each day's delay, a fine of one anna per day will be realised, upto 20th of the month, after which their names will be struck off from the College and they may have to leave the Hostel.

Ground Floor	...	...	Rs. 66 per annum.
First Floor	...	...	Rs. 78 ,, ,,

7. The above will be paid in 10 equal monthly instalments beginning from the month of July in every session.

8. Messing expenses for each month will be advanced to the Mess-Committee through the Mess-Assistant by suitable instalments.

Monthly instalments of Seat Rent etc. for the current month and boarding charges for the previous month, must be paid at the office of the College in one sum.

9. The Hostel will remain closed during Puja Holidays and Summer Vacation.

10. Withdrawal from the Hostel will require the sanction of the Superintendent of the College. Application for withdrawal must be counter-signed by the guardian of the boarder.

Rules and regulations of the Hostel will be sent on request.

ADMISSION REQUIREMENTS.

Engineering Courses.

(1) Students who have passed the Final School Standard Examination of the National Council of Education or Matriculation Examination of the Calcutta University or other Examinations of similar standard are eligible for admission in the First year class.

(2) Students who have passed the I.Sc. Examination with Physics, Chemistry and Mathematics are admitted into the Second year class. They will be exempted from appearing in the following papers in the First Engineering Examination :—Algebra, Trigonometry, General Physics and Sound, Inorganic Chemistry.

(3*a*) Students who have passed the B. Sc. Examination (with Physics, Chemistry and Mathematics) are admitted into the Third year class in the Chemical Engineering Department but by the end of the academic year such students will have to satisfactorily finish the class work in Drawing prescribed for the First and Second year classes and must pass the Examinations in Drawing prescribed for the First Engineering Examination.

(3*b*) Such students are admitted in the Second year class of the Mechanical and Electrical Engineering Department but they will have to pass the First Engineering Examination in the following papers :— Chemistry of Engineering Materials, Engineering Mechanics, Drawing and Mechanical Drawing and they will have to satisfactorily finish the work-shop practice prescribed for the First and Second year classes before getting promotion to the Third year class.

Junior Technical Course.

Students who have read upto the Matriculation standard of the Calcutta University, or Final School Standard of the National Council of Education, Bengal, or students possessing similar qualification are eligible for admission in this course.

PROMOTION TO THE NEXT HIGHER CLASS.

(A) Engineering Courses.

(1) Students of the First and Third year classes will be promoted without any Examination to the Second and Fourth year classes respectively provided they have satisfactorily completed the prescribed Practical work for their respective classes, which will be determined from the record kept by the class teachers under the Supervision of the Professor in charge of that subject throughout the year.

(2) Students passing the First Engineering Examination will be promoted to the Third year class.

Students getting plucked in not more than two papers, but both of them not belonging to the same group, in the First Engineering Examination will be promoted to the next higher class provided they have secured not less than 40 per cent of the total marks in theoretical papers *i.e.* at least 520 out of a total of 1,300 and not less than 20 per cent of the total marks in each papers separately, and that in case of failure in one paper by only a minimum of 15 per cent of the total marks in that paper. But such students shall, at the end of the academic year in the 3rd year class, have to sit for and pass Examinations in the papers in which they failed in the previous year and on their passing in these papers they will be declared to have passed the First Engineering Examination and will be eligible for promotion to the 4th year class provided they have fulfilled other requirements for such promotion; such students will be eligible to sit for the Intermediate Engineering Examinations in those papers for which students of the third year class are eligible.

(3) No student of the Mechanical and Electrical Engineering Fourth year classes will be promoted to the Fifth year class unless he secures pass marks in at least 11 out of 14 papers in the Intermediate Engineering Examination.

(4) Students of the Fourth year class in the Chemical Engineering Department will not be promoted to the Fifth year class unless he secures pass marks in 8 out of 11 papers prescribed for the Intermediate Engineering Examination.

(5) Those students who are declared eligible to appear at any of the Examinations because of their fulfilling the requirements for regular attendance and practical work but are not promoted to next higher class because of their failure at the Examinations or non-appearance at the same will have to continue in the same class throughout the whole period of the next academic year, but they will be exempted from practical work and attendance in those lecture classes, papers on which they have passed at the Examinations.

Those students who are declared ineligible for promotion or Examination will have to continue in the same class during the whole period of the next academic year and attend all theoretical and practical classes.

(B) Junior Technical & Other Courses.

There will be Annual Examination at the end of each session, in April and the successful students will be promoted to the next higher class.

The minimum pass-marks in Annual and Final Examinations shall be 30% of the total marks in each theoretical paper and 40% of the total marks in each practical subject.

Satisfactory completion of practical works in Laboratories, Workshop and Drawing Classes shall be prerequisites for eligibility for appearing at Annual and Final Examinations. Satisfactory completion of practical works —means securing 50% marks in practical works prescribed for the respective classes and it will be determined from the record kept by the Class Teachers.

SCHEME OF EXAMINATION.

Engineering Courses.

(1) The following examinations for students of Engineering Courses will be held by the National Council of Education, Bengal every year in the month of April :—

I. First Engineering Examination.
II. Intermediate Engineering Examination.
III. Final Engineering Examination.

(2) Students must pass separately in every paper in the above Examinations, the minimum pass-marks being 35% in each paper.

(3) Class-records of practical subjects for which no provision for separate examination is made will be considered as results of examination in those subjects, the minimum pass-marks in such cases being 50%.

(4) All examinations will be held according to the "Compartment System" *i.e.* a student passing in any paper will not have to sit for examination in that paper again.

(5) No certificate will be issued by the Council on the results of the First and Intermediate Engineering Examination. The diploma will be granted to students who pass the Final Engineering Examination.

(*a*) Second Class Honours will be granted to students securing not less than 60 per cent. of the total marks in papers of the Intermediate and Final Engineering Examinations combined, and 60 per cent. of the total marks in practical class works assigned for the 3rd, 4th & 5th year classes.

(*b*) First Class Honours will be granted to students securing not less than 70 per cent. of the total marks in papers of the Intermediate & Final Engineering Examinations combined and not less than 60 per cent. of the total marks in practical class works assigned for the 3rd, 4th & 5th year classes.

(6) Students will have to pay examination fees per paper at the rate of Re. 1/-, Rs. 1/8, and Rs. 2/- for the First, Intermediate and Final Engineering Examinations respectively.

CHEMICAL ENGINEERING.

First Engineering Examination.

I.	Mathematics :—		
	1. Algebra	One paper.	Full marks—100
	2. Trigonometry	,,	,,
	3. Co-ordinate Geometry	,,	,,
	4. Differential Calculus	,,	,,
II.	Physics :—		
	5. General Physics & Sound	,,	,,
	6. Heat & Light	,,	,,
	7. Electricity & Magnetism	,,	,,
III.	Chemistry.		
	8. Inorganic Chemistry	,,	,,
	9. Advanced Inorganic Chemistry I	,,	,,
	10. Organic Chemistry I	,,	,,
IV.	Engineering :—		
	11. Drawing	,,	,,
	12. Machine Drawing	,,	,,
V.	General :—		
	13. History	,,	,,

Students of the second year class who have satisfactorily finished the practical work in the Laboratories, Workshop and Drawing classes and fulfilled the attendance requirements for the first two years are eligible to sit for this examination. Students of the first year class who have satisfactorily finished the practical work of that class will also be allowed, if they so desire, to sit for the following papers and they will be exempted from further examination in those papers in which they are successful :—

(1) Algebra
(2) Trigonometry
(3) Inorganic Chemistry
(4) General Physics
(5) Drawing.

Intermediate Engineering Examination.

		One paper.	Full Marks—100
1.	Advanced Inorganic Chemistry—II	,,	,,
2.	Organic Chemistry—II	,,	,,
3.	Physical Chemistry	,,	,,
4.	Integral Calculus	,,	,,
5.	Engineering Mechanics	,,	,,
6.	Electrical Engineering	,,	,,
7.	Heat Engines	,,	,,
8.	Electro-Chemistry	,,	,,
9.	Metallurgy	,,	,,
10.	Fuels and their Combustion	,,	,,
11.	Economics	,,	,,

Students of the fourth year class who have satisfactorily finished the practical work in the Laboratories and fulfilled the attendance requirements for the third and fourth year classes are eligible to sit for this examination. Students of the third year class who have satisfactorily finished the Laboratory work of that class will also be allowed, if so desired, to sit for the following papers and they will be exempted from further examination in those papers in which they are successful :—

(1) Advanced Inorganic Chemistry—II
(2) Organic Chemistry—II
(3) Physical Chemistry
(4) Integral Calculus
(5) Engineering Mechanics
(6) Electrical Engineering.
(7) Heat Engines.

Final Engineering Examination.

		Two papers. Full marks—100 each.
1.	Chemical Engineering	,, ,,
2.	Industrial Chemistry	,, ,,
		One paper. Full Marks—100
3.	Chemical Technology of Oils and Fats	,, ,,
4.	General Knowledge in Chemistry and Chemical Engineering (oral)	,,

Students of the Fifth year class who have satisfactorily finished the practical work in the Laboratories and fulfilled the attendance requirements for that year are eligible to sit for this examination. They will have to pass the examination in all the papers mentioned above and also in those of the Intermediate Engineering Examination which they have not already passed. On fulfilment of these conditions students are granted Diploma in Chemical Engineering by the National Council of Education, Bengal.

ELECTRICAL ENGINEERING.

First Engineering Examination.

I.	Mathematics :—	
	1. Algebra	One paper. Full marks—100
	2. Trigonometry	,, ,,
	3. Co-ordinate Geometry	,, ,,
	4. Differential Calculus	,, ,,
II.	Physics :—	
	5. General Physics & Sound	,, ,,
	6. Heat & Light	,, ,,
	7. Electricity & Magnetism	,, ,,
III.	Chemistry :—	
	8. Inorganic Chemistry	,, ,,
	9. Chemistry of Engineering Materials	,, ,,

IV.	Engineering :—	
	10. Engineering Mechanics—I	One paper Full marks—100
	11. Drawing	,, ,,
	12. Mechanical Drawing	,, ,,
V.	General :—	
	13. History	,, ,,

Students of the Second year class who have satisfactorily finished the practical work in the Laboratories, Workshop and Drawing classes and fulfilled the attendance requirements for the first two years are eligible to sit for this examination. Students of the first year class who have satisfactorily finished the practical work of that class will also be allowed, if they so desire, to sit for the following papers and they will be exempted from further examination in those papers in which they are successful :—

(1) Algebra
(2) Trigonometry
(3) Inorganic Chemistry
(4) General Physics
(5) Drawing.

Intermediate Engineering Examination.

1.	Mathematics :— Integral Calculus and Differential Equation	One Paper. Full marks—100.
2.	Engineering Mechanics—II	,, ,,
3.	Applied Thermodynamics	,, ,,
4.	Mechanism	,, ,,
5.	Principles of Electrical Engineering	,, ,,
6.	Direct Current Machines and Measuring Instruments	,, ,,
7.	Steam Engine and Boiler	,, ,,
8.	Internal Combustion Engine	,, ,,
9.	Survey	,, ,,
10.	Theory of Machine Design	,, ,,
11.	Alternate Current Machinery	,, ,,
12.	Transmission, Distribution and Measuring Instruments	,, ,,
13.	Telegraph and Telephony	,, ,,
14.	Economics	,, ,,

Students of the Fourth year class who have satisfactorily finished the practical work in the Laboratory, Workshop and Drawing classes and fulfilled the attendance requirements for the third and fourth year classes are eligible to sit for this examination. Students of the third year class who have satisfactorily finished the practical work of that class will also be allowed, if so desired, to sit for the following papers and they will be exempted from further examination in those papers in which they are successful :—

(1) Integral Calculus.

(2) Engineering Mechanics II.
(3) Applied Thermodynamics.
(4) Mechanism.
(5) Principles of Electrical Engineering.
(6) Direct Current Machines and Measuring Instruments.

Final Engineering Examination.

		One paper.	Full marks—100.
1.	Steam Turbines	,,	,,
2.	Power Plant Engineering	,,	,,
3.	Hydraulics	,,	,,
4.	Industrial Motors and their Applications	,,	,,
5.	Transmission and Distribution (advanced)	,,	,,
6.	Telegraphy and Telephony (advanced)	,,	,,
7.	Electrical Laboratory (oral and practical)		,

Students of the Fifth year class who have satisfactorily finished the practical work in the Laboratories, Workshop and Drawing classes and fulfilled the attendance requirements for that year are eligible to sit for the examination. They will have to pass the examination in all the papers mentioned above and also in those of the Intermediate Engineering Examination which they have not already passed. On fulfilment of these conditions students are granted Diploma in Electrical Engineering by the National Council of Education, Bengal.

MECHANICAL ENGINEERING.

First Engineering Examination.

			One paper.	Full marks—100.
I.	Mathematics :—			
	1.	Algebra	,,	,,
	2.	Trigonometry	,,	,,
	3.	Co-ordinate Geometry	,,	,,
	4.	Differential Calculus	,,	,,
II.	Physics :—			
	5.	General Physics and Sound	,,	,,
	6.	Heat and Light	,,	,,
	7.	Electricity and Magnetism	,,	,,
III.	Chemistry :—			
	8.	Inorganic Chemistry	,,	,,
	9.	Chemistry of Engineering Materials	,,	,,
IV.	Engineering :—			
	10.	Engineering Mechanics I	,,	,,
	11.	Drawing	,,	,,
	12.	Mechanical Drawing	,,	,,
V.	General :—			
	13.	History	,,	,,

Students of the Second year class who have satisfactorily finished the practical work in the Laboratories, Workshop and Drawing classes and fulfilled the attendance requirements for the first two years are eligible to sit for this examination. Students of the first year class who have satisfactorily finished the practical work of that class will also be allowed, if they so desire, to sit for the following papers and they will be exempted from further examination in those papers in which they are successful :—

(1) Algebra.
(2) Trigonometry.
(3) Inorganic Chemistry.
(4) General Physics.
(5) Drawing.

Intermediate Engineering Examination.

		One Paper.	Full marks—100.
1.	Mathematics :— Integral Calculus and Differential Equations	,,	,,
2.	Engineering Mechanics II	,,	,,
3.	Applied Thermodynamics	,,	,,
4.	Mechanism	,,	,,
5.	Principles of Electrical Engineering	,,	,,
6.	Direct Current Machines and Measuring Instruments	,,	,,
7.	Steam Engine and Boiler	,,	,,
8.	Internal Combustion Engine	,,	,,
9.	Higher Engineering Mechanics	,,	,,
10.	Hydraulics	,,	,,
11.	Survey	,,	,,
12.	Electric Power Generation and Distribution	,,	,,
13.	Theory of Machine Design	,,	,,
14.	Economics	,,	,,

Students of the Fourth year class who have satisfactorily finished the practical work in the Laboratories, Workshop and Drawing classes and fulfilled the attendance requirements for the third and fourth year classes are eligible to sit for this examination. Students of the third year class who have satisfactorily finished the practical work of that class will also be allowed, if so desired, to sit for the following papers and they will be exempted from further examination in those papers in which they are successful :—

(1) Integral Calculus.
(2) Engineering Mechanics II.
(3) Applied Thermodynamics.
(4) Mechanism.
(5) Principles of Electrical Engineering.
(6) Direct Current Machines and Measuring Instruments.

Final Engineering Examination.

1.	Steam Turbines	One paper.	Full marks—100.
2.	Powerplant Engineering	,,	,,
3.	Workshop Practice (oral and practical)		,,
4.	Mechanical Engineering Laboratory (oral and practical)		,,
5.	Machine Tools and Factory Organisation and Management	,,	,,
6.	Mechanical Handling of Materials and Materials of Construction	,,	,,
7.	Hydraulic Machines and Water Power Engineering	,,	,,
8.	Motor Car Engineering	,,	,,

Students of the fifth year class who have satisfactorily finished the practical work in the Laboratories, Workshop and Drawing classes and fulfilled the attendance requirements for that year are eligible to sit for this examination. They will have to pass the examination in all the papers mentioned above and also in those of the Intermediate Engineering Examination which they have not already passed. On fulfilment of these conditions students are granted Diploma in Mechanical Engineering by the National Council of Education, Bengal.

JUNIOR TECHNICAL EXAMINATION.

This will be held by the National Council of Education, Bengal, in April every year, and the candidates who have completed the Junior Technical course shall be examined in the following papers. The fee for this Examination is Rs. 10.

Theoretical—(3 Papers—Full marks 300.)

	Subjects.	No. of Papers.	Time.	Full marks.
1.	Heat Engines	One Paper	3 hours	100
2.	Electrical Engineering	do.	do.	100
3.	Drawing	do.	6 hours	100
				300

Practical—(3 Papers, and Drawing Exercises—Full marks 450.)

4.	Machine shop	One Paper	6 hours	100
5.	Fitting	do.	do.	100
6.	Wiring	do.	do.	100
7.	Drawing Exercises done in class ...	...	...	150
				450

Answers to questions in all the subjects may be given either in Bengali or in English.

In order to pass the examination a candidate must obtain at least 30 per cent. of the total marks in each of the Theoretical and 40 per cent. of the total marks in each of the Practical subjects. Candidates obtaining 60 per cent. of the marks in the aggregate and upwards are placed in the First Division, those obtaining 50 per cent. and upwards in the Second Division, and those obtaining 40 per cent. and upwards in the Third Division.

Satisfactory completion of practical works in Laboratories, Workshops and Drawing classes shall be prerequisites for eligibility for appearing at Final Examination. Satisfactory completion of practical works—means securing 50 per cent. marks in practical work prescribed for the respective classes and it will be determined from the record kept by the class teachers.

SURVEY & DRAFTSMANSHIP EXAMINATION.

This Examination will be held every year by the National Council of Education, Bengal, according to the following scheme. The fee for this Examination is Rs. 5.

Theoretical—(2 Papers—Full marks 200).

	Subjects.	No. of Papers.	Time.	Full marks.
1.	Surveying	One Paper	3 hours	100
2.	Drawing	do.	6 ,,	100
				200

Practical—(2 Papers—Full marks 200).

3.	Surveying	One Paper	100
4.	Drawing Exercises and Survey Maps, done in class and field books	do.	100
			200

Answers to questions in all the subjects may be given either in Bengali or in English.

In order to pass the examination a candidate must obtain at least 25 per cent. of the total marks in each of the Theoretical and 40 per cent. of the total marks in each of the Practical subjects. Candidates obtaining 50 per cent. of the marks in the aggregate and upwards are placed in the First Division, those obtaining 40 per cent. and upwards in the Second Division, and those obtaining 33 per cent. and upwards in the Third Division.

PROGRAMME OF STUDIES.

ENGINEERING COURSES.

The object of these courses is to turn Mechanical, Electrical and Chemical Engineers who will be able to take charge of Factories.

Chemical Engineering.

(Five years' Course leading to Diploma).

FIRST YEAR.

	Hours per Week. Lecture.	Practical.
Inorganic Chemistry (Chem. 3)	4	...
Chemical Laboratory (Chem. 3A)	...	4
Physics (P. 1)	4	...
Physical Laboratory (P. 1A)	...	3
Algebra (M. 1)	3	...
Trigonometry (M. 2)	3	...
Drawing (D. 1)	...	6
Workshop (W. 1)	...	6
History (H. 1)	2	...
Total ...	16	19

SECOND YEAR.

	Hours per Week. Lecture.	Practical.
Inorganic Chemistry (Chem. 5)	3	...
Qualitative Analysis (Chem. 5A)	1	9
Organic Chemistry (Chem. 6)	2	...
Physics (P. 2)	4	...
Physical Laboratory (P. 2A)	...	6
Co-ordinate Geometry (M. 3)	3	...
Calculus (M. 4)	3	...
Machine Drawing (M. E. 8a)	...	6
History (H. 2)	2	...
Total ...	18	21

THIRD YEAR.

	Hours per Week. Lecture.	Practical.	
Inorganic Chemistry (Chem. 7) ...	2	...	
Quantitative Analysis (Chem. 7A) ...	1	18	First half-year.
Organic Chemistry (Chem. 8) ...	3	...	
Organic Preparations and Detections (Chem. 8A)		18	Second half-year.
Physical Chemistry (Chem. 9) ...	3	...	
Mathematics (M. 5)	2	...	
Engineering Mechanics (E. M. 4) ...	2	...	
Electrical Engineering (E. E. 15) ...	2	...	
Electrical Laboratory (E. E. 15)		2	
Heat Engines (M. E. 20)	2	...	
Total ...	17	20	

FOURTH YEAR.

	Hours per Week. Lecture.	Practical.	
Electrochemistry (Chem. 10)	3	...	
Physico-Chemical Measurements and Preparations (Chem. 11)		24	Second half-year.
Chemical Engineering (Chem. 12) ...	3	...	
Industrial Chemistry (Chem. 13) ...	2	...	
Technical Analysis (Chem. 13A)		24	First half-year.
Metallurgy (Chem. 14A)	2	...	
Fuels and their Combustion (Chem. 14B)	2	...	
Economics (H. 3)	2	...	
Total ...	14	24	

FIFTH YEAR.

	Hours per Week. Lecture.	Practical.
Chemical Engineering (Chem. 15)	2	...
Chemical Technology of Oils and Fats (Chem. 16) ...	2	...
Advanced Laboratory Work in Chemistry (Chem. 17) ...		30
Industrial Chemistry (Chem. 13)	2	...
Total ...	6	30

Electrical Engineering.

(Five years' Course leading to Diploma).

First Year.

	Hours per Week. Lecture.	Practical.
Mathematics—		
Algebra (M. 1)	3	...
Trigonometry (M. 2)	3	...
Physics (P. 1)	4	...
Physical Laboratory (P. 1A)	...	3
Chemistry (Chem. 3)	4	...
Chemical Laboratory (Chem. 3A)	...	4
Drawing (D. 1)	...	6
Workshop (W. 1)	...	6
History (H. 1)	2	...
Total	16	19

Second Year.

	Hours per Week. Lecture.	Practical.
Mathematics—		
Co-ordinate Geometry (M. 3)	3	...
Calculus (M. 4)	3	...
Physics (P. 2)	4	...
Physical Laboratory (P. 2A)	...	6
Chemistry of Engineering Materials (Chem. 4)	3	...
Chemical Laboratory (Chem. 4A)	...	2
Engineering Mechanics (E. M. 1)	3	...
Mechanical Drawing (D. 2)	...	6
Workshop (W. 2)	...	6
History (H. 2)	2	...
Total	18	20

Third Year.

	Hours per Week. Lecture.	Practical.
Mathematics (M. 5)	2	...
Engineering Mechanics (E. M. 2)	4	...
Principles of Electrical Engineering (E. E. 1 & 4)	4	...
Direct Current Machines and Measuring Instruments (E. E. 2 & 3)	3	...
Applied Thermodynamics (M. E. 1)	3	...
Mechanism (M. E. 5)	3	...
Electrical Engineering Laboratory (E. E. Lab. 1)	...	3
Electrical Drawing (E. E. 5)	...	3
Machine Drawing (M. E. 8)	...	9
Workshop (W. 3)	...	6
Total	19	21

Fourth Year.

	Hours per Week. Lecture.	Practical.
Economics (H. 3)	2	...
Alternate Current Machinery (E. E. 6)	3	...
Transmission and Distribution (E. E. 7)	3	...
Measuring Instruments (E. E. 8)	1	...
Telegraphy and Telephony (E. E. 13)	1	...
Steam Engine and Boiler (M. E. 2)	4	...
Internal Combustion Engine (M. E. 4)	2	...
Theory of Machine Design (M. E. 9)	2	...
Survey (S. 1)	1	...
Machine Drawing and Design (M. E. 10a)	...	6
Electrical Engineering Laboratory (E. E. Lab. 2)	...	3
Mechanical Engineering Laboratory (M. E. 13)	...	3
Electrical Design (E. E. 9)	...	3
Workshop Practice (W. 4)	...	6
Total	19	21

Fifth Year.

	Hours per Week. Lecture.	Practical.
Industrial Motors and their Application (E. E. 10)	3	...
Transmission and Distribution (Advanced Course) (E. E. 12)	2	...
Telegraphy and Telephony (Advanced Course) E. E. 14)	2	...
Design of Electrical Machines (E. E. 11)	1	6
Power Plant Engineering (M. E. 19)	3	...
Steam Turbine (M. E. 3)	2	...
Hydraulics (M. E. 6)	2	...
Electrical Engineering Laboratory (E. E. Lab. 3)	...	6
Electrical Workshop (E. E. Lab. 4)	...	3
Total	15	15

Mechanical Engineering.

(Five years' Course leading to Diploma).

First Year.

	Hours per Week. Lecture.	Practical.
Mathematics—		
Algebra (M. 1)	3	...
Trigonometry (M. 2)	3	...
Physics (P. 1)	4	...
Physical Laboratory (P. 1A)	...	3
Chemistry (Chem. 3)	4	...
Chemical Laboratory (Chem. 3A)	...	4
Drawing (D. 1)	...	6
Workshop (W. 1)	...	6
History (H. 1)	2	...
Total ...	16	19

Second Year.

	Hours per Week. Lecture.	Practical.
Mathematics—		
Co-ordinate Geometry (M. 3)	3	...
Calculus (M. 4)	3	...
Physics (P. 2)	4	...
Physical Laboratory (P. 2A)	...	6
Chemistry of Engineering Materials (Chem. 4) ..	3	...
Chemical Laboratory (Chem. 4A)	...	2
Engineering Mechanics (E. M. 1)	3	...
Mechanical Drawing (D. 2)	...	6
Workshop (W. 2)	...	6
History (H. 2)	2	...
Total ...	18	20

Third Year.

	Hours per Week. Lecture.	Practical.
Mathematics (M. 5)	2	...
Engineering Mechanics (E. M. 2)	4	...
Applied Thermodynamics (M. E. 1)	3	...
Mechanism (M. E. 5)	3	...
Principles of Electrical Engineering (E. E. 1 & 4) ...	4	...
Direct Current Machines & Measuring Instruments (E. E. 2 & 3) ...	3	...
Machine Drawing (M. E. 8)	...	9
Electrical Drawing (E. E. 5)	...	3
Electrical Engineering Laboratory (E. E. Lab. 1)	...	3
Workshop (W. 3)	...	6
Total ...	19	21

Fourth Year.

	Hours per Week. Lecture.	Practical.
Economics (H. 3)	2	...
Higher Engineering Mechanics (E. M. 3) ...	4	...
Steam Engine and Boiler (M. E. 2)	4	...
Internal Combustion Engine (M. E. 4)	2	...
Hydraulics (M. E. 6)	2	...
Survey (S. 1)	1	...
Electric Power Generation and Distribution (E. E. 16)	2	...
Theory of Machine Design (M. E. 9)	2	...
Machine Drawing and Design (M. E. 10)	...	9
Mechanical Engineering Laboratory (M. E. 12)	...	6
Workshop Practice (W. 4)	...	6
Total ...	19	21

Fifth Year.

	Hours per Week. Lecture.	Practical.
Power Plant Engineering (M. E. 19)	3	...
Hydraulic Machines & Water Power Engineering (M. E. 7)	2	...
Steam Turbine (M. E. 3)	2	...
Machine Tools (M. E. 14)	2	...
Factory Organisation & Management (M. E. 15) ...	1	...
Mechanical Handling of Materials (M. E. 16) ...	2	...
Materials of Construction (M. E. 18)	1	...
Motor-car Engineering (M. E. 17)	1	...
Machine Design (M. E. 11)	...	12
Mechanical Engineering Laboratory (M. E. 12)	...	3
Advanced Workshop Practice (W. 5)	...	6
Total ...	14	21

JUNIOR TECHNICAL COURSE.

(*Three Years' Course*).

This Course is intended for turning out skilled Operatives and Assistants to Foreman, Engine-Drivers, Fitters (Mechanical and Electrical) and Mechanical Draftsmen.

First Year.

1. Drawing.
2. Physics—Theoretical and Practical.
3. Chemistry.
4. Mathematics—Arithmetic, Algebra and Geometry.
5. Workshop—Carpentry and Foundry.

Second Year.

1. Drawing.
2. Chemistry.
3. Mathematics—Arithmetic, Algebra, Geometry, Trigonometry and Mensuration.
4. Mechanics.
5. Physics—Theoretical and Practical.
6. Elements of Electrical Engineering.
7. Workshop—Smithy and Turning.

Third Year.

1. Drawing.
2. Workshop—Practical training in :—
   (*a*) Engine, (*b*) Boiler, (*c*) Power House, (*d*) Machine-shop and Fitting, (*e*) Wiring and Electrical Fitting.
3. Steam Engine, etc.
4. Electrical Engineering.

SURVEY AND DRAFTSMANSHIP COURSE.

(*Two Years' Course*).

1. Drawing.
2. Surveying.
   - Chain Surveying.
   - Chaining.
   - Field Book.
   - Simple Processes.
   - General Surveys.
   - Level Book and Section.
   - Plotting Sections.
   - Office work.
   - Preparations of Plans and Sections.
   - Copying Plans.
   - Computing Areas.
   - Survey with Angular Instruments.

Simple and Compound Levelling.

Plane-Table and Compass Survey, etc. and elementary use of Theodolite in Surveying if necessary.

COURSES OF INSTRUCTION.

HISTORY AND ECONOMICS.

H. 1. Historical Study of India and its Civilisation.

A general survey of the leading events in the different epochs with special reference to their reaction upon the life and culture of its people as shaped and guided by its genius and wisdom, as broadly outlined below :—

Early Aryans and their colonisation of India; results of their conflicts and contact with the aboriginal Non-Aryan races.

Origin of the Social system on the basis of castes : its later developments.

Vedic literature and religion. Growth and development of the Hindu Religious system in later ages, helped and guided by the Philosophical theories, Puranas and Tantras : contributions of Non-Aryan cults towards it.

Jainism and Buddhism : Buddhist missionary activity in and outside India : Buddhist view of life : its ethical discipline and spirit of service to all living beings.

Decline of Buddhism and rise of Neo-Hinduism under Buddhist reaction; Greeks : India in Greek records. Later foreign inroads and their impress upon the Social and Political life of the Hindus.

The Empires and the great Emperors.

A general view of the corporate life of the Hindus;—Family system on communistic basis; organisation of classes, tribes, caste-groups on socialistic principles, Economic, Civic and Political life in villages, towns and states.

Learning, Literature and Education; Influence of ancient culture and its spiritual and ethical discipline upon Hindu mind and character : How it formed the basic plank of the Unity of Hindu India.

Rise of Islam in Western Asia; Islamic Empire of the Saracens and its civilisation. Fall of the Saracen Empire and rise of the Turks and their kingdoms; the Persians and the Turks; The Khaliphate and the Ottoman Empire.

India on the eve of the Mahammadan conquest; the Rajputs, the northern and the southern Kingdoms.

Mahammedan conquest of India and its extent; the Pathan and the Moghal Empires; independent and semi-independent Hindu powers during their respective dominance. The Rajputs and their struggles with the imperial rulers of Delhi.

Character of the Mahammadan rule (Pathan and Moghul regimes); how far and in what way it dominated the Hindus; the scope of freedom the native Hindu peoples enjoyed in the management of their own acairs; how far it was affected by the imperial policy inaugurated by the Moghul Akbar.

The Moghul empire from Akbar to Aurangzeb; its decline after the death of the latter.

Hinduism during Mahammadan rule; the new religious movements among the Hindus; Literature and the vernaculars.

The social system and Castes—how affected by the protective measures against aggressive Mahammadanism. Spirit of toleration, mutual good will and trust growing in later ages particularly in the provinces away from the centre of Mahammadan power in N. W. India. Consequent unity in common interests of life as fellow-countrymen to the extent even of participating in each others religious festivals.

Social life and material condition of the people as evidenced in contemporary records, native and foreign.

Rise of the Marathas and their empire; their Military and Political dominance in the 18th Century.

Rise of the Sikh Power in the Punjab, its consolidation in a kingdom under Ranjit Singh.

Nadir Shah and Ahmad Shah Durani. Dissolution of the Moghul empire.

Diplomatic and Trade relations between India and Modern Europe; the East India Companies and their commercial settlements in India.

The English and the French in Southern India, Duplex and the Karnatic Wars; how territorial occupation began; foundation of the British dominion under the East India Company in the Madras Presidency.

Spread of British dominion in other parts of India—Clive, Warren Hastings, Cornwallis, Wellesley and Dalhousie.

The Sepoy Mutiny and after. Growth of the administrative system.

Public education and the Universities under State control or supervision.

Local self-Government in Civic life. Constitution of the Imperial and Provincial Governments; progressive measures in its growth and developments.

British trade and modern industries; their effect upon the socio-economic life of the people.

Impact of European culture and civilisation upon India and how it has affected the foundations of the Indian system of life and thought. Religious and Social reform movements.

New ideals of an all-India political life; the growing spirit of Indian Nationalism fostered by the Congress movement, brief history with its aims and ideals. Modern education and literature.

H. 2. History :—A general survey of European History with special reference to the growth of its religious, social, civic and political institutions up till the 18th Century.

European colonies and conquests outside (from the 16th to the 18th Century).

The French Revolution and Europe of the 19th century.

Economic, political and cultural dominance of Europe over the modern World.

International conflicts in commercial and political interests; the Great War. Bolshevic Revolution of Russia. Fascism in Italy.

Modern political constitution of the leading countries of the West. Modern States.

H. 3.—Economics & Accounting :— A general study of economic principles relating to—Wants and utilities: Wealth and services: Production of wealth (Land, Labour and Capital), productive agencies and distribution: Exchange of wealth and services: Exchange value: Method of its determination.

Production, productive agencies and distribution in different stages of socio-economic life, (i) Stage of family economy; (ii) Stage of home industries in guilds and caste organizations: Status and custom; working principles of associativeness and limitations in competition therein; (iii) Stage of organised marketing of home products by capital owners; (iv) Stage of modern industries—organised production and sale by joint-stock corporations guided by active principles of free competition and contract.

Regulation of production, Law of markets: Economic crises.

Factory organisation, working technique of factories; factory laws; business organisation in general.

Results of individualistic free competition and contract taking place of older models of status and custom upon the economic life of modern society—(i) Free artisan families of rural areas disappearing giving rise to a new class of homeless wage earning labourers in factory areas. Labour conditions in factories: life in factory towns: (ii) The big Bourgeiosie; control of capital, credit; production and marketing; trusts; rings; corners.

Conflict between capital and labour; sharp class contrast between the Bourgeiosie and the Proletariate. Labour movements; Trade unionism; Communism; Socialism; Anarchism; Syndication; Strikes and other methods of direct action. Co-operative movements.

Exchange; money, currency and prices; credit and credit instruments; Banks.

International trade; exports and imports; balance of trade and rate of exchange. Free trade, protection, bounties.

Taxation; excise and custom duties. Land and land tenure; rent: State as individual proprietorship of land.

Economic India :—Land tenure and agricultural industry: older system of manufacture and trade, family, castes, village units. Progress of modern industries and its effects upon the older system with the socio-economic life closely connected with it. Notable modern industries and their countries: coal mines, jute, tea, cotton, silk; sugar: their productive organisations and market.

Accounting, Book-keeping, Laws of Joint Stock Companies, Commercial Geography.

MATHEMATICS.

M. 1. Algebra :— Theory of Indices, Surds and Imaginary Quantities, Ratio and Proportions, Variation, Quadratic Equations and Expressions, Simultaneous Quadratic Equations one of which is linear, Graphical Solution of Simple and Quadratic Equations, Simple Rules of Arithmetic, Geometric and Harmonic Progressions, Permutations and Combinations, Binomial Theorem, Logarithms, Exponential and Logarithmic Series.

M. 2. Trigonometry :— Measurement of Angles, Trigonometrical Ratios, Applications of Algebric Signs to Trigonometry, Angles of any magnitude, Elementary Trigonometrical Formulæ with applications, Identities and Trigonometrical Equations, Graphs of Trigonometrical Ratios, Logarithmic Sines, Cosines, etc., Use of Logarithmic Tables, Applications of Logarithms to Arithmetical and Trigonometrical Calculations, Relations between the sides and angles of a Triangle, Solutions of Triangles, Problems of Heights and Distances. Inverse circular functions.

Mensuration :— Areas of plane surfaces such as Triangle, Regular and Irregular Polygons, Circles, Circular Ring and Ellipse; Length of Chord and Circular Arc; Surfaces and Volume of Solids viz. Prism, Cylinder, Pyramid, Cone, Wedge, Frustum of a Cone, Sphere, etc.

M. 3. Analytical Geometry :— Co-Ordinates, Cartesian and Polar. Lengths of Straight lines and areas of Triangles. Point of division of Straight line. Definition of the equation to a Locus. Equations of Straight lines. Equations representing two or more straight lines. General Equation representing two or more straight lines. General Equation of the Second degree. Transformation of Co-Ordinates, Change of Axes. Circle, Parabola, Ellipse and Hyperbola :—their Equations and properties with simple examples. Tangents and Normals. Relations between a Line and a Conic. Tracing some commonly occurring Curves whose equations are simple in form in Cartisian or Polar Co-ordinates. Cartisian Co-ordinates in space. Direction of Cosines of a line. Length between two Points in space. Angle between two lines in space. Point of division of a line in space. Definition of the Equation to a Locus in space. The plane and the General equation of the First degree in three Variables. The straight line in space and its general Equations. The Projecting Planes of a line. Special surfaces :—Spheres, Cylinders, the projecting Cylinder of a curve, Cones, Surfaces of revolution and Ruled surfaces. Transformation of Co-ordinates in space. Quadratic surfaces and Equations of the second degree in three Variables. Relation between a line and a quadric.

Tracing of curves will receive considerable attention throughout the whole course.

M. 4. Differential Calculus :— Constants and Variables. Functions, Limits and Infinitesimals. Differentiation of :—Constant; Sum, Product and Quotient of Functions, Function of a Function, Inverse Functions, Logarithmic and Trigonometrical Function. Differentiation of a Function of Several Variables, Partial Differentiation. Euler's Theorem. Differentials. Successive Differentiation. Taylor's and Maclaurin's Theorems. Rates, Maxima and Minima. Curvature. Equations of Tangents and Normals. Subtangents and Subnormals. Geometrical and Physical applications chiefly from the Engineers' point of view.

M. 5. Integral Calculus & Differential Equations :— Simple methods of Integration. Integration by substitution of a new Variable. Integration by parts. Integration by resolution into partial Fractions. Length and Areas of Plane Curves. Volume of solid of revolutions. Simple cases of definite Integrals. Mean value of ϕ (x). Successive and Partial Integration. Plane area as a definite double Integral. Volume found by triple Integration. Moment of area. Centre of area. Moment of Inertia. Fourier's series. Differential Equations of the first order and of the first degree. Differential Equations of the *n*th. order and of the first degree. Simple Geometrical and Physical applications chiefly from the Engineers' point of view.

PHYSICS.

P. 1. General Physics. *Mechanics* :—Units and Measurements; Newton's Laws of Motion; Velocity and Acceleration; Relative Velocity; Angular Velocity; Laws of Falling Bodies; Force, Composition and Resolution of Forces; Parallel Forces, Centre of Inertia, Conditions of Equilibrium; the different States of Equilibrium; Centripetal and Centrifugal Forces; Momentum of the Force, Couple; Friction, the Limiting Friction; Work, Power, Energy, Transformation and Conservation of Energy; Machines, Simple Machines, Levers, Pulleys, etc., Balance; Moment of Inertia, Moment of Inertia and Angular Acceleration; the Simple Harmonic Motion, Fundamental Ideas; Simple Pendulum; the Laws of Pendulum.

General Properties of Matter :—Properties of Matter, Inertia, Gravitation; Physical and Chemical Classification of Matter; three states of matter; Properties of Solids; Density and Specific Gravity.

Hydrostatics :—Fluids, Liquids and Gases; Pascal's Law of Pressure due to Gravity; Pressure at a Point; Hydrostatic Paradox; Hydraulic Pressure; Equilibrium of Liquids; Pressure on Bodies Immersed in Liquids. Principle of Archimedes, Equilibrium of Immersed and Floating Bodies; Determination of Specific Gravity, Hydrometers, Specific Gravity Bottle; Pressure of Air; the Barometer, Manometers, Pumps, the Syphon, Boyle's Law.

Sound :—Origin of Sound, Characteristic of Wave Motion, Characteristic of Sound; Loudness; Pitch, Quality, Velocity of Sound, Reflection of Sound; Resonance, Stationary Vibrations; Nodes, Antinodes; Overtones, Harmonics; Sonometer; Open and Closed Organ Pipes, Reed Instruments, Stringed Instruments, Vocal Organs; the Ear.

Light :—Nature of Light, Shadows; Reflection, Refraction; Photo-

metry; Mirrors, Plane, Concave and Convex; Prisms, Lenses, Dispersion, Spectrum, Natural Colour; Optical Instruments; the Eye.

P. 1A. Physical Laboratory. *General Physics* :—Use of Scale, Dividers; Length of Curved Lines; Value of π ; Use of Vernier Scale; Decimal Diagonal Scale; Sliding Calipers; Screw Gauge; Spherometer. Determination of Area of a Trapizium, a Circle; an Ellipse; an Irregular Figure. Determination of Volume of a Parallelopiped; a Cylinder; a Sphere. Use of Balance; Different methods of Weighing, Use of Riders; Graphic Representation of Force, Determination of the Resultant of two Forces. Centre of Gravity of a Sheet of Card-Board; Verification of the Laws of Pendulum; Determination of *"g"*. Determination of the Co-efficient of Friction; Use of Inclined Plane. Verification of the Principle of Archimedes; Comparison of the Densities of Two Liquids (a) which do not mix, by balancing columns (b) which mix, by Hare's Apparatus. Determination of Specific Gravity, Use of Hydrostatic Balance, Hydrometers, Sp. Gr. Bottle; Area of a Figure by Weighing. Use of Barometer.

Sound :—Determination of Velocity of Sound by Resonance Method; Use of Sonometer.

Light :—Photometry; Verification of Laws of Reflection and Refraction, Determination of Focal Length of Mirrors and Lenses.

P. 2. Heat, Electricity and Magnetism. *Temperature, Thermometry* :—Different Scales of Temperature; Mercury and other Liquid Thermometers; Gas Thermometers, Maximum and Minimum Thermometers; Construction of Mercury Thermometers; the Fixed points of a Thermometer,—corrections to be applied.

Calorimetry :—Quantity of Heat; Specific Heat; Capacity for Heat; Calorimeters and their Water Equivalents; Determination of Specific Heat; Latent Heat; Determination of Latent Heat of Water and Steam; Ice Calorimeters.

Expansion of Solids :—Co-efficients of Expansion; Measurement of the Co-efficient of Linear Expansion of a Metal; Effects of Expansion—Pendulums—Compensation of Pendulums and Balance Wheels (of Watches).

Expansion of Liquids :—Apparent Expansion; True Expansion; Measurement of Co-efficient of Relative Expansion—Wet Thermometers—Measurements of Co-efficient of Absolute Expansion; Pyknometers; Expansion of Water; Maximum Density of Water; Correction to Barometric Heights.

Expansion of Gases :—Boyle's Law and its verification; Charles' Law; Absolute Scale of Temperature; Relation PV=RT; Pressure and Volume Co-efficients of a Gas and their Determination; Gas Thermometers.

Change of State :—Fusion; Laws of Fusion; Regelation; Evaporation; Boiling; Variation of Boiling Point with Pressure.

Kinetic Theory of Gases and Properties of Vapours :—Kinetic Theory of Gases; Saturated and Unsaturated Vapours; Measurement of Vapour Pressure; Temperature Effect; Dalton's Laws; Mixture of Gases and Vapours; Atmospheric Phenomena; Dew; Dew Point; Hygrometric State of the Atmosphere; Relative Humidity; Hygrometers.

The First Law of Thermodynamics :—Theories of Heat; Work and Heat; Mechanical Equivalent of Heat; Joule's Experiment; the First Law of Thermodynamics.

Convection, Conduction, and Radiation of Heat :—Definitions; Co-efficient of Conductivity; Measurement of Conductivity; Properties of Radiation; Emissivity of a Surface; Law of Cooling; Specific Heat of a Liquid.

Magnetic attraction and Repulsion and Magnetic Induction :—Magnetic Needles; Position of Poles and Axis; Theory of Magnetism; Consequent Poles; Magnetic Shells and Magnetic Substances; Induced Magnetism; Retentivity; Methods of Magnetisation and Demagnetisation.

Fields of Magnetic Force :—Law of Attraction and Repulsion; Unit Pole; Field of Force; Deflection Magnetometer; Tangent A & B Positions of Gauss; Oscillation Magnetometer; Comparison of Moments of Magnets; Magnetic Potential; Magnetic Screening; Lines of Force; Lines of Magnetisation and Lines of Induction.

Terrestrial Magnetism :—Declination; Dip; Horizontal Intensity; Determination of H; Magnetic Maps; Ship's Compass.

Static Electricity :—Production of Frictional Electricity; Theories of Electrification; Electrons; Electroscope; Conductors and Non-Conductors; Law of Inverse Squares; Unit Charge; Torsion Balance; Surface Distribution.

Electrostatic Induction :—Charging by Induction; Faraday's Ice-pail Experiments; the Electrophorus; Electrical Screening.

Electric Field :—Field of Force; Intensity; Potential; Tube of Force.

Capacity :—Capacity; Principle of Condenser; Capacity of Different Condensers; Specific Inductive Capacity; Residual Charge; Leyden Jars; Condensers in Series and in Parallel; Energy of a Charged Condenser; the Farad.

The Atmospherical Electricity :—Lightning; the Aurora.

Dynamic Electricity. Voltaic Cells :—Electric Current; Simple Cell; Theory of Simple Cell; Local Action; Polarisation; E. M. F. and Potential Difference; One-Fluid Cells; Two-Fluid Cells; Dry-Cells; Standard Cells.

Magnetic Fields due to Electric Currents :—Oersted's Experiments, Maxwell's Corkscrew Rule; Laplace's Law; Magnetic Fields due to a current in a Circular Conductor; Strength of the Fields at the Centre; C. G. S. Electromagnetic Unit of Current; Solenoids; Action of Magnets on Currents; Principle of a Motor; Action of Current on Currents.

Galvanometers :—Astatic Galvanometers; Tangent Galvanometer; Sine Galvanometer; Mirror Galvanometer; Suspended Coil Galvanometer; Dead-beat Galvanometer; Ampere Balance; Electrodynamometer; Ammeter and Voltmeter; Soft Iron and Hot Wire Instruments.

Resistance :—Ohm's Law; Specific Resistance; Temperature Co-efficient; Resistance of Systems of Conductors (i) in Series, (ii) in Parallel; Shunts; Kirchoff's Laws, Wheatstone's Bridge; Meter Bridge; Post Office Box; Platinum Resistance Thermometers; Grouping of Cells.

Some Electrical Measurements :—Resistance of a Galvanometer—Direct Method, Thomson's Method; Resistance of a Battery, Mance's Method, Ammeter and Voltmeter Method; Comparison of E. M. F. of Voltaic Cells—Method of Sum and Difference, Method of Direct Deflection, Potentiometer Method; High Resistance; Low Resistance; Resistance of Electrolyte.

Thermal Effects of Electric Current :—Conversion of Electric Energy into Heat; Joule's Law; Determination of J; Units of Electric Energy and Power; Heat and Light Effects; Incandescent Lamps; Arc Lamp.

Electrolysis :—Faraday's Laws; E. C. E. of Elements; Voltameters; Secondary Reactions; Storage Battery; Electroplating; Electrotyping; Reduction Factor of a Galvanometer.

Magnetisation of Iron :—Permeability; Electromagnets.

Electromagnetic Inductions :—Faraday's Law; Lenz's Law; General Principles; Fleming's Right-hand Rule; Faraday's Disc; Eddy Currents; Principle of a Dynamo; Self-Induction; Mutual Induction; Transformers; Ruhmkorff Induction Coil, Earth Induction.

Miscellaneous :—Thermo-Electricity; Conduction through Gases; X-Rays; Radio-activity; Electric Telegraph and Telephones; Wireless Telegraphy.

P. 2A. Physical Laboratory. *Heat* :—Lower Fixed Point of a Thermometer; Upper Fixed Point of a Thermometer. (Hypsometer); Specific Heat of a Solid; Latent Heat of Fusion of Ice; Latent Heat of Steam; Co-efficient of Linear Expansion—(a) Pullinger's Method, (b) Microscope Method; Co-efficient of Absolute Expansion of Liquid; Verification of Boyle's Law; Pressure Co-efficient of Air, (Constant-Volume Air-Thermometer); Volume Co-efficient of Air, (Constant-Pressure Air-Thermometer); Melting Point of Paraffin; Relative Humidity—(Hygrometer); Specific Heat of a Liquid (Method of Cooling).

Magnetism :—Position of Poles and Axis of a Magnet; Lines of Force of a Magnet; Neutral Points with respect to a Bar-Magnet; Comparison of Moments of Magnets (Deflection Magnetometer—Tangent A and B Position of Gauss); 'H' in the Laboratory; Determination of Dip.

Static Electricity :—Production of Electricity: (a) by Friction, (b) by Induction; Use of Electroscope, Electrophorous; Use of Condenser—Leyden Jar.

Dynamic Electricity :—Preparation of Cells; Setting up of a Galvanometer; Measurement of a Resistance: (*a*) Meter Bridge, (*b*) Post Office Box, (*c*) Thompson's Method—Resistance of Galvanometer, (*d*) Mance's Method—Resistance of a Battery, (*e*) Ammeter and Voltmeter Method—Resistance of a Battery, (*f*) Half Deflection Method—Resistance of Galvanometer, (*g*) Low Resistance (Method of Projection of equal Potentials), (*h*) High Resistance, (*i*) Resistance of Electrolyte. Comparison of E. M. F.'s—Potentiometer; Mechanical Equivalent of Heat; Voltmeter—(*a*) Reduction Factor of a Galvanometer, (*b*) E. C. E. of Copper. Calibration of Measuring Instruments.

SURVEYING.

S. 1. This course is meant for the Mechanical and Electrical Engineering Fourth year class.

Scales.—Construction of Different kinds of Scales, Measure of length and area.

Chain Surveying.—Different kinds of Chain and their construction, Testing Chains. Sources of errors. Hand sketch. Method of Triangulation. Forms of Field-Book, Offsets, Tie line, Station points, Optical Square, Offset Rod. Chaining over, round and through obstacles, when and where recommended; Finding Meridian line by sun's shadow.

Compass Surveying.—Construction and use of Prismatic, Surveying and Levelling Compass. Testing the Compass. Method of traversing with chain and Compass etc.

Plane Table.—Accessories. Securing paper on the Table. Method of Surveying. Advantages and disadvantages.

Levelling.—Definition, Different Classes. Permanent and Temporary adjustments (Cook's Reversible and Dumpy Level), Method of taking the readings along a line of section. Forms of Field-book. Arithmetical Check. Correction for Curvature and refraction. Longitudinal Section. Bench-mark. Datum Line. Stadia Reading. Reduction of Levels. Sources of errors.

Elementary use of Theodolite. Useful Problems in Surveying.

Field-book.—The field work consists of Surveys with Chain and Tape, traversing with the chain, tape and compass, traversing with plane table, determination of Longitudinal Section with the level. Plotting of the Field Book. Calculation of areas; Surveying of obstacles and altitudes.

CHEMICAL ENGINEERING.

Chemical Engineering is a new subject in India, though the Universities and Engineering Institutions of U. S. A. opened independent departments in this subject about 40 years ago. In England, as a result of the experiences during the World War, it was felt that to develop and run Chemical Works on an efficient basis, men with sound training in Chemical Engineering were needed and Ramsay Memorial Laboratory of Chemical Engineering was founded in the University College, London. The first graduate in Chemical Engineering from Glasgow University came out in 1928.

The course in Chemical Engineering was started in the College of Engineering & Technology (at that time called the Bengal Technical Institute) in 1921. Up till now there is no other educational institution in India which runs an independent course in the subject.

As the subject is new, misconceptions and misunderstandings about its nature are numerous, and to remove them some words of explanation are necessary.

"Out of the common experience of the industrial chemist and the engineering a new applied science is being evolved, the science of applied physical chemistry which is largely the basis of what is commonly called Chemical Engineering.

Chemical Engineering is not a simple mixture of Chemistry and Engineering. It is a separate science with its own problems, its own methods, and its own opportunities. The successful development of modern chemical industry will depend increasingly upon the activities of men who are trained in the principles of Chemical Engineering and experienced in its methods.

Chemical Engineering is concerned, primarily, with the quantitative study of the various unit operations—for example, grinding, roasting, dissolving, filtering, evaporating, distilling, crystallizing and drying, which in their proper sequence make up a chemical process on an industrial scale. It differs from applied or industrial chemistry which is concerned primarily with *general* processes and products. It differs from Mechanical Engineering and Electrical Engineering which are concerned with the construction and operation of mechanical devices for the generation and utilization of power, and from Civil Engineering, which deals with the design and erection of structures and plants.

Some of the problems that peculiarly concern the chemical engineer are: the flow at different temperatures and pressures of fluids and semi-fluids differing widely in viscosity and density, and in chemical and physical stability; the efficient heating or cooling of large quantities of different materials; the control of large scale chemical reactions; the design and operation of unit types of chemical plant; the chemical and physical testing of the special materials that are used in the construction of chemical plants; the production of new materials suitable for special duties; the design of new types of plants and in general, the application of physico-chemical laws to all industrial operations.

Professor E. C. Williams has defined a chemical engineer as "a scientific man whose duty it is to plan the large scale commercial processes and to design and operate the plant required for the carrying out of the chemical reactions and physical changes involved."

Every chemical process is at heart a chemical reaction between dissimilar atoms. Upon which way and how far the reaction proceeds depends the success or failure of the process. The chemical engineer must, therefore, be familiar with the chemical reactions involved and be able to appreciate fully the physical and chemical conditions that are essential to the successful working of the reactions. He must also be able to visualize the complete process as it is to be carried out in the works. He must plan the arrangement of the plant, prepare a quantitative flow-sheet of materials and energy and draw up a costs analysis. He must be able to prepare and lay-out drawings, draw up complete specifications for the purchasing of standard plant units and make complete drawings

E. E. 3. Direct Current Measuring Instruments. Measurement of Resistance; Measurement of Current; Measurement of Voltage; Measurement of Power; Measurement of Energy; Calibration of Meters.

E. E. 4. Principles of Alternating Current. Algebra of Vectors and of Complex Quantities used in Electrical Engineering; Alternating Currents; Power when Current and Voltage are Sinusoidal; Non-sinusoidal Waves; Circuits containing Resistance, Inductance and Capacitance; Mutual Induction; Impedances in Series and Parallel; Effective Resistance and Reactance.

E. E. 5. Electrical Drawing. Wiring; Costing; Layouts of Different Systems; Diagrams; Protection Switches; Fuses; Circuit-breakers; Controllers; Arresters etc. Switch Board.

E. E. 6. Alternating Current Machinery. Synchronous Generator; Static Transformer; Synchronous Motor; Parallel Operation of Alternators; Synchronous Converter; Polyphase Induction Motor; Single-phase Induction Motor; Series and Repulsion Motor.

E. E. 7. Polyphase Circuits: Transmission and Distribution of Power. Polyphase Currents: Kirchoff's Laws and Equivalent *Y*—and Delta-connected Circuits; Harmonics in polyphase Circuits; Power and Power-factor of polyphase Circuits; Unbalanced 3-phase Circuits; Power Transmission; Distribution Systems.

E. E. 8. Alternating Current Measuring Instruments. Instruments suitable for both Direct and Alternating Current Circuits; Special Instruments for Alternating Current Circuits only; Oscillographs; Frequency Meters; Power-factor Meter; Induction type of Power and Energy Meters; Intigrating type of Meters; Calibration of Meters.

E. E. 9. Electrical Design. Complete Design of a D. C. Compound Machine with Interpoles; Complete Design of a D. C. Series Motor with Controller; (Assembly Drawing of each should be submitted with detailed calculations) Complete Design of a D. C. Distribution System for a small Industrial Town.

E. E. 10. Industrial Motors and their Application. (*a*) Choice of Motors and System of Control for Particular Services; Group Driven and Individual Drive; High Speed Induction Motors; Hoist Motors; Different Systems of Braking; Single-phase Induction Motor and Control; Automatic Starting; Multi-voltage System; Power Pumps; Mill Motors; Motors for various other similar purposes; Various kinds of Starters, Speed Regulators and Braking Devices. (*b*) Electric Railways: Train Resistance; Types of Railway Motors; Their Characteristics; Braking; Self-propelled Cars; Electric Locomotives; Power Distribution for Railway Electrification; Railway Signalling.

E. E. 11. Design of Electrical Machines. (*a*) Synchronous Generator; (*b*) Static Transformer; (*c*) Induction Motor; (*d*) Rotary Converter.

Complete Design of the above Machines and Assembly Drawing of any two, as assigned by the Professor in Charge.

E. E. 12. Transmission & Distribution of Power. (Advanced Course):—(*a*) Power Transmission; Systems in Common Use; c

Advantages and Disadvantages; Electrical Calculations; System Disturbances; Selection of Protective Equipment; General Features of Design; Line Insulators; System of Connections and Switching; Power-factor Correction; Stresses in Spans; Strength of Supporting Members; Fundamental Considerations of Line Construction; Private Right of Way; The Conductor Material; Conductor Spacing; Ground Wire Construction; Over-head Crossings; Under-ground Cables; Sub-stations; Out-door Switching Stations; Transmission Economics; Cost Data; Estimated Line Costs. (*b*) Distribution Systems; Classification of Systems; Types of Circuits; Feeders; Urban Transmission Systems; Design of Circuits; Sub-stations; Bus-bar Arrangements; Transformer Sub-stations; Frequency-changer Sub-stations; Motor-generator Set; Synchronous Converter Sub-stations; Low-tension Switch-boards; High-tension Switch-boards; Oil Switches; Pressure Regulation; Tirrill Regulator; Secondary Distribution; Protective Apparatus; Under-ground Low-tension Net Work; Circuit-breakers; Relays; Lightning Arresters; Over-head Construction; Under-ground Construction; Conduit Systems; Cable Supports; Types of Cable; Cable Insulations; Jointing; Distribution Economics.

E. E. 13. Telegraphy and Telephony. *Elements of Telephony* :—Introduction; Transmitter; Receiver; Induction Coil; their Uses; Classification of Telephone Installation; Signalling; Magneto-telephone Connections; Magneto Telephone Exchange; Central Battery Telephone System; Switch Board Connections and Operation; Influence of Resistance and Capacity on Speech Transmission.

Elements of Telegraphy :—Standard Manual Telegraph Systems; Manual Morse Telegraph System; Morse Characters; the Closed Circuit; Morse System; the Open Circuit Morse System Speed of Signalling; Circuit Efficiency; the Main Line Relay; Sounders; Single Line Repeaters.

Radio Telegraphy (Theoretical) :—Introduction; Different Systems of Telegraphy; Aerial; Thermionic Tubes and Receiving Circuits; Vacuum Tube Transmitter.

Radio Telephony :—Introduction; Microphones and Telephones; Radio Measurements; Miscellaneous.

Radio Telegraphy and Telephony (Practical).—Characteristic Curve of a Crystal; Characteristic Curves of Thermionic Tubes; Construction of Receiving Circuits; Tuning and Measurement of Wave Length.

E. E. 14. Telegraphy and Telephony. (Advanced Course) : *Elements of Telephony* (Advanced Course) :—Detailed Study of the first Course; Signalling Equipments and Systems; Non-multiple Common-battery System; Multiple Common-battery Switch Board; Multi-office Manual Switch Board; Telephone Protective Devices; Inter-communicating System; Strowger Automatic Telephone System; Vacuum Tubes; Telephone Repeaters; Multiplex Telephony.

Elements of Telegraphy (Advanced Course) :—Duplex Telegraphy; Quadruplex Telegraphy; Balancing Duplexes and Quadruplexes; the Phantoplex; High-Speed Automatic Telegraphy; Simultaneous Telephony and Telegraphy over the same wires; Telegraph Transmission; Construction; Testing; Specification.

Radio Telegraphy and Telephony (Advanced Course) Theoretical :—Detailed Treatment of the first Course; Duplex Telegraphy; Atmospherics; Frequency Multipliers; Piezo Oscillations; Television; Frequency Measurement and Testing; Establishment of a Wireless Transmitting Station; Design; Recent Achievements.

Practical :—High Frequency Measurements; Measurement of Inductance and Capacity; Construction of Oscillators; Construction of Transmitters; Attending Transmitting Stations.

E. E. 15. Electrical Engineering. This Course is meant for Chemical Engineering Third Year Class.

General Laws and Definitions; Principles of Direct Current and Circuit; Calculations. Induction of Currents; Fleming's Rule; Lenz's Law; Practical application of Induction; Self and Mutual Induction. Magnetic Properties of Materials; General Laws and Terminology; Magnetic Circuit; Calculations. Electrical Measurements and Measuring Instruments.

Dynamos and Motors; Principles involved; Different Types and their functions; Management; Power and Efficiency Calculations. Accumulators; Principles involved; Construction and maintenance.

Principles of Alternating Currents; Circuit Calculations; Single-phase, two-phase and three-phase current; Vector diagrams; Simple Alternator; Induction and Synchronous Motor; Elementary Theory of Transformers and their uses; Rotary Converter and Rectifiers.

Power Transmission; Switch Board Diagrams; Advantages of high tension Alternating Current Transmission. Electrodeposition of Metals; Utility of A. C. and D. C. compared with respect to the adaptibility to Chemical Industry. Cost of Generation and upkeep.

The above course is supplemented by the following Laboratory Work :—Measurement of Resistance; Measurement of Internal Resistance of Storage Battery; Calibration of Ammeter and Voltmeter; Study of Energy-meters; Study of D. C. Generators (Shunt, Series and Compound); Characteristics of an A. C. Series Circuit; Study of Alternators (Single and Poly-phase); Measurement of 3-phase Power by Two Wattmeters; Synchronising and Parallel operation of two Alternators; Study of a Poly-phase Induction Motor; Study of a Transformer; Study of a Rotary Converter; Study of an Induction Regulator.

E. E. 16. Electrical Power Generation & Distribution. —This is an abridged course of E. E. 6 and is intended for the Mechanical Engineering 4th Year Class.

Elementary Principles of Alternating Current; Resonance; Poly-phase Circuits; Construction, Operation and Simple Characteristics of Alternators, Transformers, Induction Motors, Synchronous Motors, Rotary Converters and other important machineries; A. C. Instruments.

E. E. Lab. 1. Electrical Engineering Laboratory. (First Course) : To Measure Resistance by Ammeter and Voltmeter Method; Measurement of the Internal Resistance of a Storage Battery; Calibration of an Ammeter in comparison with a Standard One; Calibration of a Voltmeter in comparison with a Standard One; Testing the Constant

of a Ballistic Galvanometer; Calibration of D. C. Ampere-hour Meter; Measurement of Insulation Resistance; Measurement of Permeability by Thompson's Permeameter; Measurement of Permeability by Ballistic Galvanometer; Calculation of Hysteresis Losses and Determination of the Hysteresis Loop of Different Grades of Steel by Ballistic Calvanometer; Magnetization Curve of a D. C. Generator; Characteristic Curves of a Shunt Generator; Characteristic Curves of a Series Generator; Characteristic Curves of a Compound Generator; Determination of the Losses and Efficiency of a D. C. Generator; Performance Curves of a Series Motor; Performance Curves of a Shunt Motor; Performance Curves of a Compound Motor; Parallel Operation of Shunt Generators; Parallel Operation of Compound Generators; Testing of a D. C. Fan Motor; Distribution of Voltage around the Commutator of a D. C. Generator; Characteristics of an A. C. Series Circuit; Characteristics of an A. C. Parallel Circuit; Characteristics of an A. C. Series-parallel Circuit.

E. E. Lab. 2. Electrical Engineering Laboratory. (Second Course) :—Operation Tests on Storage Battery; Localization of Fault in an Electric Main by Murray's Loop Test; Separation of Losses of an Electric Machine; Efficiency Test on a Shunt Motor by Hopkinson Method; Performance Test on a Rosenberg type of Train-lighting Generator and System; Calibration of an A. C. Watt-hour Meter; Magnetization Curve of an Alternator; Measurement of 3-phase Power and Power-factor by Two-Watt-meters; Efficiency of Transformer from Losses; Performance Curves of an Alternator; Synchronising and Parallel Operation of Alternators; Performance Curves of a Polyphase Induction Motor; Performance Curves of a Single-phase Induction Motor; Effect of Variation of Excitation of a Synchronous Motor at Constant Load; Testing of an A. C. Fan Motor; Characteristic and Efficiency of a Rotary Convertor when run from the A. C. Side; Characteristic and Efficiency of a Rotary Convertor when run from the D. C. Side; Performance and Vector Diagram of an Induction Regulator; Characteristics of an Induction Generator; Performance Test on a Repulsion Motor; Commercial Tests on D. C. and A. C. Machines; Heat runs on Electric Machines; Photometric Tests on Incandescent Lamps; Calibration of Meters with the help of a Potentiometer.

E. E. Lab. 3. Electrical Engineering Laboratory. (Senior Course) :—High Tension Tests :—High Tension Tests on oils and Insulators; Corona; High Current Tests :—High Current Tests on Switches and Circuit Breakers; Transients and Harmonics with their Oscillographic Tests; Standardization of Meters; Artificial Lines; Loading Stability and Charging Current of a System; Special Tests : Tests on Special types of A. C. Commutator Motors.

E. E. Lab. 4. Electrical Workshop. Testing of Faults in Parts; Rewinding of Armature and Field; Commutator setting and other petty repairs; Repairing of Meters and other Instruments; Construction of Resistance and Inductance Coils.

MECHANICAL ENGINEERING.

The following are the Courses of Instruction given under the Mechanical Engineering Department.

D. 1. Drawing. for Mechanical, Electrical and Chemical Engineering First Year Classes.

D. 2. Descriptive Geometry and Mechanical Drawing. for Mechanical and Electrical Engineering Second Year Classes.

E. M. 1 & 2. Elementary Engineering Mechanics. for Mechanical and Electrical Engineering Second and Third Year Classes.

E. M. 3. Higher Engineering Mechanics. for Mechanical Engineering Fourth Year Class.

E. M. 4. Engineering Mechanics. for Chemical Engineering Third Year Class.

M. E. 1. Applied Thermodynamics. for Mechanical and Electrical Engineering Third Year Class.

M. E. 2. Steam Engine and Boiler. for Mechanical and Electrical Engineering Fourth Year Classes.

M. E. 3. Steam Turbine. for Mechanical and Electrical Engineering Fifth Year Classes.

M. E. 4. Internal Combustion Engine. for Mechanical and Electrical Engineering Fourth Year Classes.

M. E. 5. Mechanism. for Mechanical and Electrical Engineering Third Year Classes.

M. E. 6. Hydraulics. for Mechanical Engineering Fourth Year Class and Electrical Engineering Fifth Year Class.

M. E. 7. Hydraulic Machines & Water Power Engineering. for Mechanical Engineering Fifth Year Class.

M. E. 8. Machine Drawing. for Mechanical and Electrical Engineering Third Year Classes.

M. E. 8a. Machine Drawing. for Chemical Engineering Second Year Class.

M. E. 9. Theory of Machine Design. for Mechanical and Electrical Engineering Fourth Year Classes.

M. E. 10. Machine Drawing and Design. for Mechanical Engineering Fourth Year Class.

M. E. 10a. Machine Drawing and Design. for Electrical Engineering Fourth Year Class.

M. E. 11. Machine Design. for Mechanical Engineering Fifth Year Class.

M. E. 12. Mechanical Engineering Laboratory. for Mechanical Engineering Fourth and Fifth Year Classes.

M. E. 13. Mechanical Engineering Laboratory. for Electrical Engineering Fourth Year Class.

M. E. 14. Machine Tools. for Mechanical Engineering Fifth Year Class.

M. E. 15. Factory Organisation and Management. for Mechanical Engineering Fifth Year Class.

M. E. 16. Mechanical Handling of Materials. for Mechanical Engineering Fifth Year Class.

M. E. 17. Motor-car Engineering. for Mechanical Engineering Fifth Year Class.

M. E. 18. Materials of Construction. for Mechanical Engineering Fifth Year Class.

M. E. 19. Power Plant Engineering. for Mechanical and Electrical Engineering Fifth Year Classes.

M. E. 20. Heat Engines. for Chemical Engineering Third Year Class.

W. 1. Workshop. for Mechanical, Electrical and Chemical Engineering First Year Classes.

W. 2. Workshop. for Mechanical and Electrical Engineering Second Year Classes.

W. 3. Workshop. for Mechanical and Electrical Engineering Third Year Classes.

W. 4. Workshop Practice. for Mechanical and Electrical Engineering Fourth Year Classes.

W. 5. Advanced Workshop Practice. for Mechanical Engineering Fifth Year Class.

DRAWING.

D. 1. Drawing. Lettering; Construction of Scales; Use of Instruments; Construction of Curves and Geometrical Drawings; Orthographic and Isometric Projections; Sections; Simple Working Drawings; Bolts, Nuts and Rivetted Joints.

D. 2. Descriptive Geometry and Mechanical Drawing. (i) Descriptive Geometry:—Instructions and Exercises are given on fundamental conceptions of Orthographic Projections; Problems on Combinations of Points, and on Lines, Planes and Solids; Sections, Developments; Tangent Lines and Planes and Warped Surfaces etc., (ii) Working Drawing of simple Machine Parts; Dimensioning; Use of Convention in Mechanical Drawings; Tracing and Blue-printing.

ENGINEERING MECHANICS.

E. M. 1 & 2. Elementary Engineering Mechanics. Kinematics, Laws of motion, Work, Power and Energy, Motion in a Circle, Centrifugal and Centripetal forces, Motion in a curved or banked track, Simple harmonic motion, Concurrent forces (treated both analytically and graphically), Moments, Couples, Friction, Journal friction and lubrication, Friction of band on pulleys, Friction and efficiency of a screw, Brakes, Statics of rigid bodies, Centre of gravity, Properties and application of centre of gravity, Theorem of Pappus or Guldinus, Moment of Inertia, Radius of gyration, Changes of energy and speed, Laws of rotation of a rigid body, Kinetic energy of rotation, Compound pendulum, Torsional and Compound harmonic motion, Kinetic Energy of rolling bodies.

Machines, Effort and resistance in a Machine, Mechanical advantage, Velocity ratio and efficiency of a machine.

Graphical Statics, Bow's Notation, Funicular Polygon, Bending, moment and Shearing Force Diagrams, Jointed Structures, Stress Diagrams, Roof-frame and Girder, Loaded Strings and Chains.

Simple stress and strain, Elasticity, Rigidity, Application of Young's modulus, Stress-strain diagram, Work done in producing strain, Resilience and Shock, Moment of resistance of a shaft to torsion, Stress introduced by bending, neutral axis. Section modulus, Combined bending and twisting, etc.

E. M. 3. Higher Engineering Mechanics. (i) Strength and resistance of Materials—Strain and stress, Elasticity, Rigidity, Stress Strain diagram, Resilience and Shock, Thin Cylindrical Shell subjected to internal pressure, Rivetted Joints, Torsion, Angle of twist of a shaft, Moment of resistance of a shaft to torsion, Helical springs, Bending moment and Shearing force diagrams, Bending of beams under various loads, Bending and shearing due to travelling loads, Bending and shearing forces in different planes, Stress introduced due to bending and shearing, Moment of resistance to bending, Bending beyond elastic limit and rupture, Deflection of beams, Deflections from bending moment diagrams, Deflection of beams having fixed ends, Propped up beams, Continuous beams and theorems of three moments, Resilience of Beams, Compound strain and stresses, Principal stresses due to combined bending and twisting, Equivalent bending and twisting, Ellipse of stress, Eccentric loading, Bending combined with torsion and compression, Strength of a ring, Poisson's ratio, Thick hollow cylinder subject to internal pressure, Column and struts, Euler's Theory of long culumns, Rankine-Gordon Formulæ for struts, Stress diagram for wind pressure, Roof-trusses, Beams and Girders. (ii) Dynamics of Machinery,—Effort, Acceleration and velocity diagram, Angular velocity diagrams, Piston or Slider and connecting rod velocity diagram, Piston Effort diagram, Crank Effort diagram, Forces in the Reciprocating parts, Fluctuation of Energy in Steam and Internal Combustion Engines, Fly-wheel, Governor, Loaded

Governors, Effect of Friction on Governors, Power, Effort and Sensitiveness of Governor and Balancing of Engine.

E. M. 4. Engineering Mechanics. This course is meant for the Chemical Engineering 3rd Year Class.

Measurement of Forces, Addition of Forces by Vectors, Triangle and Polygon of Forces, Resultant and component of Forces, Moments, Couples, Cranks and Levers, Centre of Gravity.

Laws of Motion, Velocity, Acceleration, Momentum, Impulsive Force, Work, Energy, Power, Measurement of Power, Brakes.

Circular motion, Simple Harmonic Motion, Simple Frames, Principle of work applied to machines, Friction and Lubrication, Inclined Planes, Screws, Work lost in friction, Ball and Roller Bearings.

Simple Machines, Velocity Ratio, Mechanical advantage and efficiency of Machines, Jack Screw, Pulley Blocks, Wheel and Axle, Lifting Machines.

Transmission of Motion and Power, Belt drive, Speed Cones, Driving by chains and ropes, Friction Gearing, Spur Gearing, Rack and Pinion, Worm and wheel.

Moment of Inertia, Strength and Stiffness of Materials, Stress and Strain, Laws of Elasticity, Springs, Bending, Shearing and Twisting, Resistance to Bending, Shearing and Twisting, Rivetted Joints and Pressure Vessels.

Simple Mechanism, Crank and Connecting rod, Quick-return motion, Ratchets, Cams, etc.

MECHANICAL ENGINEERING.

M. E. 1. Applied Thermodynamics. This course embraces the Study of the Principles of Thermodynamics governing the various forms of Heat Engines and Heat Producers such as :—Steam Engine, Steam Turbine, Oil and Gas Engines, Gas Producer, Boiler, Air and Refrigerating Compressors, etc., etc.

Heat units, Measuring Instruments, Laws of Thermodynamics, Mechanical Equivalent of Heat, Laws of Perfect Gases and their Characteristic Equation, Gas Constants and their Physical Significance, Specific Heats, two Specific Heats of Gases, Specific heat of a mixture of gases, Relation between two specific heats of a gas and its constant, Internal Energy, Adiabatic, Isothermal and Polytropic expansion and compression of gases, Work done during expansion and compression in general, Work done during Isothermal and Adiabatic expansion and compression of gases, Relation between Pressure, Volume and Temperature in Adiabatic and Isothermal changes, Carnot's and other Cycles, Reversible Engine, Condition of maximum efficiency and reversibility, Single and Multistage air-compressor, Work required in a compressor, Air-Motors, Internal Combustion Engine Cycles, Heat transmission through different mediums, fuels, higher and lower calorific values, other properties of fuels, combustion and air, coefficient of excess air, regulation of combustion from flue gas analysis, Formation of Steam, Properties of saturated

and superheated steam, Internal energy, Total heat of Saturated and Superheated Steam, High pressure Steam, Critical pressure, Use of Steam Tables, Entropy, Entropy chart for Water and Steam, Study of Mollier chart and its application in Steam Engines (Rotary and Reciprocating Engines), working under various conditions, Wiredrawing and throttling of Steam, Quality of Steam, Dryness fraction and its determination by Steam Calorimeters.

Steam Engine Cycles, Representation on P-V Diagrams and Entropy Diagrams, Flow of Steam through Nozzles and Orifices, Conversion of Pressure Energy into Kinetic Energy and vice-versa, Pressure, Volume and Entropy diagram for expansion through Nozzles.

Other important vapours as used in Refrigerating Machines such as :— SO_2, CO_2, NH_3, etc., etc., their Characteristics.

M. E. 2. Steam Engine and Boiler. A brief survey of principles of Thermodynamics as applied to Steam Engines, Properties of Steam, Behaviour of Steam in the Steam Cylinder, Wire drawing, Clearance, Compression, Cushioning, Cylinder feed, Initial Condensation, Action of Steam Jacket, Advantage of high speed, Super heating, Jacketting and Compound Expansion. Theoretical Indicator Diagram, Mean Effective Pressure, Indicated Horse Power, Steam Consumption from Indicator Diagram, Effect of Clearance, Expansion and Compression on Economy, Relation between Steam Consumption and Power, Willoans Line, Study of Indicator and Indicator Diagrams.

Reciprocating Steam Engine Mechanism, Types of Reciprocating Steam Engines, Simple and Compound, Condensing and Non-condensing, Uniflow Engines, Reciprocating Steam Engine details.

Performance of Reciprocating Engines, Heat balance. Brake Horse Power, Mechanical Efficiency, Available heat, Steam Consumption and Equivalent Heat, Thermal Efficiency, Efficiency Ratio, Economy due to Superheating.

Valve and Valve Gears, Bilgram Diagrams, Zeuner Diagrams, Reulaeux's Valve Diagrams, Slide Valves, Piston Valves. Consequences of Early and Late Cut off, Meyer Expansion Valve, Movable Eccentric, Stephenson Link Motion. Gooch and other Link Motion, Equivalent Eccentric, Radial Valve Gears, Corliss Valve and Valve Diagrams, Drop Valves.

Dynamics of Reciprocating parts, Piston or Slider Velocity Diagrams. Piston or Slider Acceleration Diagrams, Angular Velocity of the Connecting Rod, Piston Velocity and Acceleration, Angular Acceleration of connecting Rod, Piston Effort and Piston Effort Diagrams, Crank Effort and Crank Effort Diagrams, Forces due to Intertia of Reciprocating parts. Fluctuation of Energy, Flywheel.

Function of a Governor, Simple Conical Pendulum Governor, Loaded and Spring Governor, Effect of friction on Governors, Isochronism and Hunting, Parabolic Governor, Sensitiveness of Governor, Effect and Power of Governor, Shaft Governors, Balancing of Engines.

Condensers and Air Pumps :—Types of Condensers, Parallel Flow and Counter Current Jet Condensers. Surface Condensers, Amount of

Water for Condensation Steam, Condenser Efficiency, Sources of Air in condenser, Function and Types of Air Pumps, Combined Wet and Dry Air Pump, Vacuum Augmenter, Air Pump Capacity, Rotary Air Pump, Steam Air Injector.

Performance of a Steam Boiler, Fuels and Combustion, Higher and Lower Calorific Values, Calculation of Air for complete Combustion, Generation of Steam, Equivalent Evaporation, Heating Surface and Grate Area; Boiler Horse Power, Operation and Efficiency of a Boiler, Heat losses in Boiler, Chimney Draught and Chimney Height, Artificial Draught, Force Draughts, Steam fed Draught.

Types and Classification of Boilers, Lancashire and Cornishs Boilers, Locomotive Boilers, Water Tube Boilers, Boiler details, Rivetted Joints, Boiler Stays, etc., etc., Boiler Mountings, Water Level Indicator, Pressure Gauges, Safety Valves, High and Low Water Safety Valves, Feed Check Valve, Boiler Accessories, Feed Pump, Injector, Feed Water Heater, Gain due to Feed Water Heating, Economiser, Feed Water Regulator and Filter, Reducing Valve, Steam Separator and Traps, Superheaters, Chain Grate and Mechanical Stoking.

M. E. 3. Steam Turbine. A brief survey of the principles of Thermodynamics as applied to Steam turbines, conservation and transformation of Energy, flow of steam through orifices and Nozzles, Adiabatic flow, Polytropic flow, Critical pressure and velocity; Design of Nozzles, Use of Entropy chart in connection with Problems relating to Nozzles, Diffusor effect of Nozzles, Velocity Coefficient and Coefficient of Discharge and Efficiency of a Nozzle and the different methods of determining them, Thermodynamical Efficiency, Mechanical and thermal efficiency of a steam turbine, Types of turbines, Impulse, Reaction, and combined Impulse and Reaction turbines, Single stage and Multistage turbines, Velocity diagram and design of turbine blades, Mechanical and Hydraulic losses in turbines, Theory of testing of steam turbines, Commercial types of turbines such as De Laval, Terry, Curtis, Zoelly, Westinghouse, Parson, Thyssen-Roder, Allis-Chalmers, Kerr etc., etc., Marine turbines, Principle of Governing and types of Governors, Exhaust turbines, Bleeder turbines, Back-pressure turbines, Steam turbines, Economics, Advantages and Disadvantages of Steam Turbines and comparison with other Prime-movers, Design of Disc, Drums, Shaft, Bearings, stuffing box etc.

Other turbines such as Mercury vapour and Gas Turbines.

M. E. 4. Internal Combustion Engine. Brief survey of the Principles of Thermodynamics as applied to Internal Combustion Engines; Otto, Diesel and other Cycles, Two Stroke and Four Stroke Cycle Engines, their Efficiencies, Comparative Study of these Cycles, Scavenging.

Fuels in Internal Combustion Engines, Oil and Gas, Producer Gas Plant and Gas Generation, Higher and Lower Calorific Values, Ignition Point, other Characteristics of fuels.

Valves and Valve Mechanism, Ignition Devices, Reciprocating Parts, Bush, Bearings, etc., etc. Timing, Methods of Governing, Balancing, Explosion, Combustion, Cooling, Lubrication, Arrangements for Starting and Stopping, Types of Engines.

M. E. 5. Mechanism. In this course instructions are given in the forms and motions of various mechanisms independent of their strength. It is the purpose of this course to familiarise the students with the principles over which various mechanisms are designed.

Instructions in this course cover the following and are supplemented by drawing office exercises.

Revolving and Oscillating Bodies such as Cranks and Levers; Transmission of Motion by Belts, Ropes and Chains; Transmission of Motion by Bodies in pure Rolling contact; Gears and Gear Teeth; Gear Wheel in Trains; Epicyclic Gear Trains; Inclined Plane, Wedge, Screw, Worm and Wheel; Cams; Four Bar Linkage; Relative Velocities of Rigidly connected Points; Link work; Straight Line Mechanism and Parallel Motion; Aggregate Combination; Pulley blocks; Intermittent Motion, etc., etc.

Application of above in actual Machines.

M. E. 6. Hydraulics. Fluid pressure and Fluid Motion, Bernoulli's Theorem, Radiating Current, Vortices, Free Circular and Spiral Vortex, Whirling Liquids, Torricelli's Theorem, Flow of water through orifices, Flow of water over Notches and Weirs, Loss of Energy Head, Loss of Head due to sudden enlargement, contraction or obstruction in pipes, Flow through mouthpieces, Fluid Friction, Flow of water through open channels and pipes, Usual and Critical Velocities, Friction and other losses in pipe lines, Hydraulic Gradient, Flow of water through Nozzles, Power transmitted in a pipe.

Venturimeter, Pitot tube, Current Meters, Impact of a Jet on fixed and moving Cups and Vanes, Reaction of a jet, Action of a jet on revolving Vanes.

Study of the Workings of some hydraulic machines such as Pelton-wheels, Waterturbines, Single and Multistage-Centrifugal pumps, Piston, Bucket and Plunger pumps, etc., etc.

M. E. 7. Hydraulic Machinery and Water Power. In this course theory and design of water turbines, Centrifugal pumps and utilisation of water power will be taken up. It will also embrace study of other water motors and hydraulic pressure machines used for commercial purposes.

Force of impact, Impact of jets on fixed vanes, Distribution of pressure across a jet, Impact on moving vanes, Graphical construction for pressure on vanes and for centre of pressure, Compounding of jets and of confined streams, Theory and principle of impulse and reaction turbines, Types of turbines, Peltonwheel, Girard Turbines, Fourneyron turbine, Francis turbine, Propellor turbines with special reference to Kaplan turbine, Specific speed, Classification of turbine according to the direction of flow, General comparison of impulse and reaction turbines, General theory of turbine design, General case of radial, axial and mixed-flow turbine, Velocity diagram, Vane thickness and curvature of vanes, Losses, Efficiency and variation of efficiency with specific speed, Measurement of Head in turbine test, Characteristic curves for turbines, Model test, Governing, Surge tanks and the effect of governor action on surge.

Centrifugal pumps, Types and construction, General theory of centrifugal pumps, General equation and characteristic, axial thrust, balancing of axial thrust on impeller shaft.

Other hydraulic motors such as overshot and undershot wheels etc., etc.

Piston, Bucket and Plunger pumps, Design of valves, theory of air vessels, Efficiency.

Other hydraulic machines used for commercial purposes such as hydraulic Rams, Presses, Accumulators, Intensifiers, Elevators, Rivetters, etc., etc.

M. E. 8. Machine Drawing. Machine Sketching (Orthographic and Isometric): Making of Assembly and Working Drawings from Sketches; Preparing Detailed Working Drawings from Assembly and Assembly Drawings from Details; Reading and Checking of Drawings; Emperical Design of Standard Machine Parts.

M. E. 8(a). Machine Drawing. This is an abridged course of **D. 2. and M. E. 8.** and is intended for the Second year students of the Chemical Engineering Department. It covers the following :—

Working drawing of Machine parts, Dimensioning, Use of Convention in Mechanical Drawing, Tracing, Blue-printing.

Machine sketching, Making of Assembly and Working Drawings from sketches, Reading and Checking of Drawings.

M. E. 9. Theory of Machine Design. This Course covers Physical Properties of Metals; a brief review of the Strength of Materials; Study of the Statical and Dynamical Forces acting in various parts of Machines; Theory of Design of Machine Parts such as Rivetted Joints, Cotters, Keys, Bolts, Nuts, Screws, Couplings, Belts, Ropes, Chains, Pulleys, Axles and Shafts, Journals, Bearings, Gearing, etc., and Engine Parts such as Eccentric, Crank, Connecting Rod, Connecting Rod Ends, Flywheel, Cross-Head, Piston, Stuffing Box, Slide Valves, Governors, etc., etc. Helical and other Springs, Thick Cylindrical Shell, Thin Cylindrical Shell subjected to Internal and External Pressure, etc., etc.

M. E. 10. Machine Drawing and Design (Elementary Course). In this Course the students are acquainted with the applications of Theory of Machine Design studied in Course **M. E. 9.** by means of suitable Problems on Design of Machine Parts such as Keys, Cotters, Bolts, Nuts, Screws, Helical and other Springs, Belts, Pulleys, Geers, Couplings, Axles and Shafts, Bearings, Journals, Hangers, Eccentrics, Stuffing Boxes, Connecting Rods, two ends of the Connecting Rod, Overhang Crank, Forged Crank, Rivetted Joints, Pressure Vessels, etc., etc.

The second part of the Course is devoted in Structural Design and each student is required to design at least one Roof-truss or one Bridge Girder, and one complete Hoisting Machine such as Travelling Cranes, Derricks, etc., etc.

M. E. 10 (a). Machine Drawing and Design. This is an abridged course of **M. E. 10** and is intended for the Fourth year students of the Electrical Engineering Course.

M. E. 11. Machine Design. In this course complete design of two machines will be required of each student. The students will be given option to select any two from the following of which at least one must be a Prime-Mover: (1) Design of reciprocating Steam Engine, (2) Design of Internal Combustion Engine, (3) Design of Steam Turbine, (4) Design of Water Turbine, (5) Design of Steam Boiler, (6) Design of Pumps or Compressors, (7) Design of Machine Tools.

M. E. 12. Mechanical Engineering Laboratory. This course is meant for the 4th and 5th year students of the Mechanical Engineering course and is intended to familiarise them with the practical application of the theories taught in lecture courses in Applied Thermodynamics, Steam Engines, Steam Boilers, Steam Turbines, Gas Engines, Oil Engines, Gas Producer, Hydraulics, Hydraulic Machinery (Pumps and Water Wheels, etc.), Applied Mechanics (Strength and Resistance of Materials), by suitably arranged series of graded experiments and to acquaint them with methods of commercial testing of Prime Movers, Boilers, Gas Producers, Pumping Machinery and Engineering Materials.

Work in this course includes the following :—

Calibration, Adjustment and Use of Instruments and Meters, such as Planimeters, Thermometers, Pyrometers, Water-meters, Gas-meters, Pressure and Vacuum Gauges, etc., used in Mechanical Engineering work; Determination of Calorific value of Fuels (Solid, Liquid and Gas).

Taking of Indicator Diagrams, Valve Setting; Location and Correction of Defects in Steam, Oil and Gas-Engines, etc., etc. Running and management of Engines, Boilers and Pumps, etc.; Determination of Indicated and Brake Horse Power, Fuel and Steam Consumption of Engines and Turbines; Economy and Efficiency Tests of Engines, Turbines, and Boilers; Heat Balance, Complete Testing of Steam Power Plant.

Calibration of Tank, Measurement of Flow of Water, Determination of Critical Velocity, Efficiency Test of Centrifugal and Reciprocating Pumps.

Tension, Compression, Bending, Shearing, Hardness and other tests of Cast iron, Wrought iron, Steel, etc., Testing of Wires and Ropes under Tension, Testing of Helical and Laminated Springs, etc.; Testing of Cement and other Engineering Materials.

In this course a report is required of each student on every experiment.

M. E. 13. Mechanical Engineering Laboratory. This is an abridged course of **M. E. 12** and is intended for the 4th year students of the Electrical Engineering Course.

M. E. 14. Machine Tools. The importance and development of Machine Tools, Examination of the finished article, Measuring system of

the Machine shop, Setting up of Machine Tools, Method of work, Feed, Cutting speed Power required, The Driving System, Changing of Speed, Principles and Design of Rotary Machine Tools such as :—Simple and Screw-cutting Lathes, Turret Lathes, Semi-Automatic and full Automatic Lathes, Drilling Machines Single Multispindle, Horizontal Boring Mills, Vertical Boring and Turning Mills, Cylinder Boring Machine, The Milling Machine, Plane and Universal, Vertical Milling Machines, Different types of Gear Cutting Machines, Grinding Machines and methods, Special Screw Cutting Machines, etc., etc.

Reciprocating Machine Tools such as :—Shaping Machines, Planing Machines, Slotting Machines, Bevel Gear and Spur Gear Shaping Machines, Key-seating Machines, Plate edge Shaping Machines, etc., etc.

Machine Saws such as :—Circular Saws, Band Saws, etc., etc., Shearing Machines, Punching Machines and Presses, Wood working Machines.

Testing of Machine Tools. Economical Utilisation of Machine Tools.

M. E. 15. Factory Organisation and Management. Theory of Factory Location, Influence of Sale Market, Raw Materials, Labour and Transportation, Planning of Factory, Problem of Internal Transportation, Possibilities of Expansion, Equipments, Staff and Departmental Organisation, Functional List, Control, Departmental Report, Object of Report, Central Office, Relative Location of Offices, various Departments and their Relations, Division of work, Advertisement and Sale, Designing and Drafting, Research and testing Laboratories, Estimating, Purchase, Stores, Production, Foundry, Machine shop, Tools, Inspection and Checking of finished parts, Assembling and Testing.

Cost accounting, material and labour costs, over head charges, Merging costs, records into double entry accounts, comparison with estimated costs, Inventry.

Employment of labour and labour problem, management of labour, wage systems, Strike, Welfare methods, apprenticeship system, Educational continuation, Factories and Engineering Institutions.

M. E. 16. Mechanical Handling of Materials. Handling of Materials by means of Automatic and Carbleways, Hand and Electric Travellers, Inclined and Vertical Hoists, Haulage System, Bucket Elevators, Spiral and Screw Conveyers, Flight Conveyers, Pan Conveyers, Belt Conveyers, Reciprocating Conveyers, and their various Combinations, Hand Cranes, Travelling Cranes and Derricks, etc.

M. E. 17. Motorcar Engineering. Gasoline Engines and Cycles, Valves and Valve operating Mechanism, Horsepower of Engines, Commercial Types of modern Auto-Engines. Fuels, Principles of Carburetting, Types of Carburators, Governing. Engine Lubrication and Cooling Systems, Radiators.

Ignition Systems, Magnetos, Types of Magnetos, Spark Plugs, Care and Maintenance of Magneto and Battery Ignition System. Automobile Storage Battery, Charging and Discharging, Starting and Lighting System, Head Lamps and Reflectors.

Automobile Chasis, Frames, Springs and Spring Suspension, Front Axle, Steering Mechanism, Brakes, Clutches, Change Gear Sets, Universal Coupling and Transmission, Types of Rear Axles, The Differential Wheels, Rims and Tyres. Automobile Troubles and Remedies, Preparation for Starting Operation and Care. Efficiency Test. Design of Engine Parts, Frames and Chasis.

M. E. 18. Materials of Construction. This course includes the study of the general nature of deformation and stress in materials used in Construction, Machines and Appliances and also their Characteristics, Physical and Mechanical Properties, Uses, Manufacture, Testing, etc., etc.

Following are the topics specially discussed :—

Physical and Mechanical Properties, Characteristics, and Uses of Iron, Steel, Wood, Preservation of Timber, Physical and Mechanical Properties of Building Stones, Structural Clay Product, Refractory Materials such as Fire Bricks, Fire Clay, etc., Portland Cement, Hydraulic and other Cements, Mortar, Concrete ; their Manufacture and Durability ; Effects of Temperature.

Important Non-Ferrous Metals and their Alloys such as Copper, Zinc, Aluminium, Lead, Tin, Nickel, Brass, Bronze, Gunmetal, Whitemetal, Babitmetal, Monelmetal, Stellit, etc.

Effect of Temperature on the properties of Metals, Fatigue of Metals, Corrosion, and its prevention, Paints, Varnishes, etc.

Study of Materials used in Belt, Rope and Cord Manufacture, Packing Materials :—Asbestos Fibres, Asbestos Cord, Leather, Rubber, Guttapercha, etc., etc.

M. E. 19. Power Plant Engineering. This course deals with Design, Operation and Economics of Power Plants. Cost of Production and Distribution of Power and Determination of rates receive considerable attention.

It covers the following topics :—

Location of Plants ; Study of Typical Power Plants and Buildings, General Lay out, Erection, Initial Cost, Operating Expenses and maintenance. Selection of Boilers, Boiler Specifications, Divison of Heating Surfaces in Units, Smoke Prevention, Smokeflue and Chimneys, Selection of Steam Engines, Specification of Steam Engines, Selection of Steam and water Turbines, Specification of Steam Turbines, Selection of Gas or Oil Engines and their specifications, advantages and disadvantages of different types of Prime Movers ; Arrangement of Steam, Gas and Water Pipings, Pipe sizes, Pipe fittings, Separators and Oiling systems, Selection of condensers and Pumps and their specifications, Cooling Towers, Boiler Feed-water Heater and Economisers.

Supply and Handling of Fuels, Supply of water, Water Softening and Purifying, Combustion of Fuel, Mechanical Stoker, Chimneys, Natural and Mechanical Draft. Calculation of sizes of Machinery and Apparatus and probable Fuel Consumption, making of Drawings to include Plan, Elevation, Sections etc., to show the Location of Machinery and Apparatus and

the necessary Pipe lines; Study of the Performance of Power Plant by recording Apparatus and Gauges.

M. E. 20. Heat Engines. This course is meant for the Chemical Engineering Third Year Class.

Heat, Absolute Temperature, Unit of heat and Work, Horse-Power, Mechanical Equivalent of Heat, Transfer of Heat, Two Specific Heats, Characteristic Equation of a Gas, Generation and Properties of Steam, Saturated and Superheated Steam, work done by Steam in Expansion, Back Pressure, Mean Effective Pressure, Indicated and Brake Horse power, Efficiency, Limit of Expansion, Cylinder Condensation, Clearance, Compounding, Effect of super heat.

Types of Engines—Simple and Compound, Valve Gears, Lap, Lead and Angle of advance, Eccentrics, Valve-setting, Reversing Gear, Link Motion, Engine Details and Driving Mechanism, Flywheel and Governor.

Boilers and their Types, Boiler Mountings and Accessories, Economiser, Feed-water Heater, Feed pumps, etc., Chimneys, Natural, Induced and Forced Draught. Condensers and Air Pumps.

Impulse and Re-action Turbines, Single-Stage and Multi-Stage.

Gas and Oil Engines, Working Cycles, Indicated and Brake Horse Power, Mechanical and Thermal Efficiency. Care and Management of Engines and Boilers.

WORKSHOP PRACTICE.

In workshop courses, instruction and training are given through assigned readings, lectures, demonstrations and carefully planned and graded practical exercises in different shops.

W. 1. Carpentry and Pattern making. Use of Carpenter's and Joiner's tools, Sawing, Planing, Making of Joints, Wood turning, Chiseling, Boring, Laying out of work, Jig, Band and Circular Sawing.

Pattern making consists of designing wood pattern from working drawing and pattern construction. The course includes patterns of pipe fittings, Pulleys, Hangers, Gears, Valves and Machine parts, etc., etc. It also includes the study and construction of split and loose piece of patterns; large, complete, part, skeleton, patterns for floor, loam and sweep work Metal pattern etc. and making of core boxes.

W. 2. Foundry work and Moulding. The use of various Moulder's tools, Cutting over, tempering and mixing foundry sand and loam, making two and three parts green sand mould from patterns supplied; making, baking and testing Core; preparing and charging Cupolas and casting.

Study of large Floor and Sweep moulding, steel casting, Foundry appliances and modern methods of foundry production, etc., etc.

W. 3. Forging. The use of handling of Blacksmith's tools; Laying and managing fires, heating, drawing, bending, forming, twisting, upsetting, bending while upsetting, upsetting of square corners; bolt making, punching, chamfering, construction of hooks and ring bolts;

tempering, spring and tool making, study of the use of Power hammer, study of the Physical properties of iron, steel and other metals, heat treatment of steel, tool making etc., etc.

W. 4. Fittings and Machine Shop. Laying out work; chipping, filing and fitting, angles of cutting tools, chipping of key-ways, grinding, drilling, production of plane surfaces by hand methods, fitting parallel parts together, lining and marking off, tapping, stud fitting; fixing pulleys in position etc., etc.,

Turning and boring steel, wrought iron and cast iron from working drawings, face plate and chuck work, outside and inside screw cutting, use of various tools, study of cutting angles, speed and different feeds suitable for each tool, machine and material, centering, squaring, taper turning, reaming, finishing, polishing, drilling, tapping, mandrel making, grinding, lapping plane, flat, and V-surfaces, the use of Milling machines, gear cutting, tool-making, making of taps, drills, reamers, Milling cutters and gauges etc., etc.

In this course every student is required to work on modern standard machine tools such as lathes of different types, planing machines, grinding machines, slotting machines, drilling and milling machines, etc., etc.

The students are required to study and use different measuring tools and devices with their advantage and limits of accuracy.

Instruction is also given whenever necessary in the mechanism of the standard machines found is modern factories and the attention of the students is drawn to the various possible adjustments for different works.

W. 5. Advanced workshop Practice. This course is intended for the Final year students of the Mechanical Engineering Department.

In this course the student will be taught to apply the principles studied in other workshop courses in Commercial production of finished articles from crude materials. Each class will be required to manufacture some useful articles and at least one complete machine or a standard machine tool from the drawings supplied.

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