RULES AND SYLLABUS

OF

THE PRELIMINARY, GRADUATE AND ASSOCIATE MEMBERSHIP EXAMINATIONS.

Framed in accordance with Articles 13, 15, 16, & 17

OF THE

Articles of Association.

RULES.

1. The examinations held by the Association shall be of two standards: —

(*i*) *The Preliminary Examination* intended for—

(*a*) Student Membership.

(*b*) Graduate Membership—1st stage

and (*c*) Associate Membership—1st stage.

(*ii*) *Associate Membership Examination*—

(*a*) Graduate Membership—Final.

(*b*) Associate Membership—Final stage.

2. Only persons whose candidature has been formally accepted by the Council subject to passing of the Examinations under Articles 13(*c*) and 58 of the Articles of Association, will be eligible for these examinations.

3. The applications are to be made in Form 1* or Form E* according as the candidate is an applicant for Studentship, or Graduateship and Associate Membership. Examinations will be held in Calcutta in June and December every year.

4. The Associate Membership Examination is for applicant desirous of getting admission as a Graduate, or Associate Member of the Association. The candidate for this examination must be such person whose age is not below 16 years and whose candidature has been approved by the Council and who has passed the Preliminary Examination or been granted

exemption. A student passing the Associate Membership Examination will be entitled for election to Associate Membership provided he has otherwise qualified by age and practical experience. A candidate failing to satisfy the Council with regard to practical experience will be eligible for the time being for election as a Graduate.

5. The Examination fees which must accompany the applications are Rs. 30/- for Preliminary Examinations and for each section of the Associate Membership Examination. A fee once paid will not be returned in the event of inability of the candidate to appear at the examination.

The candidate will be duly notified of his success or failure, and also the subject or subjects he showed weakness in. The candidate will not be entitled to get any other information regarding the examination. The results will be made known within two months after the examinations.

6. The candidates passing the following examinations are exempted from Preliminary Examination:—

(*i*) Graduates of any University in the British Empire.

(*ii*) Persons passing the Preliminary Examinations of the Institution of Civil Engineers (England). Institution of Mechanical Engineers (England), Institution of Electrical Engineers (England) or Institution of Engineers (India).

(*iii*) Candidate passing the Intermediate Examination in Science of the Indian Universities provided the requisite subjects of the Preliminary Examination have been passed.

7. The Associate Membership Examination will be in three sections—A, B & C of which Section "C" will be an oral examination which will be held after the candidate has completed his practical training. The candidate may appear in any one of these sections or all of them at a time at the discretion of the Association.

8. In Section 'A' there will be two papers, *viz.*—

(*a*) Strength and Elasticity of Materials.

(*b*) (*i*) Theory of Structures or

(*ii*) Theory of Machines or

(*iii*) Electricity and Magnetism.

In Section 'B' the candiate is required to pass in three subjects, not more than two from each of the following groups:

GROUP I.

Geodesy.
Electric Traction.
Internal Combustion Engines.
Thermo Electro-Chemistry.

GROUP II.

Hydraulics & Hydraulic Machinery.
Design of Electric Machinery.
Metallurgy.
Applied Chemistry.

GROUP III.

Architecture.
Steam Heat Engines.
Electric Supply and Generation.
Geology and Minerology.

In Section 'C' the candidate will be examined *viva voce* in engineering drawing, specification and quantities.

Mathematics. The standard of mathematics in this examination will be the same as in the mathematical portion of the preliminary examination and no separate paper will be set. Questions involving the use of higher mathematics may be set in subjects where it is necessary.

10. The time allowed for each paper will be three hours. The candidate will be required to attend the examination hall 10 minutes before the examination hour.

Four figure logarithmic table and steam table will be provided for the use of the candidate requiring them. The candidate who prefers to use slide-rule may bring their own rule.

The candidate is required to bring his own drawing instruments, set squares, scales, etc., required for answering the questions.

No books, papers or other appliances other than those mentioned above will be allowed in the examination hall.

The candidate is required to write on the first cover of the answer papers (which will be supplied by the Association) the roll number given on the receipt for the examination fees. His name or his address must not appear anywhere in the answer papers which will be rejected if any one does so.

SYLLABUS OF THE PRELIMINARY EXAMINATION.

The following papers will be set in this examination:

(*a*) English.

(*b*) Second Language.

(*c*) Mathematics—two papers—(1) Arithmatic and Algebra and (2) Geometry and Trigonometry.

(*d*) Chemistry.

(*e*) Elementary Mechanics.

(*f*) Elementary Physics.

(*a*) *English.* A general paper comprising questions in general knowledge of modern Geography, *History* and literature. In literature the candidate's power of expressing his ideas and also of reproducing those of others will be tested.

(*b*) *Vernacular.* The candidate may take one of the following languages:

Telegu.	Bengali.
Tamil.	Sanskrit.
Punjabi.	Urdu.
Hindi.	Maheratty.

There will be one paper for translation into English.

(*c*) *Arithmatic.* First four rules as applied to whole numbers, vulgar and decimal fractions, contracted method of approximation to the specified degree of accuracy, British and Metric systems, acreage, ratio and proportion, percentage, profit and loss, discount, interest, stocks and shares and mensuration.

Algebra. Symbolical expression of general results in arithmatic, algebraic laws and their applications, greatest common measure, least com-

mon multiple, equations of first and second degree and problems leading thereto, theory of quadratic equations and expressions; simultaneous quadratic equations one of which is linear; Permutations and combinations; variation; proportion; binomial theorem, theory of indices, surds and imaginary quantities; logarithms, exponential logarithmic series; graph of simple algebraic functions and logarithmic functions.

Geometry. The subjects of Euclid (Book I—V) with simple deductions including easy areas of triangles and parallelograms of which bases and altitudes are given (Euclid proof will not be insisted upon); solid geometry. Simple properties of parabolla and ellipse.

Trigonometry. Measurement of angles, trigonometrical ratios, application of algebraic signs: angles of any magnitude: graphs of trigonometrical ratios; elementary trigonometrical formulae and their applications; lagarithmic "Sines,' 'Cosines,' etc., practical solution of triangles with application; numerical examples involving the lagarithmic and other tables.

(*d*) Chemistry. Nature of physical and chemical changes; conservation of matter; laws of definite and multiple proportions; properties of gases; Avogadro's hypothesis; chemical equivalents; valency; chemical calculations, acids, bases and salts, general chemistry of metals and non-metals, combustion; physical chemistry; atomic and molecular weights; classification of elements; the periodic law; electrolysis; dissociation; and spectrum analysis.

(*e*) *Mechanics.* Velocity; accleration; composition and resolution; mass and momentum; forces; laws of motion; energy and work; equilibrium, moments; centre of gravity; machines; liquid pressures; immersed floating bodies; density; gaseous pressure and the atmosphere.

(*f*) *Physics.—Heat.* Thermometry; calorimetry; specific heat; change of state; hygrometry; latent heat; expansion of solids, liquids and gases; transference of heat and mechanical equivalent of heat.

Sound. Production and propagation; intensity; pitch and quality; wave motion; amplitude and frequency; vibration of string; air columns; tuning fork; resonance; and velocity of sound.

Light. Propagation; reflection; refraction, on plane and curved surfaces; images; prisms; spectrum; lenses and photometry.

Electricity and Magnetism. Magnetic properties; lines of forces; magnetic field; intensity; magnetic moment; terrestial magnetism; electrifica-

tion of bodies: electroscope induction; charges; conductors and condensors; electrostatic machines; cells; current electricity; resistance; ohm's law; electromotive forces; current heat; electrolysis; electromagnetic induction; induction coils; telegraph and telephone; Mariners' compass.

SYLLABUS FOR THE ASSOCIATE MEMBERSHIP EXAMINATION.

SECTION A.

Strength and Elasticity of Materials. Physical properties and elastic constants of cast iron; wrought iron; steel; timber; stone and cement; relation of stress and strain, limit of elasticity, yield point, Young's modulus; co-efficient of rigidity; etension and lateral contraction; resistance within the elastic limit in tension, compression, shear and torsion; combined bending and torsion; thin shells; strength and deflection in simple cases of bending; distribution of shearing stress in beams; beams of uniform resistance; suddenly applied loads.

Ultimate strength with different modes of loading; plasticity, working stress; phenomenon in an ordinary tensile test; stress-strain diagram; elongation and contraction of area; effects of hardening, tempering and anealing; fatigue of metals; measurement of hardness.

Forms of arrangement of testing-machines for tension, compression, torsion, and bending tests; instruments of measuring extension, compression and twist; forms of test pieces and arrangements for holding them; influence of form on strength and elongation; methods of ordinary commercial testing; percentage of elongation and contraction of area; test conditions in specifications for cast iron, mild steel and cement.

Theory of Structures. Graphic and analytic methods for the calculation of bending moments and of shearing forces, and of the stresses in individual members of form work structures loaded at joints; plate and box girders; incomplete and redundant frames; stresses suddenly applied and effects of impact; resistance of struts; strength of columns; effect of different end-fastenings on their resistance; combined strains; calculations connected with statically indeterminate problems, as beams supported at three points, etc.; travelling loads; rivetted and pin-jointed girders; rigid and hinged arches; strains due to weight of structures; theory of earth pressure and foundations; stability of masonry and brickwork structures.

Theory of Machines and Machine Design. Kinematics of machines; inversion of kinematic chains; virtual centres; belt-rope, chain, toothed

and screw gearing; velocity, acceleration and effort diagrams; inertia of reciprocating parts; elementary cases of balancing-governors and flywheels; friction and efficiency; design of fastenings; bearings and supports; shaft-couplings; pulleys; gear pipes, cylinders and engine parts.

Electricity and Magnetism. Fundamental laws; electrification; potential; capacity; dielectric strengths, direct currents; ohm's law; electrical energy; work and power; magnetism; the magnetic field; induced magnetism; magnetic shells; electromagnetism; M. M. F. Electromagnetic induction; self and mutual induction; magnetic circuits; electro-chemistry; primary cells; galvanometer; shunts; electrical measurements and instruments; alternating currents and A. C. circuits.

SECTION B.

Geodesy. The theory, structure and adjustment of the principal surveying and levelling instruments and the principles of their employment under various conditions; errors of observation and their elimination; determination of position and time; plane and geodetic triangulation; land surveying; contouring; setting out of curves; mining surveying and hydrographical surveying; observation of currents and tides, with determination of mean sea-level; and setting out of works.

Internal Combustion Engines. Thermodynamics of the internal combustion engines; combustion of gaseous fuels; effect of compression and of combustion chamber design; principles, construction and of working of Gas, Oil and Petrol engines; ignition and carburation; governors; inertia forces; balancing; indicating; gas producers.

Electricity Supply and Generation. Alternating current instruments; A. C. and D. C. motors; alternators; transformers; rectifiers and convertors; storage batteries and boosters; transmission; switchgears; mains; substations; voltage regulation; wiring; electric sign; electric heating and incandescent lighting; heat and steam; steam engine mechanism; engine testing; steam turbines; steam, oil, gas and water power electric plants.

Thermo-Electro-Chemistry. The nature of the principal fuel; theory of combustion; calorific value of carbon and hydrogen as used for the production of heat, and of the principal fuels—solid, liquid and gaseous; examination of the chemical processes which occur in the working of open and closed furnaces, and in the working of engines either by coal or producer-gas, or by petroleum, etc.; theory and use of the principal apparatus employed in the determination of calorific values; methods of production and calorific value of coal-gas, water-gas and gas producer; calculation of thermal changes in industrial processes; caloric intensity and the instru-

ments used for its measurement; theory of electrolysis and principal electrolytic processes; chemistry of primary and secondary batteries; the use of electric currents for heating and chemical decomposition.

Hydraulics and Hydraulic Machinery. Pressure of water at a point, centre of pressure; pressure on a surface, flow of water through orifices, notches and weirs, laws of fluid friction, steady flow in pipes and uniform channels, general phenomena of flow in rivers; impact of jets on plane; types of turbines, general principles of design of turbines; reciprocating pumps; general principles of design of centrifugal pumps; general principles of hydraulic transmission of powers.

Steam and Steam Engine. Properties of steam; Mollier and Temperature-Entropy diagrams; thermodynamic principles and laws; heat engine cycles; reversibility; Carnot and Rankine cycles; steam engines; indicating; superheating; compounding; testing; Willans' law; steam engine mechanism; balancing; steam turbines; fuels and combustion; steam boilers and accessories.

Electric Traction. Alternating-current instruments; D. C. and A. C. motors; alternators; transformers; rectifiers and converters; storage batteries and boosters; transmission switchgear; mains; sub-stations; voltage regulation; tramway systems, tracks, overhead work, cars and equipment; brakes and brake rigging; tramway motors and controllers; direct and alternating-current railways; electric signalling on railways.

APPLIED CHEMISTRY.

(*a*) *Air, Water, Sewage, Lime and Cement.* Composition and physical properties of air; nature and sources of impurities; ventilation. Chemistry of water and characteristics of waters derived from various sources; hardness and its artificial reduction; chemical characteristics of potable and feed waters and their determination. Chemical characteristics of sewage and their determination; the chemical bases of sewage purification; pollution of water by trade wastes, etc., chemistry of limestone, chalk, and lime and of hardening of mortar; chemistry of manufacture of cement, including Portland, alumnous and quick-hardening cements, and of raw materials used in cement manufacture. Chemical tests for and analyses of cements, and the nature of the chemical changes which occur during setting.

(*b*) *Fuel, Combustion, Gas Manufacture, Oils and Lubricating Oils.* Classification, chemical and physical changes and calorific value of solid, liquid and gaseous fuels; chemistry of the carbonization of bituminous coal at low and high temperature, and of the recovery of the commercial bye-products; analysis of coals and coke; reactions in gas producers; physical

and chemical conditions of combustion and nature of flame. Chemistry of the purification of gases derived from coal and oil, and of recovery and distillation process. Nature and chemical characteristics of the commoner oils used in engineering work; the refining of petroleum, animal fat and vegetable oils; chemical methods of examining, testing and identifying oils; properties of lubricating oils (and other substances used as lubricants) suitable for various purposes, including their chemical composition.

It will be possible for candidates to pass in this subject by satisfying the examiners in either (*a*) or (*b*).

GROUP III.

Architecture. The orders of architecture general and in special reference to Indian Architecture of different periods; proportions and peculiarities of each order; general principles of design; feature of recent English and Indian Architecture.

Development of town planning; town sites and building estates etc.; social and economic conditions; transport; open spaces; architectural features; road system; town planning in ancient India.

Metallurgy. Physical properties of the ordinary metals of construction; cold working; heat treatment; metallography; fuels and heating; pyrometry; manufacture of iron and steel; classification of steels; effects of carbon; manganese, phosphorus, sulphur and other materials on the properties of steel; physical properties and methods of production of non-ferrous metals; electrolytic processes; corrosion.

Design of Electrical Machines. Alternate-current instruments; D. C. and A. C. motors; alternator; transformers; rectifiers and converters; storage batteries and boosters; transmission; switchgear; mains; sub-stations; voltage regulation; dynamo design; alternating-current motor design commercial testing of electrical machinery; classification of dynamos; homopolar and hetropolar machines.

Geology and Minerology. The nature of common mineral and the methods by which they can be discriminated; mode of occurrence of minerals in rocks and in mineral deposits; composition and classification of the rocks forming the earth's crust, changes taking place in the earth's crust by the action of the atmosphere and of water upon it; denudation and the formation of flubiatile, glacial, lacustrine, deltaic, and marine deposits; action of internal forces upon the globe, volcanic phenomena and earthquakes; movements of terrestrial rock-masses; methods of measuring and recording in sections and maps the positions of the rock-masses of the

globe; the general succession of the stratified deposits in the British Isles and India, based on the study of the fossils which they contain.

SECTION 'C.'

ENGINEERING DRAWING, SPECIFICATION AND QUANTITIES.

The candidate will have to submit the original drawing made by him together with the details of design and calculation specification and bills of quantities together with a certificate from the engineer under whom he received practical training as pupil, apprentice or assistant. He will be asked questions regarding the methods of design, estimate, specification of works which are shewn in such drawings. He may also be required to take out quantities of various kinds of works shewn in them, *e.g.* (1). Cast Iron or steel stanchions, (2) Masonary, (3) Re-inforced concrete, (4) Machinery of all kinds.

The candidate will be asked questions regarding specification of different kinds of materials, and works, and necessary tests for their acceptance and general conditions usually attached to engineering contracts and their bearing on the responsibility of the Engineer, the Contractor and the Principals.

The candidate may also be asked questions regarding the drawings necessary in the preparation of schemes and proposals for submission to Government or other sanctioning authority and for engineering contracts; the nature of the drawings requisite for the actual execution of engineering work, both constructional and mechanical; the usual scales for such drawings: and the information to be contained in them.