

P.D.1293.

*Officers' 33 L*  
*Conversion Course*

OFFICERS' 33.L. CONVERSION COURSE

PRELIMINARY MATHEMATICS, D.C. AND A.C.  
 MECHANICS.  
 ADVANCED ELECTRICAL TECHNOLOGY.

PRELIMINARY MATHEMATICS

Week	Day	Period	Syllabus Details
1	Mon.	a.m.	Simple equations; simultaneous equations; factorisation; quadratics.
		p.m.	Simultaneous quadratics; indices; theory of logarithms.
	Tues.	a.m.	Surds; variation; progression.
		p.m.	Binomial Theorem.
	Wed.	a.m.	Partial fractions; limiting values.
		p.m.	Trigonometry; circular measure.
	Thur.	a.m.	Solution of triangles.
		p.m.	Compound angles.
	Fri.	a.m.	Calculus, definitions, differential coefficient.
		p.m.	Differentiation, sum, difference, product, quotient.
2	Mon.	a.m.	Differential coefficient of trigonometrical ratios; function of a function.
		p.m.	Maximum and minimum; turning points.
	Tues.	a.m.	Exponential series; Maclaurin's Theorem.
		p.m.	De Moivre; expansion of $\sin x$ and $\cos x$ .
	Wed.	a.m.	Integration, introduction and standard forms.
		p.m.	Applications; areas; mean values; R.M.S. values.
	Thur.	a.m.	Hyperbolic and Exponential Functions.
		p.m.	Vector representation.
	Fri.	a.m.	Vector representation
		p.m.	TEST - no marks to count.

D.C. BASIC: FUNDAMENTALS, GENERATORS, MOTORS, DISTRIBUTION, PHOTOMETRY

D.C. FUNDAMENTALS

3.	Mon.	a.m.	Fundamental quantities; units of energy, work, power. Kirchoff's Laws.
	Tues.	a.m.	Magnetism; Electromagnetism - fields of st. wire, single turn coil and solenoid. Magnetic blowouts.
	Wed.	a.m.	Magnetic circuits; calculations, including tractive power.
	Thur.	a.m.	Electromagnetic induction; self and mutual induction; time constant; breaker discrimination.
	Fri.	a.m.	Hysteresis; energy of magnetic field; B/H loop.

D.C. GENERATORS

Week	Day	Period	Syllabus Details
4	Mon.	a.m.	Construction; armature windings; E.M.F. formula.
	Tues.	a.m.	Equalising connections; selective commutation,
	Wed.	a.m.	Commutation; armature reaction.
	Thur.	a.m.	Aids to sparkless commutation.
	Fri.	a.m.	Characteristics, series, shunt and compound; parallel operation.

D.C. GENERATORS (cont'd); D.C. MOTORS

5	Mon.	a.m.	Losses, efficiency and temperature rise of generators.
	Tues.	a.m.	D.C. motor action; back E.M.F.; armature reaction; $f = \frac{E \cdot I}{10}$ dynes.
	Wed.	a.m.	Torque; losses; efficiency.
	Thur.	a.m.	Characteristics; speed control.
	Fri.	a.m.	Shunt motor starters, hand operated and automatic.

DISTRIBUTION; PHOTOMETRY

6	Mon.	a.m.	Distribution systems. Kirchoff application.
	Tues.	a.m.	Ring main and 3 wire systems.
	Wed.	a.m.	Photometry; definitions; laws of illumination; illuminants; illumination.
	Thur.	a.m.	----- do -----
	Fri.	a.m.	D.C. EXAMINATION - 100 marks (to count).

PRELIMINARY A.C.

12	Mon.	a.m.	Production of A.C.; sine wave ; R.M.S.; average value; form factor; crest factor simple vector representation; - addition and subtraction.
	Tues.	a.m.	Reactance; impedance for R, L and C combinations in series; phase angle; series resonance; power in S.P. circuits - K.W., K.V.A., K.V.A.R.
	Wed.	a.m.	----- do -----
	Thur.	a.m.	----- do -----
	Fri.	a.m.	----- do -----

PRELIMINARY A.C. (cont'd)

Week	Day	Period	Syllabus details
13	Mon.	a.m.	Parallel circuits, admittance method; parallel resonance; power factor correction.
	Tues.	a.m.	----- do -----
	Wed.	a.m.	Electrostatics, principles, units; types of condenser; parallel plate condenser; voltage gradient; energy stored.
	Thur.	a.m.	Time constant; condensers in series & parallel; capacity of single core cable.
	Fri.	a.m.	TEST - no marks to count.

ADVANCED ELECTRICAL TECHNOLOGY

Transformer; Alternator; 3 Phase Systems; Induction Motor; N.S. Motor; Synchronous Motor; A.C. Switch Gear; Mercury Arc Rectifier; Servo Mechanism Theory; Electrical & Mechanical Computation; Mechanics.

TRANSFORMER (a.m.)      MECHANICS (p.m.)

Week	Day	Period	Syllabus details
14	Mon.	a.m.	"j" Operator applied to circuits.
		p.m.	Force; Newton's 3rd Law; equilibrium; resultant; moment.
	Tues.	a.m.	"j" Operator applied to circuits (cont'd).
		p.m.	Parallelogram & Triangle of Forces; Lami's Theorem.
	Wed.	a.m.	S.P. Transformer; E.M.F. equation; no load current and its wave form; resistance and leakage reactance; transformer on load; complete vector diagram.
		p.m.	Friction.
	Thur.	a.m.	Equivalent circuit; open and short circuit tests; regulation; approximate drop formula.
		p.m.	Centre of gravity.
	Fri.	a.m.	Losses and efficiency; maximum efficiency; separation of hysteresis and eddy current losses.
		p.m.	Couples and resultants.

TRANSFORMER (cont'd) ALTERNATOR (a.m.) MECHANICS (p.m.)

Week	Day	Period	Syllabus details
15	Mon.	a.m.	Transformer back-to-back test; parallel operation of transformers; auto-transformer.
		p.m.	Velocity; acceleration of moving bodies.
	Tues.	a.m.	S.P. Transformers - Laboratory Tests.
		p.m.	Mass; force; acceleration.
	Wed.	a.m.	S.P. Transformers - Laboratory Tests.
		p.m.	Relative and resultant velocities.
	Thur.	a.m.	S.P. Alternators; general construction; $K_D$ ; $K_C$ ; $K_F$ ; E.M.F. formula.
		p.m.	Projectiles.
	Fri.	a.m.	Armature reaction and reactance; synchronous impedance; calculations on regulation.
		p.m.	ELECTRICS & MECHANICS TEST - no marks to count.

ALTERNATOR cont'd (a.m.) MECHANICS (p.m.)

16	Mon.	a.m.	Determination of regulation; O.C.C. & S.C.C.; Behn Eschenberg, Poitier and Harrison Jones methods of pre-determination of regulation.
		p.m.	Work; horse-power; momentum.
	Tues.	a.m.	Laboratory tests on the alternator.
		p.m.	Direct and oblique impact.
	Wed.	a.m.	Laboratory tests on the alternator.
		p.m.	Circular motion.
	Thur.	a.m.	3 phase alternator; general construction; star and delta connections of windings; armature reaction of 3 phase alternators.
		p.m.	Simple harmonic motion.
	Fri.	a.m.	Armature reaction of 3 phase alternators (cont'd); Inductor type alternator (briefly).
		p.m.	Rotation and inertia.

ALTERNATOR (cont'd); POLYPHASE SYSTEMS (a.m.) MECHANICS (p.m.)

Week	Day	Period	Syllabus details
17	Mon.	a.m.	Percentage reactance; transient and sub-transient reactance; short circuit ratio; phasing out.
		p.m.	Rotation and inertia (cont'd).
	Tues.	a.m.	Parallel operation; synchronising and stability.
		p.m.	The elastic law, extension, compression, bending, twisting.
	Wed.	a.m.	Polyphase systems; 3 phase transformer.
	p.m.	Strength and stiffness of materials.	
	Thur.	a.m.	Balanced loads; unbalanced loads, delta and 3 phase, 4 wire.
		p.m.	Torsion.
	Fri.	a.m.	EXAMINATION (Electrics & Mechanics) - 100 marks (to count).

POWER IN 3 PHASE; HARMONICS; ROTATING FIELDS; A.C. INSTRUMENTS.

18	Mon.	a.m.	Power measurement; 2 and 3 wattmeter methods.
	Tues.	a.m.	Harmonics in 3 phase alternators; harmonics in 3 phase systems.
	Wed.	a.m.	Rotating fields, vectorially and analytically; principles of synchrosopes.
	Thur.	a.m.	Principle of frequency meters, P.F. meters, reverse current relay. Instrument transformers.
	Fri.	a.m.	----- do -----

## INDUCTION MOTOR

19	Mon.	a.m.	Induction motor, 3 phase; principle and types of squirrel cage rotor; starting torque, wound rotor.
	Tues.	a.m.	Development of theory of torque and slip-torque curves; condition for maximum torque.
	Wed.	a.m.	Transformer analogy; circle diagram.
	Thur.	a.m.	Methods of starting; switching transients.
	Fri.	a.m.	Laboratory tests on Induction Motor.

INDUCTION MOTOR (cont'd); N.S. MOTOR; SYNCHRONOUS MOTOR;  
A.C. SWITCHGEAR

Week	Day	Period	Syllabus details
20	Mon.	a.m. p.m.	Laboratory tests on induction motor. ----- do -----
	Tues.	a.m. p.m.	----- do ----- Locking and crawling of induction motor.
	Wed.	a.m. p.m.	Speed control of induction motors; the N.S. motor; N.S. motor (cont'd); A.C. series motor.
	Thur.	a.m. p.m.	Synchronous motor; principle; variation of $I_a$ and P.F. with $I_f$ (vectorially). Vee curves; starting methods, including synchronous induction motor.
	Fri.	a.m. p.m.	A.C. switchgear (paper by Feldbauer, I.E.E. Journal, Aug. 1948). ----- do -----

A.C. MACHINES; MERCURY ARC RECTIFIER

21	Mon.	a.m. p.m.	A.C. machines, Service applications. ----- do -----
	Tues.	a.m. p.m.	Mercury arc rectifier. ----- do -----
	Wed.	a.m. p.m.	----- do ----- ----- do -----
	Thur.	a.m.	FINAL EXAMINATION 150 marks, (to count).

DIFFERENTIAL EQUATIONS; SERVO MECHANISM THEORY

Week	Day	Period	Syllabus details
25	Mon.	a.m.	Differential equations.
		p.m.	----- do -----
	Tues.	a.m.	----- do -----
		p.m.	----- do -----
	Wed.	a.m.	Servo mechanism theory.
		p.m.	----- do -----
	Thur.	a.m.	----- do -----
		p.m.	----- do -----
	Fri.	a.m.	----- do -----
		p.m.	----- do -----

SERVO MECHANISM THEORY

26	Mon.	a.m.	Servo mechanism theory
		p.m.	----- do -----
	Tues.	a.m.	----- do -----
		p.m.	----- do -----

ELECTRICAL AND MECHANICAL COMPUTATION

28	Mon.	a.m.	Electrical and Mechanical Computing principles & mechanisms.
		p.m.	----- do -----
	Tues.	a.m.	----- do -----
		p.m.	----- do -----
	Wed.	a.m.	----- do -----
		p.m.	----- do -----
	Thur.	a.m.	----- do -----
		p.m.	----- do -----
	Fri.	a.m.	----- do -----
		p.m.	----- do -----