

## 3207 ELECTRICAL MACHINES II

IV Term ( Core )

7 Hours / Week

Total Hours : 84

### Major Divisions

Unit I	Alternator Principle & Construction
Unit II	Alternator Performance & Testing
Unit III	Three Phase Induction Motor
Unit IV	Synchronous Motor & Single Phase Motors
Unit V	Maintenance Of Induction Motors And Starters

### Unit I Alternator Principle & Construction

17 Hrs

Basic Principle – Requirements of alternator – Rotating Field System – Rotating Armature System – Advantages of Rotating Field (Stationary Armature) system – Types of Rotor – Salient Pole rotor – Non salient pole rotor – Constructional details of salient pole alternator – Constructional details of Non salient pole alternator – Turbo alternator construction – Alternators – Brush less alternator – Types of armature windings (No winding diagram) – Single layer – Double layer – Lap & Concentric winding – Phase spread – Integral Slot winding – Fractional Slot winding – Pitch Factor – Distribution factor – Effect of Pitch factor on EMF – Advantages of chorded pitch winding – Effect of pitch factor on harmonics – Methods of obtaining Sine wave in salient pole & non salient pole alternators – EMF equation of alternators (Simple problems) – Critical speed – Run away speed – Cooling of alternators – Different methods – Hydrogen cooling & advantages – Transients in alternators – Different types of excitation – Stability of Excitation.

### Unit II Alternator Performance & Testing

17 Hrs

Alternator on No load – Armature reaction in single phase alternators on load at various power factors – Effective Armature resistance – Leakage resistance – Reactance due to Armature reaction – Synchronous reactance – Synchronous impedance – Causes of Voltage drop in alternators – Vector diagram of alternators on load (for lag, lead and unity power factors) – Voltage regulation (Definition & Simple problems) – Open circuit & Short circuit test – Determination of regulation by direct load test – Pre – determination of Regulation by EMF method, MMF method, ZPF method.

Parallel operation of alternators – Necessity of Synchronization – Advantages – Methods – Dark lamp method – Bright Lamp method – Synchroscope method – Synchronizing current, Synchronizing power, Synchronizing torque – Effect of change in excitation of alternators in parallel – Load sharing of two alternators (Simple problems) – Control of active load, reactive load – Infinite bus bar – Control of voltage & frequency of infinite bus bar – Governor characteristics.

### **Unit III Three phase Induction Motor**

**17 Hrs**

Rotating magnetic field produced by 2 $\phi$  and 3 $\phi$  2pole system-principle of operation of 3Ph induction motors-slip and frequency-comparison between cage and slip ring induction motors – development of Phasor diagram of three phase induction motor – expression for torque in synchronous watts – slip torque characteristics – stable and unstable region – no load test and blocked rotor test – development of approximate equivalent circuit – problems on the above topics – simplified circle diagram – determination of maximum torque, slip etc. (no problems) – starting torque and starting current expression – relationship between starting torque and full load torque – speed control by injected e.m.f method, pole changing method, rotor resistance method and cascading method – starters of induction motor – direct on line starter, rotor resistance starter – auto transformer starter – star delta starter – crawling, cogging in induction motor – double cage motor – linear induction motor.

### **UnitIV SynchronousMotor & Single Phase Motors**

**17 Hrs**

Synchronous Motor Basic theory – Reasons for not self starting – Different methods of starting Synchronous motor – Vector diagram on No load (Simple problems) – “V” curve and inverted “V” curve for different excitation at constant input power – Effect of change in load, excitation – Power factor improvement using Synchronous motor – Synchronous condenser – Synchronous Phase Modifier – Hunting – Applications – Comparison between Synchronous motor & Three Phase Induction motor.

Single Phase Induction Motor – Double Field Revolving theory for Single Phase Induction Motor – Construction, Principle of working & applications of Split Phase motors, Capacitor type motors, Shaded pole motor, Universal motor, Repulsion motor, reluctance Motor - Stepper motor, AC & DC servo motor – Amplidyne.

### **Unit V Maintenance of Induction Motors and Starters**

**16 Hrs**

BIS publication dealing with the code of practice of induction motors and starters – classification of cage motor – continuous rating and intermittent rating – various types of enclosures – specifications of motors – selecting the cable rating – drying out – alignment – diagram of CT selector switch (ASEA) – single phase prevention using current operated relay – commissioning - annual maintenance – points to be checked up – important factors which influence the selection of starters of induction motor – common induction motor troubles and their remedies – causes of noise and vibration – care of bearings – static balancing – degreasing – vacuum impregnation - varnishing – effect of unbalanced supply on the performance of induction motor.

**Reference Books :**

<b>Sl.No.</b>	<b>Name of the Book</b>	<b>Author</b>	<b>Publisher</b>
1	Electrical Machines	S.K.Bhattacharya, Principals, TTTI, Chandigar	Tata McGraw Hill Publishing Company, New Delhi.
2	Operation and Maintenance of Electrical Machines	B.V.S.Rao	Khanna Publishers, New Delhi
3	A text book of electrical technology	1. B.L. Theraja 2. A.L. Theraja	S.Chand & Co Publisher, New Delhi 55.
4	Electrical Technology	Edward Hughes	Addison – Wesley International Student Edition
5	Performance and Design of AC machines	MG Say	CBS Publication, New Delhi

# 3208 MEASUREMENTS AND INSTRUMENTATION

IV Term ( Core )

7 Hours / Week

Total Hours : 84

## Major Divisions

- Unit I Classification And Characteristics Of Instruments
- Unit II Measurement Of Voltage, Current And Resistance.
- Unit III Measurement Of Power And Energy
- Unit IV Special Instruments And Bridges
- Unit V Transducers And Industrial Instrumentation

### Unit I Classification and characteristics of instruments 17 Hrs

General – definition of measurement – functions of measurement system (Indicating, recording and controlling functions) - Applications of measurement systems-classification – absolute and secondary instruments – indicating, recording and integrating instruments -Definition of true value, accuracy , precision, percentage static error and correction , instrument efficiency.

Principle of operation - effects used in instruments- Operating forces – deflecting, controlling and damping forces – construction details- moving system - types of supports- balancing - torque weight ratio control systems (spring control and gravity control) – damping systems – Magnets –pointers and scales.

### Unit II Measurement of voltage, current and resistance 17 Hrs

Types of instruments – Construction, working and derivation of torque equation of moving coil, moving iron, dynamometer type and induction type(shaded pole construction) instruments - extension of instrument ranges –shunt and multiplier (calculation and requirements, Simple Problems), current transformer and potential transformer (No derivations, working principle only) Measurement of resistance –ohm meter (series and shunt type), multimeter and megger, Cathode Ray Oscilloscope – CRT- constructional parts - Electron Gun - Deflection Plate - Fluorescent Screen - Glass envelope – Base – Time Base Generators - block diagram of a general purpose CRO, Basic CRO circuits and controls – vertical deflection system - horizontal deflection system types of sweeps - synchronization – Blanking – Intensity Modulation – positioning control – focus control – intensity control – calibration circuit – astigmatism – Measurement of Phase and frequency – Applications of CRO.

### Unit III Measurement of power and energy 16 Hrs

Types of wattmeter - Construction and operation of dynamometer type wattmeter & LPF wattmeter – 3 phase two element wattmeter - Construction and working of induction type single phase energy meter – friction compensation -creep and prevention – Errors and adjustments in energy meters- 3 phase energy meter (connection circuit only) -

Testing of energy meter with Phantom loading and RSS meter - Measurement of power and energy using CT and PT (Circuit only) – Construction and working of single phase dynamometer type power factor meter.

#### Unit IV Special instruments and bridges

**17 Hrs**

Merz price maximum demand indicator - Trivector meter - Synchroscope - Construction and working of Weston type - Phase sequence indicator – construction and working of rotating type - Frequency meter – mechanical resonance (vibrating reed type) and Weston type frequency meters – digital frequency meter (simplified composite block diagram) -XY recorder –Block diagram and applications - Electronic Multimeter – Digital Multimeter - Bridges - Wheatstone Bridge – Basic form of AC bridge – Anderson and Schering bridge for measurement of Inductance and capacitance (No derivation – Formula only) - Localization of cable faults –Murray and Varley loop tests to Locate ground and short circuit faults.

#### Unit V Transducers and industrial instrumentation

**17 Hrs**

##### **(Qualitative treatment only)**

Transducers – Definition -Electrical transducers - Classification of electrical transducers based upon principle of transduction (Table) –Theory and construction only for Strain gauge – LVDT – RVDT – Piezo electric – thermo couples – Thermistors – Proximity sensors – Inductive and Capacitive types – Introduction to digital encoding transducers .

##### **Industrial instrumentation**

Measurement of strain using wheatstone bridge – measurement of pressure using inductive transducer – measurement of angular velocity using DC Tachometer generator – measurement of temperature using bimetallic thermometers – measurement of flow using electromagnetic flow meter – measurement of thickness using ultrasonic vibrations – measurement of pH value using a pH cell – Measurement of radiation using Geiger Muller tube.

##### **Reference Books :**

<b>Sl.No.</b>	<b>Name of the Book</b>	<b>Author</b>	<b>Publisher</b>
1	A course in electrical and electronic measurements and instrumentation	1. A.K.Sawhney 2. Puneet Sawhney	Dhanpat Rai & Co., (P) Ltd., New Delhi.
2	Electronic Instrumentation	HS Kalsi	1. Tata McGraw Hill Publishing Co., New Delhi  2. Learning Materials Centre, ISTE, New Delhi

3	Modern Electronic Instrumentation and Measurement techniques	Albert D.Helfrick William David Cooper	Prentice-Hall of India (P) Ltd., New Delhi
4	Electronics and Instrumentation	1. Dr.S.K.Battachar iy 2. Dr.Renu Vig	S.K.Kataria & Sons, New Delhi 6.
5	A course in electrical and electronic measurements and instrumentation	Umesh Sinha	Satya Prakashan, New Delhi

## **3209 BASICS OF MECHANICAL ENGINEERING**

**IV Term ( Core )**

**6 Hours / Week**

**Total Hours : 72**

### **Major Divisions**

- Unit I Stress and Strain  
Torsion and Springs
- Unit II Bearings and Lubrication  
Transmission of Motion
- Unit III Steam Boilers  
Turbines
- Unit IV Pumps  
Internal Combustion Engines
- UNITV Foundry  
Lathe and Drilling Machine

### **UNIT I**

**15 Hrs**

#### **Stress and strain**

Mechanical properties – elasticity – plasticity – ductility – malleability – toughness – hardness – stiffness.

Stresses – tensile – compressive and shear – strain – Hooke's law – stress-strain diagram for mild steel – factor of safety – working stress – Ultimate stress - elastic constants –Young's modulus – Poisson's ratio – modulus of rigidity – bulk modulus – relation between elastic constants ( no derivation ) – simple problems.

#### **Torsion and springs**

Theory of torsion – torsion of solid and hollow circular shafts – torsion equation (no derivation ) – simple problems on torsional shear stress, torque, power transmitted and diameter of shafts – description of flange coupling

Springs – classification and applications – spring materials – difference between open coiled and closely coiled springs – stiffness of the spring – deflection of the spring (no derivation) – simple problems.

## **UNIT II**

**14 Hrs**

### **Bearings and lubrication**

Bearings – types – journal – ball – roller –taper roller – needle bearings – advantages and disadvantages of ball bearings –comparison of journal and ball bearings – lubricant - types – solid, semisolid and liquid lubricants – methods of lubrication – ring oiler lubrication – drip system – grease cup – properties of lubricants

### **Transmission of motion**

Drives – types – belt, chain, gear drives – applications – merits and demerits of each.

## **UNIT III**

**14 Hrs**

### **Steam boilers**

Formation of steam –types of steam – wet, dry, and superheated steam - boilers – classifications – description and working of BHEL high pressure boiler – boiler mountings and accessories.

### **Turbines**

Steam turbines – classification – impulse and reaction turbines – compounding – necessity – types – description of velocity compounding only – impulse Vs reaction turbines.

Hydraulic turbines – Pelton wheel – Francis and Kaplan turbines – speed control in Pelton wheel – selection of turbines – gas turbine – construction and working of open cycle gas turbine – advantages and disadvantages.

## **UNIT IV**

**14 Hrs**

### **Pumps**

Construction and working of – single stage , single acting reciprocating pump – centrifugal pump – jet pump – deep well pump.

### **Internal combustion engines**

IC engines – classifications – construction and working of a two-stroke and four stroke cycle petrol engine – four stroke cycle diesel engine –fuel supply system in a petrol engine –functions of a carburetor – simple carburetor - ignition system – compression ignition – coil and magneto ignition systems – fuel supply system in diesel engines – fuel injection pumps – fuel injector – lubrication system – splash and high pressure lubrication systems – cooling systems – air and water cooling – advantages and disadvantages.

## UNIT V

15 Hrs

### Foundry

Pattern – pattern materials – types – single piece ( solid ) and split types only – allowances – moulding – moulding tools and boxes – moulding sands – classifications and properties – green sand moulding – dry sand moulding – casting – sand casting using green and dry sand moulds.

### Lathe and Drilling Machine

Lathe – types – specifications – simple sketches – principal parts of lathe – head stock – carriage – cross-slide – tail stock – work holding devices – face plate – three and four jaw chucks – lathe operations – Plain turning, taper turning, step turning, knurling, drilling and reaming.

Drills – twist drills – types of drilling machines – bench type – floor type – radial type – gang drill – principle of operation – drilling holes – methods of holding drill bits – drill chucks – socket and sleeve – drilling operations – drilling – reaming – counter-sinking.

### Reference Book :

SI.No.	Name of the Book	Author	Publisher
1	Strength of Materials	R.S.Khurmi	S.Chand & Co., New Delhi
2	Mechanical Engineering	R.S.Khurmi	S.Chand & Co., New Delhi
3	Applied Mechanics and Strength of Materials	R.K.Bansal	Lakshmi Publication (P) Ltd., New Delhi
4	Fluid Mechanics and Hydraulic Machines	R.K.Bansal	Lakshmi Publication (P) Ltd., New Delhi
5	Elements of Workshop Technology	Hajra Choudhry	Media Promoters & Publishers (P) Ltd, Mumbai
6	Thermal Engineering	P.L.Ballany	Khanna Publishers, New Delhi

## 3210 ELECTRICAL MACHINES – II LABORATORY

IV Term (Core )

6 Hours / Week

TotalHour:72

### List of Experiments :

1. Calibration of Wattmeter.
2. Calibration of Single phase energy meter (using R.S.S meter).
3. Calibration of 3 phase energy meter.
4. Study of Synchronising of 3 Phase alternators.
5. Predetermination of Regulation of Alternator (By Z's method).
6. Load test on 1 phase alternator.
7. Load test on 3 phase alternator.
8. Load test on 3 phase squirrel cage induction motor.
9. Equivalent circuit of 3 phase induction motors by No Load and blocked rotor tests.
10. Load test on single phase Induction motor.
11. Determination of 'V' Curve (No Load) of Synchronous motor.
12. Load test on 3 phase slip-ring Induction motor.
13. Study of Induction motor starters.
14. Predetermination of regulation of alternator by MMF method.
15. P.F improvement of 3 phase cage induction motor using capacitor bank.
16. Predetermine the efficiency of 3 phase cage motor by circle diagram method.
17. Starting of FHP motor by DOL starter and note the starting and running current.
18. Study of Shaded Pole motor.

## 3211 MECHANICAL ENGINEERING LAB

IV Term ( Core )

3 hours / week

Total hour:36

### List of Exercises:

#### Study Exercises

1. Universal testing m/c.
2. Various types of pumps.
3. Working of two stroke and four stroke petrol engines.
4. Working of four stroke diesel engine.
5. Working of ignition system in IC engine.
6. Drilling Machine

#### Compulsory Exercises

#### **I Lathe**

- 1) Plain turning
- 2) Step turning & Knurling
- 3) Step turning & Drilling
- 4) Taper turning

#### **II Foundry**

- 1) Preparation of mould of straight pipe.
- 2) Preparation of mould of a Thumbles.
- 3) Preparation of mould of a flange coupling.
- 4) Preparation of mould of a gear Wheel.

#### **III Welding**

Making the following joints in MS flats of 6mm thick by arc welding

- 1) Lap joint
- 2) Butt joint
- 3) 'T' joint
- 4) Corner joint

## 3212 COMPUTER AIDED ELECTRICAL DRAWING LABORATORY

IV Term (Core )

6 Hours / Week

Total Hours : 72

### List of Experiments :

#### Electrical Symbols :-

01. Draw symbols of resistors – inductors – capacitors – DC armatures – alternators – field winding shunt, series and compound – relays – contactors – fuses – main switch – electric bell – earth – aerial – DPST – DPDT – TPST – Network link – ammeters – voltmeters – wattmeters – energy meters – frequency meters – power factor meters – timers – buzzers – transformers – auto transformers

02. Draw symbols of diodes – transistors – FET – SCR – UJT – DIAC – TRIAC – MOSFET'S - LOGIC GATES – AND – OR – NOT – NAND – NOR – EXOR.

#### Drawing – electrical connection diagrams :-

1. Draw the panel wiring diagram of two shunt generators in parallel.
2. Draw the panel wiring diagram of two single phase alternators in parallel.
3. Draw the winding diagram of lap connected DC armature with commutator connections and brush positions.
4. Draw the winding diagram of wave connected DC armature with commutator connections and brush positions.
5. Draw the mesh winding diagram of a three phase induction motor.
6. Draw the concentric winding diagram of a single phase induction motor.
7. Draw the control circuit of jogging.
8. Draw the control circuit of automatic rotor starters.
9. Draw the connection diagram of on load tap changer.
10. Draw the circuit of three phase transformers in parallel.
11. Draw the line diagram of wiring of a drawing hall.
12. Draw the connections of three point starter.
13. Draw the connections of automatic star - delta starter.
14. Draw the connections of direct on line starter.
15. Draw the layout of the pole mounted distribution substation.
16. Draw the single line diagram of indoor substation.

