COURSE NAME : ELECTRICAL ENGINEERING GROUP

COURSE CODE : EE/EP

SEMESTER : FIFTH

SUBJECT TITLE : UTILISATION OF ELECTRICAL ENERGY

SUBJECT CODE : 9087

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
04	--	--	03	80	20	--	--	--	100

Rationale:

Electrical Engineering Diploma holders are appointed in industries in the supervisory cadre. Their main job functions are to supervise the operation & control of various electrical drives, electrical furnaces, electrical welding equipments, and refrigeration and air conditioning systems. The factory illumination scheme is also to be maintained by them. Therefore, the knowledge of operation and control of these machines and equipments is vital for every Diploma holder.

Railway is one of the major employers of Electrical Diploma holders; therefore, Diploma holder should also study the electrical traction.

Now, a days there are power crises and the cost of electrical energy is increasing day by day. Economical utilisation of electrical energy and energy conservation are thus essential aspects. Therefore, economics of utilising electrical energy is essential part of curriculum of Diploma in Electrical Engineering.

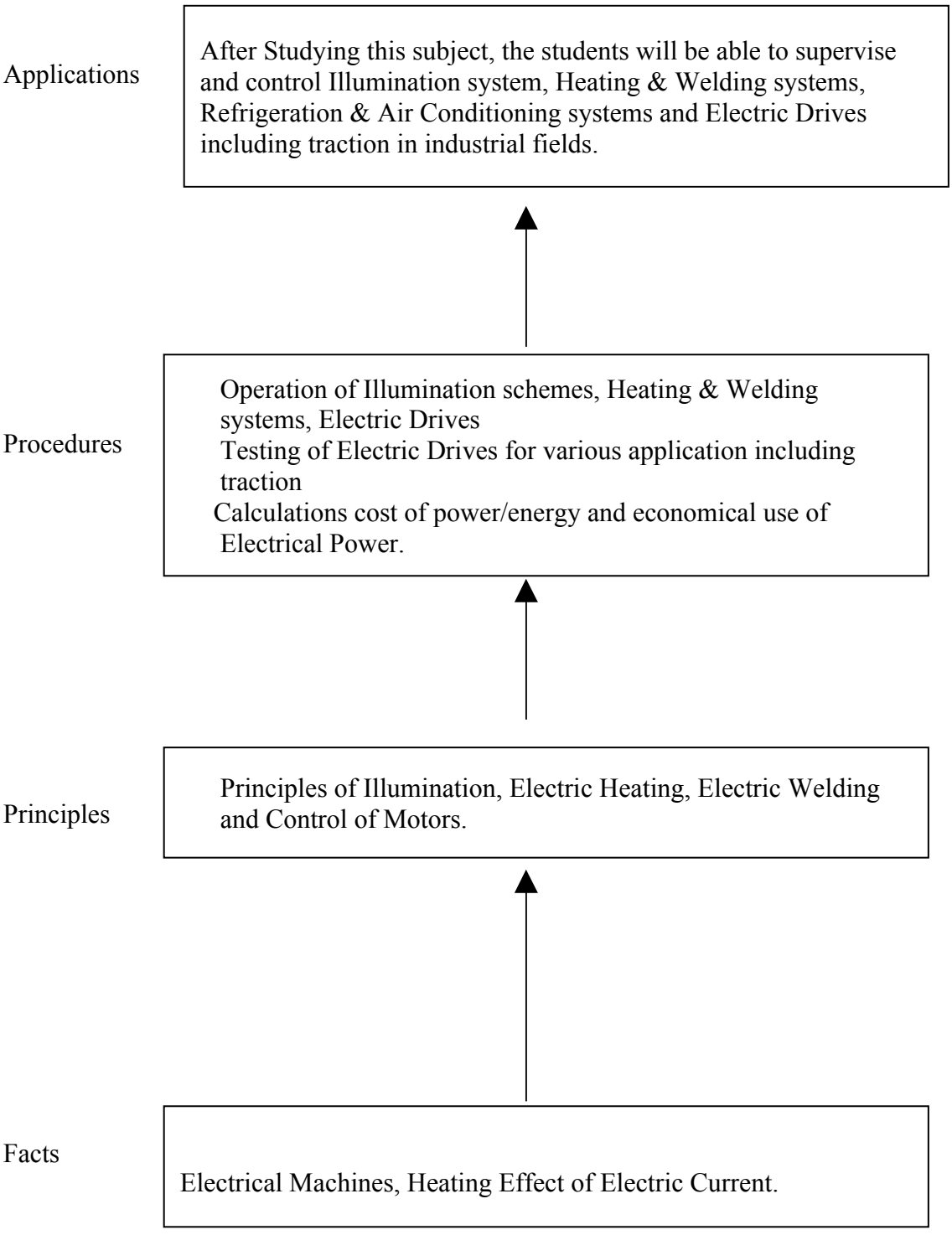
Hence, it is essential for every Diploma students to study the subject of Utilisation of Electrical Energy. This subject belongs to technology area.

Objectives:

The students will be able to:

1. Explain the importance of good illumination in factory and flood lighting.
2. Compare different methods of electric heating and electric welding.
3. Select Electric Drive for specific applications.
4. Explain the working of various components in Electric Traction system and list the advantages.
5. Analyse the electric circuits of refrigerator, water cooler and room air conditioner for troubleshooting.
6. Apply various measures for economic aspects of utilising electrical energy.

Learning Structure:



Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	**Illumination:** 1.1 Definitions of Terms Used in Illumination: Light, Luminous Flux, Luminous Intensity, Lumen, Candle Power, Illumination, Lux or Meter Candle, Mean Horizontal Candle Power (MHCP), Mean Spherical Candle Power (MSCP), Mean Hemi-spherical Candle Power (MHSCP), Reduction Factor, Lamp Efficiency, Specific Consumption, Glare, Space-Height Ratio, Utilisation Factor, Maintenance Factor, Depreciation Factor, Waste Light Factor, Absorption Factor, Reflection Factor, Solid Angle. 1.2 Laws of Illumination: Law of Inverse Squares Lambert's Cosine Law. (No Numerical) 1.3 Sources of Light: Construction, Working and Applications of Following Lamps: - Incandescent Lamps. - Halogen Lamps. - Low Pressure Mercury Vapour Lamps (Fluorescent Tube). - High Pressure Mercury Vapour Lamps. - Sodium Vapour Lamps. - Compact Fluorescent Lamps (C.F.L.) - Metal Halide Lamps - LED Lamps - Neon Signs. 1.4 – Basic Principles of Light Control. 1.5 – Types of Lighting Schemes. Direct, Semi-direct, Semi-indirect, Indirect, General Lighting. 1.6 – Design of Lighting Scheme: Objectives of Lighting Scheme. Factors to be considered While Designing the Lighting Scheme. (Simple Numericals) 1.7 - Factory Lighting: - General Requirements - Types of Installations: General Lighting, Local Lighting, Emergency Lighting. 1.8 – Lumen or Light Flux Method of Lighting Calculations. (Simple Numericals) 1.9 – Flood Lighting - Flood Lighting Purposes. - Classification of Projectors. - Location and Mounting of Projectors. (Simple Numericals)	10	12
02	**Electric Heating and Welding:** **Electric Heating:** 2.1.1– Advantages of Electric Heating.	12	(16) 08

	2.1.2 – Modes of Transfer of Heat: - Conduction, Convection and Radiation. 2.1.3 – Classification of Electric Heating Methods: 2.1.4 – Resistance Heating:(Construction & Operation) - Direct Resistance Heating: Salt Bath Furnace. - Indirect Resistance Heating: Resistance Ovens, Requirements of Heating Element Material, Causes of Failure of Heating Elements, Methods of Temperature Control. - Applications of Resistance Heating. 2.1.5 – Arc Heating: (Construction & Operation) - Direct Arc Furnace: - Indirect Arc Furnace. - Applications of Arc Heating. 2.1.6 –Induction Heating: (Construction & Operation) - Core Type Induction Furnaces: Ajax Wyatt Furnace. - Coreless Induction Furnace. - Applications of Induction Heating. (Simple Numericals on Melting Furnaces) 2.1.7 – Dielectric Heating: - Principle of Dielectric Heating. - Advantages of Dielectric Heating - Limitations of Dielectric Heating. - Applications of Dielectric Heating. (Simple Numericals on Dielectric Heating) **Electric Welding:** 2.2.1– Methods of Electric Welding: Electric Arc Welding, Resistance Welding. 2.2.2 – Resistance Welding: Principle of Resistance Welding. - Advantages of Resistance Welding. - Types of Resistance Welding - (Only List) 2.2.3 – Spot Welding Machine. 2.2.4 – Electric Arc Welding: - Formation and Characteristics of Electric Arc. - Effect of Arc Length. - Arc Blow. 2.2.5 – Polarity in DC Welding: 2.2.6 – Electrodes for Metal Arc Welding: 2.2.7 – V-I Characteristics of Arc Welding DC Machines. 2.2.8 – Arc Welding Machines: - DC Welding Machines – MG Set, AC Rectified Welding Unit. - AC Welding Machines – Welding Transformer.		08
03	**Elevators:** 3.1 Types of electric elevators 3.2 Size and shape of elevator car 3.3 Speed of elevators 3.4 Location of elevator machine 3.5 Types of elevator machines, elevator motors	06	08

	3.6 Power transmission gears braking 3.7 Safety in elevators 3.8 Bombay lift act.		
04	**Electric Drives:** 4.1 – Introduction: - What is drive? - Drives – Mechanical Drive and Electric Drive. 4.2 – Advantages and Disadvantages of Electric Drive. 4.3 – Factors Governing Selection of Electric Motors. 4.4 - Nature of Electric Supply: 3 ϕ & 1ϕ AC and DC. 4.5 - Type of Drive: Group Drive & Individual Drive. 4.6 - Nature of Load: Nature of the Mechanical Load, Matching of the Speed Torque Characteristics of the Motor with that of the Load, and Starting Conditions of the Load. 4.7 - Electrical Characteristics: (Only DC Series, Three Phase and Single Phase Induction Motors are to be dealt) - Running Characteristics: Three Typical Speed Torque Characteristics – Inverse, Constant Speed and Drooping. - Starting Characteristics: Starting Torque only. (No Starters). - Speed Control: Suitability to Economic and Efficient Speed Control Methods (Above and Below Normal Speed). - Braking Characteristics: Plugging, Rheostatic Braking and Regenerative Braking, as Applied to DC Series and Three Phase Induction Motor. 4.8 - Mechanical Features: - Type of Enclosure as per IS - Type of Bearings - Type of Transmission for Drive - Noise Level. 4.9 - Size of Motor: - Load Conditions – Continuous Loads, Short Time Loads, Intermittent Loads, Continuous Operation with Short Time Loads and Continuous Operation with Intermittent Loads. Duty Cycles. Standard Ratings for Motors as per ISS. Estimation of Rating of a Motor. (Simple Numericals on Estimating Size of Continuously Rated Motor) - Load Equalisation. (No Calculations) 4.10 - Cost: - Capital Cost - Running Cost (Losses, p.f., Maintenance).	12	16
05	**Electric Traction:** 5.1 – Requirements of an Ideal Traction System. 5.2 – Traction Systems: - Non-electric Traction Systems. - Electric Traction Systems: Straight Electric	16	20

	Traction, Its advantages and Disadvantages. Diesel Electric Traction, Its advantages and Disadvantages. 5.3 - Systems of Track Electrification: DC System, Composite System – Single Phase to Three Phase System and Single Phase AC to DC System (Kando System). Advantages and Disadvantages of Single Phase 25 KV AC System Over DC System. 5.4 – Traction Mechanics: - Units Used in Traction Mechanics. - Types of Services. - Speed Time Curve. - Simplified Speed Time Curve (No Derivation) - Average Speed and Schedule Speed. - Factors Affecting The Schedule Speed. - Tractive Effort - Specific Energy Consumption - Factors Affecting Specific Energy Consumption. - Coefficient of Adhesion. (Simple Numerical on Simplified Speed Time Curves and Specific Energy Consumption) 5.5 – Traction Motors: - Desirable Characteristics of Traction Motors, Special features of traction motor. - Suitability of DC Series Motor for Traction. - Suitability of Three Phase Induction Motor for Traction. 5.6 - Traction Motor Control: - Requirements. - Traction Control of DC Locomotives and EMUs: Series Parallel Control Combined with Rheostatic Control, Transition from Series to Parallel Combination (Open Circuit Transition, Shunt Transition and Bridge Transition), Energy Efficiency and Limitations of Series Parallel cum Rheostatic Control, Chopper Control of Motors in DC Traction Systems. - Traction Control System of AC Locomotives: Tap Changer, Step less Voltage Control through Use of Thyristors, PWM Control of Induction Motors. 5.7 – Braking: - Requirements of a Braking System. - Mechanical Braking: Vacuum Braking, Compressed Air Braking, Hand Brake for Parking. - Electric Braking: Rheostatic Braking and Regenerative Braking. (No Derivation and No Numericals). - Sequence of Braking - Dead Man's Handle		
06	**Economic Aspects of Utilising Electrical Energy:** 6.1 – Economic Aspects of Utilising Electrical Energy. 6.2 – Costing of Electrical Energy: Fixed Charges, Semi Fixed Charges and Running Charges.	08	08

	6.3 – Formulation of Electrical Tariffs. 6.4 – Various Types of Tariffs: Tariffs in force for Domestic, Commercial and Industrial Consumers. 6.5 – Power Factor Improvement: Causes of Low Power Factor, Disadvantages of Low Power Factor, Power Factor Improvement by using Static Capacitors, Location of Capacitors for Power Factor Improvement, Most Economical Power Factor. Automatic Power Factor Controller (Derivation and Simple Numericals) 6.6 – Energy Conservation: Importance and need of Energy Conservation, Measures for Energy Conservation in (i) Electric Drives (ii) Electric Traction (iii) Electric Heating (iv) Refrigeration and Air Conditioning (v) Illumination.		
	Total	**64**	**80**

Learning Resources:

Books:

Sr. No.	Author	Title	Publisher
01	H. Partab	Art & Science of Utilisation of Electrical Energy	Dhanpat Rai & Sons
02	J. B. Gupta	Utilisation of Electric Power & Electric Traction.	S. K. Kataria & Sons
03	G. C. Garg	Utilisation of Electric Power & Electric Traction.	Khanna Publishers
04	J. Upadhyay S. N. Mahendra	Electric Traction	Allied Publisher Ltd.
05	G. K. Dubey	Fundamentals of Electrical Drives	Narosa Publishing House.