

## FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
4.1	*Communication Skill- II	4	-	2	4	20	10	30	50	2 ½	20	3	70	100	
4.2	Industrial Electronics and Control	5	1	4	6	20	20	40	50	2 ½	40	3	90	130	
4.3	Electrical Design, Drawing and Estimating-I	3	-	8	5	20	20	40	50	3	40	4	90	130	
4.4	Power Plant Engineering	5	-	-	4	20	-	20	50	2 ½	-	-	50	70	
4.5	Transmission and Distribution of Electrical Power	6	1	-	5	20	-	20	50	2 ½	-	-	50	70	
4.6	*Energy Conservation	3	-	2	3	20	10	30	50	2 ½	20	3	70	100	
4.7	Universal Human Values	2	-	1	1	-	20	20	-	-	30	3	30	50	
# Student Centred Activities		-	-	1	1	-	30	30	-	-	-	-	-	30	
Total		28	2	18	29	120	110	230	300	-	150	-	450	680	

Note: Industrial Training for 4 weeks after fourth semester during summer vacation.

# Student Centred Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

## 4.1 COMMUNICATION SKILLS – II

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**4 - 2**

### RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

### LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Frame correct sentences with illustrations
- Comprehend the language correctly
- Interpret the language correctly
- Use given material in new situations.
- Correspond effectively using various types of writings like letters, memos etc.
- Communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an organised set up and social context.

### DETAILED CONTENTS

- |   |              |
|---|--------------|
| 1. Functional Grammar   | (16 periods) |
| 1.1 Prepositions  |              |
| 1.2 Framing Questions   |              |
| 1.3 Conjunctions  |              |
| 1.4 Tenses  |              |
| 2 Reading   | (16 periods) |
| 2.1 Unseen Passage for Comprehension (Vocabulary enhancement - Prefixes, Suffixes, one word substitution, Synonym and Antonym) based upon the passage should be covered under this topic. |              |
| 3 Writing Skill   | (24 periods) |
| 3.1 Correspondence  |              |

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- a) Business Letters- Floating Quotations, Placing Orders, Complaint Letters.
- b) Official Letters- Letters to Government and other Offices
- 3.2 Memos, Circular, Office Orders
- 3.3 Agenda & Minutes of Meeting
- 3.4 Report Writing

### **LIST OF PRACTICALS**

**Note:** Teaching Learning Process should be focused on the use of the language in writing reports and making presentations.

Topics such as Effective listening, effective note taking, group discussions and regular presentations by the students need to be taught in a project oriented manner where the learning happens as a byproduct.

### **Speaking and Listening Skills**

1. Debate
2. Telephonic Conversation: general etiquette for making and receiving calls
3. Offering- Responding to offers.
4. Requesting – Responding to requests
5. Congratulating
6. Exploring sympathy and condolences
7. Asking Questions- Polite Responses
8. Apologizing, forgiving
9. Complaining
10. Warning
11. Asking and giving information
12. Getting and giving permission
13. Asking for and giving opinions

### **INSTRUCTIONAL STRATEGY**

Students should be encouraged to participate in role play and other student-centered activities in class rooms and actively participate in listening exercises

### **MEANS OF ASSESSMENT**

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

### **RECOMMENDED BOOKS**

1. Communicating Effectively in English, Book-I by RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

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**Websites for Reference:**

1. [http://www.mindtools.com/](http://www.mindtools.com/page%208.html) page 8.html – 99k
2. <http://www.letstalk.com.in>
3. <http://www.englishlearning.com>
4. <http://learnenglish.britishcouncil.org/en/>
5. <http://swayam.gov.in>

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	16	28
2	16	28
3	24	44
<b>Total</b>	<b>56</b>	<b>100</b>

## 4.2 INDUSTRIAL ELECTRONICS AND CONTROL

L T P  
5 14

### RATIONALE

Industrial electronics plays a very vital role in the field of Control Engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compare to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical Engineering diploma holder, many times, has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of this subject, it has been incorporated in the curriculum.

### LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Use Power diode with load R and R-L.
- Use SCR, TRIAC and Diac as per requirement of circuit
- Control fan speed using Triac and Quadriac
- Control speed of D.C. shunt motor or universal motor
- Demonstrate the output wave shape on CRO
- Repair UPS and Inverter
- Maintain storage batteries
- Maintain panels used in the modern control process

### DETAILED CONTENTS

- |      |  |              |
|------|--|--------------|
| 1.   | Introduction to SCR  | (18 Periods) |
| 1.1  | Power diode characteristics, application of general purpose diode, fast recovery diode and Schottkey diode, use in R, RL series circuit.               |              |
| 1.2  | Construction and working principles of an SCR, two transistor analogy and characteristics of SCR   |              |
| 1.3  | SCR specifications and rating  |              |
| 1.4  | Construction, working principles and V-I characteristics of DIAC, TRIAC and Quadriac   |              |
| 1.5  | Basic idea about the selection of heat sinks for SCR and TRIACS  |              |
| 1.6  | Methods of triggering a Thyristor. Study of triggering circuits  |              |
| 1.7  | UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator   |              |
| 1.8  | Commutation of Thyristors  |              |
| 1.9  | Series and parallel operation of Thyristors  |              |
| 1.10 | Applications of SCR, TRIACS and Quadriac such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger etc. |              |
| 1.11 | dv/dt and di/dt protection of SCR.   |              |

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2.      Controlled Rectifiers (12 Periods)
  - 2.1    Single phase half wave controlled rectifier with resistive load and inductive load, concept of freewheeling diode.
  - 2.2    Single phase half controlled full wave rectifier
  - 2.3    Single phase fully controlled full wave rectifier
  - 2.4    Single phase full wave centre tapped rectifier
  - 2.5    Three phase full wave half controlled bridge rectifier
  - 2.6    Three phase full wave fully controlled bridge rectifier
  
3.      Inverters, Choppers, Dual Converters and Cyclo Convertors (24 Periods)
  - 3.1    Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications
  - 3.2    Choppers-introduction, types of choppers and their working principles and applications
  - 3.3    Dual converters-introduction, working principles and applications
  - 3.4    Cyclo-converters- introduction, types, working principles and applications
  
4.      Thyristor Control of Electric Drives (18 Periods)
  - 4.1    DC drives control (Basic Concept)
  - 4.2    Half wave drives
  - 4.3    Full wave drives
  - 4.4    Chopper drives
  - 4.5    AC drives control
  - 4.6    Phase control
  - 4.7    Variable frequency a.c. drives
  - 4.8    Constant V/F application
  - 4.9    Voltage controlled inverter drives
  - 4.10   Constant current inverter drives
  - 4.11   Cyclo convertors controlled AC drives
  - 4.12   Slip control AC drives
  
- 5      Uninterrupted power supplies (12 Periods)
  - 5.1    UPS online, off line
  - 5.2    Storage devices (batteries)
  - 5.3    SMPS, CVT

#### LIST OF PRACTICALS

1.    To draw V-I characteristics of an SCR
2.    To draw V-I characteristics of a TRIAC
3.    To draw V-I characteristics of a DIAC

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4. To draw uni-junction transistor characteristics
5. Observe the output wave of an UJT relaxation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC Quadriac (fabrication of this circuit)
8. Speed-control of a DC shunt motor or universal motor
9. To observe the output wave shape on CRO of
  - (a) Single phase half controlled full wave rectifier
  - (b) Single phase controlled rectifier

#### INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

#### MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests.
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

#### BOOKS RECOMMENDED

1. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions.
2. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi
3. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
4. Power Electronics by PC Sen
5. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi
6. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
7. Power Electronics by SK Sahdev, Uneek Publication, Jalandhar
8. Industrial Power Electronics by JC Karhava, King India Publication,
9. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi
10. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

#### Websites for Reference:

<http://swayam.gov.in>

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allocation (%)</b>
1.	18	20
2.	12	15
3.	24	25
4.	18	20
5.	12	20
<b>Total</b>	<b>84</b>	<b>100</b>

### 4.3 ELECTRICAL DESIGN, DRAWING AND ESTIMATING - I

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#### RATIONALE

A diploma holder in Electrical Engineering is supposed to have ability to read, understand and interpret engineering drawings and communicate through sketches and drawings. He is also expected to prepare working drawings of panels, transmission and distribution. The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

#### LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Recognize various electrical devices and their symbols
- Recognize various electrical devices placed on the panels/distribution boards and to design the panels
- Recognize the internal details of various electrical machines and devices
- Read schematic and wiring diagrams of electrical devices
- Read and interpret electrical installation plan
- Communicate about circuits and devices through sketches and drawings
- Determine various types of wiring systems and their use
- Practice and execute any type of wiring
- Estimate and determine the cost of wiring installation
- Estimate the material required for HT and LT lines
- Prepare a tender document for a particular job
- Estimate the material required for pole-mounted sub-stations

#### DETAILED CONTENTS ( To make 16 Sheets)

1. Symbols and Signs Conventions (2 Sheets)  
  
Various Electrical Symbols used in Domestic and Industrial Installation and Power System (Generation, Transmission and Distribution including Sub-stations) as per BIS Code.
2. Wiring Diagram  
  
2.1. Wiring diagram of light, fan, bell and alarm circuits. (6 Sheets)  
2.2. Staircase and godown wiring  
2.3. Traffic light signal control circuit at crossroads
3. Panels/Distribution Boards (6 Sheets)

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Design and Drawing of panels/Distribution board using MCB, ELCB main switches and change over switches for domestic installation, industrial and commercial installation.

4. Orthographic projections of Simple Electrical Parts (8 Sheets)
- Bus bar post/ Kit Kat
  - Pin type and shackle type insulator (Pin Type 11kV/66kV)
  - Bobbins of a small transformer / choke
  - Stay insulators/Suspension type insulators
  - Rotor of a squirrel cage induction motor
  - Motor body (induction motor) as per IS Specifications (using outside dimensions)
  - Slip rings of 3-phase induction Motor.
  - Stator of 3 phase Induction motor (Sectional View)
5. Prepare atleast 2 wiring diagram and block diagrams for circuits/systems using any Engineering Graphic package (preferably CAD) (4 Sheets)
6. Introduction to Estimating & Costing(04 periods)
- Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, preparation of tender document (with 2-3 exercises), net rice list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills.
7. Types of Wiring (04 periods)
- Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables ( to be prepared/arranged)
8. Estimating and Costing (18 periods)
- 8.1 Domestic installations; standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)
- 8.2 Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with single-phase, 3-phase motor load and the light load (3-phase supply system)

8.3 Service line connections estimate for domestic and industrial loads (over-head and underground connections) from pole to energy meter.

**9. Estimating Materials Required (12**

Periods)

9.1 Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

9.2 Substation: Types of substations, substation schemes and components, estimate of 11/0.4 kV pole mounted substation up to 200 kVA rating, earthing of substations, single Diagram of 66 kV/11 kV, 132KV/11KV, 220KV/33KV Substation

9.3 Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

**10. Preparation of Tender Documents (04**

Periods)

Tender – constituents, finalization, specimen tender.

Procedure to take financial loans from banks for taking contracts.

## **INSTRUCTIONAL STRATEGY**

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

## **MEANS OF ASSESSMENT**

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Sketching
- Design and Drawing
- Workshop Job
- Model prototype making

## **LIST OF PRACTICALS**

1. Framing of Tender and reply to tender to get job/project
2. Identification of wiring for different applications
3. Prepare an estimate for a Two room residential building as per given plan
4. Prepare an estimate for service connection for residential building having connected load

## **RECOMMENDED BOOKS**

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1. Electrical Engineering Design and Drawings by Surjeet Singh, Dhanpat Rai and Co, New Delhi
2. Electrical Engineering Design and Drawings by SK Bhattacharya, SK Kataria and Sons, New Delhi
3. Electrical Engineering Design and Drawings by Ubhi& Marwaha, IPH, New Delhi
4. Electrical Design and Drawing by SK Sahdev, Uneek Publications, Jalandhar
5. Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi
6. Electrical Installation, Estimating and Costing by JB Gupta, SK Kataria and Sons, New Delhi
7. Estimating and Costing by SK Bhattacharya, Tata McGraw Hill, New Delhi
8. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., New Delhi
9. Estimating and Costing by Praveen Kumar; North Publication, Jalandhar
10. Estimating and Costing by SL Uppal, Khanna Publishers, New Delhi
11. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, New Delhi
12. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

**Websites for Reference:**

<http://swayam.gov.in>

#### 4.4 POWER PLANT ENGINEERING

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##### RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of generation, transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in transmission and distribution of electrical power.

##### LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Distinguish and select suitable resource of energy required for a particular area and environment
- Calculate effective cost generation
- Explain the working of various plants for power generation

##### DETAILED CONTENTS

1. Power Generation (06 Periods)
  - 1.1 Main resources of energy, conventional and non-conventional
  - 1.2 Different types of power stations-thermal, hydro, gas, diesel and nuclear power stations, comparison of generating stations.
  
2. Thermal Station (10 Periods)

Main parts and working of stations-thermodynamic cycles, fuel handling, combustion and combustion equipment, problem of ash disposal, circulating water schemes and supply of make up water, choice of pressure of steam generation and steam temperature, selection of appropriate vacuum; economizer, air pre-heater feed water heaters and dust collection. Characteristics of turbo alternators, steam power plant heat balance and efficiency.

3. Hydro-Electric Plant (8 Periods)
- Hydrology, stream flow, hydrograph, flow duration curves. Types of hydroelectric plants and their fields of use, capacity calculations for hydropower, Dams, head water control, penstocks, water turbines, specific speeds, turbine governors. Hydroplant auxiliaries, plant layout, automatic and remote control of hydroplants, pumped storage projects, cost of hydro-electric projects. Cooling of alternators.
4. Nuclear Power Plant (9 Periods)
- Elements of nuclear power plant, nuclear reactor, fuels, moderators, coolants, control. Classification of nuclear power stations. Cost of nuclear power.
5. Diesel Power Plant (6 Periods)
- Diesel engine performance and operation, Plant layout, Log sheets, applications, selection of engine size.
6. Gas Turbine Plant (9 Periods)
- Plant layout, methods of improving output and performance. Fuels and fuel systems. Methods of testing. Open and closed cycle plants. Operating characteristics. Applications. Free piston engine plants, limitation and applications. Non conventional energy sources.
7. Combined Working of Power Plant (10 Periods)
- Advantages of combined working of different types of power plants. Need for co-ordination of various types of power plants in power systems, base load stations and peak load stations.
8. Economics of Generation (12 Periods)
- 8.1 Fixed and running cost, load estimation, load curves, demand factor, load factor, diversity factor, power factor and their effect on cost of generation, simple problems.
- 8.2 Base load and peak load power stations, concept of regional and national grid, reason of grid failure and its remedies.
9. Non Conventional Source of Energy (5 Periods)
- Introduction, Concept of Solar Energy, Bio Mass Energy, Wind Energy, Tidal Energy, Geothermal Energy, Microhydel Energy, Biodiesel Energy.

## INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

## MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

## RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3<sup>rd</sup> edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi
9. Electrical Power by Soni Gupta and Bhatnagar; Dhanpat Rai & Sons, New Delhi
10. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

**Websites for Reference:** <http://swayam.gov.in>

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	06	08
2	10	14
3	08	12
4	09	12

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5	06	08
6	09	14
7	10	14
8	12	18
Total	70	100

## 4.5 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

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### RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in transmission and distribution of electrical power.

### LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Select suitable supporting structure, insulators, conductors and other accessories for transmission lines and distribution lines
- Prepare layout plan for HT and LT lines/distribution system
- Prepare estimate for HT and LT (OH and underground cables) lines
- Operate and maintain indoor and outdoor substations
- Use various methods for improvement of power factor
- Assess the revenue and energy loss in power distribution

### DETAILED CONTENTS

1. Transmission Systems (28 Periods)
  - 1.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission both AC and DC
  - 1.2 Comparison of different system: AC versus DC for power transmission, conductor material and sizes from standard tables
  - 1.3 Constructional features of transmission lines: Types of supports, types of insulators, Types of conductors, Selection of insulators, conductors, earth wire and their accessories, Transposition of conductors and string efficiency of suspension type insulators, Bundle Conductors.
  - 1.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice related problems; Indian electricity rules pertaining to clearance
  - 1.5 Electrical features of line: Calculation of resistance, inductance and capacitance without derivation in a.c. transmission line, voltage regulation, and concept of corona. Effects of corona and remedial measures
  - 1.6 Transmission Losses
  - 1.7 Economic Principle of Transmission  
Kelvin's law, limitation of Kelvin's law modification in Kelvin's law

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2. Distribution System (21 Periods)
- 2.1 Lay out of HT and LT distribution system, constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system, determination of size of conductor
  - 2.2 Preparation of estimates of HT and LT lines (OH and Cables).
  - 2.3 Constructional features of LT (400 V), HT (11 kV) underground cables, advantages and disadvantages of underground system with respect to overhead system.
  - 2.4 Losses in distribution system
  - 2.5 Faults in underground cables-determine fault location by Blavier Test, Murray Loop Test, Varley Loop Test
3. Substations: (21 Periods)
- 3.1 Brief idea about substations; out door grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation
  - 3.2 Layout of 33/11 KV & 220/33KV distribution substation and various auxiliaries and equipment associated with it.
4. Power Factor: (14 Periods)
- 4.1 Concept of power factor
  - 4.2 Reasons and disadvantages of low power factor
  - 4.3 Methods for improvement of power factor using capacitor banks, Static VAR Compensator (SVC)
5. Revenue and Energy loss (14 Periods)
- Technical losses and Commercial losses, Input energy calculation, Sales calculation, Billing efficiency, Collection efficiency, Total energy billed (KWH), Percent aggregated technical and commercial losses.

**Note:** Students should visit power generation plants, sub-stations etc.

### INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

### MEANS OF ASSESSMENT

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- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

### RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3<sup>rd</sup> edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi
9. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

### Websites for Reference:

<http://swayam.gov.in>

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	28	30%
2	21	20%
3	21	20%
4	14	15%
5	14	15%

<b>Total</b>	<b>98</b>	<b>100</b>
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## 4.6 ENERGY CONSERVATION

**L T P**  
**3 - 2**

### RATIONALE

The requirement of energy has increased manifolds in last two decades due to rapid urbanization and growth in industrial/service sector. It has become challenging task to meet ever increasing energy demands with limited conventional fuels and natural resources. Due to fast depletion of fossil fuels and a tremendous gap between supply and demand of energy, it is essential to adopt energy conservation techniques in almost every field like industries, commercial and residential sectors etc. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This course covers the concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in general industry and details out energy audit methodology and energy audit instruments.

### LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- define principles and objectives of energy management and energy audit.
- understand Energy Conservation Act 2001 and its features.
- understand various forms & elements of energy.
- identify electrical and thermal utilities. Understand their basic principle of operation and assess performance of various equipments.
- identify areas of energy conservation and adopt conservation methods in various systems.
- evaluate the techno economic feasibility of the energy conservation technique adopted.

### DETAILED CONTENTS

1. Basics of Energy
  - 1.1 Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy, Capacity factor of solar and wind power generators.
  - 1.2 Global fuel reserve
  - 1.3 Energy scenario in India and state of U.P. Sector-wise energy consumption (domestic, industrial, agricultural and other sectors)
  - 1.4 Impact of energy usage on climate
  
2. Energy Conservation and EC Act 2001
  - 2.1 Introduction to energy management, energy conservation, energy efficiency and its need

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- 2.2 Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance. Prominent organizations at centre and state level responsible for its implementation.
- 2.3 Standards and Labeling: Concept of star rating and its importance, Types of product available for star rating
3. Electrical Supply System and Motors
  - 3.1 Types of electrical supply system
  - 3.2 Single line diagram
  - 3.3 Losses in electrical power distribution system
  - 3.4 Understanding Electricity Bill: Transformers Tariff structure, Components of power (kW, kVA and kVAR) and power factor, improvement of power factor, Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)
  - 3.5 Transformers: Introduction, Losses in transformer, transformer Loading, Tips for energy savings in transformers
  - 3.6 Electric Motors  
Types of motors, Losses in induction motors Features and characteristics of energy efficient motors, Estimation of motor loading, Variation in efficiency and power factor with loading, Tips for energy savings in motors
4. Energy Efficiency in Electrical Utilities
  - 4.1 Pumps: Introduction to pump and its applications, Efficient pumping system operation, Energy efficiency in agriculture pumps, Tips for energy saving in pumps
  - 4.2 Compressed Air System: Types of air compressor and its applications, Leakage test, Energy saving opportunities in compressors.
  - 4.3 Energy Conservation in HVAC and Refrigeration System: Introduction, Concept of Energy Efficiency Ratio (EER), Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.
5. Lighting and DG Systems
  - 5.1 Lighting Systems: Basic definitions- Lux, lumen and efficacy, Types of different lamps and their features, Energy efficient practices in lighting
  - 5.2 DG Systems: Introduction, Energy efficiency opportunities in DG systems, Loading estimation
6. Energy Efficiency in Thermal Utilities
  - 6.1 Thermal Basics: Thermal energy, Energy content in fuels, Energy Units and its conversions in terms of Metric Tonne of Oil Equivalent (MTOE)
  - 6.2 Energy Conservation in boilers and furnaces : Introduction and types of boilers, Energy performance assessment of boilers, Concept of stoichiometric air and excess air for combustion, Energy conservation in boilers and furnaces, Do's and Don'ts for efficient use of boilers and furnaces
  - 6.3 Cooling Towers: Basic concept of cooling towers, Tips for energy savings in cooling towers
  - 6.4 Efficient Steam Utilization
7. Energy Conservation Building Code (ECBC)
  - 7.1 ECBC and its salient features

- 7.2 Tips for energy savings in buildings: New Buildings, Existing Buildings
8. Waste Heat Recovery and Co-Generation
- 8.1 Concept, classification and benefits of waste heat recovery
- 8.2 Concept and types of co-generation system
9. General Energy Saving Tips  
Energy saving tips in:
- 9.1 Lighting
- 9.2 Room Air Conditioner
- 9.3 Refrigerator
- 9.4 Water Heater
- 9.5 Computer
- 9.6 Fan, Heater, Blower and Washing Machine
- 9.7 Colour Television
- 9.8 Water Pump
- 9.9 Cooking
- 9.10 Transport
10. Energy Audit
- 10.1 Types and methodology
- 10.2 Energy audit instruments
- 10.3 Energy auditing reporting format

### **PRACTICAL EXERCISES**

1. To conduct load survey and power consumption calculations of small building.
2. To check efficacy of different lamps by measuring power consumption and lumens using lux meter.
3. To measure energy efficiency ratio (EER) of an air conditioner.
4. To measure effect of valve throttling and variable frequency drive (VFD ) on energy consumption by centrifugal pump.
5. To measure and calculate energy saving by arresting air leakages in compressor.
6. To measure the effect of blower speed on energy consumed by it.

### **STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY**

- Presentations of Case Studies
- Debate competitions
- Poster competitions
- Industrial visits
- Visual Aids

### **INSTRUCTIONAL STRATEGY**

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Teachers are expected to lay considerable stress on understanding the basic concepts in energy conservation, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject must be supplemented by demonstrations and practical work in the laboratory. Visits to industries must be carried out. Expert from industry must be invited to deliver talks on energy conservation to students and faculty.

## RECOMMENDED BOOKS

1. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
2. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
3. Guide book on Energy Efficiency in Thermal Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
4. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition

### Important Links:

- (i) Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India. [www.beeindia.gov.in](http://www.beeindia.gov.in).
- (ii) Ministry of New and Renewable Energy (MNRE), Government of India. [www.mnre.gov.in](http://www.mnre.gov.in).
- (iii) Uttar Pradesh New and Renewable Energy Agency (UPNEDA), Government of Uttar Pradesh. [www.upneda.org.in](http://www.upneda.org.in).
- (iv) **Central Pollution Control Board (CPCB)**, Ministry of Environment, Forest and Climate Change, Government of India. [www.cpcb.nic.in](http://www.cpcb.nic.in).
- (v) **Energy Efficiency Services Limited (EESL)**. [www.eeslindia.org](http://www.eeslindia.org).
- (vi) Electrical India, Magazine on power and electrical products industry. [www.electricalindia.in](http://www.electricalindia.in).

## 4.7 Universal Human Values

L-T-P  
2-0-1

### Course Objectives

This introductory course input is intended

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

### Course Methodology

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or value prescriptions.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

### The syllabus for the lectures is given below:

- After every two lectures of one hour each, there is one hour practice session.
- The assessment for this subject is as follows:
- Sessions Marks (Internal): 20
- Practical Marks (External): 30
- Total Marks: 50

### UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration—what is it? - its content and process; 'Natural Acceptance' and

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Experiential Validation- as the mechanism for self-exploration

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

### **UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!**

1. Understanding human being as a co-existence of the sentient 'I' and the material the Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*  
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

### **UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

1. *Understanding Harmony in the family – the basic unit of human interaction*
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
  - a. Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
3. Understanding the meaning of *Vishwas*; Difference between intention and competence
4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitvaas* comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha* )- from family to world family!  
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

### **UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence  
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

### **UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

1. Natural acceptance of human values

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2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
  - a) Ability to utilize the professional competence for augmenting universal human order
  - b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
  - c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
  - a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
  - b) At the level of society: as mutually enriching institutions and organizations
7. To inculcate Human Values among Students: The Role of self, Parents and Teachers  
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

**Practical Session also Includes Different Yogic Exercises and Meditation Session**

**INSTRUCTIONAL STRATEGY**

The content of this course is to be taught on conceptual basis with plenty of real world examples.

**MEANS OF ASSESSMENT**

- Assignments and quiz/class tests,
- Mid-term and end-term written tests
- Practical assessment

**Reference Material**

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

b. The teacher's manual (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi.

In addition, the following reference books may be found useful for supplementary reading in connection with different parts of the course:

1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Publishers.
3. Sussan George, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *limits to Growth*, Club of Rome's Report, Universe Books.

6. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ekParichay*, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if peoplemattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.

**Relevant websites, movies and documentaries**

1. Value Education websites, <http://uhv.ac.in>, <http://www.aktu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology–the Untold Story*
6. Case study Hevade Bazar Movie
7. RC Shekhar , *Ethical Contradiction* , Trident New Delhi
8. *Gandhi A., Right Here Right Now*, Cyclewala Production

*SUGGESTED DISTRIBUTION OF MARKS*

<b>Unit</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	08	20
2	08	20
3	08	20
4	08	20
5	10	20
<b>Total</b>	<b>42</b>	<b>100</b>

## **INDUSTRIAL TRAINING**

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organised during the semester break starting after second year i.e. after 4<sup>th</sup> semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has been provided in the study and evaluation scheme of 5<sup>th</sup> Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4<sup>th</sup> semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

a) Punctuality and regularity	15%
b) Initiative in learning new things	15%
c) Presentation and VIVA	15%
d) Industrial training report	55%