

CURRICULUM  
FOR  
DIPLOMA PROGRAMME

IN

**ELECTRICAL & ELECTRONICS ENGINEERING**

(5<sup>th</sup> & 6<sup>th</sup> Semester)

FOR THE STATE OF HIMACHAL PRADESH



*(Implemented w.e.f. Session 2014-15)*

*Prepared by:-*

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Directorate of Technical Education,  
Vocational & Industrial Training, Sundernagar(H.P.)

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## PREFACE

*India, in last two decades, has made significant progress in all major spheres of activity. Since 1947, the Technical Education System has grown into fairly large sized system, offering opportunities for education and training in wide variety of trades / disciplines at different levels. Needless to say that well trained technical manpower is the backbone of any growing economy in the era of fast industrialization. It has been the endeavor of the Technical Education Department to take decisive steps to enhance the capacities of technical institutions with major emphasis on quality and excellence in technical education. Our country is the only country in the world which has 50% population below the age of 25 years whereas America has 30% and China 40%. Working Age Population (WAP) is increasing in India whereas it is decreasing in other parts in the world. Challenge before us is to train this WAP for the world of work. Updated curriculum is one of the most powerful tools to improve the quality of training.*

*Curriculum Document is a comprehensive plan or a blue print for developing various curriculum materials and implementing given educational programme to achieve desired and formally pre-stated educational objectives. Moreover it (the document) is the output of exhaustive process of curriculum planning and design, undertaken by the implementers under the expert guidance of curriculum designer.*

*While working out the detailed contents and study and evaluation scheme, the following important elements have been kept in mind:*

- i) Major employment opportunities of the diploma holders.*
- ii) Modified competency profile of the diploma holders with a view to meet the changing needs due to technological advancement and requirements of various employment sectors.*
- iii) Vertical and horizontal mobility of diploma pass outs for their professional growth.*
- iv) Pragmatic approach in implementing all the curricula of diploma programmes in engineering and technology in the state of H.P.*

*The document is an outcome of the feedback received from field organizations/ industry of different categories viz. small, medium and large scale which offer wage employment for the diploma pass outs. In every stage of planning and designing of this curriculum, suggestions and advice of experts representing industry, institutions of higher learning, research organizations etc. were sought and incorporated as per the requirement of curriculum. The document contains the study and evaluation scheme and detailed subject/course contents to enable the H.P. Polytechnics to implement revised curriculum and to achieve the desired objectives.*

*Time has specifically been allocated for undertaking extra-curricular activities. Emphasis has been laid on developing and improving communication skills in the students for which Communication Lab has been introduced during the first year itself.*

*We hope that this revision will prove useful in producing competent diploma holders in the state of Himachal Pradesh. The success of this curriculum depends upon its effective implementation and it is expected that the managers of polytechnic education system in Himachal Pradesh will make efforts to create better facilities, develop linkages with the world of work and foster conducive and requisite learning environment.*

**Er. L.R. Rana**  
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**Sundernagar, Himachal Pradesh.**

## 3<sup>rd</sup> YEAR OF THREE YEAR DIPLOMA PROGRAMME IN ELECTRICAL & ELECTRONICS ENGINEERING

### 1. SALIENT FEATURES

- 1) Name of the Programme : Three year Diploma Programme  
Electrical & Electronics Engineering
- 2) Duration of the Programme : Three years (06 Semesters)
- 3) Entry Qualification : As prescribed by H.P. Takniki  
Shiksha Board
- 4) Intake : As approved by H.P. Takniki  
Shiksha Board
- 5) Pattern of the Programme : Semester Pattern
- 6) Curriculum for : 3<sup>rd</sup> year of Three year Diploma  
Programme(Technical Stream)
- 7) **Student Centred Activities:**  
A provision of 2-4 hrs per week has been made for organizing Student Centred Activities for overall personality development of students. These activities will comprise of co-curricular & other activities such as expert lectures, games, seminars, declamation contests, educational field visits, NCC, NSS and cultural activities & hobby classes like photography, painting, singing etc.

## 2. GUIDELINES

### 2.1 GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

Distribution of 25 marks for SCA will be as follows:

- i. 5 Marks shall be given for general behaviour
- ii. 5 Marks for attendance shall be based on the following distribution:
  1. Less than 75% Nil
  2. 75-79.9% 3 Marks
  3. 80-84.9% 4 Marks
  4. Above 85% 5 Marks
- iii. 15 Marks shall be given for the Sports/NCC/Cultural and Co-curricular activities/other activities after due consideration to the following points:
  1. For participation in sports/NCC/Cultural/Co-curricular activities at National or above level, shall be rewarded with minimum of 10 marks
  2. For participation in sports/NCC/Cultural/Co-curricular activities at Inter-polytechnic level, shall be rewarded with minimum of 08 marks
  3. For participation in two or more of the listed activities, 5 extra marks should be rewarded

*Note: Head of Department shall ensure that these marks are conveyed to the H.P. Takniki Shiksha Board, Dharamsala at the end of semester along with sessional record.*

### 2.2 GUIDELINES FOR SESSIONAL ASSESSMENT

- The distribution of marks for Internal Assessment in theory subjects and drawing shall be made as per the following guidelines:
  - i. 60% of internal assessment shall be based on the performance in the tests. At least three tests shall be conducted during the semester out of which at least one should be house test. 30% weightage shall be given to house test and 30% to class test(One best out of two).
  - ii. 20% marks shall be given to home assignments, class assignments, seminars etc.
  - iii. 20% marks shall be given for attendance/punctuality in the subject concerned.
- The distribution of marks for Internal/External Assessment in practical subjects shall be made as per the following guidelines:
  - i. 60% marks shall be awarded for performance in practical.
  - ii. 20% marks shall be given for Report/Practical book and punctuality in equal proportion.
  - iii. 20% marks shall be for Viva-voce conducted during the practicals.
- The distribution of mark for internal assessment in drawing subjects shall be as per following guidelines:-
  - (i) 60% marks for sheets ii. 40% for test.

## STUDY AND EVALUATION SCHEME

### FIFTH SEMESTER (ELECTRICAL AND ELECTRONICS ENGINEERING)

Sr. No	Subjects	Study Scheme Hrs/Week		MARKS IN EVALUATION SCHEME								Total Marks
				Internal Assessment			External Assessment					
				Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
1	* Electrical Machines– II	5	2	30	20	50	100	3	50	3	150	200
2	# Power Electronics	5	2	30	20	50	100	3	50	3	150	200
3	Microprocessor and Microcontroller	5	2	30	20	50	100	3	50	3	150	200
4	* Electrical Power-II (Transmission and Distribution)	5	-	-	50	50	100	3	-	-	100	150
5	Minor Project	-	4	-	50	50	-	-	50	3	50	100
6	Elective-1	4	-	50	-	50	100	3	-	-	100	150
7	Industrial training	-	-	-	50	50	-	-	50	-	50	100
8	Students Centered Activities		6	-	25	25	-	-	-	-	-	25
<b>TOTAL</b>		<b>24</b>	<b>16</b>	<b>140</b>	<b>235</b>	<b>375</b>	<b>500</b>		<b>250</b>		<b>750</b>	<b>1125</b>

- Elective-I
- i) \*Non-Conventional Energy Sources
  - ii) Fundamentals of Communication Engineering
  - iii) @ Medical Electronics

\*Common with 5<sup>th</sup> Semester Electrical Engg.

# Common with 4<sup>th</sup> Semester Electronics & Communication Engg.

@ Common with 5<sup>th</sup> semester Electronics & Communication Engg.

**SIXTH SEMESTER (ELECTRICAL AND ELECTRONICS ENGINEERING)**

Sr. No	Subjects	Study Scheme Hrs/Week		MARKS IN EVALUATION SCHEME								Total Marks
				Internal Assessment			External Assessment					
				Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
1	\$Basic of Management	3	-	50	-	50	100	3	-	-	100	150
2	*Energy Management	5	2	30	20	50	100	3	50	3	150	200
3	PLC and Its applications	5	2	30	20	50	100	3	50	3	150	200
4	Elective -II	5	-	50	-	50	100	3	-	-	100	150
5	Major Project	-	8		100	100			100	3	100	200
6	\$Practice in Communication Skills	-	2	-	50	50	-	-	50	3	50	100
	Students Centered Activities	-	6	-	25	25	-	-	-	-	-	25
<b>TOTAL</b>		<b>18</b>	<b>20</b>	<b>160</b>	<b>215</b>	<b>375</b>	<b>400</b>		<b>250</b>		<b>650</b>	<b>1025</b>

Elective-II    i) Utilization of Electrical Engineering  
                   ii) # P C Organization  
                   iii) # Optical Fiber Communication

*\$ Common with other diploma programmes*

*\*Common with 6<sup>th</sup> Semester Electrical Engg.*

*# Common with 5<sup>th</sup> Semester Electronics & Communication Engg.*

# 5.1 ELECTRICAL MACHINES-II

(Common with 5<sup>th</sup> Sem. Electrical Engg.)

L T P  
5 - 2

## RATIONALE

*Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical & electronics engineering diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.*

## DETAILED CONTENTS

### 1. Synchronous Machines

(24hrs)

- 1.1 Constructional details of Stator and Rotor
- 1.2 Advantages of rotating field system
- 1.3 Different types of excitation system
- 1.4 Generation of three phase e.m.f. and e.m.f equation
- 1.5 Production of rotating magnetic field in a three phase winding
- 1.6 Concentrated and distributed windings, Concept of distribution factor and coil span factor and pitch factor
- 1.7 Effect of armature reaction on terminal voltage when synchronous generator Independently supplying load at unity lagging and leading power factor
- 1.8 Concept of synchronous impedance. Voltage regulation and its representation with phasor diagrams for various power factor loads.
- 1.9 Voltage Regulation by synchronous impedance method.
- 1.10 Need and necessary conditions for parallel operation of alternators. Synchronization of alternators with bus bars-Synchroscope method and two lamp method.
- 1.11 Operation of synchronous machine as a motor –its starting methods.
- 1.12 Effect of change in excitation of a synchronous motor, concept of Synchronous condenser
- 1.13 Concept and Cause of hunting and its prevention
- 1.14 Rating and cooling of synchronous machines
- 1.15 Applications of synchronous machines (as an alternator, as asynchronous Condenser)

### 2. Induction Motors

(20hrs)

- 2.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
- 2.2 Principle of operation of an induction motor. Slip and its significance.
- 2.3 Effect of slip on various parameters of rotor circuit.
- 2.4 Power flow diagram and relationship between copper losses and the motor slip
- 2.5 Factors determining the torque, starting and running torque, maximum torque, Torque-slip curve, stable and unstable zones
- 2.6 Effect of rotor resistance upon the torque slip relationship
- 2.7 Double cage rotor motor and its applications
- 2.8 Starting of 3-phase induction motors, DOL, star-delta, autotransformer
- 2.9 Testing of 3-phase motor on no load and blocked rotor test and to find efficiency
- 2.10 Harmonics and its effects, cogging and crawling in Induction motors.



### 3. Fractional Kilo Watt (FKW) Motors

(14hrs)

- 3.1 Single phase induction motors;
- 3.2 Nature of field produced (double field revolving theory and cross field theory) in single phase induction motor
- 3.3 Split phase induction motor
  - 3.3.1 Capacitors start and run motor
  - 3.3.2 Shaded pole motor
  - 3.3.3 Reluctance start motor
- 3.4 Alternating current series motor and universal motors
- 3.5 Single phase synchronous motor
  - 3.5.1 Reluctance motor
  - 3.5.2 Hysteresis motor

### 4. Special Purpose Machines

(12 hrs)

Construction and working principle of linear induction motor, stepper motor, Servomotor, Submersible Motor, Introduction to Energy efficient Motors, Brush less DC motors.

### LIST OF PRACTICALS

1. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
2. Determination of relationship between the field current and load current of an alternator keeping, voltage and speed constant
3. Determination of relationship between voltage and load current of an alternator, keeping excitation and speed constant
4. Determination of regulation and efficiency of an alternator from the open circuit and short circuit test.
5. Synchronization of polyphase alternators and load sharing by two Lamps method and synchroscope method.
6. Determination of effect of variation of excitation on performance of a synchronous motor.
7. Determination of efficiency by no load test and blocked rotor test on an induction motor.
8. Determination of effect of rotor resistance on torque speed curve of a wound rotor induction motor.
9. To study the effect of a capacitor on the starting and running of a single phase induction motor by changing the value of capacitor and also reverse the direction of rotation of a single phase induction motor

### INSTRUCTIONAL STRATEGY

*Teacher should lay-emphasis on development of understanding amongst students about basic principles of operation and control of electrical machines. This may be achieved by conducting quiz tests and by giving home assignments. The teachers should also conduct laboratories classes themselves encouraging each should to perform with his/her own hands and draw conclusions.*

### RECOMMENDED BOOKS

- 1) *Electrical Machines* by SK Bhattacharya, Tata McGraw Hill, New Delhi
- 2) *Electrical Machines* by SK Sahdev, Unique International Publications, Jalandhar
- 3) *Electrical Machines* by Nagrath and Kothari, Tata McGraw Hill, New Delhi
- 4) *Electrical Engineering* by JB Gupta, SK Kataria and sons, New Delhi
- 5) *Electrical Machines* by Samarjit Ghosh, Pearson Education (Singapore) Pte, Ltd. 482, FIE Patparganj, Delhi 110092
- 6) *Electrical Machines* by DR Arora, Ishan Publications, Ambala City.

### SUGGESTED DISTRIBUTION OF MARKS

Sr. No	Topic	Time Allotted (Hrs)	Marks Allotted%
1	Synchronous Machines	24	40
2	Induction Motors	20	30
3	Fractional Kilo Watt Motors	14	20
4	Special Purpose Machines	12	10
Total		70	100

## 5.2 POWER ELECTRONICS

(Common with 4<sup>th</sup> Semester Electronics & Comm. Engg.)

L T P  
5 - 2

### RATIONALE

Diploma holders in Electrical & Electronics Engg are required to handle a wide variety of power electronic equipment used in process control Industry. This subject will provide the student basic understanding of the principles of their working. The practical training will further re-enforce the knowledge and skill of the students.

### DETAILED CONTENTS

1. **Introduction to Thyristors and other Power Electronics Devices (20 hrs)**
  - 1.1 Construction, Working principles of SCR, two transistor analogy of SCR, V-I characteristics of SCR.
  - 1.2 SCR specifications & ratings.
  - 1.3 Different methods of SCR triggering.
  - 1.4 Commutation of SCR's and different commutation methods for SCR.
  - 1.5 Series & parallel operation of SCR.
  - 1.6 Construction & working principle of DIAC, TRIAC & their V-I characteristics.
  - 1.7 Construction and working principle of UJT, V-I characteristics of UJT. UJT as relaxation oscillator.
  - 1.8 Brief introduction to Gate Turn Off(GTO)Thyristor, Programmable uni-junction transistor (PUT).
  - 1.9 Basic idea about the selection of Heat sink for thyristors.
  - 1.10 Applications such as light intensity control, speed control of universal motors, fan regulator, battery charger.
  
2. **Controlled Rectifiers (10 hrs)**
  - 2.1 Single phase half wave fully controlled rectifier with R & R-L load.
  - 2.2 Single phase half controlled full wave rectifier with R & R-L Load.
  - 2.3 Single phase fully controlled full wave bridge rectifier with R & R-L Load.
  - 2.4 Single phase fully controlled full wave centre tap rectifier with R & R-L Load.
  
3. **Inverters, Choppers, Dual Converters and Cyclo converters. (18 hrs)**
  - 3.1 Principle of operation of basic inverter circuits, concepts of duty cycle, series & parallel inverters & their applications.
  - 3.2 Choppers: Introduction, types of choppers (Class A, Class B, Class C and Class D). Step up and step down choppers.
  - 3.3 Dual Converters and cyclo converters: Introduction, types & basic working principle of dual converter and cyclo converters & their applications.
  
4. **Thyristorised Control of Electric drives (16 hrs)**
  - 4.1 DC drive control
    - 4.1.1 Half wave drives.
    - 4.1.2 Full Wave Drives
    - 4.1.3 Chopper drives (Speed control of DC motor using choppers).
  - 4.2 AC drive control
    - 4.2.1 Phase control

- 4.2.2 Constant V/F operation
- 4.2.3 Cycloconverter/Inverter drives

5. **Uninterrupted Power supplies** (06hrs)
- 5.1 UPS, on-line and off- line , their specifications
  - 5.2 Concept of high voltage DC transmission
  - 5.3 Idea of SMPS

#### LIST OF PRACTICALS

- 1) To plot VI characteristic of an SCR.
- 2) To plot VI characteristics of DIAC.
- 3) To plot VI characteristics of TRIAC.
- 4) To plot VI characteristics of UJT and its use as relaxation oscillator.
- 5) Observation of wave shapes of voltages at relevant points of single-phase half wave controlled rectifier and effect of change of firing angle.
- 6) Observation of wave shapes of voltage at relevant points of single phase full wave controlled rectifier and effect of change of firing angle.
- 7) Observation of wave shapes and measurement of voltage at relevant points in TRIAC based AC phase control circuit for varying lamp intensity.
- 8) Speed control of motor using SCR

#### INSTRUCTIONAL STRATEGY

*Power Electronics being very important for industrial controls, requires a thorough know how about industrial devices. Teacher should take to the class various SCRs and other semiconductor devices to demonstrate these to the students. The teacher may encourage students to perform practical simultaneously for better understanding of the subject and verification of theoretical concepts. So industrial visit during the course is a must.*

#### Recommended Books:

- 1) *Power Electronics by P.C. Sen Tata McGraw Hill. New Delhi*
- 2) *Power Electronics by P.S. Bhimbhra, Khanna Publishers, New Delhi*
- 3) *Power Electronics by M.S. Berde, Khanna Publishers, New Delhi.*
- 4) *Power Electronics by MH Rashid*
- 5) *Industrial Electronics and Control by SK Bhattacharya and S. Chatterji, New Age Publications. New Delhi*
- 6) *Power Electronics by S Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi*
- 7) *Power Electronics by Sugandhi and Sugandhi*
- 8) *Power Electronics – Principles and Applications by J Michael Jacob, Vikas Publishing House, New Delhi*

#### SUGGESTIVE DISTRIBUTION OF MARKS

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted%
1	Introduction to thyristors and other power electronics devices	20	30
2	Controlled Rectifiers	10	15
3	Inverters, Choppers, Dual Converters and Cyclo converters.	18	25
4	Thyristorised Control of Electric drives	16	20
5	Uninterrupted Power supplies	06	10
<b>Total</b>		<b>70</b>	<b>100</b>

## 5.3 MICROPROCESSOR AND MICROCONTROLLER

L T P  
5 - 2

### RATIONALE

*The study of microprocessors in terms of architecture and software leads to the understanding of working of CPU in a microcomputer. Microprocessors find application in process control industry. They also form a part of the electronic switching system between source and destination in long distance telecommunications. Thus the microprocessor is an area of specialization. Students of electrical & electronics and related engineering branches often use microprocessors to introduce programmable control in their projects, in industrial training. Microcontrollers have also assumed great significance in the field of electronics and common goods industry, and thus considered to be an important field of engineering. This subject aims to expose the students to both of these and give them adequate knowledge of these topics*

### DETAILED CONTENTS

- 1. Evolution of Microprocessor (04hrs)**
  - 1.1 Typical organization of a microcomputer system and functions of its various blocks.
  - 1.2 Microprocessor, its evolution, function and impact on modern society.
- 2. Architecture of a Microprocessor (With reference to 8085 microprocessor) (10Hrs)**
  - 2.1 Concept of Bus, bus organization of 8085
  - 2.2 Functional block diagram of 8085 and function of each block
  - 2.3 Pin details of 8085 and related signals
  - 2.4 Demultiplexing of address/data bus.
  - 2.5 Generation of memory read/write and control signals.
- 3. Memories and I/O interfacing. (10 hrs)**
  - 3.1 Memory organization; RAM, ROMs, Concept of memory mapping, Partitioning of total memory space. Address decoding, Concept of I/O mapped I/O and memory mapped I/O. Interfacing of memory mapped I/O devices.
  - 3.2 Concept of stack and its function
- 4. Programming (with respect to 8085 microprocessor) (20 hrs)**
  - 4.1 Brief idea of machine and assembly languages, Machine and Mnemonic codes.
  - 4.2 Instruction format and addressing modes.
  - 4.3 Explanation of the instructions of the following groups of instruction set:-  
Data transfer group, Arithmetic Group, Logic Group, Stack, I/O and Machine Control Group.
  - 4.4 Programming exercises in assembly language. (Examples can be taken from the list of experiments).
- 5. Instruction Timing and Cycles (08 hrs)**
  - 5.1 Instruction cycle, machine cycle and T-states
  - 5.2 Fetch and execute cycle.

## 6. Interrupts

(08 hrs)

- 6.1 Concept of interrupt,
- 6.2 Mask able and non-mask able interrupts,
- 6.3 Edge triggered and level triggered interrupts,
- 6.4 Software interrupts
- 6.5 Restart interrupts and their use.
- 6.6 Various hardware interrupts of 8085
- 6.7 Servicing interrupts.

## 7. Microcontroller series (MCS) – 51 Overview

(10 hrs)

### Architecture of 8051/8031 Microcontroller

- 7.1 Pin details
- 7.2 I/O Port structure
- 7.3 Memory Organization
- 7.4 Special Function Registers (SFRs)
- 7.5 External Memory

## LIST OF PRACTICALS

1. Familiarization with 8085 microprocessor trainer kit.
2. Writing and execution of ALP for addition and subtraction of two 8 bit numbers.
3. Writing and execution of ALP for multiplication and division of two 8 bit numbers.
4. Writing and execution of ALP for arranging 10 numbers in ascending/descending order.
5. Writing and execution of ALP for 0 to 9 BCD counters (up/down counter according to choice stored in memory).
6. Familiarization with 8051 Micro-controller Kit.

## INSTRUCTIONAL STRATEGY

*The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing). Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the given in the list may be given to the students.*

## RECOMMENDED BOOKS

- 1 *Microprocessor Architecture, Programming and Applications with 8080/8085 by Ramesh S Gaonker, Willey Eastern Ltd. New Delhi*
- 2 *Microprocessor and Microcontrollers by Dr BP Singh, Galgotia Publications, New Delhi*
- 3 *Microprocessor and Applications by B Ram*
- 4 *Microprocessor and Microcomputers by Refiquzzaman, Prentice Hall of India Ltd., New Delhi.*
- 5 *Digital Electronics and Microprocessor by Rajiv Sapra, Ishan Publication, Ambala*
- 6 *Microcontrollers by Ayala*
- 7 *Microcontrollers by Mazidi*
- 8 *Microcontrollers by Neil Makanzie*
- 9 *Microcontrollers by Deshmukh.*

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Sr No</b>	<b>Topic</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted%</b>
1	Evolution of Microprocessor	04	05
2	Architecture of a Microprocessor (With reference to 8085 microprocessor)	10	20
3	Memories and I/O interfacing	10	15
4	Programming (with respect to 8085 microprocessor)	20	20
5	Instruction Timing and Cycles	08	10
6	Interrupts	08	15
7	Microcontroller series (MCS) – 51 Overview	10	15
	<b>Total</b>	<b>70</b>	<b>100</b>

## **5.4 ELECTRICAL POWER – II** **(Transmission and Distribution of Electrical Power)**

L T P  
5 - -

### **RATIONALE**

*The majority of the polytechnic passouts who get employment in National/State electricity boards/corporations like NTPC, NHPC etc, 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.*

### **DETAILED CONTENTS**

- 1. Transmission Systems** **(20hrs)**
  - 1.1 Layout of transmission system, selection of voltage for H.T. and L.T. lines, advantages of high voltage Transmission both AC and DC
  - 1.2 Comparison of different systems: 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, Methods for improving string efficiency, Bundle Conductors.
  - 1.4 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.
  
- 2. Distribution System** **(14hrs)**
  - 2.1 Layout 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.
  - 2.3 Constructional features of LT (400 V), HT (11 KV) underground cables, advantages and disadvantages of underground system with respect to overhead system.
  
- 3. Substations:** **(14hrs)**
  - 3.1 Brief idea about substations; outdoor grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation
  - 3.2 Layout of 33/11 kV/400V distribution substation and various auxiliaries and equipment associated with it.
  
- 4. Faults:** **(8 hrs)**

Common type of faults in both overhead and underground systems, Symmetrical / unsymmetrical faults. Line to line fault, Single line to ground fault, double line to ground fault, 3-phase to ground fault, open circuit.



**5. Power Factor:****(6 hrs)**

- 5.1 Concept of power factor
- 5.2 Most economical power factor & simple problems.
- 5.2 Reasons and disadvantages of low power factor
- 5.3 Methods for improvement of power factor using capacitor banks, VAR Static Compensator (SVC)

**6. Various Types of Tariffs:****(8hrs)**

- 6.1 Concept of Tariffs
- 6.2 Block rate, flat rate, maximum demand and two part tariffs
- 6.3 Simple problems

*Note: Students may be taken to various Sub-stations. Students must be familiarized with present tariff system employed by State Electricity Boards.*

**INSTRUCTIONAL STRATEGY**

*Since this subject is field oriented, the students should be exposed to different types of Substations including grid stations before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 5 visits during the year. The students may be asked to prepare notes while on visit and submit the report. After that Viva-voce may be conducted to evaluate the knowledge gained during the field visit.*

**RECOMMENDED BOOKS**

1. *Electrical Power System and Analysis* by CL Wadhwa, 3rd 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, Unique International 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

**SUGGESTED DISTRIBUTION OF MARKS**

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Transmission Systems	20	30
2	Distribution System	14	20
3	Substations	14	20
4	Faults	08	10
5	Power Factor	06	10
6	Various Types of Tariffs	08	10
	<b>Total</b>	<b>70</b>	<b>100</b>

## 5.5 MINOR PROJECT

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- - 4

*Minor project work aims at exposing the students to industrial/field practices and/or to give practice to the students in elementary design and fabrication of small electronics appliances. Also the students will be able to comprehend concepts, principles and practices taught in the classroom and their application in solving field/industrial problems. Minor project work aims at developing interest of the students about the, what is inside the electrical/electronic devices, what is happening and how it happens. It would enable first-hand experience of components, their purchase, assembly, testing and trouble shooting. It would boost up confidence of the students to repair and preparation of electrical/ electronic gadgets. The work done in minor project work will also prepare them in taking up problem solving at later stage under major project work.*

Depending upon the interests of the students, location of the organization the students may be asked for market study or to fabricate electrical/electronic projects. **Suggestive list is as follows:-**

### **Market survey of:**

- Various types of cables available in the market, their current rating/specifications, different makes/manufacturing companies (minimum three), comparison of cost between different makes.
- Various types of domestic/wiring components such as switches, sockets, holders etc., their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.
- Various types of protective devices used in domestic and industrial wiring such as MCBs, ELCB/RCCB, fuses etc. their specifications, make (minimum three), and comparison of cost between different makes.
- Various types of electric lamps (luminaries) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.
- Various types of Electrical Appliances (domestic and commercial) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes. (Compare any one type).

### **Or fabrication of:-**

- Regulated power supply
- Timers using 555 and other oscillators
- Touch plate switches – transistorized or 555 based
- Door bell/cordless bell
- Clapping switch and IR switch
- Sirens and hooters
- Cell charger, battery charger, mobile charger
- Fire/smoke/intruder alarm
- Liquid level controller
- Electronics musical instruments
- Telephone handset
- Audio amplifiers
- Automatic stabilizer/CVT

- Emergency light
- Design and manufacture of transformer
- Fan regulator
- Any project related to repair and maintenance of Electrical/ Electronic equipment lying in the institution.

**NOTE:** *The students of the class may be divided into groups and work may be assigned to each group as per their interest.*

The components of evaluation will include the following:

	<b>Component</b>	<b>Weightage</b>
a)	Punctuality and regularity	15
b)	Initiative in learning new things	15
c)	Team work & Interpersonal Relationship with others/workers	15
d)	Project Report/ Technical report	55

**Elective-I**  
**5.6.1 NON-CONVENTIONAL ENERGY SOURCES**  
*(Common with 5<sup>th</sup> Sem. Electrical Engg.)*

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4 - -

**RATIONALE**

*Energy is a crucial input in the process of economic, social and industrial development. High-energy consumption has traditionally been associated with higher quality of life, which in turn is related to Gross National Product (GNP). Since the conventional energy resources are under strain of depletion, it is high time to tap the non-conventional energy sources. The Electrical & Electronics diploma holder will have to face these challenges in future life. Therefore this subject is introduced as an elective subject in diploma programme to familiarize the diploma students with non-conventional engineering sources, so that they may exploit them in near future.*

**DETAILED CONTENTS**

1. **Introduction:** (04 hrs)  
Importance of Non- conventional sources of energy, Present Scenario, Future Prospects, Economic Criteria.
2. **Solar Energy:** (08 hrs)  
Principle of conversion of solar radiation into heat, Photo-voltaic cell, Electricity generation, Application of solar energy like solar water heaters, Solar lighting.
3. **Hydro Energy:** (06 hrs)  
Hydro-electric Power Plants, Mini and Micro hydro-electric power generation.
4. **Bio-energy:** (10 hrs)  
Bio-mass Conversion Technologies- wet and dry processes (Anaerobic digestion, aerobic digestion, Fermentation and distillation, etc., and incineration, pyrolysis etc), Methods for obtaining energy from biomass. Landfill gas collector system, Gasifier, types of gasifier (Updraft, downdraft and cross draft gasifier), Power generation by using gasifier.
5. **Wind Energy:** (05 hrs)  
Wind Energy Conversion, Windmills, Electricity generation from wind. Types of wind mills, local control, energy storage, Hybrid wind solar power plant.
6. **Geo-thermal and Tidal Energy:** (07 hrs)  
Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid cycles. Prime movers for geo-thermal energy conversion. Steam Generation and electricity generation.
7. **MHD** (05 hrs)  
Magneto Hydro Dynamic (MHD) Power Generation, Lorentz Force, Hybrid MHD Thermal power plant.
8. **Chemical Energy Sources:** (07 hrs)  
Design and operating principles of a fuel cell, conversion efficiency, work output and emf of fuel cells, applications, storage battery characteristics.

**9. Thermo Electric Power:****(04 hrs)**

Basic principle, performance analysis of thermo electric power generation, thermoelectric materials and their application.

**INSTRUNCTIONAL STRATEGY**

The teacher should make the student s aware about the depletion of energy sources and the availability of alternate sources of energy. Their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. Teacher must give practical application of these energy sources in nearby surrounding areas.

**RECOMMENDED BOOKS:**

- 1) *Solar Energy – Principles of thermal collection and Storage* SP Sukhatme, Tata McGraw Hill Publication, New Delhi.
- 2) *Solar Energy Utilization*; GD Rai ;Khanna Publishers, New Delhi.
- 3) *Reviews of Renewable Energy Sources, Vol. 3, Edited by MS. Sodha, S.S. Mathur, MAS Malik, TC Kandpal ; Wiley Eastern Limited, New Delhi.*
- 4) *Renewable Energy Sources and Conversion Technology* by NK Bansal, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.
- 5) *Energy Today and Tomorrow*; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.
- 6) *Energy Technology (non-conventional, renewable and conventional)* by S Rao and BB Parulekar, Khanna Publishers, New Delhi
- 7) *Non-Conventional Energy Resources* by RK Singal, SK Kataria and Sons, New Delhi

**SUGGESTED DISTRIBUTION OF MARKS**

S.NO.	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction	04	05
2	Solar Energy	08	15
3	Hydro Energy	06	10
4	Bio-Energy	10	15
5	Wind Energy	05	10
6	Geo-thermal and Tidal Energy	07	10
7	MHD	05	10
8	Chemical Energy Sources	07	15
9	Thermo Electric Power	04	10
<b>Total</b>		<b>56</b>	<b>100</b>

## 5.6.2 FUNDAMENTALS OF COMMUNICATION ENGINEERING

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4 -

### RATIONALE

*The study of principles of communication systems leads to further specialized study of audio and video systems, line communications and microwave communication systems. Thus the diploma-holder in Electrical & Electronics Engineering shall find employment in areas of production, servicing and maintenance of various communication systems. The students should understand the advantages and limitations of various analog and digital modulation systems on a comparative scale and relate to them while studying practical communication systems*

### DETAILED CONTENTS

- |                                       |  |                 |
|---------------------------------------|--|-----------------|
| <b>1. Introduction</b>                |  | <b>(02hrs)</b>  |
| 1.1                                   | Need for modulation and demodulation in communication systems.   |                 |
| 1.2                                   | Basic scheme of a modern communication system.   |                 |
| <b>2. Amplitude modulation</b>        |  | <b>(06 hrs)</b> |
| 2.1                                   | Derivation of expression for an amplitude modulated wave. Carrier and side band components. Modulation index. Spectrum and bandwidth of AM Wave. Relative power distribution in carrier and side bands.                |                 |
| 2.2                                   | Elementary idea of DSB-SC, SSB-SC, SSB and VSB modulations. their comparison and their areas of application.   |                 |
| <b>3. Frequency modulation</b>        |  | <b>(06 hrs)</b> |
| 3.1                                   | Expression for frequency modulated wave and its frequency spectrum (without Proof and analysis of Bessel function) Modulation index, maximum frequency deviation and deviation ratio, BW of FM signals, Carson's rule. |                 |
| 3.2                                   | Effect of noise on FM carrier. Noise triangle, Need for pre-emphasis and de-emphasis,  |                 |
| 3.3                                   | Comparison of FM and AM in communication systems.  |                 |
| <b>4. Phase modulation</b>            |  | <b>(02hrs)</b>  |
|                                       | Derivation of expression for phase modulated wave, modulation index, comparison with frequency modulation.   |                 |
| <b>5. Principles of AM Modulators</b> |  | <b>(06hrs)</b>  |
|                                       | Working principles and typical application of:-  |                 |
|                                       | - Square Law Modulation.   |                 |
|                                       | - Collector modulator  |                 |
|                                       | - Balanced Modulator   |                 |
| <b>6. Principles of FM Modulators</b> |  | <b>(07 hrs)</b> |
|                                       | Working principles and applications of reactance modulator, Varactor diode modulator, Armstrong phase modulator  |                 |

7. **Demodulation of AM Waves** (08 hrs)
- 7.1 Principles of demodulation of AM wave using diode detector circuit; concept of clipping and formula for RC time constant for minimum distortion (no derivation)
- 7.2 Principle of demodulation of AM Wave using synchronous detection.
8. **Demodulation of FM Waves** (08 hrs)
- 8.1 Basic principles of FM detection using slope detector
- 8.2 Principle of working of the following FM demodulators:-  
 - Foster-Seeley discriminator  
 - Ratio detector
9. **Pulse Modulation** (11hrs)
- 9.1 Statement of sampling theorem and elementary idea of sampling frequency for pulse modulation.
- 9.2 Basic ideas about PAM, PPM, PWM.
- 9.3 Pulse code Modulation (PCM) Basic scheme of PCM system. Quantization, quantization error, commanding, block diagram of TDMPCM communication system and function of each block. Advantages of PCM systems. Concepts of differential PCM (DPCM).
- 9.4 Delta Modulation (DM), Basic principle of delta modulation system, advantages of delta modulation system over PCM system. Limitations of delta modulation, concept of adaptive delta modulation (ADM).

#### RECOMMENDED BOOKS

1. *Electronics Communication by Kennedy, Tata McGraw Hill, New Delhi*
2. *Electronics Communication by KS Jamwal, Dhanpat Rai and Co, New Delhi*  
*Radio Engineering by GK Mittal, Khanna Publishers, New Delhi*
3. *Principles of Communication Engineering by DR Arora, Ishan Publications, Ambala.*
4. *Communication Engineering by A Kumar*
5. *Principles of Communication Engineering by Manoj Kumar, Satya Prakashan, New Delhi.*
6. *Principles of Communication Engineering by Anokh Singh, S. Chand and Co., New Delhi.*
7. *Principles of Communication Engineering by Roody, Coolin.*

#### SUGGESTIVE DISTRIBUTION OF MARKS

Sr No	Topic	Time Allotted	Marks Allocation%
1	Introduction	2	05
2	Amplitude modulation	6	10
3	Frequency modulation	6	10
4	Phase modulation	2	05
5	Principles of AM Modulators	6	12
6	Principles of FM Modulators	7	13
7	Demodulation of AM Waves	8	15
8	Demodulation of FM Waves	8	15
9	Pulse Modulation	11	15
	<b>Total</b>	<b>56</b>	<b>100</b>

## Elective-I

### 5.6.3 MEDICAL ELECTRONICS

(Common with 5<sup>th</sup> Sem. Electronics & Communication Engg.)

L T P  
4 - -

#### RATIONALE

*A large number of electronic equipment are being used in hospitals for patient care and diagnosis or carry out advanced surgeries. This subject will enable the students to learn the basic principles of different instruments used in medical science.*

#### DETAILED CONTENTS

1. **Anatomy and Physiology** (08 hrs)
  - 1.1 Elementary ideas of cell structure
  - 1.2 Heart and circulatory system.
  - 1.3 Central nervous system
  - 1.4 Muscle action
  - 1.5 Respiratory system
2. Overview of Medical Electronics Equipment, classification, application and specifications of diagnostic, therapeutic and clinical laboratory equipment, method of operation of these instruments (05 hrs)
3. **Electrodes** (07 hrs)

Bioelectric signals, Bio electrodes, Electrode, Electrode tissue interface, Contact impedance, Types of Electrodes, Electrodes used for ECG, EEG
4. **Transducers** (08 hrs)

Typical signals from physiological parameters, pressure transducer, flow transducer, temperature transducer, pulse sensor, respiration sensor,
5. **Bio Medical Recorders** (08hrs)

Block diagram description and application of following instruments

  - 5.1 ECG Machine
  - 5.2 EEG Machine
  - 5.3 EMG Machine
6. **Patient Monitoring Systems** (12 hrs)
  - 6.1 Heart rate measurement
  - 6.2 Pulse rate measurement
  - 6.3 Respiration rate measurement
  - 6.4. Blood pressure measurement
  - 6.5. Principle of defibrillator and pace marker.
7. **Safety Aspects of Medical Instruments** (08 hrs)
  - 7.1 Gross current shock
  - 7.2 Micro current shock
  - 7.3 Special design from safety consideration.
  - 7.4 Safety standards.



### INSTRUCTIONAL STRATEGY

The teacher has to play a proactive role in arranging visits to hospitals and well equipped laboratories to reinforce theory. The apparatus and equipment available should be shown to students so they can understand where and how the various biomedical instruments are used. Various charts and models be used for demonstration. Exposure to Spectrometer and UV Spectrometer must be given to students in addition to arranging visits to biomedical industries.

### RECOMMENDED BOOKS

1. Handbook of biomedical Instrumentation by RS Khandpu.
2. Biomedical Instrumentation by Cromwell,
3. Modern Electronics Equipment by RS Khandpur, TMH, New Delhi
4. Introduction to Biomedical Electronics by Edward J. Perkstein; Howard Bj, USA

### SUGGESTED DISTRIBUTION OF MARKS

Sr No	Topic	Time Allotted(hrs)	Marks Allocation%
1	Anatomy and Physiology	08	10
2	Overview of medical electronics equipment, classification, application etc.	05	08
3	Electrodes	07	18
4	Transducers	08	18
5	Bio Medical Recorders	08	18
6	Patient Monitoring Systems	12	18
7	Safety Aspects of Medical Instruments	08	10
Total		56	100

## 6.1 BASICS OF MANAGEMENT

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3 - -

### **RATIONALE:**

*Diploma holders are expected to take up middle level managerial positions, their exposure to basic management principles is very essential. Some topics like Structure and ownership of Organization, Leadership, Motivation, Customer Relationship Management (CRM), Legal Environment of Business, Environmental Management, Accident and Safety: Total Quality Management (TQM), Intellectual Property Rights (IPR) etc. have been included in the subject.*

### **DETAILED CONTENTS**

1. **Introduction:** (12 hrs)  
Definition and concept of management, functions of management- planning, organizing, staffing, coordinating and controlling. Various areas of management-
  - (a) Human Resource Management(HRM)-Manpower recruitment and selection, induction , training and development and performance appraisal.
  - (b) Financial Management- Meaning of financial management, its importance, various sources of finance- long term and short term. Concept of Internal Rate of Return(IRR), Net Present Value (NPV) and Average Rate of Return.
  - (c) Marketing Management- Product life cycle, concept of pricing, promotion strategies- advertising, sales promotion and market research.
  - (d) Material Management – Inventory management, concept of economic order quantity and waste management.
  
2. **Structure and Ownership of Organization:** (04 hrs)  
Concept and structure of an organization, hierarchical management structure (top, middle and lower level management), functional management structure and matrix organizational structure. Types of business ownership (salient features)- Sole Proprietorship, Partnership, Joint Stock Companies and Cooperative Ownership.
  
3. **Leadership:** (02 hrs)  
Meaning, importance , types of leadership and qualities of a good leader.
  
4. **Motivation:** (04 hrs)  
Concept and importance of motivation-drives and incentives, types of motivation and theories of motivation- Abharam Maslow Theory and Herzberg Two Factor Theory.
  
5. **Customer Relationship Management:** (04hrs)  
Need, various types of customers, customer satisfaction, Customer Satisfaction Index(CSI) and its significance in playing effective role of engineers in changing scenario.
  
6. **Legal Environment and Business:** (08 hrs)
  - a) Various labour laws and their necessity. Salient features of Income Tax Act – computation of income tax on salary income, Sales and Excise Tax Act-VAT & Excise duty and Factory Act. 1948.
  - b) Labour Welfare Schemes including wage payment types, system of wage payment and incentives.

- c) Intellectual Property Rights(IPR)- Concepts, infringements and remedies related to patents, copy rights, trademarks and designs.
- d) Accident and Safety- Meaning and concept of accident and safety, causes, safety precautions and various measures after accidents.

7. **Total Quality Management:** (04 hrs)  
 Meaning and concept of Total Quality Management(TQM), various factors/measures to achieve TQM in an organization. Standards and Codes-National & International.
8. **Environmental Management:** (04 hrs)  
 Concept of ecology and environment, factors contributing to air pollution, water pollution and noise pollution. Different measures to control pollution. Disaster management-features and measures.

**INSTRUCTIONAL STRATEGY:**

*Generally the diploma holders occupy middle level managerial positions in an organization, therefore, their exposure to basic management principles is very essential. Accordingly students may be given conceptual understanding of different topics related to management. Some of the topics may be taught using question answer, assignment or seminar. The teacher will discuss success stories and case studies with students, which in turn, will develop appropriate managerial qualities in the students. In addition, expert lectures may also be arranged from within the institutions or from management organisations. Appropriate extracted reading material and handouts may be provided.*

**RECOMMENDED BOOKS:**

1. *Principles of Management by Philip Kotler TEE Publication*
2. *Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi.*
3. *Financial Management by MY Khan and PK Jain, Tata McGraw Hill Publishing Co.: 7, West Patel Nagar , New Delhi.*
4. *Modern Management Techniques by SL Goel: Deep and Deep Publications Pvt Limited , Rajouri Garden, New Delhi.*
5. *Management by James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr. : Prentice Hall of India Pvt Ltd, New Delhi.*
6. *Essentials of Management by H Koontz, C O' Daniel , Mc Graw Hill Book Company, New Delhi.*
7. *Marketing Management by Philip Kotler, Prentice Hall of India, New Delhi*
8. *Total Quality Management by Dr DD Sharma, Sultan Chand and Sons, New Delhi.*
9. *Intellectual Property Rights and the Law by Dr. GB Reddy.*
10. *Service Quality Standards, Sales & Marketing Department, Maruti Udyog Ltd.*
11. *Customer Relationship Management: A step-by-step approach, Mohamed & Sagadevan Oscar Publication, Delhi*
12. *Customer Relation Management, Sugandhi RK, Oscar Publication, Delhi*
13. *Environment Engineering by GN Pandey & GC Pandey, Tata McGraw Hill Publication.*

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	12	20
2	4	10
3	2	08
4	4	12
5	4	10
6	8	18
7	4	10
8	4	12
<b>TOTAL</b>	<b>42</b>	<b>100</b>

## **6.2 ENERGY MANAGEMENT**

(Common with 6<sup>th</sup> Sem. Electrical Engg.)

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5 - 2

### **RATIONALE**

*One of the reasons for India not been able to catch up with the desired extent of modernization of industrial processes in light of challenges posed by multinationals is the non-availability of required energy supply. The solution primarily lies in tapping all possible energy generation sources but efficient use of available energy is also important.*

*Energy management focuses on these aspects. This course will develop awareness amongst the diploma engineers and will enable them to practice the energy management techniques in whatever field they are engaged in.*

### **DETAILED CONTENTS**

- 1. Energy Management** **(12hrs)**
  - 1.1 Introduction of energy management, its importance & Energy Management techniques,
  - 1.2 Need for energy conservation with brief description of oil and coal crisis. Tips for conservation of oil & coal and its judicious use.
  - 1.3 Alternative sources of energy in detail.
  - 1.4 Environmental aspects with regard to Energy management.
  - 1.5 Energy efficiency- its significance & strategies for energy efficiency.
  
- 2. Energy Conservation** **(12hrs)**
  - 2.1 Energy conservation act 2001 and its salient features.
  - 2.2 Energy conservation in Domestic sector- Lighting, home appliances
  - 2.3 Energy conservation in Industrial sector- Motors, Industrial lighting, Distribution system, Pumps, Fans, Blowers etc.
  - 2.4 Energy conservation in Agriculture sector, Tube well pumps, diesel generating Sets & Standby energy sources.
  - 2.5 Macro Level approach for energy conservation at design stage.
  
- 3. Energy Efficient Technology** **(24hrs)**
  - 3.1 Energy efficient technology an overview, Role of Bureau of Energy Efficiency (BEE) and Energy Star.
  - 3.2 Need for energy efficient devices
  - 3.3 Initial cost versus life cycle, cost analysis on life cycle basis
  - 3.4 Energy efficient motors as compared to standard motors.
  - 3.5 Study of BIS Code, BIS specifications for energy efficient motors, salient design features,
  - 3.6 Efficiency as a function of load.
  - 3.7 Energy efficient lighting system, different sources, lumens/watt, role of voltage on efficiency of the lighting system.
  - 3.8 Power quality measureable quantities: Voltage sag, voltage fluctuation, voltage spikes and transients, frequency deviation, Harmonics contents etc and their effect on power quality.
  - 3.9 Energy efficient distribution system: Distribution system- Optimum cable size, amorphous core transformer, role of power factor, use of compensating capacitors (manual and automatic), capacitor bank, location of capacitors and their switching.

#### 4. Energy Audit

(16Hrs)

- 4.1 Introduction to Energy Audit & its need.
- 4.2 Types of Energy Audit & Energy audit methodology
- 4.3 Efficiency of energy conversion processes, monitoring system
- 4.4 Specific energy consumption – three pronged approach, fine tuning, technical up gradation, avoidable losses.
- 4.5 Energy Audit reporting format. Case studies of energy audit of domestic installation, Distribution system, and related Industries audit activities.

#### 5. Environmental Impact Assessment

(6hrs)

- 5.1 Need for environmental impact assessment
- 5.2 Standard format for assessment and its completion
- 5.3 Evaluation of the assessment.

#### LIST OF PRACTICALS

1. Energy auditing of domestic installation
2. Energy auditing of institute/nearby industrial unit
3. Comparisons of different types of lamps in respect of Lumens/Watt.
4. Study of star ratings of various electrical appliances and their energy efficiencies.

#### INSTRUCTIONAL STRATEGY

*While explaining the need and energy management, the teacher should give students home assignments based on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy, energy auditing procedure etc. Best learning will take place if students are given real life problems on energy audit.*

#### RECOMMENDED BOOKS:

1. *Manual on Energy Efficiency at Design Stage, CII Energy Management Cell.*
2. *Manual on Energy Efficiency in Pumping System, CII Energy Management Cell.*
3. *Manual on Variable Speed Drives for Energy Efficiency CII Energy Management Cell.*
4. *Energy Conservation-case studies in ceramic industry, sugar industry, fertilizer industry, cement industry. CII, Energy Management Cell etc.*
5. *Energy management, by Umesh Rathore, S.K. Kataria & Sons.*

#### SUGGESTED DISTRIBUTION OF MARKS

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Energy Management	12	20
2	Energy Conservation	12	20
3	Energy Efficient technology	24	30
4	Energy Audit	16	20
5	Environmental Impact Assessment	06	10
<b>Total</b>		<b>70</b>	<b>100</b>

## 6.3 PLC AND ITS APPLICATIONS

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5 - 2

### RATIONALE

*A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). A PLC is a solid state device, designed to operate in noisy industrial environments and can perform all logic functions. PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design, modify and troubleshoot such control circuits. Looking at the industrial applications of PLCs in the modern industry, this subject finds its usefulness in the present curriculum..*

### DETAILED CONTENTS

1. **Introduction to PLC** (06hrs)  
What is PLC, History and applications of PLCs, Building blocks of PLC, Difference between relay, contractor and PLC. Limitations of Relays. Advantages of PLCs over electromagnetic relays.
2. **Working of PLC** (12hrs)
  - 2.1 Basic operation and principle of PLC
  - 2.2 Architectural details of PLC.
  - 2.3 Description of different PLC modules & cards.
  - 2.4 Why I/O configuration is required? How the I/O modules are addressed for different PLCs.
  - 2.5 Memory structures
  - 2.6 Power supply.
3. **Programs & Ladder diagrams** (08hrs)
  - 3.1 First steps with the programming device,
  - 3.2 Introducing the basic ladder logic
  - 3.3 Instructions, contacts, coils, and PLC scan.
4. **Instruction Set with programming examples** (20 hrs)
  - 4.1 Basic instruction i.e. NO/NC,
  - 4.2 Concept of Latching
  - 4.3 Triggering.
  - 4.4 Timer instructions like on-delay timers, off-delay timers, retentive timers, resetting of timers.
  - 4.5 Counter instructions like up-counter, down counter, resetting of counters.
  - 4.6 Comparison, Arithmetic, Logical & Move functions.
  - 4.7 Programming based on Basic instructions, Logic gates, timer, counter etc.

- 5. Applications of PLCs in followings. (08 hrs)**
- 5.1 CNC Machines
  - 5.2 Packaging
  - 5.3 Process controls
  - 5.4 Car parking
  - 5.5 Security operation
  - 5.6 Traffic light control
  - 5.7 Sorting of objects etc
- 6. SCADA. (08hrs)**
- 6.1 Introduction to SCADA,
  - 6.2 Configuration of different drivers, gateway.
  - 6.3 Database of tags and its use.
  - 6.4 Interfacing with PLC and simulation of PLC.
  - 6.5 Application of SCADA.
- 7. AC & DC drives using PLC. (08hrs)**
- 7.1 Fundamentals of DC & AC Drives.
  - 7.2 Block diagram of DC & AC drives,
  - 7.3 Configuration of different drives with PLC.
  - 7.4 Control of drive with and without PLC.
  - 7.5 Various applications of DC & AC Drives.
  - 7.6 Interfacing with PLC.

#### **INSTRUCTIONAL STRATEGY**

*Introduce the subject and make the students familiar with PLCs, applications of PLCs and SCADA. The inputs shall start with theoretical inputs to architecture, ladders diagrams and programming. Small projects may be identified, be designed and implemented. PLC ladder diagram and programming should be supplemented with visits to industry.*

#### **RECOMMENDED BOOKS**

- 1) *Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA*
- 2) *Introduction to PLCs by Gary Dunning, McGraw Hill*
- 3) *Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh*
- 4) *Module on "Allen Bradlag PLC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh*
- 5) *Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh*

#### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Sr No</b>	<b>Topic</b>	<b>Time Allotted( hrs)</b>	<b>Marks Allocation %</b>
1	Introduction to PLC	06	10
2	Working of PLC	12	20
3	Programs & Ladder diagrams	08	10
4	Instruction Set with programming examples	20	20
5	Applications of PLCs	08	10
6	SCADA	08	15
7	AC & DC drives using PLC.	08	15
<b>Total</b>		<b>70</b>	<b>100</b>



## LIST OF PRACTICALS

1. Familiarization with the working of PLC
2. Components/sub-components of a PLC, learning functions of different modules of a PLC system
3. Introduction to ladder diagram concepts, instruction list syntax
4. Basic logic operations, AND, OR, NOT etc. functions.
5. At least two programs with the help of following:
  - i) Latching
  - ii) Triggering
  - iii) Timers
  - iv) Counters
  - v) Sequencer
  - v) Arithmetic and comparator
6. Interfacing of PLC using SCADA software.
7. Interfacing of PLC with DC/AC drives.

## Elective II

### 6.4.1 UTILIZATION OF ELECTRICAL ENERGY (UEE)

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#### RATIONALE

*This subject assumes importance in view of the fact that a technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations.*

*The curriculum has been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas.*

#### DETAILED CONTENTS

##### 1. Electric Drives:

(16Hrs)

- 1.1 Advantages of electric drives
- 1.2 Characteristics of different mechanical loads
- 1.3 Types of motors used as electric drive
- 1.4 Electric braking
  - 1.4.1 Plugging
  - 1.4.2 Rheostatic braking
  - 1.4.3 Regenerative braking
- 1.5 Methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.
- 1.6 Examples of selection of motors for different types of domestic loads
- 1.7 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.
- 1.8 Specifications of commonly used motors e.g. squirrel cage motors, slip ring induction motors, AC series motors, Fractional KW(FKW)motors

##### 2. Illumination:

(10Hrs)

- 2.1 Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light
- 2.2 Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux.
- 2.3 Laws of illumination – simple numerical.
- 2.4 Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour sodium lamp, fluorescent lamp, halogen lamp, neon lamp.
- 2.5 Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor illumination levels
- 2.6 Main requirements of proper lighting; absence of glare, contrast and shadow.
- 2.7 General ideas about time switches Street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.

- 3. Electric Heating** (10Hrs)
- 3.1 Advantages of electrical heating
  - 3.2 Heating methods:
    - 3.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit
    - 3.2.2 Induction heating; principle of core type and coreless induction furnace, their construction and applications
    - 3.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace
    - 3.2.4 Dielectric heating, applications in various industrial fields
    - 3.2.5 Infra-red heating and its applications
    - 3.2.6 Microwave heating and its applications
  - 3.3 Simple design problems of resistance heating element
- 4. Electric Welding:** (08Hrs)
- 4.1 Advantages of electric welding
  - 4.2 Welding method
    - 4.2.1 Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment
    - 4.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper.
  - 4.3 Introduction to TIG and MIG welding
- 5. Electrolytic Processes:** (08Hrs)
- 5.1 Need of electro-deposition
  - 5.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing
  - 5.3 Equipment and accessories for electroplating
  - 5.4 Factors affecting electro-deposition
  - 5.5 Principle of galvanizing and its applications
  - 5.6 Principles of anodizing and its applications
  - 5.7 Electroplating of non-conducting materials
  - 5.8 Manufacture of chemicals by electrolytic process
- 6. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers:** (08Hrs)
- 6.1 Principle of air conditioning, vapour pressure, refrigeration cycle, co-friendly refrigerants
  - 6.2 Description of Electrical circuit used in:
    - a) Refrigerator,
    - b) Air-conditioner, and
    - c) Water cooler

## 7. Electric Traction:

(10Hrs)

- 7.1 Advantages of electric traction
- 7.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves
- 7.3 Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph
- 7.4 Factors affecting scheduled speed
- 7.5 Electrical block diagram of an electric locomotive with description of various equipment and accessories used.
- 7.6 Types of motors used for electric traction
- 7.7 Starting and braking of electric locomotives
- 7.8 Introduction to EMU and metro railways

**Note:** Students should be taken for visits to nearest electrified railway track to study the electric traction system.

### INSTRUCTIONAL STRATEGY

It is desired to give ample practical examples in the class while teaching this subject. Teacher must supplement his/her classroom teaching with aids such as models, charts, and video films from time to time. This subject requires demonstrations and exposure actual workplace/industry/field. For this purpose, the subject teacher should do advance planning for visits/studies related to each topic in consultation with HOD and Principal of the polytechnic/institution.

### SUGGESTIVE DISTRIBUTION OF MARKS

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted %
1	Electric Drives	16	25
2	Illumination	10	15
3	Electric Heating	10	15
4	Electric Welding	08	10
5	Electrolytic Processes	08	10
6	Electrical Circuits used in	08	10
7	Electric Traction	10	15
<b>Total</b>		<b>70</b>	<b>100</b>

### RECOMMENDED BOOKS

1. *Art and Science of Utilization of Electrical Energy* by H Partap, Dhanpat Rai & Sons, Delhi
2. *Utilization of Electrical Energy* by JB Gupta, Kataria Publications, Ludhiana
3. *Utilization of Electrical Energy* by Sahdev, Unique International Publication, Jalandhar
4. *A Text of Book Electrical Power* by Dr. SL Uppal, Khanna Publications, Delhi
5. *Modern Electric Traction* by H Partap, Dhanpat Rai & Sons, Delhi
6. *Utilization of Electrical Energy* by OS Taylor, Pitman Publications
7. *Generation, Distribution and Utilization of Electrical Power* by CL Wadhwa, Wiley Eastern Ltd., New Delhi

## Elective-II

### 6.4.2 PERSONAL COMPUTER ORGANIZATION

(Common with 5<sup>th</sup> Sem. Electronics & Communication Engg.)

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#### RATIONALE

*Personal Computers have become a necessity in Industry, Offices and becoming popular in homes too. This course gives organization structure and principles of working of various other components like visual display, keyboard, drives and printers etc. Diploma holders will find employment in computer industry, repair and maintenance field.*

#### DETAILED CONTENTS

- 1. Mother Board (14 hrs)**
  - 1.1 Introduction to different type of mother boards.
  - 1.2 Single Board Based System, Block diagram of motherboard. Installation of Computer system.
- 2. Buses and Ports (14 hrs)**
  - 2.1 Different type of Buses PCI, SCSI and Serial and Parallel ports (COM ports) Ports COM 1, LPT1, USB, RS 232 C, use of computer for instrumentation.
- 3. Memory (10 hrs)**

Principle and Construction of Floppy Disk Drive and hard disk device (HDD). Floppy disk Controller & Hard disk controller. Pen Drives, common faults with hard disk drive and floppy disk drive, RAM Module.
- 4. Keyboard and Mouse (10hrs)**

Block Diagram of keyboard Controller, keyboard switches, keyboard faults, mouse, common faults with mouse. Introduction to scanner and digitizer.
- 5. CRT Display Devices: (12hrs)**

Block Diagram, Principle of operation of Computer Monitor, Difference between TV & Computer Monitor. Video display Adaptors (monochrome and Colour), introduction to solid state displays.
- 6. Printers (10hrs)**

Printing Mechanism, Construction and working principles of Dot Matrix Printer, Inkjet Printer, Laser Printer, Printer Controller, Centronic Interface, Signals from PC to Printer and Printer to PC.

#### INSTRUCTIONAL STRATEGY

*This subject gives complete knowledge regarding the Computer Hardware. Teacher must give hands on practice related to operation, maintenance, installation etc. Teacher should encourage the students to do assembly of PC.*

## RECOMMENDED BOOKS

1. *PC Organisation* by S. Chowdhary, Dhanpat Rai & Sons, Delhi.
2. *IBM PC Colons* by Govinda Rajalu, Tata McGraw Hills Publishers, New Delhi.
3. *Text Book* by Mark Minasi.
4. *Computers* by P. Norton.

## SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Hrs)	Marks Allocation (%age)
1	Mother Board	14	20
2	Buses and Ports	14	20
3	Memory	10	15
4	Keyboard and Mouse	10	15
5	CRT Display Devices	12	15
6	Printers	10	15
<b>Total</b>		<b>72</b>	<b>100</b>

## 6.4.3 OPTICAL FIBER COMMUNICATION

(Common with 5<sup>th</sup> Semester of Electronics & Communication Engg.)

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### RATIONALE

*Progressing from communication over copper wire to today's fibre optic communication, we have increased our ability to transmit more information, more quickly and over longer distances. This has expanded our boundaries and is finding a good slot in communication system. Optical fibers has replaced existing transmission media due to its advantages. As a result the technicians are supposed to have knowledge of optical communication. This subject will provide basic concepts and requisite knowledge and skill required.*

### DETAILED CONTENTS

- 1. Introduction: (12hrs)**
  - 1.1 Historical perspective, basic communication systems, optical frequency range, advantages of optical fiber communication, application of fiber optic communication.
  - 1.2 Electromagnetic spectrum used. Advantages and disadvantages of optical communication.
  - 1.3 Principle of light penetration, reflection, critical angle.
  
- 2. Optical Fibers and Cables (10hrs)**

Constructional details of various optical fibers, multimode and mono mode fibers, step index and graded index fibers, acceptance angle and types of optical fiber cables.
  
- 3. Losses in Optical Fiber Cable (10hrs)**
  - 3.1 Absorption Losses, Scattering Losses, Radiation losses, Compelling losses, bending losses.
  - 3.2 Dispersion, Material dispersion, wave guide dispersion, intermodal
  
- 4. Optical Sources (10hrs)**

Characteristics of light used in optical communication, principle of operation of LED, different types of LED structures used and their brief description, LED using circuitry, injection laser diode, principle of operation, different injection laser diodes, comparison of LED and ILD, non semiconductor laser.
  
- 5. Optical Detectors (08hrs)**

Characteristics of photo detectors used in optical communication; PIN diode and avalanche photo diode (APD), their brief description.
  
- 6. Optical Amplifiers (10hrs)**

Types of optical amplifiers, semiconductor & fiber optical amplifiers, Functional types, principle of operation of SOA, types of SOA.FPA, TWA SOA applications, advantages, drawbacks, EDFAS, Raman amplifiers.
  
- 7. Optical Fiber System (10hrs)**

Optical transmitter circuit, optical receiver circuit, optical power budgeting, multiplexing methods used. Modulation methods used.

### **INSTRUCTIONAL STRATEGY**

*This subject gives the complete knowledge of optical fibre communication techniques. The teacher should make the students aware about the historical development, optical sources and optical fibre system in addition to applications of optical fibre in . Since this subject deals with theory and practical. The theory should be re-enforced by visit to sites and industries like HFCL having optical fiber installations in addition to practical work in the laboratory.*

### **RECOMMENDED BOOKS**

1. *Optical fiber Communication by John M Senior, Prentice Hall of India, New Delhi*
2. *Optical fiber Communication by J. Gower , Prentice Hall of India, New Delhi*
3. *Optical fiber Communication by ' Gerd Keiser, McGraw Hill International Editions*
4. *Optical Communications – Components and Systems by JH Franz and VK Jain, Narosa Publishing House, New Delhi*
5. *Optical fiber Communication Systems by GP Agrawal, John Wiley & Sons, New Delhi*

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted</b>	<b>Marks Allotted (%age)</b>
1	12	15
2	10	15
3	10	15
4	10	15
5	8	10
6	10	15
7	10	15
<b>Total</b>	<b>70</b>	<b>100</b>



## 6.5 Major Project

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### RATIONALE

*Major Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period with a view to:*

- i) Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study.*
- ii) Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.*
- iii) Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.*
- iv) Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.*

*The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance. Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brain storming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 6 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.*

*This practical training cum project work **should not be considered** as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organizations for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.*

**Some of the suggestive project activities are given below:-**

- Projects related to designing small electrical / electronic equipment / instruments.
- Projects related to increasing productivity in electrical / electronic manufacturing areas.
- Projects related to quality assurance.
- Projects connected with repair and maintenance of plant and equipment.
- Projects related to suggesting substitutes of electronics components being used.
- Projects related to design of small oscillators and amplifier circuits.
- Projects related to design, fabrication, testing and application of simple digital circuits and components.

- Projects related to microprocessor/microcontroller based circuits/ instruments.
- Projects related with repair and maintenance of machine parts
- Estimating and costing projects
- Design of components/ parts/ jigs / fixtures
- Projects related to quality control
- Project work related to increasing productivity
- Project connected with work study
- Projects relating to erection, installation, calibration and testing
- Projects related to wastage reduction
- Projects related to energy audit.

**Some of the suggestive projects based on above areas are listed below for the benefit of students:**

- Microprocessor/Microcontroller based rolling display/bell and calendar.
- Microprocessor based stepper motor control.
- Speed control of DC Machines by Microprocessor/Microcontrollers
- Temperature monitoring using Microprocessor/Microcontroller based systems.
- Microprocessor/Microcontroller based liquid level indicator and control
- Fabrication and assembling of digital clock.
- Fabrication of ON line/OFF line UPS of different ratings and inverters
- Design, fabrication and testing of different types of experimental boards as per the curriculum of Electrical & Electronics Engineering.
- Repair of oscilloscope, function generator
- Installation of computer network (LAN).
- Microprocessor/Microcontroller based solar tracking system
- Microprocessor/Microcontroller Based A/D converter
- Microprocessor/Microcontroller Based D/A converters.
- Simulation of class A, Class B, Class AB and Class C amplifiers
- Design and Construction of a small transformer (100 VA to 1 kVA)
- Construction of phase sequence indicator
- Construction of hot air drier
- Construction of a Simple loop generator
- Design and fabrication of Automatic curtain operator
- Construction of Automatic Water level controller
- Design and construction of Desert coolers
- Fabrication of electric motor (FKW)
- Design and construction of Geyser
- Electroplating of small domestic gadgets
- Erection/installation and commissioning of rotating electrical machine
- Fault detection and repair of electrical/electronic instruments
- Emergency light using SCR
- Low cost intercom for home
- Analog computer
- Automatic battery charger using SCR
- Automatic street light/dressing table light
- Inverter circuit 500 watt.
- SCR based automatic battery charger
- SCR based speed controller for DC shunt motor
- Speed control circuit of DC shunt motor using SCR
- Design and Construction of a small transformer (100 VA to 1 kVA)
- Construction of Automatic Water level controller

**NOTE:**

*The list is only the guideline for selecting a project, however a student is at liberty to select any other related project OR inter disciplinary project of his choice independently under guidance of his teachers.*

A suggestive criterion for assessing student's performance by the examiner is given in table below:

Sr. No.	Performance Criteria	Reading Scale				
		Max.** Marks	Excel	Very Good	Fair	Poor
1.	Selection of project assignment	10%				
2.	Planning and execution of considerations	10%				
3.	Quality of performance	20%				
4.	Providing solution of the problems or production of final product	20%				
5.	Sense of responsibility	10%				
6.	Self-expression/communication skills	5%				
7.	Interpersonal skills/human relations	5%				
8.	Report writing skills	10%				
9.	Viva voce	10%				
<b>Total Marks</b>		<b>100</b>				

## 6.6 PRACTICE IN COMMUNICATION SKILLS

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### RATIONALE

*For successful completion of diploma programme, the students should possess adequate command on language and communication skills so that they are able to express themselves with ease and felicity. The language used by the students should be appropriate to objectives and occasion. The contents of this subject shall provide them practical training through language laboratory.*

### LIST OF PRACTICAL EXERCISES

1. Exercises on phonetics
2. Group Discussion
3. Exercises on self-assessment using tools like SWOT analysis.
4. Internet communication
5. Correspondence
  - 5.1 Resume writing
  - 5.2 Covering letter
  - 5.3 Follow-up correspondence
  - 5.4 Business Correspondence
6. Practice on listening skills.
7. Speaking exercises with emphasis on voice modulation (reading and extempore)
8. Demonstration and practice on Body language and Dress sense.
9. Exercises on etiquettes and mannerism in difficult situations like business meetings, table manners, telephone etiquette and manners related to opposite gender.
10. Mock interviews (telephonic/personal)
11. Cross-cultural Communication
12. Role play for effective Communication.
13. Exercises on wit and humour in conversations and creating lively environment.