

REVISED CURRICULUM

FOR

DIPLOMA PROGRAMME

IN

ELECTRICAL ENGINEERING

FOR THE STATE OF HIMACHAL PRADESH



Prepared by:-

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FOREWORD

Globalization, liberalization and privatization have been sweeping the developing world over the last few decades. They have removed barriers of distances, state boundaries, culture, language etc. for trade and commerce, so that a person or a firm with superior quality product and services can reach any where in the world, trade and prosper. Emergence of Indian multinationals viz. Infosys, Tata etc. is evidence to this phenomenon. This has resulted into an era where the motto of “survival of the fittest” works. We as a country have been exposed to the competition of ever lasting nature, affecting our society, industry as well as individuals. Moreover it has broken monopolistic trade practices that industries use to enjoy before.

Coupled with globalization are advancements in science and technology affecting economical and socio-political systems at various levels viz. international, continental, national and regional. The emergence of new bodies of knowledge has been posing a great threat to existing manufacturing and related trade practices. There is a visible growth drift from manufacturing sector to service sector giving rise to knowledge economy.

The knowledge economy, a recently known term uses knowledge as a major resource for national growth in production and services, and in increasing its Gross Domestic Product. The economy where emphasis is laid on new ideas instead of exploiting labour, where life-long learning is preferred over traditional learning, where inter-disciplinary research is promoted resulting into short product development cycle.

Under such circumstances the importance and requirement of technical manpower that is well-qualified and equipped with higher order competencies has increased manifold. Such a manpower is being considered as “Human Capital” globally and the countries based on knowledge economy are treating it (Human Capital) as a prime resource to compete at international level and for keeping an edge over the others.

Under prevailing situation where India is emerging as a global economy, technical education of our country has a great role to play. The polytechnics in the country are supposed to cater to national need of human capital at middle level managers by way of developing diploma graduates having requisite technical as well as generic skill sets. This is the only way through which we can realize our dream of becoming knowledge society by 2020.

Composite Curriculum Development Centre (CCDC) of our State has been extending expert services to polytechnic education system of the states in northern region. It has track record of precisely sensing contemporary techno-socio-politico-economical context, and deriving aims and objectives of a given programme and finally design its curriculum for its implementation for satisfying societal need.

This curriculum document is the result of the judicious/exhaustive exercise undertaken by CCDC considering the prevailing context as stated above. In order to meet the present day need of our national human capital, a course on Generic Skill Development is appropriately introduced in this curriculum of diploma programme along with other requisite changes in various technical courses.

It is now upto the managers of the technical education system to transform this scheme into reality by planning, developing and implementing learning experiences at various levels.

The attention of all concerned educational managers is solicited to strive hard and convert this plan into reality. I wish them good luck.

**S. S. Guleria HAS
Director(TE)**

PREFACE

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.

Technical Education Department of Himachal Pradesh has undertaken restructuring of the diploma programmes offered by the polytechnics in the State. Consequently H.P. State Board of Technical Education assigned the project for revision of six existing diploma programmes to this institute in the month of April 2007 with a view to update the courses and their contents as per employment needs of the world of work. A series of workshops were held in the months of April-May, 2007 and 1st Year curriculum of diploma programmes was handed over to the H.P. State Board of Technical Education for its implementation from July, 2007. Subsequently another series of workshops were held for the revision of 2nd and 3rd Year curriculum of all these courses during September – December 2007.

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 industry/field organizations 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. Moreover, the representative sample of polytechnic faculty from H.P. state, who are the actual implementers of these programmes were drawn for the revision to ensure seamless curriculum implementation. The document contains the study and evaluation scheme and detailed subject/course contents for all the three years to enable the HP Polytechnics to implement revised curriculum to achieve the desired objectives.

We have taken cognizance of recommendation of experts both from industry and academic institutions and have adequately incorporated segments of Entrepreneurship Development, Environment and Safety Awareness, Industry Oriented Practice Based Minor and Major Projects, Industrial Training etc. 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 all efforts to create better facilities, develop linkages with the world of work and foster conducive and requisite learning environment as prescribed in the curriculum document.

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Recommendations for Effective Curriculum Implementation

This curriculum document is a Plan of Action (POA) and has been prepared based on exhaustive exercise of curriculum planning and design. The representative sample comprising selected senior personnel (lecturers and HODs) from various institutions and experts from industry/field have been involved in curriculum design process.

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. As it is emphasized that a proper mix of different teaching methods in all these places of instruction only can bring the desired changes in students behaviour as stipulated in curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every course teacher to read them carefully, comprehend and start using them.

(A) Broad Suggestions:

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.
2. Punjab State Board of Technical Education (PSBTE) may make the academic plan available to all polytechnics well in advance. The Principals have a great role to play in its dissemination and, percolation upto grass-root level. Polytechnics in turn are supposed to prepare institutional academic plan by referring state level PSBTE plan.
3. HOD of every Programme Department along with HODs and incharges of other departments viz. English, Maths, Physics, Chemistry etc. are required to prepare academic plan at department level referring institutional academic plan.
4. All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B) Course Level Suggestions

Teachers are educational managers at class room level and their success in achieving course level objectives using course plan and their judicious execution which is very important for the success of programme by achieving its objectives.

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/ workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of 16 weeks which is made available to them in the academic plan at PSBTE level. With the amount of time to their credit, it is essential for them to use it efficiently by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process effectively:

1. Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available, course to be taught, different learning experiences required to be developed etc.
2. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of content to be covered, learning material (transparencies, VCDs, Models etc. for execution of a lesson plan. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver subject content to be taught, check desired learning outcome and reinforce learning etc.
3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.
4. Teachers are required to plan for library guided exercises by identification of course specific experience requirement, setting time, assessment, etc. The tutorial, assignment and seminar can be thought of as terminal outcome of library experiences.
5. Concept and content based field visits with appropriate releases (day-block) may be planned and executed for such content of course which otherwise is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.
6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.

7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive explicit feed back to every student. It has to be planned properly; otherwise very purpose of the same is lost.
8. The co-curricular activities like camp, social gathering, study tour, hobby club etc may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.
9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.
10. While imparting instructions, emphasis may be laid on the development of cognitive, psychomotor, reactive and interactive skills in the students.
11. Teachers may take working drawings from the industry/ field and provide practices in reading these drawings.
12. Considerable emphasis should be laid in discipline specific contracting and repair and maintenance of machines, tools and installations.
13. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.
14. Case studies and assignments may be given to students for understanding of Enterprise Resource Management (ERM).
15. Students be made aware about issues related to environment and ecology, safety, concern for wastage of energy and other resources etc.
16. Students may be given relevant and well thought out minor and major project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment (wage and self)
17. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, Research Institutes and other important field organizations in the state.

DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING

(For the State of Himachal Pradesh)

1. **SALIENT FEATURES**

1. Name of the Programme : Diploma Programme in **Electrical Engineering**
2. Duration of the Programme : Three years (Six Semesters)
3. Entry Qualification : Matriculation or equivalent as prescribed by State Board of Technical Education, H.P.
4. Intake : 40/60 (or as prescribed by the Board)
5. Pattern of the Programme : Semester Pattern
6. Ratio between theory and **Practical classes** : 50 : 50 (Approx.)
7. **Industrial Training:**
A minimum duration of four weeks of industrial training is included after 4th semester during summer vacation. An Internal assessment out of 50 marks and an external assessment out of another 50 marks have been added in 5th semester. Total marks allotted to industrial training will be 100.
Distribution of Marks:
 - Daily diary and reports of training - 50 Marks
 - Viva Voce - 50 Marks
8. **Ecology and Environment:**
As per directives of Government of India directives, an awareness camp on Ecology and Environment has been incorporated during second semester.
9. **Entrepreneurship Development:**
An Entrepreneurial Awareness Camp and a full subject on Generic Skills and Entrepreneurship Development has been incorporated in the scheme.
10. **Student Centred Activities:**
A provision of 3-4 hrs per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co-curricular activities such as expert lectures, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities 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

2.2 GUIDELINES FOR INTERNAL ASSESSMENT

- 2.1 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 house tests. At least three such tests shall be conducted during the semester out of which at least one house test should be conducted. 30% weight age will 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.
- 2.2 The distribution of marks for Internal 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 practical.

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN ELECTRICAL ENGINEERING

It is observed that employment in government/public sector undertakings are dwindling day by day. Keeping present scenario in view following employment opportunities are visualized in different sectors of employment for diploma holders in electrical engineering

(1) Manufacturing Industry (Mechanical)

The Electrical diploma holder will be involved in following activities in mechanical manufacturing industry:

- Planning and execution for Electrical installation
- Diesel Generation and Diesel Generating Set Maintenance
- Distribution of Electrical Power
- Maintenance of Industrial Electrical System
- Repair and Maintenance of Electrical Machines and Equipment
- Repair and Maintenance of Electronic Control Circuitry
- Testing and Standardization for Quality Control
- Energy Conservation

(2) Manufacturing Industry (Electrical and Electronics)

The Electrical diploma holder will be involved in following activities in Electrical and Electronics manufacturing industry:

- Assistance in Research and Development
- Assistance in Planning, Designing and Detailing
- Shop-floor Management including Quality Control
- Diesel Generation and Distribution
- Installation of Electrical Power Supply Systems
- Maintenance of Electrical and Electronic System(s)
- Repair and Maintenance of Electrical Machines/Equipment (including testing)
- Production
- Inventory Management
- Marketing and Sales

(3) Government Departments such as Electricity Board, MES, PWD, Railways, Air bases, Airports, Defence, Thermal, Hydro and Nuclear Power Stations and other Boards and Corporations

The Electrical diploma holder will be involved in following type of activities in above mentioned Government Departments:

- Assistance in Planning and Design of Electrical generation, transmission, distribution and protection system including testing, quality control
- Estimating for electrical installation
- Construction, erection and commissioning of lines and Sub-stations
- Electrical Safety measures

- Operation and Maintenance of Lines and Sub-stations/underground cables
- Tariffs and Calculations of bills for consumption of electricity
- Inventory Management
- Repair and Maintenance of Electrical Machines/ Equipment
- Operation and maintenance of Thermal, Hydro and Nuclear Power Stations

(4) Hospitals, Commercial Complexes, Service Sector Organizations like Hotels, Tourist-Resorts, high-rise buildings, Cinema/Theater Halls etc.

The diploma holder in electrical engineering will be involved in following type of activities in above mentioned Service Sector Organizations:

- Layout of wiring circuit, planning and execution for Electrical Installation
- Standby or captive Power Generation and its Distribution
- Maintenance of Electrical and Electronic Equipment
- Preventive Maintenance of Communication System, Lifts, Air-Conditioning Plants and Water Supply System
- Inventory Management
- Estimation for electrical repair and maintenance work

(5) Self Employment

Following type of self employment opportunities are available to the diploma holder in electrical engineering:

- Trading of Electrical Goods
- Establishing Repair and Maintenance Unit/ Centre
- Free Lancer for Repair and Maintenance of House-hold Electrical and Electronic Gadgets such as: Washing Machines, Geysers, Air Conditioners, Coolers and electrical installations etc.
- Electrical contractor
- Motor Winding Unit
- Auto-electrical Work
- Service sector

3. COMPETENCY PROFILE OF DIPLOMA HOLDER IN ELECTRICAL ENGINEERING

Keeping in view the employment scenario and requirement of four domains of learning viz. Professional Development Domain, Continued Learning Domain, Human Relations Domain and Personal Development Domain, a diploma holder in Electrical Engineering should have the:

- (1) ability to read and interpret drawings related to electrical machines, equipment, wiring installations for light and power, motor control system using Programmable Logic Controllers (PLCs) and Micro-Processor based Process Control and protection systems
- (2) competency in selection of right kind and quality of materials and preparation of estimates for installation of control panels used in industry
- (3) ability to prepare tender document as per given drawings
- (4) ability to use measuring instruments, tools and testing devices for varied field applications
- (5) competency in the design of control circuits for electrical machine control, control panels, wiring circuits etc.
- (6) understanding of constructional details, principle of working, characteristics and application of electrical machines, equipment, appliances and instruments
- (7) understanding of salient features and working principles of generation, transmission, distribution, protection and utilization of electrical power in different sectors
- (8) understanding of practices involved in erection, testing/installation and commissioning of electrical machines, equipment, control panels and systems
- (9) ability for fault diagnosis and repair of electrical machines, wiring installations, equipment and control systems
- (10) knowledge and awareness of:
 - Power Tariff (Power Trade and Control)
 - Indian Electricity rules, codes and Standards
 - Electrical Safety and Shock prevention Measures
 - Labour Management
 - Technical Report-writing Skills

- Team Working, Interpersonal Relations and Human Values
- Entrepreneurship Development (Self Employment)
- Concern for wastage
- Energy Management and Auditing

- (11) understanding of safety practices such as earthing, fire and shock prevention measures adopted in industry and service sector
- (12) understanding the principles of basic and digital electronics, microprocessors and micro-controller based systems and their applications in electrical control circuits
- (13) ability to use Information Technology and computers for various applications in the field of electrical engineering
- (14) knowledge of applied and engineering sciences for better comprehension of technologies used in electrical industry and service sector and to develop scientific temper, analytical skills and to facilitate continuing education
- (15) competencies in general, manual and machining skills for supervising shop floor/ work site operations
- (16) Ability to manage self for self development i.e. intellectually, physiologically, psychologically.
- (17) Proficiency in oral and written communication, technical report preparation, managing relationship with juniors, peers and seniors for effective functioning in the world of work competency to communicate (oral and written) effectively in the professional life and develop self-learning habits
- (18) Ability to collaborate, managing different tasks and to solve unstructured problems related to various functional areas of electrical engineering may it be prototype development, diagnostic and fault finding or repair and maintenance of plant and equipment
- (19) understanding of basic principles of managing men, material and equipment and competency in organising men, material and machinery on shop floors techniques of achieving economy and quality
- (20) awareness about the environment, use of non-conventional energy sources, external financial and technical support system, adopting energy conservation techniques
- (21) Knowledge of latest trends in the field of communication, instrumentation

4. CURRICULUM AREAS/SUBJECTS DERIVED FROM COMPETENCY PROFILE

Sr. No.	Competency Profile	Curriculum Areas / Subjects
1.	Ability to read and interpret drawings related to electrical machines, equipment, wiring installations for light and power, motor control system using Programmable Logic Controllers (PLCs) and Micro-Processor based Process Control and protection systems	<ul style="list-style-type: none"> - Basic Graphic and Drawing Skills - Drawings of Electrical Machines, Equipment, Installation and Control System
2.	Competency in selection of right kind and quality of materials and preparation of estimates for installation of control panels used in industry	<ul style="list-style-type: none"> - Electrical and Electronics Engg, Materials - Electrical Engineering Drawing - Electrical Estimation and Costing
3.	Ability to prepare tender document as per given drawings	Electrical Estimation and Costing
4.	Ability to use measuring instruments, tools and testing devices for varied field applications	<ul style="list-style-type: none"> - Electrical and Electronic Instruments and Measurements - Instrumentation
5.	Competency in the design of control circuits for electrical machine control, control panels, wiring circuits etc.	<ul style="list-style-type: none"> - Design and Drawing of wiring and Control circuits - Electrical Workshop Practice
6.	Understanding of constructional details, principle of working, characteristics and application of electrical machines, equipment, appliances and instruments	<ul style="list-style-type: none"> - Electrical Machines - Utilization of Electrical Energy
7.	Understanding of salient features and working principles of generation, transmission, distribution, protection and utilization of electrical power in different sectors	<ul style="list-style-type: none"> - Transmission and Distribution of Electrical Power - Generation and Protection of Electrical Power

Sr. No.	Competency Profile	Curriculum Areas
8.	Understanding of practices involved in erection/installation and commissioning of electrical machines, equipment, control panels and systems	- Erection, Commissioning and Operation of Electrical Machines and - Installations of electrical Equipment and Control Panel etc
9.	Ability of fault diagnosis and repair of electrical machines, wiring installations, equipment and control systems	Testing, repair and maintenance of Electrical Machines and other Installations and Control System
10.	Knowledge and awareness of: <ul style="list-style-type: none"> - Power Tariff (Power Trade and Control) - Indian Electricity rules, codes and Standards - Safety and Shock prevention Measures - Labour Management - Technical Report-writing Skills - Team Working, Interpersonal Relations and Human Values - Entrepreneurship Dev. (Self Employment) - Concern for wastage 	<ul style="list-style-type: none"> - Energy Management - Electrical Safety Measures - Basics of Management - Communication Skills - Project Work - Industrial Training - Generic Skills Development and Entrepreneurship Development
11.	Understanding of safety practices such as earthing, fire and shock prevention measures adopted in industry and service sector	Electrical Workshop Practice
12.	Understanding the principles of basic and digital electronics, microprocessors and micro-controller based systems and their applications in electrical control circuits	<ul style="list-style-type: none"> - Basic Electronics - Digital Electronics and applications - Programmable Logic Controllers (PLCs) and Microcontrollers - Microprocessor based Process Control
13.	Ability to use Information Technology and computers for various applications in the field of electrical engineering	<ul style="list-style-type: none"> - Basics of Information Technology - Computer Programming and Applications
14.	Knowledge of applied and engineering sciences for better comprehension of technologies used in electrical industry and service sector and to develop scientific temper, analytical skills and to facilitate continuing education	<ul style="list-style-type: none"> - Applied Physics - Applied Chemistry - Applied Mathematics - Workshop Practice (Electrical and Mechanical)

Sr. No.	Competency Profile	Curriculum Areas
15.	Competencies in general, manual and machining skills for supervising shop floor/ work site operations	<ul style="list-style-type: none"> - Workshop Practice - Electrical Workshop Practice - Industrial Training
16.	Ability to manage self for self development i.e. intellectually, physiologically, psychologically.	Generic Skills Development
17.	Proficiency in oral and written communication, technical report preparation, managing relationship with juniors, peers and seniors for effective functioning in the world of work competency to communicate (oral and written) effectively in the professional life and develop self-learning habits	<ul style="list-style-type: none"> - Communication Techniques/ Skills - Project Work - Exposure to World of Work - Basics of Management - Generic Skills Development
18.	Ability to collaborate, managing different tasks and to solve unstructured problems related to various functional areas of electrical engineering may it be prototype development, diagnostic and fault finding or repair and maintenance of plant and equipment	<ul style="list-style-type: none"> - Repair and Maintenance of Electrical Installations - Electrical Engineering Drawing, - Estimation and Costing in Electrical Engineering
19.	Understanding of basic principles of managing men, material and equipment and techniques of achieving economy and quality, labour laws, Intellectual Property Rights(IPR)	<ul style="list-style-type: none"> - Entrepreneurship Development and Management
20..	Awareness about the environment, use of non-conventional energy sources, external financial and technical support system, adopting energy conservation techniques	<ul style="list-style-type: none"> - Environmental and Entrepreneurial Awareness - Non-Conventional Sources of Energy - Energy Management
21.	Knowledge of latest trends in the field of communication, instrumentation	<ul style="list-style-type: none"> - Communication Systems - Optical Fibre Communication

5. ABSTRACT OF CURRICULUM AREAS/SUBJECTS

a) Basic Sciences and Humanities

1. English and Communication Skills – I & II
2. Generic Skills and Entrepreneurship Development
3. Basics of Management
4. Practice in Communication Skills

b) Applied Sciences

5. Applied Mathematics –I& II
6. Applied Physics I & II
7. Applied Chemistry I & II

c) Basic Courses in Engineering/Technology

8. Engineering Drawing I & II
9. General Workshop Practice I & II
10. Basics of Information Technology

d) Applied Courses in Engineering/Technology

11. Fundamentals of Electrical Engineering
12. Basic Electronics-I
13. Electrical and Electronics Engineering Materials
14. Electrical Measurements and Measuring Instruments
15. Electronics-II
16. Electrical Machines I&II
17. Estimating and Costing in Electrical Engineering
18. Electrical Engineering Design and Drawing – I
19. Electrical Power-I (Transmission and Distribution of Electrical Power)
20. Electrical Workshop Practice- I & II
21. Computer Programming and Applications
22. Minor Project Work
23. Industrial Electronics and Control of Drives
24. Digital Electronics and Controllers
25. Electrical Power-II (Power Generation and System Protection)
26. Utilization of Electrical Energy(UEE)
27. Energy Management
28. Major Project Work

e) Specialised Courses in Engineering/Technology)

(Electives-I, to choose any one from the following)

29. Instrumentation
30. Non Conventional Sources of Energy
31. Installation and Maintenance of Electrical Equipment

(Electives-II, to choose any one from the following)

32. Microcontrollers and PLCs
33. Optical Fibre Communication
34. Modern Electric Traction System

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS (ELECTRICAL ENGINEERING)

Sr. No.	Subjects	Time Distribution in Hours/week In Various Semesters					
		I	II	III	IV	V	VI
1.	English and Communication Skills	5	5	-	-	-	-
2.	Applied Mathematics	5	5	-	-	-	-
3.	Applied Physics	6	6	-	-	-	-
4.	Applied Chemistry	6	6	-	-	-	-
5.	Basics of Information Technology	-	4	-	-	-	-
6.	Engineering Drawing	7	6	-	-	-	-
7.	General Workshop Practice	7	6	-	-	-	-
8.	Fundamentals of Electrical Engineering	-	-	6	-	-	-
9.	Electronics-I	-	-	6	-	-	-
10.	General Engineering	-	-	6	-	-	-
11.	Electrical Engineering Design and Drawing	-	-	6	-	-	-
12.	Computer Programming and Applications	-	-	6	-	-	-
13.	Electrical Workshop Practice	-	-	6	6	-	-
14.	Electrical Machines-I	-	-	-	6	-	-
15.	Electrical Measurement and Measuring Instruments	-	-	-	6	-	-
16.	Electrical and Electronics Engineering Materials	-	-	-	5	-	-
17.	Electronics-II	-	-	-	6	-	-
18.	Estimating and Costing in Electrical Engineering	-	-	-	4	-	-
19.	Generic Skills and Entrepreneurship Development	-	-	-	3	-	-
20.	Electrical Machines-II	-	-	-	-	7	-
21.	Electrical Power-I (Generation, T& D)	-	-	-	-	5	-
22.	Industrial Electronics and Electric Drives	-	-	-	-	6	-
23.	Elective –I	-	-	-	-	4	-
24.	Digital Electronics and Microprocessors	-	-	-	-	6	-
25.	PC Maintenance and Repair	-	-	-	-	4	-
26.	Minor Project Work	-	-	-	-	4	-
27.	Utilization of Electrical Engineering(U EE)	-	-	-	-	-	5
28.	Energy Management	-	-	-	-	-	6
29.	Electrical Power-II (Power Generation and System Protection)	-	-	-	-	-	7
30.	Elective – II	-	-	-	-	-	4
31.	Basics of Management	-	-	-	-	-	3
32.	Major Project Work	-	-	-	-	-	8
33.	Practice in Communication Skills	-	-	-	-	-	2
34.	Student Centred Activities	4	2	4	4	4	5
Total		40	40	40	40	40	40

STUDY
AND
EVALUATION SCHEME

1. **STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING, HIMACHAL PRADESH**

FIRST SEMESTER ELECTRICAL ENGINEERING

SR. NO	SUBJECTS	STUDY SCHEME		MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
		<i>Hrs/Week</i>		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	*English and Communication Skills – I	3	2	30	20	50	100	3	50	3	150	200
1.2	*Applied Mathematics - I	5	-	50	-	50	100	3	-	-	100	150
1.3	*Applied Physics – I	4	2	30	20	50	100	3	50	3	150	200
1.4	*Applied Chemistry – I	4	2	30	20	50	100	3	50	3	150	200
1.5	*Engineering Drawing – I	-	7	-	50	50	100	3	-	-	100	150
1.6	*General Workshop Practice – I	-	7	-	100	100	-	-	50	4	50	150
#Student Centred Activities		-	4	-	-	-	-	-	-	-	-	-
<i>Total</i>		16	24	140	210	350	500	-	200	-	700	1050

* Common with other diploma programmes

Will comprise of co-curricular activities like games, hobby clubs, including photography, seminars, declamation contests, extension lectures, educational field visits, N.C.C., NSS, cultural activities etc.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING
(FOR HIMACHAL PRADESH)**

SECOND SEMESTER (ELECTRICAL ENGINEERING)

SR. NO.	SUBJECTS	STUDY SCHEME <i>Hrs/Week</i>		MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
2.1	*English and Communication Skills - II	3	2	30	20	50	100	3	50	3	150	200
2.2	*Applied Mathematics – II	5	-	50	-	50	100	3	-	-	100	150
2.3	* Applied Physics-II	3	2	30	20	50	100	3	50	3	150	200
2.4	* Applied Chemistry-II	3	2	30	20	50	100	3	50	3	150	200
2.5	*Basic of Information Technology	-	4	-	50	50	-	-	50	3	50	100
2.6	* Engineering Drawing-II	-	6	-	50	50	100	4	-	-	100	150
2.7	*General Workshop Practice – II	-	6	-	100	100	-	-	50	4	50	150
#Student Centred Activities		-	4	-	-	-	-	-	-	-	-	-
Total		14	26	140	260	400	500	16	250	16	750	1150

* Common with other diploma programmes

Will comprise of co-curricular activities like games, hobby clubs, including photography, seminars, declamation contests, extension lectures, educational field visits, N.C.C., NSS, cultural activities etc.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING
(FOR HIMACHAL PRADESH)**

THIRD SEMESTER (Electrical Engg)

SR. NO	SUBJECTS	STUDY SCHEME Hrs/Week		MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
3.1	Fundamentals of Electrical Engineering	4	2	30	20	50	100	3	50	3	150	200
3.2	Electronics – I	4	2	30	20	50	100	3	50	3	150	200
3.3	* General Engineering	4	2	30	20	50	100	3	50	3	150	200
3.4	Computer Programming and Applications	2	4	30	20	50	100	3	50	3	150	200
3.5	Electrical Engineering Design and Drawing	-	6	-	50	50	100	-	-	-	100	150
3.6	Electrical Workshop Practice – I	-	6	-	50	50	-	-	100	3	100	150
# Student Centred Activities (including Ecology and Environmental Awareness Camp)		-	4	-	25	25	-	-	-	-	-	25
Total		14	26	120	205	325	500	-	300	-	800	1125

* Common with other diploma programmes (if it is opted in any other diploma programme)

Will comprise of co-curricular activities like games, hobby clubs, including photography, seminars, declamation contests, extension lectures, educational field visits, N.C.C., NSS, cultural activities etc.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING
(FOR HIMACHAL PRADESH)**

FOURTH SEMESTER (Electrical Engg)

SR. NO	SUBJECTS	STUDY SCHEME Hrs/Week		MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	Electrical Machines – I	4	2	30	20	50	100	3	50	3	150	200
4.2	Electrical Measurements and Instruments	4	2	30	20	50	100	3	50	3	150	200
4.3	Electronics –II	4	2	30	20	50	100	3	50	3	150	200
4.4	Electrical and Electronics Engineering Materials	5	-	50	-	50	100	3	-	-	100	150
4.5	Estimating and Costing in Electrical Engineering	4	-	50	-	50	100	3	-	-	100	150
4.6	Electrical Workshop Practice–II	-	6	-	50	50	-	-	100	3	100	150
4.7	* Generic Skills and Entrepreneurship Development	3	-	50	-	50	100	3	-	-	100	150
# Student Centred Activities(SCA) including Entrepreneurial Awareness camp		-	4		25	25	-	-	-	-	-	25
Total		24	16	240	135	375	600	-	250	-	850	1225

* Common with other diploma programmes

Will comprise of co-curricular activities like games, hobby clubs, including photography, seminars, declamation contests, extension lectures, educational field visits, N.C.C., NSS, cultural activities etc.

Industrial Training - After examination of 4th Semester, the students shall go for training in a relevant industry/field organisation for a minimum period of 4 weeks and shall prepare a diary. It shall be evaluated during 5th semester by his/her teacher for 50 marks. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated for another 50 marks. This evaluation will be done by HOD and lecturer incharge – training at the start of 5th Semester.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING
(FOR HIMACHAL PRADESH)**

FIFTH SEMESTER(Electrical Engg)

SR. NO.	SUBJECTS	STUDY SCHEME		MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
5.1	Electrical Machine – II	5	2	30	20	50	100	3	50	3	150	200
5.2	Electrical Power–I(T&D of Elect Power)	5	-	50	-	50	100	3	-	-	100	150
5.3	Industrial Electronics and Control of Drives	4	2	30	20	50	100	3	50	3	150	200
5.4	Elective – I	4	-	50	-	50	100	3	-	-	100	150
5.5	Digital Electronics	4	2	30	20	50	100	3	50	3	150	200
5.6	PC Maintenance and Repairs	-	4	-	50	50	-	-	50	3	50	100
5.7	Minor Project Work	-	4	-	50	50	-	-	50	3	50	100
INDUSTRIAL TRAINING		-	-	-	50	50	-	-	50	-	50	100
# Student Centred Activities(SCA)		-	4		25	25	-	-	-	-	-	25
Total		22	18	190	235	425	500	-	300	-	800	1225

- There will be a compulsory industrial/educational tour for one week after the semester

Will comprise of co-curricular activities like games, hobby clubs, including photography, seminars, declamation contests, extension lectures, educational field visits, N.C.C., NSS, cultural activities etc.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL ENGINEERING
(FOR HIMACHAL PRADESH)**

SIXTH SEMESTER (Electrical Engg)

SR. NO.	SUBJECTS	STUDY SCHEME		MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Hrs/Week	Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	
6.1	Utilization of Electrical Energy(UEE)	5	-	50	-	50	100	3	-	-	100	150
6.2	Energy Management	4	2	30	20	50	100	3	50	3	150	200
6.3	Electrical Power – II (Power Generation and System Protection)	5	2	30	20	50	100	3	50	3	150	200
6.4	Elective-II	4	-	50	-	50	100	3	-	-	100	150
6.5	*Basics of Management	3	-	50	-	50	100	3	-	-	100	150
6.6	Major Project Work	-	8	-	100	100	-	-	100	3	100	200
6.7	*Practice in Communication Skills	-	2	-	50	50	-	-	50	3	50	100
# Student Centred Activities(SCA)		-	5		25	25	-	-	-	-	-	25
Total		21	19	210	215	425	500	-	250	-	750	1175

* Common Course with other diploma programmes

Will comprise of co-curricular activities like games, hobby clubs, including photography, seminars, declamation contests, extension lectures, educational field visits, N.C.C., NSS, cultural activities etc.

9. INDUSTRIAL TRAINING OF STUDENTS

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 a minimum of 4 weeks duration to be organised during the semester break starting after second year i.e. after IV 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. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of V 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. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry.

Teachers and students are requested to see the footnote below the study and evaluation scheme of IV Semester for further details.

2. DETAILED CONTENTS OF ELECTRICAL ENGINEERING SUBJECTS

1.1 ENGLISH AND COMMUNICATION SKILLS – I

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RATIONALE

Language is the most commonly used medium of self-expression in all spheres of human life – personal, social and professional. A student must have a fair knowledge of English language and skills to communicate effectively to handle the future jobs in industry. The objective of this course is to enable the diploma holders to acquire proficiency, both in spoken (oral) and written language. At the end of the course, the student will be able to develop comprehension skills, improve vocabulary, use proper grammar, acquire writing skills, correspond with others and enhance skills in spoken English. It is expected that each polytechnic will establish a **communication skill laboratory** for conducting practicals mentioned in the curriculum.

DETAILED CONTENTS

1. **Facets of Literature** (14 hrs)
 - 1.1 Short Stories
 - 1.1.1 Homecoming – R.N. Tagore
 - 1.1.2 The Selfish Giant - Oscar Wilde
 - 1.1.3 The Diamond Necklace- Guy- De Maupassant
 - 1.2 Prose
 - 1.2.1 I Have A Dream – Martin Luther King
 - 1.2.2 On Habits – A. G. Gardiner
 - 1.2.3 My struggle for An Education- Booker T Washington
 - 1.3 Poems
 - 1.3.1 Ozymandias – P.B. Shelley
 - 1.3.2 Daffodils – William Wordsworth
 - 1.3.3 Stopping by Woods on a Snowy Evening – Robert Frost
2. **Grammar and Usage** (10 hrs)
 - 2.1 Parts of speech
 - 2.1.1 Nouns
 - 2.1.2 Pronouns
 - 2.1.3 Adjectives
 - 2.1.4 Articles
 - 2.1.5 Verbs
 - 2.1.6 Adverbs
 - 2.1.7 Prepositions
 - 2.1.8 Conjunction
 - 2.1.9 Interjection
 - 2.1.10 Identifying parts of speech

- 2.2 **Pair of words (Words commonly confused and misused)**
- 2.1 Tenses
- 2.2 Correction of incorrect sentences
- 2.3 One word Substitution
3. **Translation** (04 hrs)
- 3.1 Glossary of Administrative Terms (English and Hindi)
- 3.2 Translation from Hindi into English and English to Hindi.
4. Paragraph of 100-150 words from outlines (08 hrs)
5. **Comprehension** (04 hrs)
- Unseen passages of literacy, scientific, data/graph based for comprehension exercises
6. **Communication** (08 hrs)
- 6.1 Definition, Introduction and Process of Communication
- 6.2 Objectives of Communication

LIST OF PRACTICALS

1. Locating a Book in Library
2. How to look up words in a Dictionary: meaning and pronunciation of words as given in the standard dictionary using symbols of phonetics,
3. How to Seek Information from an Encyclopedia
4. Listening pre-recorded English language learning programme
5. Paper Reading before an audience (reading unseen passages)
6. Study of spelling Rules
7. Study of essentials of a Good Speech to respond and comprehend visual, oral themes, situations or stimulus and practice before select gathering
8. Exercises on use of different abbreviations
9. Greetings for different occasions
10. Introducing oneself, others and leave taking
11. Exercises on writing sentences on a topic

Note:

1. *The Text Book on “English and Communication Skills, Book-I By Kuldip Jaidka et. al. developed by NITTTR, Chandigarh is recommended to be used for teaching and setting-up the question papers.*
2. *A communication laboratory may be set up consisting of appropriate audio-video system with facility of playing CDs/DVDs and a video camera for recording the performance of each student with play back facility. A set of CDs from any language training organization e.g. British Council etc. may be procured for use of students.*
3. *Elements of body language will be incorporated in all practicals*
4. *The practical exercises involving writing may also be included in Theory Examination.*

RECOMMENDED BOOKS

1. English and Communication Skills, Book-I By Kuldip Jaidka, Alwainder Dhillon and Parmod Kumar Singla, Prescribed by NITTTR, Chandigarh Published By Abhishek Publication, 57-59, Sector-17, Chandigarh
2. Essentials of Business Communication by Pal and Rorualling; Sultan Chand and Sons
3. The Essence of Effective Communication, Ludlow and Panthon; Prentice Hall of India
4. New Design English Grammar, Reading and Writing Skills by AL Kohli (Course A and course B), Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,
5. New Design English Reading and Advanced Writing Skills for Class XI and XII by MK Kohli and AL Kohli; Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,
6. A Practical English Grammar by Thomson and Marlinet
7. Spoken English by V Sasikumar and PV Dhamija; Tata McGraw Hill
8. English Conversation Practice by Grount Taylor; Tata McGraw Hill
9. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
10. Business Correspondence and Report Writing by RC Sharma and Krishna Mohan; Tata McGraw Hill Publishing Company Ltd. New Delhi
11. Communication Skills by Ms R Datta Roy and KK Dhir; Vishal Publication, Jalandhar

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	40
2	10	15
3	4	10
4	8	10
5	4	10
6	8	15
Total	48	100

Glossary of Administrative Terms

1.	Senior	वरिष्ठ
2.	Cashier	खजान्ची
3.	Consent	सहमती
4.	Earned Leave	जमा छुट्टी
5.	Under Consideration	विचार अधीन
6.	Criterion	कसौटी
7.	Staff	कर्मचारी
8.	Tenure	कार्यकाल
9.	Working Committee	कार्य समिति
10.	Estate	सम्पदा
11.	Self-Sufficient	आत्मनिर्भर
12.	Emergency	आपात्तकाल
13.	General Body	आम सभा
14.	Exemption	छूट
15.	Daily wages	दिहाड़ीदार
16.	Death-Cum Retirement	मृत्यु और निवृत्ती
17.	Despatch Register	रवानगी रजिस्टर
18.	Despatch	रवानगी
19.	Stenography	आशुलिपिक
20.	Assurance	दिलासा
21.	Justify	सही साबित करना
22.	Superior	बढ़िया
23.	High Commission	उच्चायुक्त
24.	Simultaneous	साथ - साथ
25.	Precautionary	एहतियाती
26.	Commanding Office	कमांडिंग अफसर
27.	Negligence	लापरवाही
28.	Performance	पुरा करना
29.	Proof Reader	पुफ रीडर
30.	Take Over	काम सभालना
31.	Timely Compliance	समय दौरान पुरा करना
32.	Responsibility	जिमेदारी
33.	Chief Justice	मुख्य न्यायधिेश
34.	Disciplinary Action	अनुशासनिक कारवाई
35.	Efficiency Bar	दक्षता रोक
36.	Flying Squad	उड़न दस्ता
37.	Regret	खेद
38.	Inconvenience	असुविधा
39.	Ambiguous	अस्पष्ट
40.	Part Time	अंशकालीन
41.	Academy	अकादमी
42.	Disparity	असमानता
43.	Extraordinary	असाधारण
44.	Provisional	अस्थायी
45.	Income Tax	आयकर
46.	Bonafide	असली
47.	Acting in Official Capacity	बतौर अधिकारिक हैसियत
48.	Contractor	ठेकेदार
49.	On probation	परिवीक्षाधीन
50.	State	राज्य

51.	Administrator	प्रशासक
52.	Admission	प्रवेश
53.	Aforesaid	पूर्वोक्त, उपरोक्त
54.	Affidavit	शपथपत्र
55.	Agenda	कार्यसूची
56.	Alma Mater	विद्यालय जहां किसी व्यक्ति ने शिक्षा प्राप्त
57.	Appointing Authority	मनोनित अधिकारी
58.	Apprentice	शिल्पकारू
59.	Additional	अतिरिक्त
60.	Advertisement	विज्ञापन
61.	Assistant	सहायक
62.	Assumption of Charge	अधिकार ग्रहण करना
63.	Attested Copy	सत्यापित प्रति
64.	Chief Minister	मुख्यमन्त्री
65.	Clerical Error	लेखन सम्बन्धी भ्रम
66.	Code	कानून की किताब, गुप्त भाषा
67.	Corruption	नैतिक भ्रष्टाचार, खोटापन
68.	Craftsman	कारीगर
69.	Compensation	हरजाना
70.	Compensatory Allowance	क्षतिपूरक भत्ता
71.	Compile	संकलन करना, संग्रह करना
72.	Confidential Letter	गुप्त पत्र
73.	Chief Engineer	मुख्य अभिन्यता
74.	Data	स्वीकृत तत्त्व (आंकड़े)
75.	Dearness Allowance	संहर्गाई भत्ता
76.	Department	विभाग
77.	Dictionary	शब्द कोष
78.	Director	निदेशक, संचालन
79.	Director of Tech. Edu.	तकनीकी शिक्षा निदेशक
80.	Executive Engineer	अधिशाली अभिन्यता
81.	Employment Exchange	व्यवसाय केन्द्र
82.	Head Office	मुख्य कार्यालय
83.	Head Clerk	प्रधान लिपिक
84.	Indian Admn. Service	भारतीय प्रशासनिक सेवा
85.	Legislative Assembly	विधान सभा
86.	Officiating	स्थानापन्न
87.	Office Record	कार्यालय रिकार्ड
88.	Office Discipline	कार्यालय अनुशासन
89.	Polytechnic	बहुतकनीकी
90.	Temporary	अस्थायी
91.	Qualified	योग्यता प्राप्ति
92.	Under Investigation	जांच अधीन
93.	Sub-treasury	उप-खजाना
94.	Target Date	लक्ष्य तिथि
95.	Technical Approval	तकनीकी मान्यता
96.	Verification	जांच पड़ताल
97.	Viva-voca	मौखिक परीक्षा
98.	Write off	बटटेखाते डालना
99.	Warning	चेतावनी
100.	Yours faithfully	भवदीय

1.2 APPLIED MATHEMATICS - I

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RATIONALE

Applied Mathematics forms the backbone of engineering students. Basic elements of algebra, trigonometry, coordinate geometry have been included in the curriculum as foundation course. This course will develop analytical abilities to make exact calculations and will provide continuing educational base to the students.

DETAILED CONTENTS

1. **Algebra** (30 hrs)
 - 1.1 Complex Numbers: Complex number, representation, modulus and amplitude. De-moivre's theorem, its application in solving algebraic equation.
 - 1.2 Geometrical progression, its nth term and sum of n terms and to infinity. Application of Arithmetic progression and Geometrical progression to Engineering problem.
 - 1.3 Partial fractions (linear factors, repeated linear factors)
 - 1.4 Permutations and Combinations: Value of ${}^n P_r$ ${}^n C_r$. Simple problems
 - 1.5 Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof) first and second binomial approximation with applications to engineering problems
2. **Trigonometry** (20 hrs)
 - 2.1 Concept of angles, measurement of angles in degrees, grades and radians and their conversions.
 - 2.2 T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T-Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2).
 - 2.3 Graphs of Sin x, Cos x, Tan x and e^x

3. Differential Calculus

(30 hrs)

3.1 Definition of function; Concept of limits.

$$\text{Lt } x \rightarrow a \frac{x^n - a^n}{x - a}$$

$$\text{Lt } x \rightarrow 0 \frac{\sin x}{x}, \quad \text{Lt } x \rightarrow 0 \frac{a^x - 1}{x}, \quad \text{Lt } x \rightarrow 0 (1+x)^{1/x}$$

3.2 Differentiation by definition of x^n , $\sin x$, $\cos x$, $\tan x$, e^x , $\log_a x$

3.3 Differentiation of sum, product and quotient of functions. Differentiation of function of a function.

3.4 Differentiation of trigonometric inverse functions. Logarithmic differentiation. Exponential differentiation Successive differentiation (excluding nth order).

3.5 Applications:

(a) Errors and increments

(b) Maxima and minima

(c) Equation of tangent and normal to a curve (for explicit functions only)

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics by Vol. I & II by S Kohli, IPH, Jalandhar
3. Applied Mathematics by Dr. RD Sharma
4. Applied Mathematics, Vol. I & II by SS Sabharwal & Sunita Jain, Eagle Parkashan, Jalandhar
5. Comprehensive Mathematics, Vol. I & II by Laxmi Publications
6. Engineering Mathematics by Dass Gupta
7. Engineering Mathematics by C Dass Chawla, Asian Publishers, New Delhi
8. Comprehensive Mathematics, Vol. I & II by Laxmi Publications
9. Engineering Mathematics, Vol I, II & III by V Sundaram et al, Vikas Publishing House (P) Ltd., New Delhi
10. Engineering Mathematics by N.Ch.S.N Iyengar et.al, Vikas Publishing House (P) Ltd., New Delhi
11. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
12. Engineering Mathematics, Vol I & II by AK Gupta, MacMillan India Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	30	30
2	20	30
3	30	40
Total	80	100

1.3 APPLIED PHYSICS– I

L T P
4 - 2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content.

DETAILED CONTENTS

1. **Units and Dimensions** (08 hrs)
 - 1.1 Physical quantities
 - 1.2 Units - fundamental and derived units, systems of units (FPS, CGS, MKS and SI units)
 - 1.3 Dimensions and dimensional formulae of physical quantities
 - 1.4 Dimensional equations and principle of homogeneity, applications to conversion from one system of units to another, checking the correctness of physical relations and derivation of simple physical relations, limitations of dimensional analysis
 - 1.5 Significant figures and error analysis

2. **Force and Motion** (12 hrs)
 - 2.1 Scalar and vector quantities – examples, addition and multiplication (scalar product and vector product) of vectors
 - 2.2 Force, resolution and composition of forces – resultant, parallelogram law of forces, equilibrium of forces, Lami's theorem
Force, type of forces, gravitational electromagnetic weak and strong force, conservative and non-conservative forces with simple examples.
 - 2.3 Newton's Laws of motion – concept of momentum, Newton's laws of motion and their applications, determination of force equation from Newton's second law of motion; Newton's third law of motion, conservation of momentum, impulse, simple numerical problems
 - 2.4 Circular motion – angular displacement, angular velocity and angular acceleration
 - 2.5 Relation between linear and angular variables (velocity and acceleration)
 - 2.6 Centripetal force (derivation) and centrifugal force
 - 2.7 Banking of roads

3. **Work, Power and Energy** (14 hrs)
 - 3.1 Work: definition and its SI units
 - 3.2 Work done in moving an object on horizontal and inclined plane (incorporating frictional forces)
 - 3.3 Power: definition and its SI units, calculation of power in simple cases

- 3.4 Energy: Definition and its SI units: Types: Kinetic energy and Potential energy with examples and their derivation
 - 3.5 Principle of conservation of mechanical energy (for freely falling bodies), transformation of energy from one form to another
 - 3.6 Relation between work, heat and energy
 - 3.7 Concept of friction, cause and types, applications of friction in daily life
4. **Rotational Motion** (06 hrs)
- 4.1 Definitions of torque, angular momentum, their relationship
 - 4.2 Conservation of angular momentum (qualitative) and its examples
 - 4.3 Moment of inertia and its physical significance, radius of gyration
 - 4.4 Theorems of parallel and perpendicular axes (statements)
 - 4.5 Moment of inertia of rod, disc, ring and sphere
5. **Properties of Matter** (10 hrs)
- 5.1 Elasticity, definition of stress and strain, different types of modulus of elasticity, stress – strain diagram, Hooke’s law
 - 5.2 Pressure – its units, gauge pressure, absolute pressure, atmospheric pressure, Pascal law and its applications.
 - 5.3 Surface tension – its units, measurement of surface tension by capillary tube method, applications of surface tension, effect of temperature and impurity on surface tension
6. **Thermometry** (10 hrs)
- 6.1 Principles of measurement of temperature and different scales of temperature
 - 6.2 Difference between heat and temperature on the basis of K.E. of molecules
 - 6.3 Types of thermometers, Physical properties on which they are based
(No description of individual thermometer)
 - 6.4 Co-efficient of linear, surface and cubical expansions and relation amongst them
 - 6.5 Modes of transfer of heat (Conduction, convection and radiation with examples)
 - 6.6 Co-efficient of thermal conductivity, determination of thermal conductivity of good conductor (Searle’s method) and bad conductor (Lee’s disc method)

7. Space Exploration and Radio-activity

(04 Hrs)

Concept of Natural, artificial satellite, equatorial orbit, Geo-Stationary orbit, Polar orbit, Apogee, Perigee, inclination, purpose of space research, space science in India, Indian satellite, Application of space science, Useful life of satellite, Natural radioactivity, units, concept of nuclear fission, fusion and nuclear reactor. Applications of Radioisotopes in Agriculture industry and medicine.

LIST OF PRACTICALS (to perform minimum eight experiments)

1. To find the diameter of wire using a screw gauge
2. To find volume of solid cylinder and hollow cylinder using a vernier caliper
3. To determine the thickness of glass strip and radius of curvature of a concave surface using a spherometer
4. To verify the parallelogram law of forces
5. To verify conservation of energy of a rolling solid sphere/cylinder
6. To find the diameter of a capillary tube using Travelling Microscop
7. To find the time period of a simple pendulum
8. To find the time period of cantilever
9. To determine the atmospheric pressure at a place using Fortin's Barometer
10. To find the coefficient of thermal conductivity of copper using Searle's conductivity apparatus

RECOMMENDED BOOKS

1. *Test Book of Physics for Class XI (Part-I, Part-II) N.C.E.R.T /C.B.S.E.*
2. *Test Book of Physics for Class XII (Part-I, Part-II) N.C.E.R.T /C.B.S.E.*
3. *Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi*
4. *Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi*
5. *Fundamentals of Physics by Resnick and Halliday & Walker, Asian Book Pvt. Ltd., New Delhi*
6. *Berkeley Physics Course, Vol. I, II & III, Tata McGraw Hill, Delhi*
7. *The Feynman Lectures on Physics by Feynman, Leighton and Sands, Vol. I & II, Narosa Publishing House, Delhi*
8. *Fundamentals of Optics by Francis A. Jenkins & Harvey E White, McGraw Hill International Editions, Physics Series*
9. *A Text Book of Optics by Subramanian and Brij Lal, S Chand & Co., New Delhi*
10. *Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publishers*
11. *Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi*
12. *Applied Physics I & II by RA Banwait & R Dogra, Eagle Parkashan, Jalandhar*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	10
2	12	20
3	14	25
4	06	10
5	10	15
6	10	15
7	04	05
Total	64	100

1.4 APPLIED CHEMISTRY - I

L T P
4 - 2

RATIONALE

The role of chemistry and chemical products in every branch of engineering is expanding greatly. Now a days various products of chemical industries are playing important role in the field of engineering with increasing number of such products each successive years. The strength of materials, the chemical composition of substances, their behavior when subjected to different treatment and environment, and the laws of heat and dynamic energy have entered in almost every activity of modern life. Chemistry is considered as one of the core subjects for diploma students in engineering and technology for developing in them scientific temper and appreciation of chemical properties of materials, which they have to handle in their professional career. Effort should be made to teach this subject through demonstration and with the active involvement of students.

DETAILED CONTENTS

1. **Basic concepts of Chemistry** (10 hrs)
 - 1.1 Units and Dimensions, derived units (with special reference to pressure, volume, temperature, density, specific gravity, surface tension, viscosity and conductivity)
 - 1.2 Matter, element, compound and mixtures, atom, molecule, ion, symbols and formulae (recapitulation only)
 - 1.3 Atomic mass (A), molar mass, mole concept, molar volume of gases
 - 1.4 Solution, strength of solutions in grams per liter, molarity (M), molality (m), mass fraction and mole fraction (numerical problems)
 - 1.5 Chemical equations, thermo-chemical equations, balancing of chemical equations (using partial equation method)
 - 1.6 Numerical problems based on mole concept
 - 1.7 Brief introduction and concept of Volumetry Analysis
2. **Atomic structure and Chemical Bonding** (10 hrs)
 - 2.1 Fundamental particles i.e. electron, proton and neutron (their masses and charges)
 - 2.2 Postulates of Bohr model of atom, success and failures of Bohr model of atom
 - 2.3 Heisenberg's uncertainty principle
 - 2.4 Elementary idea of modern concept of atom, quantum numbers (significance only), definition of shells, sub shells and orbitals, concept of orbitals, shapes of s & p orbitals only. Electronic configuration of elements (atomic number 1 to 30 only) on the basis of Aufbau principle, Pauli's principle and Hund's rule
 - 2.5 Modern periodic law, introduction of periodic table, periods and groups,
 - 2.6 Division of the periodic table into s, p, d, and f blocks (details excluded)
 - 2.7 Chemical bond and cause of bonding
 - 2.8 Ionic bond, covalent bond, orbital concept of covalent bonding, valence bond theory, sigma (σ) and pi (π) bonds.
 - 2.9 Metallic bonding (electron sea model)
 - 2.10 Coordinate bond with examples of ozone, ammonium chloride, $\text{H}_3\text{N}-\text{BF}_3$ complex

3. **Water** (10 hrs)
- 3.1 Sources of water
 - 3.2 Hard water, soft water, types of hardness, action of soap on hard water
 - 3.3 Degree of hardness in terms of calcium carbonate, Units of hardness in Clark degree, French degree and ppm
 - 3.4 Estimation of hardness by EDTA method,
 - 3.5 Disadvantages of hard water in domestic and industrial uses
 - 3.6 Boiler water: causes and prevention of scale and sludge formation, corrosion, priming & foaming and caustic embitterment
 - 3.7 Softening of hard water by premitit and ion exchange processes
 - 3.8 Qualities of drinking water and purification of available water for drinking purposes
 - 3.9 Chemical analysis: Estimation of alkalinity, estimation of total dissolved solids (TDS), free chlorine, chloride, and dissolved oxygen
 - 3.10 Numerical problems
4. **Equilibrium, Acids and Bases.** (10 hrs)
- 4.1 Equilibrium state, equilibrium constant and statement of Le-chatelier's principle with illustration
 - 4.2 Ionization of electrolyte in aqueous solution, ionic equilibrium, degree of ionization, self-ionization of water and ionic product of water (K_w)
 - 4.3 Concept of pH and pH scale
 - 4.4 Arrhenius concept of acids/bases; strong acids/bases, weak acids/bases, dissociation constants of acids/bases. Neutralization, acid base titration, choice of indicators for acid base titration
 - 4.5 Hydrolysis of salts, buffer solutions (acidic and basic), buffer action of a buffer solution, applications of buffer solution
 - 4.6 Simple numerical problems
5. **Electrochemistry.** (10 hrs)
- 5.1 Electronic concept of oxidation and reduction, redox reactions
 - 5.2 Electrolytes and non electrolytes
 - 5.3 Electrolysis, Faradays laws of electrolysis
 - 5.4 Applications of electrolysis in electrometallurgy, electro-refining and electroplating (numerical)
 - 5.5 Galvanic cells (elementary idea) brief description of Daniel cell, Ni-Cd cell, dry cell and lithium iodide cell
 - 5.6 Lead storage batteries and maintenance free batteries
 - 5.7 Simple numerical problems related to Faraday's laws
6. **Organic Chemistry.** (08 hrs)
- 6.1 Tetra covalency of carbon, catenation (definition only)
 - 6.2 Structural and condensed formulae of organic compounds
 - 6.3 Homologous series, functional groups and following organic families: (a) alkanes (b) alkenes (c) alkynes (d) alcohols (e) ethers (f) aldehydes and ketones (g) Carboxylic acids (h) esters (i) amides (with structure, IUPAC names and method of preparation of first member of the series)

7. **Environmental Pollution and its control.** (06 hrs)
- 7.1 Introduction
- 7.2 Causes and control of air, water, and soil pollutions
- 7.3 Noise pollution
- 7.4 Radio active pollution and its control
- 7.5 Sewage and its treatment

LIST OF PRACTICALS

1. Introduction to volumetric analysis, apparatus used and molarity based calculations
 2. To determine strength of given solution of sodium hydroxide by titrating against standard solution of oxalic acid using phenolphthalein indicator.
 3. To determine strength of given solution of sulphuric acid by titrating against standard solution of sodium carbonate using methyl orange indicator (or by conductometrically).
 4. Estimation of hardness of water by EDTA method.
 5. Estimation of total alkalinity in the given sample of water by titrating against standard solution of sulfuric acid.
 6. Determination of the dosage of bleaching powder required for sterilization or disinfection of different samples of water, using standard sodium thiosulfate solution
 7. Estimation of chloride ions in the given sample of water by titrating against standard solution of silver nitrate.
 8. To determine %age purity of ferrous sulphate in given solution of known strength using potassium permanganate solution.
 9. To distinguish between aldehyde and ketone by Tollen's reagent (benzaldehyde and acetone may be used)
 10. To prepare iodoform from ethanol or acetone
- OR
11. To prepare the Mohr's salt from ferrous sulphate and ammonium sulphate.

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose And J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C.Jain and Monika Jain, Dhanapat Rai Publishing Company New Delhi.
3. Engineering Chemistry by Shashi Chawla.
4. Progressive Applied Chemistry – I by Dr. G.H. Hugar Eagle Prakashan Jalandhar

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	10	15
3	10	10
4	10	20
5	10	20
6	08	10
7	06	10
Total	64	100

1.5 ENGINEERING DRAWING - I

L T P
- - 7

RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawing is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

Note:

- i) *First angle projection is to be followed*
- ii) *Minimum of 14 sheets to be prepared*
- iii) *Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students*

DETAILED CONTENTS

1. **Handling, Use and Care of Drawing Instruments and Materials**
 - 1.1 Drawing Instruments
 - 1.2 Materials
 - 1.3 Layout of drawing sheets
2. **Free Hand Sketching and Lettering** (01 sheets)
 - 2.1 Different types of lines in Engineering drawing as per BIS specifications
 - 2.2 Practice of free hand sketching of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves
3. **Lettering Technique and Practice** (02 sheets)
 - 3.1 Instrumental single stroke lettering of 35 mm and 70 mm height in the ratio of 7:4
 - 3.2 Free hand lettering (Alphabet and numerals)- lower case and upper case, single stroke, vertical and inclined at 75 degree in different standards, series of 3, 5, 8 and 12 mm heights in the ratio of 7:4
4. **Dimensioning Technique** (01 sheet)
 - 4.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)
 - 4.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sink holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches
5. **Scales** (02 sheets)
 - 5.1 Scales - their need and importance (Theoretical instructions).
 - 5.2 Drawing of plain and diagonal scales

6. **Projection** (04 sheets)
- 6.1 Theory of projections (Elaborate theoretical instructions)
 - 6.2 Drawing 3 views of given objects (Non-symmetrical objects may be selected for this exercise)
 - 6.3 Drawing 6 views of given objects (Non-symmetrical objects may be selected for this exercise)
 - 6.4 Identification of surfaces on drawn views and objects drawn
 - 6.5 Exercises on missing surfaces and views
 - 6.6 Introduction to third angle projections
7. **Sections** (02 sheets)
- 7.1 Importance and salient features, Methods of representing sections, conventional sections of various materials, classification of sections, conventions in sectioning
 - 7.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.
 - 7.3 Drawing of different conventions for materials in section, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections
 - 7.4 Exercises on sectional views of different objects.
8. **Isometric Views** (02 sheets)
- 8.1 Fundamentals of isometric projections (Theoretical instructions)
 - 8.2 Isometric views from 2 or 3 given orthographic views.
9. **Symbols and Conventions** (02 sheets)
- 9.1 Civil engineering, sanitary fitting symbols
 - 9.2 Electrical fitting symbols for domestic interior installations
 - 9.3 Building plan drawing with electrical and civil engineering symbols, Material symbols and conventions.

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh, Dhanpat Rai & Co., Delhi
2. Engineering Drawing by PS Gill, SK Kataria & Sons, New Delhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt,
Charactar Publishing House
4. Engineering Drawing I & II by JS Layall, Eagle Parkashan, Jalandhar

1.6 GENERAL WORKSHOP PRACTICE - I

L T P

- - 7

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hand on experience about use of different tools and basic manufacturing practices.

This course aims at developing general manual and machining skills in the students. Besides above, the development of dignity of labour, precision, safety at work place, team working and development of right attitude are the other objectives.

DETAILED CONTENTS (PRACTICALS)

The following shops are included in the syllabus:

1. Carpentry and Painting Shop-I
2. Fitting Shop -I
3. Welding Shop-I
4. Electric Shop –I
5. Smithy Shop –I or Electronic Shop-I
6. Sheet Metal Shop-I

Note:

1. The branches e.g. Civil Engineering, Electrical Engineering, Mechanical Engineering, Automobile Engineering and Instrumentation & Control Engineering will do **Smithy Shop - I** instead of Electronic shop- I
2. The branches e.g. Electronics and Communication Engineering, will do **Electronic shop-I** instead of Smithy Shop-I.

1. Carpentry and Painting Shop – I

- 1.1 Introduction to various types of wood such as Deodar, Kail, Partal, Teak, Hollack, Sheesham, Champ, etc. (Demonstration and their identification).
- 1.2 Demonstration, function and use of commonly used hand tools. Care, maintenance of tools and safety measures to be observed.
Job I Marking, sawing and planing practice
Job II Extensive planing practice on soft wood
Job III Chiseling practice
- 1.3 Introduction to various types of wooden joints, their relative advantages and uses.
Job IV Preparation of half lap joint
Job V Preparation of Mortise and Tenon Joint
- 1.4 Demonstration of various methods of painting wooden items.
Job V Preparation of surface before painting.
Job VI Application of primer coat
Job VII Painting wooden items by brush/roller/spray

2. Fitting Shop – I

- 2.1 Introduction to fitting shop, common materials used in fitting shop, Identification of materials. (e.g. Steel, Brass, Copper, Aluminium etc.) Identification of various sections of steel such as Flat, Angle, Tee, Channel, Bar Girder, Square, Z-Section, etc.
- 2.2 Description and demonstration of various types of work benches. Holding devices and files, Precautions while filing. Different types of punches and their uses
Job I Filing practice (Production of flat surfaces) Checking by straight edge.
Job II Marking of jobs, use of marking tools and measuring instruments.
Job III Filing a dimensioned rectangular or Square piece of an accuracy of $\pm 0.25\text{mm}$.
- 2.3 Introduction to chipping, Demonstration on chipping and its applications. Demonstration and function of chipping tools.
Job IV Chipping practice
- 2.4 Care and maintenance of measuring tools like calipers, steel rule, try square, vernier calipers, micrometer, height gauge, combination set, surface plate, universal angle plate. Handling of measuring instruments, checking of zero error, finding of least count.
Job III Preparation of a job by filing on non-ferrous metal upto an accuracy of $\pm 0.1\text{mm}$
Job IV Preparation of job involving thread on GI pipe/ PVC pipe and fixing of different types of elbow, tee union, socket, stopcock, taps, etc.
- 2.5 Description and demonstration of simple operation of hack-sawing, demonstration and description of various types of blades and their specifications, uses and method of fitting the blade.
Job V Making a cutout from a square piece of MS Flat using Hand hacksaw.

3. Welding Shop – I

- 3.1 Introduction to welding and its importance in engineering practice; types of welding; common materials that can be welded, introduction to welding equipment e.g. a.c. welding set, d.c. rectifier, Electrode holder, electrodes and their specifications, welding screens and other welding related equipment and accessories.
- 3.2 Electric arc welding, (ac. and dc.) precautions while using electric arc welding, Practice in setting current and voltage for striking proper arc.
Job I Practice of striking arc while using electric arc welding set.
Job II Welding practice job on arc welding for making uniform and straight weld beads.
- 3.3 Various types of joints and end preparation.
Job III Preparation of butt joint by arc welding.
Job IV Preparation of lap joint by arc welding.
Job V Preparation of corner joint by using electric arc welding.
Job VI Preparation of Tee joint by arc welding.

4. Electric Shop – I

- 4.1 Study, demonstration and identification of common electrical materials such as wires, cables, switches, fuses, ceiling roses, battens, cleats and allied items, tools and accessories.
- 4.2 Study of electrical safety measures and demonstration about use of protective devices.
Job I Identification of phase, neutral and earth of domestic appliances and their connection to two pin/three pin, plugs.
Job II Lay out of complete wiring of a house (i) batten wiring (ii) plastic casing and capping.
- 4.3 Study of common electrical appliances such as electric iron, electric kettle, ceiling fan/ table fan, electric mixer, electric Geyser, desert cooler etc.
Job III Testing and rectification of simulated faults in above said electrical appliances.
- 4.4 Introduction to a Lead-acid battery and its working.
Job IV Installation of a battery and to connect in series and parallel
Job V Charging a battery and testing it with the help of hydrometer and cell tester.

5. Smithy Shop – I

- 5.1 Demonstration and detailed explanation of tools and equipment used. Forging operations in Smithy shop. Safety measures to be observed in the smithy shop.
- 5.2 Demonstration and description of bending operation, upsetting operation, description and specification of anvils, swage blocks, hammers, etc.
- 5.3 Demonstration and description of tongs, fullers, swages
Job I To forge a L-Hook.
Job II To prepare a job involving upsetting process
Job III To forge a chisel
Job IV To prepare a cube from a M.S. round by forging method.

OR

5. Electronic Shop – I

- 5.1 Identification and familiarization with the following electronic instruments:
 - a) Multimeter digital (Three and half digit)
 - b) Single beam simple CRO, function of every knob on the front panel
 - c) Audio-oscillator sine and square wave output
 - d) Power supply fixed voltage and variable voltage, single output as well as dual output.Job I - Practice in the use of above mentioned equipment through a small experiment
- 5.2 Identification and familiarization with commonly used tools: statement of their uses. Identification and familiarisation with active and passive components; colour code and types of resistor and potentiometers (including VDR, LDR, and thermistor). Identification of components including LED, LCD, UJT, FET, Coils, relays,

switches (SPDT, DPDT, etc.) connectors, micro switches, reed relays, transformers (mains, audio and RF, etc) Linear and Digital ICs, Thyristors, etc.

NOTE: *Demonstration Boards for the above components should be made.*

Job II Cut, strip, join and insulate two length of wires/ cables (repeat with different types of cables/wires)

Job III Cut, strip, connect/solder/crimp different kinds of wires/ cables (including shielded cable) to different types of power/general purpose/Audio Video/Telephone plugs, sockets, jacks, terminals, binding posts, terminal strips, connectors. The tasks should include making complete recording/ playback/ antenna/ speaker leads for common electronic products such as Radio, TV, VCR, Cassette Recorder, Hi-Fi equipment, Head set, microphone

Job IV Cut, bend, tin component, Leads, inserts and solder components (resistor, capacitor, diodes, transistors, IFT type coils, DIL, ICs etc) on a PCB

Job V Wiring of a small circuit on a PCB/tag strip involving lapping, sleeving and use of identifier tags

6. Sheet Metal Shop –I

Introduction to sheet metal shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.

6.1 Introduction and demonstration of hand tools used in sheet metal shop.

6.2 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Nibbling machine, Turning Machine, Wiring Machine, Setting Down Machine, Forming Machine , Punching Machine, Brake, Bending Machine etc.

6.3 Introduction to various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheets etc.

6.4 Study of various types of Nuts, Bolts, Rivets, Steel Screws etc.

Job I Shearing practice on a sheet using hand shears.

a) Single rivetted lap joint/Double rivetted lap joint

b) Single cover plate chain type/zig-zag type single rivetted Butt Joint

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Choudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.
3. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd. New Delhi
4. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi

2.1 ENGLISH AND COMMUNICATION SKILLS - II

L T P
3 - 2

RATIONALE

*Language is the most commonly used medium of self-expression in all spheres of human life – personal, social and professional. A student must have a fair knowledge of English language and skills to communicate effectively to handle the future jobs in industry. The objective of this course is to enable the diploma holders to acquire proficiency, both in spoken (oral) and written language. At the end of the course, the student will be able to develop comprehension skills, improve vocabulary, use proper grammar, acquire writing skills, correspond with others and enhance skills in spoken English. It is expected that each polytechnic will establish a **communication skill laboratory** for conducting practicals mentioned in the curriculum.*

DETAILED CONTENTS

1. **Facets of Literature** (12 hrs)
 - 1.1 Short stories
 - 1.1.1 The Portrait of a Lady - Khushwant Singh
 - 1.1.2 The Refugees – Pearl S. Buck
 - 1.2 Prose
 - 1.2.1 Forgetting- Robert Lynd.
 - 1.2.2 Walking Tours- Robert Louis Stevenson
 - 1.3 Poems
 - 1.3.1 All The World's A Stage – W. Shakespeare
 - 1.3.2 No Men are Foreign- James Kirkup
2. **The Art of Précis Writing** (04 hrs)
3. **Grammar and Usage** (08 hrs)
 - 3.1 Narration
 - 3.2 Voice
 - 3.3 Idioms and Phrases
4. **Correspondence** (06 hrs)
 - 4.1 Business Letters
 - 4.2 Personal letters
 - 4.3 Application for Job
5. **Drafting** (08 hrs)
 - 5.1 Report Writing
 - 5.2 Inspection Notes
 - 5.3 Memos, Circulars
 - 5.4 Telegrams
 - 5.5 Press Release
 - 5.6 Agenda and Minutes of Meetings
6. **Glossary of Technical & Scientific Terms** (02 hrs)

7. **Communication** (08 hrs)
- 7.1 Media and Modes of Communication
 - 7.2 Channels of Communication
 - 7.3 Barriers to Communication
 - 7.4 Listening Skills- Types of Listening
 - 7.5 Body language

LIST OF PRACTICALS

1. Practice on browsing information from Internet
2. Group Discussions
3. Mock Interviews
4. Telephone Etiquette – demonstration and practice
5. Situational Conversation with feedback through video recording
6. Presentation on a given theme (using PowerPoint)
7. Exercises leading to personality development like mannerism, etiquettes, body language etc.
8. Reading unseen passages
9. Writing (developing) a paragraph
10. Exercises on writing notices and telephonic messages

Note:-

1. *The Text Book on “English and Communication Skills, Book-II By Kuldip Jaidka et. al. developed by NITTTR, Chandigarh is recommended to be used for teaching & setting-up the question papers.*
2. *A communication laboratory may be set up consisting of appropriate audio-video system with facility of playing CDs/DVDS and a video camera for recording the performance of each student with play back facility. A set of CDs from any language training organization e.g. British Council etc. may be procured for use of students.*
2. *Elements of body language will be incorporated in all practicals.*
3. *The practical exercises involving writing may also be included in Theory Examination.*

RECOMMENDED BOOKS

1. *English and Communication Skills, Book-II By Kuldip Jaidka, Alwainder Dhillon and Parmod Kumar Singla, Prescribed by NITTTR, Chandigarh & Published By Abhishek Publication, 57-59, Sector-17, Chandigarh*
2. *Essentials of Business Communication by Pal and Rorualling; Sultan Chand and Sons*
3. *The Essence of Effective Communication, Ludlow and Panthon; Prentice Hall of India*
4. *New Design English Grammar, Reading and Writing Skills by AL Kohli (Course A and course B), Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,*
5. *New Design English Reading and Advanced Writing Skills for Class XI and XII by MK Kohli and AL Kohli; Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,*
6. *A Practical English Grammar by Thomson and Marlinet*
7. *Spoken English by V Sasikumar and PV Dhamija; Tata McGraw Hill*
8. *English Conversation Practice by Grount Taylor; Tata McGraw Hill*

9. *Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi*
10. *Business Correspondence and Report Writing by RC Sharma and Krishna Mohan; Tata McGraw Hill Publishing Company Ltd. New Delhi*
11. *Communication Skills by Ms R Datta Roy and KK Dhir; Vishal Publication, Jalandhar*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	40
2	4	10
3	8	15
4	6	10
5	8	10
6	2	5
7	8	10
Total	48	100

GLOSSARY OF TECHNICAL & SCIENTIFIC TERMS

1. Absolute	परम, अचर, पूर्ण, स्थिर
2. Acceleration	त्वरण, प्रवेग
3. Acid	अम्ल
4. Alkaline	क्षारीय, खारा
5. Air Compressor	वायु - संपीडक
6. Air Conditioning	वातानुकूलन
7. Alignment	सरेखन
8. Alternating Current	प्रत्यावर्ती धारा
9. Altimeter	ऊँचाई मापने का यंत्र
10. Alum	फिटकरी
11. Ammeter	अम्मीटर
12. Ampere	ऐम्पियर
13. Amplification	प्रवर्धन
14. Amplitude	आयाम
15. Angle	कोण
16. Angular Velocity	कोणीय वेग
17. Angular Momentum	कोणीय संवेग
18. Annealing	तापानुशीतन
19. Anode	अनोड
20. Apex	शीर्ष, शिखर, शिखाग्र
21. Apparent	स्पष्ट
22. Applied Mechanics	अनुप्रयुक्त यंत्रिकी
23. Applied Science	अनुप्रयुक्त विज्ञान
24. Archimedes's Principle	आर्किमिडीज़ का सिद्धांत
25. Architecture	वास्तुकला, स्थापत्यकला
26. Armature	आर्मेचर
27. Atom	परमाणु
28. Automatic	स्वचलित
29. Axis	अक्ष
30. Axle	धुरी
31. Balance (Scale)	तुला, तराजू
32. Ball Bearing	बाल - बेयरिंग
33. Bar magnet	छड़ - चुम्बक
34. Barometer	वायुदाबमापी
35. Base	आधार
36. Base Plate	आधार पट्टिका
37. Battery	बैटरी
38. Beaker	बीकर
39. Bending Moment	वक्रण आघूर्ण
40. Blast Furnace	झोंका भट्टी
41. Bleach	विरंजक
42. Boiler	उबालक
43. Bridge	पुल
44. Burette	ब्यूरेट
45. Callipers	कैलिपर्स
46. Calorie	कैलोरी
47. Canal	नहर
48. Capacitance	धारिता
49. Carburettor	कार्बुरेटर
50. Cast Iron	ढलवा लोहा

51.	Catalyst	उत्प्रेरक
52.	Cathode	कैथोड
53.	Centre of Gravity	गुरुत्वाकर्षण - केन्द्र
54.	Centrifugal	उपकेन्द्रीय
55.	Centripetal	अभिकेन्द्रीय
56.	Centroid	केन्द्रीय
57.	C.G.S. System	सी.जी.एस. पद्धति
58.	Chemical Action	रासायनिक क्रिया
59.	Chai	श्रृंखला, माला
60.	Change of State	अवस्था परिवर्तन
61.	Characteristics	लक्षण
62.	Charge (n)	आवेश
63.	Choke	चोक
64.	Chord, Major	गुरु स्वर - संघात
65.	Chord, Minor	लघु स्वर - संघात
66.	Circular	वृत्ताकार, वर्तुल
67.	Clock-wise	दक्षिणा वर्त
68.	Coagulation	स्कंदन
69.	Coefficient of Expansion	प्रसार गुणांक
70.	Coil	कुंडली
71.	Combustion	दहन
72.	Compass	दिशासूचक
73.	Compound	यौगिक
74.	Concave	अवतल
75.	Convex	उत्तल
76.	Concentrated (Solution)	गाढ़ा, सांद्रित (घोल)
77.	Concrete	कंकरीट
78.	Conduction	चालन
79.	Conductor	चालक
80.	Cone	शंकु
81.	Connection	सम्बंध, जोड़
82.	Constant (Adj.)	स्थिर, अचल, एकसमान
83.	Convection	संवहन
84.	Coulomb	कूलोम (विद्युत शक्ति की इकाई)
85.	Couple	बल युग्म
86.	Crane	क्रेन
87.	Crystalline	रवेदार
88.	Dehydrate	निर्जल करना
89.	Distil	आसहन करना
90.	Effervescence	बुदबुदाहट
91.	Element	तत्त्व, मूलतत्त्व
92.	Empirical Formula	मूलअनुपाती सूत्र
93.	Equivalent Weight	तुल्यांकी - भार
94.	Flame Test	ज्वाला - परीक्षण
95.	Flash Point	प्रज्वलन - ताप
96.	Flask	फ्लास्क
97.	Spring Balance	कमानी तुला
98.	Soluble	विलयशील
99.	Viscosity	गाढ़ापन
100.	Volumetric Analysis	आयतनी विश्लेषण

2.2 APPLIED MATHEMATICS - II

L T P
5 - -

RATIONALE

Applied mathematics forms the backbone of engineering students. Basic elements of Differential calculus and integral calculus and statistics have been included in this course. This will develop analytical abilities to apply in engineering field and will provide continuing educational base to the students.

DETAILED CONTENTS

1. **Algebra** (12 hrs)
 - 1.1 Determinants: Elementary properties of determinants up to 3rd order, consistency of equations, Cramer's rule.
 - 1.2 Matrix: Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.

2. **Co-Ordinate Geometry** (20 hrs)
 - 2.1 Cartesian and Polar coordinates (two dimensional), conversion from cartesian to polar coordinates and vice-versa, distance between two points (cartesian co-ordinates), section formulae
 - 2.2 Area of triangle when its vertices are given, co-ordinates of centroid, in center of a triangle when the vertices are given, simple problems on locus.
 - 2.3 Equation of straight line in various standard forms (without proof), inter section of two straight lines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula
 - 2.4 General equation of a circle and its characteristics. To find the equation of a circle, given:
 - * Centre and radius
 - * Three points lying on it
 - * Coordinates of end points of a diameter;

3. **Integral Calculus** (30 hrs)
 - 3.1 Integration as inverse operation of differentiation
 - 3.2 Simple integration by substitution, by parts and by partial fractions (for linear factors only)
 - 3.3 Applications of integration for :
 - (a) Simple problem on evaluation of area bounded by a curve and axes.
 - (b) Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems).
 - (c) To calculate average and root mean square value of a function

4. **Vector Algebra** (12 hrs)
 a) Definition notation and rectangular resolution of a vector.
 b) Addition and subtraction of vectors.
 c) Scalar and vector products of 2 vectors.
 d) Simple problems related to work, moment and angular velocity

5. **Differential Equations** (06 hrs)
 Solution of first order and first degree differential equation by variable separation method (simple problems)

RECOMMENDED BOOKS

1. *Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi.*
2. *Engineering Mathematics by Vol. I & II by S Kohli, IPH, Jalandhar*
3. *Applied Mathematics by Dr. RD Sharma*
4. *Applied Mathematics, Vol. I & II by SS Sabharwal & Sunita Jain/ M.L. Moudgil & P.C. Chopra, Eagle Parkashan, Jalandhar*
5. *Comprehensive Mathematics, Vol. I & II by Laxmi Publications*
6. *Engineering Mathematics by Dass Gupta*
7. *Engineering Mathematics by C Dass Chawla, Asian Publishers, New Delhi*
8. *Comprehensive Mathematics, Vol. I & II by Laxmi Publications*
9. *Engineering Mathematics, Vol I, II & III by V Sundaram et.al, Vikas Publishing House (P) Ltd., New Delhi*
10. *Engineering Mathematics by N.Ch.S.N Iyengar et.al, Vikas Publishing House (P) Ltd., New Delhi*
11. *Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,*
12. *Engineering Mathematics, Vol I & II by AK Gupta, Macmillan India Ltd., New Delhi*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	20	20
3	30	40
4	12	10
5	06	10
Total	80	100

2.3 APPLIED PHYSICS – II

L T P
3 - 2

RATIONALE

Applied physics includes the study of a large number of diverse topics related to things that go in the world around us. It aims to give an understanding of this world both by observation and prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology

DETAILED CONTENTS

Section – A : Waves and Applications

1. **Waves and vibrations** (10 hrs)
 - 1.1 Wave motion with examples, generation of waves by vibrating particles
 - 1.2 Types of wave motion - transverse and longitudinal wave motion with examples, sound and light waves, velocity, frequency and wave length of a wave. Relationship between wave velocity, frequency and wave length.
 - 1.3 Simple harmonic motion: definition, expression for displacement, velocity, acceleration, time period, frequency in S.H.M.
 - 1.4 Vibration of cantilever and beam, determination of time period of a cantilever
 - 1.5 Free, forced and resonant vibrations with examples
2. **Applications of sound waves** (05 hrs)
 - 2.1 Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time
 - 2.2 Ultrasonics – production (magnetostriction and piezoelectric methods) and their engineering applications
3. **Light** (10 hrs)

Electromagnetic Waves, properties of Electromagnetic waves, Electromagnetic Spectrum interference of light, types of interference, young's double slit experimentm Coherent source of Light, Diffraction of light, Difference between diffraction and interference.

Section – B : Electrical Circuits and Electromagnetism

4. **Electrostatics** (08 hrs)
- 4.1 Coulombs law, unit charge
 - 4.2 Electric flux and Gauss's Law, Electric field intensity and electric potential
 - 4.3 Electric field of point charge, charged sphere (conducting and non-conducting), straight charged conductor, plane charged sheet
 - 4.4 Capacitance, types of capacitors, capacitance of parallel plate capacitor, series and parallel combination of capacitors, charging and discharging of capacitor, their behaviour under AC and DC
 - 4.5 Dielectric and its effect on capacitors, dielectric constant and dielectric break down
5. **DC Circuits** (08 hrs)
- 5.1 Concept of electricity, various applications of electricity
 - 5.2 Current, voltage and resistance, potential difference, power, electrical energy and their units, advantages of electrical energy over other forms of energy
 - 5.3 Ohm's law
 - 5.4 Series and parallel combination of resistors, specific resistance, effect of temperature on resistance, co-efficient of resistance
 - 5.5 Kirchhoff's laws, wheatstone bridge principle and its applications
 - 5.6 Heating effect of current and concept of electric power
6. **Electromagnetism** (08 hrs)
- 6.1. Magnetic field and its units
 - 6.2. Biot-Savart Law, magnetic field around a current carrying straight conductor, circular loop and solenoid
 - 6.3. Force on a moving charge and current in a magnetic field, force between two current carrying parallel conductors
 - 6.4. Moving coil galvanometer, conversion of galvanometer into ammeter and voltmeter
 - 6.5. Permeability, dia, para and ferro-magnetic materials

Section – C : Advanced Physics

7. **Semiconductor physics** (05 hrs)
- 7.1 Energy bands, intrinsic and extrinsic semiconductors, p-n junction diode and its characteristics
 - 7.2 Diode as rectifier – half wave and full wave rectifier
8. **Modern Physics** (10 hrs)
- 8.1 Lasers: concept of energy levels, ionization and excitation potentials; spontaneous and stimulated emission; lasers and its characteristics, population inversion, types of lasers, helium – neon and ruby lasers and applications
 - 8.2 Fibre optics: introduction, optical fiber materials, types, light propagation and applications
 - 8.3 Superconductivity: phenomenon of superconductivity, effect of magnetic field, critical field, type I and type II superconductors and their applications

LIST OF PRACTICALS (To perform minimum eight experiments)

1. To determine and verify the time period of cantilever by drawing graph between load (w) and depression (d)
2. To verify Ohm's law
3. Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions
4. To verify laws of resistances in series and in parallel
5. To convert a galvanometer into an ammeter of a given range
6. To convert a galvanometer into a voltmeter of a given range
7. To study the capacitance of a parallel plate capacitor
8. To study characteristics of a pn junction diode
9. To find the wavelength of a He-Ne laser
10. To compare capacitance using DeSauty bridge
11. To determine ionization potential of Mercury
12. To determine high resistance by substitution method
13. To plot sine wave, square wave on CRO and to determine wavelength and velocity of waves

RECOMMENDED BOOKS

1. *Test Book of Physics for Class XI (Part-I, Part-II) N.C.E.R.T*
2. *Test Book of Physics for Class XII (Part-I, Part-II) N.C.E.R.T*
3. *Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi*
4. *Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi*
5. *Fundamentals of Physics by Resnick, Halliday and Walker, Asian Book Pvt. Ltd., New Delhi*

6. *Berkeley Physics Course, Vol. I, II & III, Tata McGraw Hill, Delhi*
7. *The Feynman Lectures on Physics by Feynman, Leighton and Sands, Vol. I & II, Narosa Publishing House, Delhi*
8. *Fundamentals of Optics by Francis A. Jenkins & Harvey E White, McGraw Hill International Editions, Physics Series*
9. *A Text Book of Optics, Subramanian and Brij Lal, S Chand & Co., New Delhi*
10. *Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publishers*
11. *Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi*
12. *Applied Physics I & II by RA Banwait & R Dogra, Eagle Parkashan, Jalandhar*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	05	10
3	10	15
4	08	10
5	08	10
6	08	15
7	05	10
8	10	15
Total	64	100

2.4 APPLIED CHEMISTRY - II

L T P
3 - 2

RATIONALE

The role of chemistry and chemical products in every branch of engineering is expanding greatly. Now a day various products of chemical industries are playing important role in the field of engineering with increasing number of such products each successive years. The strength of materials, the chemical composition of substances, their behavior when subjected to different treatment and environment, and the laws of heat and dynamic energy have entered in almost every activity of modern life. Chemistry is considered as one of the core subjects for diploma students in engineering and technology for developing in them scientific temper and appreciation of chemical properties of materials, which they have to handle in their professional career. Effort should be made to teach this subject through demonstration and with the active involvement of students.

DETAILED CONTENTS

1. **Metallurgy** (10 hrs)
 - 1.1 General metallurgical terms/operations
 - 1.2 Extraction of pure iron, copper and aluminium from their chief ores
 - 1.3 Manufacture of wrought iron from pig iron, manufacture of steel by open hearth process and L.D. process
 - 1.4 Alloys: Types of alloys (ferrous and non ferrous) purposes of alloying, composition, properties and uses of – invar steel, nichrome, stain less steel, brass, bronze, gun metal, duralumin, alnico, germen silver, magnalium

2. **Corrosion.** (06 hrs)
 - 2.1 Definition and electro chemical theory of corrosion, passivity of metals (e.g. Ti, Cr, Fe and Al)
 - 2.2 Preventions and control measures: (i) Internal measures (purification of metals, alloying with corrosion resistant elements, heat treatment) (ii) External measures (application of inhibitors, alteration of corrosion environments, protective coatings – (a) Metallic (b) Non-metallic coating and sacrificial anode)

3. **Fuels.** (12 hrs)
 - 3.1 Introduction, combustion, classification of fuels, characteristics of good fuel
 - 3.2 Calorific value, determination of calorific value by Bomb calorimeter, and Dulong's formula (equation to be assumed, numerical problems)
 - 3.3 Proximate and Ultimate analysis of coal
 - 3.4 Fuel rating: Octane number, cetane number, influence of chemical composition and structure on fuel rating
 - 3.5 Gaseous fuels : Natural gas, LPG, CNG, Hydrogen, Composition, manufacture and uses of water gas, producer gas, biogas,

- 3.6 Merits and demerits of gaseous fuels over solid and liquid fuels
 - 3.7 Numerical problems (of section 3.1 (only on combustion), 3.2 and 3.3)
4. **Lubricants.** (04hrs)
- 4.1 Definition and classification of lubricants
 - 4.2 Mechanism of lubrication
 - 4.3 Characteristics of good lubricants
 - 4.4 Properties of lubricants: such as oiliness, emulsification, flash and fire point, volatility, viscosity and viscosity index, cloud and pour point, acidity value, soapification value, coke number.
5. **Paints and Varnishes.** (04hrs)
- 5.1 Constituent of paints, characteristics of good paint
 - 5.2 Constituent and characteristics of varnishes
 - 5.3 Constituent of enamels
 - 5.4 Uses of paints varnishes and enamels
6. **Refractories** (04 hrs)
- 6.1 Introduction and characteristics of good refractory materials
 - 6.2 Types and chemical composition of acidic, basic and neutral refractories
 - 6.3 Applications of refractories
7. **Polymers, Plastics and Adhesives.** (08 hrs)
- 7.1 Polymerization, degree of polymerization (DP). Addition and condensation polymers with suitable examples
 - 7.2 Definition, structure and applications of thermoplastics and thermosetting plastics with examples of each type
 - 7.3 Plasticizer, fillers and binders
 - 7.4 Definition and examples of fibers and elastomers (natural and synthetic rubber)
 - 7.5 Adhesives, synthetic resins (both thermosetting and thermoplastic)

LIST OF PRACTICALS

1. Estimation of copper in the given copper ore solution by titrating against standard solution of sodium thiosulfate/ or spectrophotometrically.
2. Estimation of total dissolved salts in the given sample of water gravimetrically.
3. Estimation of moisture in the given coal sample gravimetrically
4. Estimation of ash in the given coal sample gravimetrically
5. Determination of viscosity of given liquid by Red Wood viscometer
6. Determination of flash / fire point of the given lubricant using Able' s flash point apparatus
7. Determination of total acid value (Total acid number TAN) of a lubricating oil

RECOMMENDED BOOKS

1. *Chemistry in Engineering* by J.C. Kuricose and J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. *Engineering Chemistry* by P.C.Jain and Monika Jain, Dhanapat Rai Publishing Company New Delhi.
3. *Engineering Chemistry* by Shashi Chawla/A.D. Sharma
4. *Progressive Applied Chemistry – II* by Dr. G.H. Hugar, Eagle Prakashan Jalandhar.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	17
2	06	10
3	12	25
4	04	10
5	04	10
6	04	10
7	08	18
Total	48	100

2.5 BASICS OF INFORMATION TECHNOLOGY

L T P
- - 4

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concept of information technology and its scope; operating a computer; use of various tools of MS office; using internet etc. form the broad competency profile of diploma holders. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

Note:

1. There will be no theory examination.
2. Explanation of Introductory part should be dovetailed with practical work so that following topics may be explained in the laboratory along with the practical exercises.

DETAILED CONTENTS

- (1) Information Technology – its concept and scope
- (2) Computers for information storage, information seeking, information processing and information transmission
- (3) Elements of computer system, computer hardware and software; data – numeric data, alpha numeric data; contents of a program, processing
- (4) Computer organization, block diagram of a computer, CPU, memory
- (5) Input devices; keyboard, Scanner, mouse etc; output devices; VDU and Printer, Plotter
- (6) Electrical requirements, inter-connections between units, connectors and cables
- (7) Secondary storage; magnetic disks – tracks and sectors, optical disk (CD, CD-RW and DVD Memory), primary and secondary memory: RAM, ROM, PROM etc., Capacity; device controllers, serial port, parallel port, system bus
- (8) Installation concept and precautions to be observed while installing the system and software
- (9) Introduction about Operating Systems such as Windows, Windows NT etc.
- (10) About the internet – server types, connectivity (TCP/IP, shell); applications of internet like: e-mail and browsing
- (11) Various Browsers like WWW (World wide web); hyperlinks; HTTP (Hyper Text Transfer Protocol); FTP (File Transfer Protocol)
- (12) Basics of Networking – LAN,WAN, Topologies

LIST OF PRACTICALS

1. Given a PC, name its various components and list their functions
2. Identification of various parts of a computer and peripherals
3. Practice in installing a computer system by giving connection and loading the system software and application software
4. Installation of DOS and simple exercises on TYPE, REN, DEL, CD, MD, COPY, TREE, BACKUP commands
5. Exercises on entering text and data (Typing Practice)
6. Installation of Windows 98 or 2000 or NT or XP.
 - (1) Features of Windows as an operating system
 - Start
 - Shutdown and restore
 - Creating and operating on the icons
 - Opening closing and sizing the windows
 - Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file
 - Creating and operating on a folder
 - Changing setting like, date, time color (back ground and fore ground)
 - Using short cuts
 - Using on line help
7. **MS-Word**
 - File Management:
Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, Giving password protection for a file
 - Page Set up:
Setting margins, tab setting, ruler, indenting
 - Editing a document:
Entering text, Cut, copy, paste using tool- bars
 - Formatting a document:
Using different fonts, changing font size and colour, changing the appearance through bold/ italic/ underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
 - Aligning of text in a document, justification of document ,Inserting bullets and numbering
 - Formatting paragraph, inserting page breaks and column breaks, line spacing
 - Use of headers, footers: Inserting footnote, end note, use of comments
 - Inserting date, time, special symbols, importing graphic images, drawing tools
 - Tables and Borders:
Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
 - Print preview, zoom, page set up, printing options

- Using Find, Replace options
- Using Tools like:
Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels
- Using shapes and drawing toolbar,
- Working with more than one window in MS Word,
- How to change the version of the document from one window OS to another
- Conversion between different text editors, software and MS word

8. **MS-Excel**

- Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, create chart, printing chart, save worksheet, switching between different spread sheets
- Menu commands:
Create, format charts, organise, manage data, solving problem by analyzing data, exchange with other applications. Programming with MS-Excel, getting information while working
- Work books:
Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations, working with arrays
- Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet
- Creating a chart:
Working with chart types, changing data in chart, formatting a chart, use chart to analyze data
- Using a list to organize data, sorting and filtering data in list
- Retrieve data with MS – query: Create a pivot table, customising a pivot table. Statistical analysis of data
- Exchange data with other application: embedding objects, linking to other applications, import, export document.

9. **MS PowerPoint**

- a) Introduction to Powerpoint
 - How to start Powerpoint
 - Working environment: concept of toolbars, slide layout, templates etc.
 - Opening a new/existing presentation
 - Different views for viewing slides in a presentation: normal, slide sorter etc.
- b) Addition, deletion and saving of slides
- c) Insertion of multimedia elements
 - Adding text boxes
 - Adding/importing pictures
 - Adding movies and sound
 - Adding tables and charts etc.
 - Adding organisational chart

- d) Formatting slides
 - Using slide master
 - Text formatting
 - Changing slide layout
 - Changing slide colour scheme
 - Changing background
 - Applying design template
 - e) How to view the slide show?
 - Viewing the presentation using slide navigator
 - Slide transition
 - Animation effects etc.
10. Internet and its Applications
- a) Log-in to internet
 - b) Navigation for information seeking on internet
 - c) Browsing and down loading of information from internet
 - d) Sending and receiving e-mail
 - Creating a message
 - Creating an address book
 - Attaching a file with e-mail message
 - Receiving a message
 - Deleting a message

RECOMMENDED BOOKS

1. *Fundamentals of Computer* by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. *Computers Today* by SK Basandara, Galgotia publication Pvt ltd. Daryaganj, New Delhi.
3. *MS-Office 2000 for Everyone* by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., New Delhi
4. *Internet for Every One* by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. *A First Course in Computer* by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
6. *Mastering Windows 95*, BPB Publication, New Delhi
7. *Computer Fundamentals* by PK Sinha; BPB Publication, New Delhi
8. *Fundamentals of Information Technology* by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
9. *On Your Marks - Net...Set...Go... Surviving in an e-world* by Anushka Wirasinha, Prentice Hall of India Pvt. Ltd., New Delhi
10. *Learning MS Office XP* by Ramesh Bangia, Khanna Book Publishing Co. (P) Ltd., New Delhi.
11. *Fundamentals of Information Technology* by Vipin Arora, Eagle Parkashan, Jalandhar

2.6 ENGINEERING DRAWING - II

L T P
- - 6

RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawing is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation . The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

Note:

1. First angle projection is to be followed
2. Minimum 15 sheets to be prepared
3. SP 46 -1988 should be followed
4. Instructions relevant to various drawings may be given along with appropriate demonstration, before assigning drawing practice to the students
5. 20 percent of drawing sheets to be prepared on the third angle projection

DETAILED CONTENTS

1. **Detail and Assembly Drawing** (02 sheets)
 - 1.1 Principle and utility of detail and assembly drawings
 - 1.2 Practical exercise on drawing from detail to assembly or vice versa using wooden joints as example
2. **Threads** (Min.02 sheets)
 - 2.1 Nomenclature of threads, types of threads (metric). Single and multiple start threads
 - 2.2 Forms of various external thread sections such as V, Square, Acme, Knuckle, Metric, Seller and Buttress thread
 - 2.3 Simplified conventions of left hand and right hand threads, both external and internal threads
3. **Nuts and Bolts** (Min.02 sheets)
 - 3.1 Different views of hexagonal and square headed bolts and nuts
 - 3.2 Assembly of nuts and bolts with washers
4. **Locking Devices** (01 sheet)
 - 4.1 Lock nuts, Castle nuts, Sawn nuts, Split pin lock nut
 - 4.2 Spring washers, Locking plates.

5. **Screws, Studs and Washers** (01 sheet)
 - 5.1 Drawing various types of machine screws
 - 5.2 Drawing various types of studs
 - 5.3 Drawing various types of washers

6. **Keys and Cotters** (Min.03 sheets)

Various types of keys and their application. Preparation of drawings of various keys and cotters

 - 6.1 Various types of joints (a) Sleeve and Cotter joint (b) Kunckle joint (c) Spigot and Socket joint

7. **Coupling** (02 sheets)

Flange coupling (protected and unprotected coupling)

 - 7.1 Pin type flexible coupling

8. **Rivets and Rivetted Joints** (02 sheets)
 - 8.1 Types of general purpose rivet heads
 - 8.2 Types of rivetted joints - lap, butt (single cover plate and double cover plate), chain and zig-zag riveting.
 - 8.3 Caulking and fullering of rivetted joints.

9. **Welded Joints** (01 sheet)
 - 9.1 Various conventions and symbols of welded joints (IS 696)
 - 9.2 Practical application of welded joints say joints of steel frames, windows, doors and furniture.

10. Introduction to AutoCAD (not to be included in examination)

RECOMMENDED BOOKS

1. *A Text Book of Engineering Drawing by Surjit Singh, Dhanpat Rai & Co., Delhi*
2. *Engineering Drawing by PS Gill, SK Kataria & Sons, New Delhi*
3. *Elementary Engineering Drawing in First Angle Projection by ND Bhatt, Charotar Publishing House*
4. *Engineering Drawing I & II by JS Layall, Eagle Parkashan, Jalandhar*

2.7 GENERAL WORKSHOP PRACTICE - II

L T P
- - 6

RATIONALE

As we know that, the psychomotor skills are mastered through practice, an opportunity therefore, has been extended to students through this course to refine their skills in different trades. The basic skills developed during first semester will be refined during this course by doing higher order skills jobs. In addition to developing general manual and machining skills in the students, the objective of development of sense of dignity of labour, precision, safety at work places, team working and right attitude among the students will also be met.

DETAILED CONTENTS (PRACTICALS)

The following shops are included in the syllabus. Student can opt relevant shops depending upon the need of his/her branch of diploma programme :

1. Carpentry and painting shop-II
2. Fitting shop -II
3. Welding shop -II
4. Electric shop -II
5. Smithy shop –II or Electronic shop-II
6. Sheet Metal Shop –II

Note:

1. *The branches e.g. Civil Engineering, Electrical Engineering, Mechanical Engineering, Automobile Engineering will do **Smithy Shop -II** instead of Electronic shop- II*

And

2. *The branches e.g. Electronics and Communication Engineering, Instrumentation and Control will do **Electronic shop- II** instead of Smithy Shop- II*

1. Carpentry and Painting Shop - II

- 1.1 Introduction to joints, their relative advantages and uses.
Job I Preparation of Dovetail joint and glued joint.
Job II Preparation of Mitre Joint
Job III Preparation of a lengthening Joint
Job IV Preparation of atleast one utility job with and without lamination.
- 1.2 Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.
- 1.3 Demonstration of job on Band Saw and Circular Saw, Jig Saw, Chain and Chisel, Universal wood working machine, Saw re-sharpening machine, Saw Brazing unit.
- 1.4 Importance and need of polishing wooden items, Introduction to polishing materials.
Job V Preparation of surface before polishing.
Job VI Application of primer coat.
Job VII Polishing on wooden items

2. Fitting Shop – II

- 2.1 Introduction to various types of threads (internal, external)-single start, multi-start, left hand and right hand threads.
- 2.2 Description and demonstration of various types of drills, taps and dies Selection of dies for threading, selection of drills and taps for tapping operations.
Job I Making internal and external threads on a job by tapping and dieing operations manually)
- 2.3 Precautions while drilling soft metals, e.g. copper, Brass, Aluminium etc.
Job II Drilling practice on soft metals (Aluminum, Brass and copper)
- 2.4 Introduction and demonstration of dial type indicator, sine bar and U block with clamps

3. Welding Shop – II

- 3.1 Introduction to gas welding, spot welding and seam welding and machinery and equipment used. Adjustments of different types of flames in gas welding demonstration and precautions about handling welding equipment.
Job I Practice in handling gas welding equipment (Low pressure and High pressure) and welding practice.
- 3.2 Common welding joints generally made by gas welding.
Job II Preparation Butt joint by gas welding.
Job III Preparation of small cot frame from conduit pipe by electric arc welding/gas welding.
Job IV Preparation of square pyramid from MS rods by welding (type of welding to be decided by students themselves).
Job V Exercise job on spot/seam welding machine.

4 Electric Shop – II

- 4.1 Importance of three-phase wiring and its effectiveness.
Job I Laying out 3 phase wiring for an electric motor or any other 3 phase machine.
- 4.2 Estimating and costing of power consumption.
Job II Connecting single-phase energy meter and testing it. Reading and working out the power consumption and the cost of energy.
Job III Checking continuity of connection (with tester and lamp) location of faults with a multimeter) and their rectification in simple machines and/or other electric circuits fitted with earthing.
- 4.3 Demonstration of dismantling, servicing and reassembling a table fan/ceiling fan/air cooler/mixer/electric iron, Electric heater, geyser, electric oven, air conditioner etc.

- Job IV Dismantling, servicing serving and reassembling of any of the above electrical appliances.
- Job V Testing Single phase/three phase electrical motor by using voltmeters, ammeter, clip on meter, tachometer etc.
- Job VI Reversing the rotation of a motor.

5. Smithy Shop – II

- 5.1 Introduction to various heat treatment processes e.g annealing, hardening, tempering, normalizing etc.
- 5.2 Description of various types of power hammers and their usage (Demonstration only).

- Job I To forge a ring to acquaint the students with forge welding
- Job II To forge a chisel and acquaint the students with simple idea of hardening and tempering.
- Job III To forge squares on both ends of a circular rod
- Job IV To forge a single/double ended spanner.
- Job V To prepare a job involving drawing down process

OR

5. Electronic Shop- II

- 5.1 Demonstrate the jointing methods of mounting and dismantling as well as uses of the items mentioned below:
 - a) Various types of single, multi-cored insulated screened power, audio video, co-axial, general purpose wires/cables
 - b) Various types of plugs, sockets connectors suitable for general purpose audio and video use, 2 and 3 pin mains plug and sockets.
Banana-plugs, and sockets, BNG, RCA, DIN, UHF, Ear phone speaker connector, telephone jacks and similar male and female connectors and terminal strips.
 - c) Various types of switches such as: normal/ miniature toggle, slide, push button piano key, rotary, micro switches, SPST, SPDT, DPST, DPDT, band selector, multi way Master Mains Switch.
 - d) Various types of protective devices such as : Wire fuse, cartridge fuse, slow acting/fast acting fuse, HRC fuse, thermal fuse, single/multiple circuit breakers, over and under current relays.
- 5.2 Identification and familiarisation with active and passive components; colour code and types of resistor, capacitors and potentiometers (including VDR, LDR, and thermistor). Identification of components including LED, LCD, UJT, FET, Coils, relays, switches (SPDT, DPDT, etc.) connectors, micro switches, read relays, transformers (mains, audio and RF, etc) Linear and Digital ICs, Thyristors, etc.

- 5.3 Demonstrate the following:
1. To make faultless solder joints and soldering on PCBs
 2. To remove components/wires by unsoldering.
 3. To assemble components on boards, chassis, tape strips.
 4. Various laying methods of cables
 5. Exposure to modern soldering and de-soldering processes
 6. Field visits to relevant work-places

Job I De-solder, remove and clean all the components, wires from a given equipment, a PCB or a tap strip using the following

Job II Soldering Iron

Job III Temperature Control soldering Iron

Job IV De-soldering pump

Job V De-soldering strip

Job VI Wiring of a small circuit on a PCB/tag strip involving lacking, sleeving and use of identifier tags

6. Sheet Metal Shop-II

- 6.1 Introduction to various metal forming processes e.g. Spinning, Punching, Blanking, cup drawing
- 6.2 Introduction to soldering and brazing.
- 6.3 Introduction to metal spinning process.
 - Job I Preparation of job involving shearing, circular shearing, rolling, folding, beading and soldering process e.g. Funnel or any other job involving above operations.
 - Job II Exercise on job involving brazing process
 - Job III Spinning a bowl/cup/saucer
 - Job IV Visit to an sheet metal industry e.g. coach builders etc.

RECOMMENDED BOOKS

1. *Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay*
2. *Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.*
3. *Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd. New Delhi*
4. *Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi.*

3.1 FUNDAMENTALS OF ELECTRICAL ENGINEERING

L T P
4 - 2

RATIONALE

For a diploma holder in electrical engineering, it becomes imperative to know the fundamentals of the subject in order to grasp the knowledge of the field. This subject will provide acquaintance with various terms knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

DETAILED CONTENTS

1. (a) **Application and Advantages of Electrical Energy** (4 Hrs)
 - Different forms of energy
 - Advantages of electrical energy
 - Uses of electrical energy(b) **Basic Electrical Quantities**
 - Basic concept of charge, current, voltage, resistance, power, energy and their units
 - Conversion of units of work, power and energy from one form to another
2. **DC Circuits** (10 Hrs)
 - 2.1 Ohm's law, resistances in series and parallel
 - 2.2 Effect of temperature on resistance, temperature coefficient of resistance and specific resistance
 - 2.3 Kirchhoff's laws and their applications in solving electrical network problems
 - 2.4 Network theorems such as Thevenin's theorem, superposition theorem Maximum power and transfer theorem and Norton's theorem
 - 2.5 Star-delta transformation
3. **Batteries** (10 Hrs)
 - 3.1 Basic idea about primary and secondary cells
 - 3.2 Working principle, construction and applications of Lead acid, Nickel Cadmium and Silver Oxide Cells
 - 3.3 Charging methods used for lead acid accumulator
 - 3.4 Care and maintenance of a lead acid battery
 - 3.5 Grouping of cells in series and parallel (simple numerical problems).
4. **Magnetism and Electromagnetism:** (8 Hrs)
 - 4.1 Introduction to electromagnetism, Magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction, force between two parallel current carrying conductors.
 - 4.2 Force on a conductor placed in the magnetic field
 - 4.3 Series & parallel magnetic circuits, simple problems
 - 4.4 Concept of hysteresis loop and hysteresis loss.
- 5.. **Electromagnetic Induction:** (8 Hrs)
 - 5.1. Faraday's Laws of electromagnetic induction
 - 5.2. Lenz's law
 - 5.3. Fleming's Right and Left Hand Rule
 - 5.4. Principle of self and mutual induction

- 5.5. Principle of self and mutually induced e.m.f. and simple problems
- 5.6. Inductances in series and parallel
- 5.7. Energy stored in a magnetic field
- 5.8. Concept of eddy currents, eddy current loss
- 6. **AC Fundamentals** (8 Hrs)
 - 6.1. Difference between a.c and d.c
 - 6.2. Concept of alternating current and voltage, equation of instantaneous values
 - 6.3. Representation of alternating sinusoidal quantities by vectors
 - 6.4. Phasor algebra (addition, subtraction, multiplication and division of complex quantities)
- 7. **AC Circuits** (16 Hrs)
 - 7.1. AC through pure resistance, inductance and capacitance
 - 7.2. Alternating voltage applied to RL,RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions)
 - 7.3. Concept of susceptance, conductance and admittance
 - 7.4. j-notation and its application in solving problems in ac circuits
 - 7.5. Power in pure resistance, inductance, capacitance, RL, RC, RLC circuits
 - 7.6. Role of use of current in RL and RC circuit.
 - 7.7. Active and reactive components of current and their significance
 - 7.8. Power factor and its practical significance
 - 7.9. Resonance in series and parallel circuits

LIST OF PRACTICALS

- 1. (a) Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions to (verify ohm's law)
- (b) Filament lamp
 - i) measure the resistance of a cold lamp filament with the help of multimeter
 - ii) measure the current drawn by the lamp at different voltages from zero to 220 volts and the resistance of lamp at different voltages, plot a graph between current and voltage
- 2. (a) To verify that $R_t = R_1 + R_2 + \dots$ where R_1, R_2 etc. are resistances connected in series
- (b) To verify $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_m}$
- Where R_1, R_2 etc. are resistances connected in parallel
- 3. Verification of Kirchoff's current and voltage laws applied to DC circuits
 - a) to construct a circuit arrangement consisting of resistances in series, parallel combination
 - b) identification of node points in the circuit
 - c) to see that algebraic sum of currents at node point is zero
 - d) to see that algebraic sum of e.m.f.s. and voltage drops in a closed loop is zero
- 4. To find ratio of inductance values of a coil having air /iron core respectively and to see the effect of introduction of a magnetic core on coil inductance

5. To construct an RL and RC circuit and to measure
 - a) their impedance
 - b) phase angle between voltage and current
 - c) construct impedance triangle
6. To plot a graph between current and frequency of RLC series circuit for resonance conditions

OR

- To find resonance conditions in RLC series circuit by changing the values of L and C
7. Measurement of power and power factor of a single phase RLC circuit. To calculate KVA and KVAR
 8. Testing a battery for its changed condition and to charge it

Note: The results should be verified analytically also.

INSTRUCTIONAL STRATEGY

Basic electrical engineering being a fundamental subject need to be handled very carefully and in a manner such that students develop clear understanding of principles and concepts and develop skill in their application in solving related problems. Teacher may lay emphasis on laboratory experiments and give lot of tutorial work to students in order to give them an opportunity in mastering the basics in solving related problems

RECOMMENDED BOOKS

1. *Electrical Science by VK Mehta, S Chand and Co., New Delhi*
2. *Fundamentals of Electrical Engineering by Sahdev, Unique International Publication, Jalandhar*
3. *Electrical Engineering by DR Arora, Ishan Publications, Ambala*
4. *Electrical Technology by JB Gupta, SK Kataria and Sons, New Delhi*
5. *Electrical Technology by BL Theraja, S Chand & Co., New Delhi*
6. *Electrical Science by S. Chandhni, R Chakrabarti and PK Chattopadhyay. Narosa Publishing House Pvt. Ltd., New Delhi*
7. *Basic Electrical Engineering by Mool Singh, Galgotia Publication Pvt. Ltd., New Delhi*
8. *Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill, New Delhi*
9. *Principles of Electrical Engineering by BR Gupta, S Chand & Co., New Delhi*
10. *Handbook of Electrical Engineering by SL Bhatia, Khanna Publishers, New Delhi*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Application and advantages of electrical energy	04	5
2	DC Circuits	10	20
3	Batteries	10	15
4	Magnetism and Electromagnetism	08	10
5	Electromagnetic Induction	08	15
6	AC Fundamentals	08	10
7	AC Circuits	16	25
Total		64	100

3.2 ELECTRONICS - I

L T P
4 - 2

RATIONALE

At present, electronics gadgets are being extensively used in various manufacturing processes in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to have a basic understanding of electronic components, their function and applications. This understanding should facilitate in operation and maintenance equipment, which are electronically controlled.

In this course, topics like semi-conductor theory, semi-conductor Diodes, Bipolar transistors, rectifiers, single stage and multistage amplifiers and field effect transistors have been included.

DETAILED CONTENTS

1. **Introduction** (5 hrs)
 - 1.1 Brief history of development of electronics (vacuum tube to solid state)
 - 1.2 Active and passive components
 - 1.3 Concept of current and voltage sources, constant voltage and current sources, their graphical representation. Conversion of voltage source into current source and vice-versa
 - 1.4 Difference between actual voltage source and constant voltage source
2. **Semi-conductor Theory** (10 hrs)
 - 2.1 Atomic structure, crystalline structure
 - 2.2 Energy band theory of crystals, energy band structure of insulator, semiconductor and conductor, generation and recombination of electron hole pairs. Energy band structure of Silicon and Germanium
 - 2.3 Silicon versus Germanium for mobility and conductivity
 - 2.4 Concept of Doping, intrinsic and extrinsic semiconductors
 - 2.5 Effect of temperature on intrinsic and extrinsic semiconductors
3. **Semiconductor Diodes** (10 hrs)
 - 3.1 PN Junction, mechanism of current flow in PN junction, drift and diffusion currents, depletion layer, potential barrier, effect of forward and reverse biasing in a PN junction. Concept of junction capacitance in forward and reverse biased conditions. Breakdown mechanism
 - 3.2 Ideal diode, Semiconductor diode characteristics, static and dynamic resistance
 - 3.3 Use of diode as half wave and full wave rectifiers (centre tapped and bridge type), relation between DC output and AC input voltage, rectifier efficiency
 - 3.4 Concept of ripples, filter circuits – shunt capacitor, series inductor, and pie (π) filters and their applications
 - 3.5 Diode ratings/specifications

- 3.6 Various types of diodes such as zener diode, varactor diode, schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics and applications
- 3.7 Zener diode and its characteristics
- 3.8 Use of zener diode for voltage stabilization
- 4. **Bi-polar Transistors** (7 hrs)
 - 4.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow
 - 4.2 Transistor configurations: common base (CB), common emitter (CE) and common collector (CC), current relation and their input/output characteristics; comparison of the three configurations
- 5. **Transistor Biasing and Stabilization** (8 hrs)
 - 5.1 Transistor biasing, its need, operating point, effect of temperature on the operating point of a transistor and need of stabilization of operating point.
 - 5.2 Different biasing circuits, limitations, simple problems to calculate operating point in different biasing circuits. Use of Thevenin's theorem to determine operating point
 - 5.3 Concept of h-parameters of a transistor
 - 5.4 Use of data book to know the parameters of a given transistor
- 6. **Single-Stage Transistor Amplifiers** (10 hrs)
 - 6.1 Single stage transistor amplifier circuit in CE configuration, function of each component
 - 6.2 Working of single stage transistor amplifier, physical and graphical explanation, phase reversal
 - 6.3 Concept of DC and AC load line
 - 6.4 Voltage gain of single stage transistor amplifier using characteristics of the device
 - 6.5 Concept of input and output impedance
 - 6.6 AC equivalent circuit of single stage transistor amplifiers
 - 6.7 Calculation of voltage gain using AC equivalent circuit
 - 6.8 Frequency response of a single stage transistor amplifier
- 7. **Multi-Stage Transistor Amplifiers** (7 hrs)
 - 7.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
 - 7.2 Knowledge of various terms such as voltage gain, current gain, power gain, frequency response, decibel gain and band width
 - 7.3 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
 - 7.4 Loading effect in multistage amplifiers
 - 7.5 Elementary idea about direct coupled amplifier, its limitations and applications
 - 7.6 Transformer coupled amplifiers, its frequency response. Effect of co-efficient of coupling on frequency response. Applications of transformer coupled amplifiers

8. **Field Effect Transistor (FET)** (07 hrs)
- 8.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
 - 8.2 JFET as an amplifier
 - 8.3 Types, construction, operation, characteristics and applications of a MOSFET
 - 8.4 Comparison between BJT, JFET and MOSFET

LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits
b) Measurement of resistances using multimeter and their comparison with colour code values
2. V-I characteristics of a Semiconductor diode and to calculate its static and dynamic resistance
3. a) V-I characteristics of a zenor diode and finding its reverse breakdown voltage
b) Fabrication of a zenor diode voltage stabilizer circuit using PCB
4. Observation of input and output wave shapes of a half-wave rectifier and verification of relationship between dc output and ac input voltage
5. Observation of input and output wave shapes of a full wave rectifier and verification and relationship between dc and ac input voltage
6. Observation of input and output wave shapes of a full wave rectifier with (i) shunt capacitor (ii) series inductor (iii) Π filter circuits
7. Plotting input and output characteristics of a transistor in CB configuration
8. Plotting input and output characteristics of a transistor in CE configuration
9. Measurement of operating point in case of (i) fixed biased circuit (ii) potential divider biasing circuit and to observe the effect of temperature variation on the operating point.
10. To measure the voltage gain and band width by plotting frequency response curve of a single stage amplifier using CE configuration at different loads
11. To study the effect of coupling capacitor on lower cut off frequency and upper cut off frequency by plotting frequency response curve of a two stage RC coupled amplifier
12. To plot V-I characteristics of a FET

INSTRUCTIONAL STRATEGY

This subject gives the knowledge of fundamental concepts of basic electronics. The teacher should give emphasis on understanding of concepts and various term used in the subject. The students be made familiar with diodes, transistors, resistors, capacitors, inductors etc. and electrical measuring instruments etc. Practical exercises will reinforce various concepts. Application of Semiconductor Diodes, Transistors, Field Effect Transistors etc must be told to students.

RECOMMENDED BOOKS

1. *Basic Electronics and Linear Circuits by NN Bhargava, Tata McGraw Hill, New Delhi*
2. *Analog Electronics by DR Arora, Ishan Publications, Ambala City.*
3. *Electronic Principles by SK Sahdev, Dhanpat Rai & Co., New Delhi*
4. *Electronic Devices and Circuits by R Boylestead*
5. *Electronic Devices and Circuits by Ravi Raj Dubey*
5. *Analog Electronics by JC Karhara, King India Publication, New Delhi*
6. *Electrical Devices and Circuits by Rama Reddy, Narosa Pulishing House Pvt. Ltd., New Delhi*
7. *Electronic Devices and Circuits by Dharma Raj Cheruku and Battula Tirumala Krishna: Pearson Education (Singapore) Pvt Ltd., Indian Branch, 482 F.I.E Patparganj, Delhi- 92*
8. *Principles of Electronics by SK Bhattacharya and Renu Vig, SK Kataria and Sons, Delhi*
9. *Basic Electronics by JB Gupta, SK Kataria and Sons, New Delhi*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Introduction	5	10
2	Semi-conductor Theory	10	15
3	Semiconductor Diodes	10	15
4	Bi-polar Transistors	7	10
5	Transistor Biasing and Stabilization	8	15
6	Single-Stage Transistor Amplifiers	10	15
7	Multi-Stage Transistor Amplifiers	7	10
8	Field Effect Transistor	7	10
	Total	64	100

3.3 GENERAL ENGINEERING

L T P
4 - 2

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil, electrical and mechanical engineering. The subject of General Engineering has been included to impart basic knowledge of civil and mechanical engineering to the students.

DETAILED CONTENTS PART-A

MECHANICAL ENGINEERING

Theory

1. **Transmission of Power** (8 hrs)
 - 1.1 Belt Drives:
Types of belts, belt materials, cross and flat belt drives, advantages of V-belt drive over flat belt drive.
 - 1.2 Gears Drives:
Types of gears (briefly), types of gear trains

2. **Internal combustion Engines** (10 hrs)
 - 2.1 Classification of IC engines
 - 2.2 Working principles of two stroke and four stroke engines
 - 2.3 Working principles of petrol engine and diesel engines
 - 2.4 Gas turbines (working principle only)

3. **Refrigeration and Air Conditioning System** (8 hrs)
 - 3.1 Different types of refrigeration principles and refrigerants
 - 3.2 Working of domestic refrigerator
 - 3.3 Working of Window type AC system

4. **Hydraulics:** (6 hrs)
 - 4.1 Classification of pumps (reciprocating and centrifugal)
 - 4.2 Working principles of both reciprocating and centrifugal pumps
 - 4.3 Turbine: Working principles of impulse turbine and reaction turbine and their applications

PRACTICAL EXERCISES IN MECHANICAL ENGINEERING

1. Demonstration and study of main parts of 4 stroke petrol and diesel engines by actually dismantling them (The idea is to acquaint the students with the most common troubles occurring in the engines)
2. Demonstration and study of main parts of 2 stroke petrol engine by actually dismantling it. (The idea is to acquaint the students with the most common trouble occurring in the engines)
3. Demonstration and study of gas turbines through models
4. Demonstration and study of different hydraulic pumps

5. Demonstration and study of various drives for transmission of powers i.e. models of belts and gears.
6. Demonstration and study of air conditioning system in a building
7. Demonstration and study of domestic refrigeration system

PART-B

CIVIL ENGINEERING

Theory

1. **Construction Materials** (10 hrs)
Basics of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/ field testing and uses, elements of brick masonry.
2. **Foundations** (8 hrs)
 - i) Bearing capacity of soil and its importance
 - ii) Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines
3. **Basic concept of concrete** (8 hrs)
Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/ field testing of concrete, mixing of concrete
4. **RCC** (6 hrs)
Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building

PRACTICAL EXERCISES IN CIVIL ENGINEERING

1. Testing of bricks
 - a) Shape and size
 - b) Soundness test
 - c) Water absorption
 - d) Crushing strength
2. Testing of concrete
 - a) Slump test
 - b) Compressive Strength of concrete cube
2. The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works

INSTRUCTIONAL STRATEGY

While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted in the laboratories and organized demonstrations for explaining various concepts and principles.

RECOMMENDED BOOKS

Mechanical Engineering

1. *General Mechanical Engineering* by M. Adithan; TTTI, Chandigarh
2. *Basic Civil and Mechanical Engineering* by Jayagopal; Vikas Publications, New Delhi
3. *IC Engines and Automobile Engineering* by Dr.MP Poonia, Standard Publishers, New Delhi
4. *Refrigeration and Air Conditioning* by RK Rajput; SK Kataria and sons; Ludhiana
5. *Theory of Machines* by RS Khurmi and JK Gupta; S. Chand and Company Ltd., New Delhi

Civil Engineering

6. *Textbook of Concrete Technology 2nd Edition* by Kulkarni, PD Ghosh RK and Phull, YR; New Age International (P) Ltd., Publishers, New Delhi
7. *Materials of Construction* by Ghose; Tata McGraw Hill Publishing Co., Ltd., New Delhi
8. *Civil Engineering Materials* by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
9. *Concrete Technology* by Gambhir; Tata McGraw Hill Publishing Co., Ltd., New Delhi
10. *Building Construction* by J Jha and Sinha; Khanna Publishers, Delhi
11. *Building Construction* by Vazirani and Chandola; Khanna Publishers, Delhi
12. *Civil Engineering Materials* by SV Deodhar and Singhai; Khanna Publishers, Delhi
13. *Soil Mechanics and foundation Engineering* by SK Garg; Khanna Publishers, Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
PART-A (MECHANICAL ENGINEERING)			
1.	Transmission of Power	8	12
2.	Internal combustion Engines	10	15
3.	Refrigeration and Air conditioning System	8	13
4.	Hydraulics	6	10
Total		32	50

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
PART-B (CIVIL ENGINEERING)			
1.	Constructional Materials	10	15
2.	Foundations	8	12
3.	Basic concept of concrete	8	13
4.	RCC	6	10
Total		32	50

3.4 COMPUTER PROGRAMMING AND APPLICATIONS (For ELECTRICAL ENGINEERING)

L T P
2 - 4

RATIONALE

Computer plays a very vital role in present day life, more so, in the professional life of Diploma engineers. In order to enable the students use the computers effectively in problem solving, this course offers the modern programming language C along with exposure to various engineering applications of computers. The knowledge of C language will be reinforced by the practical exercises and demonstration of application software in the field of Electrical Engineering during the course of study. Introduction to data base management system is also a very significant field with vast employment potential.

DETAILED CONTENTS

1. **Algorithm and Program Development** (4 hrs)
 - a) Steps in development of a program
 - b) Flow-charts, algorithm development
 - c) Introduction to various computer languages
 - d) Concept of interpreter, compiler, high level language(HLL), machine language (ML) and Assembly Language

2. **Program Structure (C Programming)** (24 hrs)
 - a) History of 'C', data types, input output statements, arithmetic and logical operations, data assignments, precedence and associativity
 - b) I/O statements
Assignment, Variables, arithmetic operation- their precedence, data types standard I/O function, formulated I/O
 - c) Control Statements
Logical and relational operators; if-else, while, do- while, for loops, breaks, switch statements
 - d) Functions: Function declaration, parameter passing- by value, storage classes (Local, Global and Static variables), standard library functions
 - e) Arrays:
Single and multi dimensional arrays, character arrays
 - f) Pointers:
To various data types, pointers in parameters passing, pointers to function
 - g) Structures:
Definition of a structure, pointer to structure, union and array of structure
 - h) Strings:
String processing, functions and standard library function

- i) Data files
File handling and manipulation, file reading and writing, Binary and ASCII files, file records using standard function type mouse
- 3. Software Applications in Electrical Engineering (4 hrs)
Computer application overview through various applications software related to Electrical Engineering branch viz: MATLAB, PSIM, MULTISIM, PSPICE Autocad in Electrical Engineering

LIST OF PRACTICALS

1. Programming exercise on executing a C Programs.
2. Programming exercise on editing a C program.
3. Programming exercise on defining variables and assigning values to variables
4. Programming exercise on arithmetic and relation operators
5. Programming exercise on arithmetic expressions and their evaluation
6. Programming exercise on reading a character
7. Programming exercise on writing a character
8. Programming exercise on formatting input using print
9. Programming exercise on formatting output using scan
10. Programming exercise on simple IF statement
11. Programming exercise on IF... ELSE statement
12. Programming exercise on SWITCH statement
13. Programming exercise on GOTO statement
14. Programming exercise on DO-WHILE statement
15. Programming exercise on FOR statement
16. Programming exercise on one dimensional arrays
17. Programming exercise on two dimensional arrays
18. Demonstration of Application software to Electrical Engineering branch such as: MATLAB, PSIM, MULTISIM, PSPICE in Electrical Engineering

INSTRUCTIONAL STRATEGY

This course is a highly practical and self- study oriented courses. The teachers are expected to explain the theoretical part and make the students to execute and debug different programs. The PC needed to have either Turbo C.

RECOMMENDED BOOKS

1. Programming in C by Schaum series McGraw Hill
2. Programming in C by Kerning Lan and Richie; Prentice Hall of India, New Delhi
3. Programming in C by Balaguru Swamy, Tata McGraw Hill, New Delhi.
4. Let us C- Yashwant Kanetkar, BPB Publications, New Delhi
5. Vijay Mukhi Series for C and C++
6. Programming in C by R Subburaj, Vikas Publishhing House Pvt. Ltd., Jangpura, New Delhi
7. Programming in C by Kris A Jansa, Galgotia Publications Pvt. Ltd., Daryaganj, New Delhi
8. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi
9. Elements of C by MH Lewin, Khanna Publishers, New Delhi

10. The Complete Reference to Visual Basic 6, by Noel Jerke, Tata McGraw Hill, New Delhi
11. Web site www.Beyondlogic.org
12. Pointers in C by Yashwant Kanetkar, BPB Publishers New Delhi
13. Programming in Applications by Chandershekhar, Unique International Publications, Jalandhar
14. The essentials of Computer Organizing and Architecture by Linda Null and Julia Labur, Narosa Publishing House Pvt. Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
1.	Algorithm and Program Development	4	15
2.	Program Structure (C Programming)	24	70
3.	Software Applications	4	15
Total		32	100

3.5 ELECTRICAL ENGINEERING DESIGN AND DRAWING

L T P
- - 6

RATIONALE

A polytechnic pass-out in electrical engineering is supposed to have ability to :

- i) Read, understand and interpret engineering drawings*
- ii) Communicate and co-relate through sketches and drawings*
- iii) 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.

DETAILED CONTENTS

1. **Symbols and Signs Conventions**
Various Electrical Symbols used in Domestic and Industrial Installation and Power System as per BIS.
2.
 - 2.1 Design and Drawing of panels/Distribution board using MCBS, ELCB main switches.
 - 2.2 Single line and wiring diagram for light and fan points and PowerPoint of a drawing room measuring 7mt x 5mt.
 - 2.3 Single line and wiring diagram of workshop measure 10mt x 4mt containing 4 motor of 2HP each.
 - 2.4 Simple Electric Circuit (Wiring of Single line diagram)
3. **Orthographic projections of simple electrical parts**
 - 3.1 Bus bar post
 - 3.2 Pin type and shackle type insulator
 - 3.3 M.C.B. and E.L.C.B Placed on Distribution Board.
4. **Drawing of Machine Parts**
 - 4.1 Rotor of a squirrel cage induction motor
 - 4.2 Pole and coil of DC machine.
 - 4.3 Slip rings of 3-phase induction Motor.
5. **Reading and Interpreting drawings related to substations, industrial and domestic circuits.**
6. **Contactors Control Circuits: Schematic and wiring diagram**
 - 6.1 DOL Starter of 3-phase induction Motor.
 - 6.2 Forwarding/reversing of 3-phase induction motor
 - 6.3 Limit switch control of a 3-phase induction motor
 - 6.4 Automatic star-delta starter for 3-phase induction motor.

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.

RECOMMENDED BOOKS

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, Unique International Publications, Jalandhar*
5. *Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi*

3.6 ELECTRICAL WORKSHOP PRACTICE - I

L T P
- - 6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, fault finding, wiring in electrical appliances and installations.

DETAILED CONTENTS

1. Study of electrical safety measures as mentioned in the Electricity Rules and shock treatment including first aid
2. **Wire jointing**
 - 2.1 Straight married joint
 - 2.2 Technology-joint
 - 2.3 Western union joint
 - 2.4 Britania joint
 - 2.5 Twist sleeve joint
 - 2.6 Bolted type joint
2. **Types of wiring and to make different light control circuits in the following types of wiring.**
 - 3.1 Casing and capping (PVC) wiring.
 - 3.2 Conduit wiring (surface/concealed) Filling and crimping of thimbles (using hydraulic and hand crimping tool)
4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection) Types of wiring and to make different light control circuits in the following types of wiring
 - 4.1 Casing and Capping (PVC) wiring
 - 4.2 Conduit wiring (surface/concealed)
5. (a) Construction of an extension board with two 5A sockets. One 15A Socket controlled by their respective switches, a fuse and indicator with series test provision.
- (b) Assembly of distribution board panel using MCB, main switch, change over switch and ELCB.
Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection)

6. Simple light and Alarm Circuits(Solve any four)

- 6.1 One lamp controlled by two switches (staircase circuit)
 - 6.2 Two lamps controlled by three switches (double staircase circuit)
 - 6.3 Two ordinary bells (for day and night) used at a distant residence
 - 6.4 Bell response circuit using one bell and one relay
 - 6.5 Bell response circuit of an office (for three rooms)
 - 6.6 Traffic light control system for two roads crossing.
 - 6.7 Wiring of a switch board containing at least two switches, one fan regulator and one 5/15A socket controlled by their respective switches using piano type switches and matching socket.
7. Wiring of a series test lamp board and to use it for finding out simple faults
 8. Testing of domestic wiring installation using meggar
 9. Fault finding and repair of a tube light circuit
 10. Wiring and testing of alarm and indicating circuits using relay, push buttons and bells (simple single phase circuits)
 10. Assembly of distribution board/ panel using MCB, main switch, changeover switch and ELCB etc.
 11. Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan, heat convactor, Semi-automatic washing machine, desert cooler, room heater, electric kettle, electric oven, electric furnace etc.

Note: *At least five electrical appliances as mentioned above be given to a group of 2 students for their repair and maintenance.*

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.

4.1 ELECTRICAL MACHINES - I

L T P
4 - 3

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 diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. 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. **Poly-Phase systems** (6 Hrs)
 - 1.1 Advantages of 3 phase over single phase system
 - 1.2 Star and delta connections (relationship between phase and line voltages, phase and line currents)
 - 1.3 Power in 3 phase circuits
 - 1.4 Measurement of power and power factor of a 3-phase load by two wattmeter method

2. **Introduction to Electrical Machines** (6 hrs)
 - 2.1 Definition of motor and generator
 - 2.2 Torque development due to alignment of two fields and the concept of torque angle
 - 2.3 Electro-magnetically induced emf
 - 2.4 Elementary concept of an electrical machine
 - 2.5 Comparison of generator and motor
 - 2.6 Generalised theory of electrical machines

3. **DC Machines** (22 hrs)
 - 3.1 Main constructional features, Types of armature winding
 - 3.2 Function of the commutator for motoring and generation action
 - 3.3 Factors determining induced emf
 - 3.4 Factors determining the electromagnetic torque
 - 3.5 Significance of types of machines
 - 3.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
 - 3.7 Armature Reaction
 - 3.8 Methods to improve commutation
 - 3.9 Performance and characteristics of different types of DC motors
 - 3.10 Speed control of dc shunt/series motors
 - 3.11 Need of starter, three point dc shunt motor starter and 4 point starter
 - 3.12 Applications of DC motors
 - 3.13 Faults in dc machines and their retrospective
 - 3.14 Losses in a DC machine
 - 3.15 Determination of losses by Swinburne's test

- 7 To find the efficiency and regulation of single phase transformer by actually loading it.
- 8 Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations
- 9 Finding the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions such as
 - (a) Star-star
 - (b) Star delta
 - (c) Delta star
 - (d) Delta - Delta configuring conditions.

INSTRUCTIONAL STRATEGY

Electrical machines being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical machines which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Special care has to be taken on conceptual understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical machine for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

RECOMMENDED BOOKS

Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi

Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar

Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi

Electrical Machines by JB Gupta, SK Kataria and Sons, New Delhi

Electrical Machines by Fitzgerald

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Poly Phase	6	5
2	Introduction to Electrical Machine	6	10
3	DC Machines	22	35
4	Transformers (single phase)	20	35
5	Transformers three phase	10	15
Total		64	100

4.2 ELECTRICAL MEASUREMENTS AND INSTRUMENTS

L T P
4 - 2

RATIONALE

Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where they perform the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries, will come across the use of various types of instruments and have to take measurements.

Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will know the construction and use of various types of electrical instruments.

DETAILED CONTENTS

1. **Introduction to Electrical Measuring Instruments:** (10 hrs)
 - 1.1 Concept of measurement and instruments
 - 1.2 Concept of measurement of electrical quantities and instruments for their measurements
 - 1.3 Types of electrical measuring instruments – indicating, integrating and recording type instruments
 - 1.4 Essentials of indicating instruments – deflecting, controlling and damping torque
2. **Ammeters and Voltmeters (Moving coil and moving iron type):** (8 hrs)
 - 2.1 Concept of ammeters and voltmeters and difference between them
 - 2.2 Construction and working principles of moving Iron and moving coil instruments
 - 2.3 Merits and demerits, sources of error and application of these instruments
3. **Wattmeters (Dynamometer Type)** (4 hrs)

Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error
4. **Energymeter (Induction type):** (6 hrs)

Construction, working principle, merits and demerits of single-phase and three-phase energy meters

 - 4.1 Errors and their compensation
 - 4.2 Simple numerical problems
 - 4.3 Construction and working principle of maximum demand indicators
 - 4.4
- 5 **Miscellaneous Measuring Instruments** (12 hrs)
 - 5.1 Construction, working principle and application of Meggar, Earth tester, Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter)

- 5.2 Instrument Transformers: Construction, working and applications
- a) CT
 - b) PT and their ratio and phase angle error
6. **Electronic Instruments:** (6 hrs)
- 6.1 Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls. Applications of CRO.
 - 6.2 Digital multi-meter (only block diagram) and Applications
7. **LCR meters.** (4 hrs)
Study of LCR meters and their applications
8. **Power Measurements in 3-phase circuits by** (6 hrs)
- (i) 2 wattmeter method in balanced and imbalanced circuits and simple problems
 - (ii) Three wattmeter method
9. **Measurement of Non-electrical Quantities (Introduction only)** (4 hrs)
Basic concept of pressure measurement, flow measurement, level measurement, displacement measurement using transducers
10. **Measurement of Temperature** (4 hrs)
Different types of thermometers, thermocouple, resistance temperature detector and their construction, principle and working.

LIST OF PRACTICALS

1. Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance
2. To calibrate 1-phase energy meter by direct loading method.
3. To measure the value of earth resistance using earth tester.
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to verify results with calculations.
5. Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
6. Measurement of voltage and frequency of a sinusoidal signal using CRO and draw wave shape of signal.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase load.
8. Use of LCR meter for measuring inductance, capacitance and resistance.
9. To record all electrical quantities from the meters installed in the institution premises.
10. To measure Energy at different Loads using Single phase Digital Energy meter.

INSTRUCTIONAL STRATEGY:-*After making the students familiar with measuring instruments, they should be made conceptually clear about the constructional features and make them confident in making connection of various measuring instruments. Teacher should demonstrate the application of each measuring instrument in laboratory and encourage students to use them independently.*

RECOMMENDED BOOKS

1. *Electrical Measurements and Measuring Instruments* by Golding and Widdis; Wheeler Publishing House, New Delhi
2. *Electrical Measurements and Measuring Instruments* by SK Sahdev, Unique International Publications, Jalandhar
3. *A Course in Electrical Measurement and Measuring Instruments* by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi
4. *Electric Instruments* by D. Cooper
5. *Experiments in Basic Electrical Engineering* by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
6. *Electronics Instrumentation* by Umesh Sinha, Satya Publication, New Delhi
7. *Basic Electrical Measurements* by Melville B. Staut.
8. *Electrical Measurement and Measuring Instruments* by JB Gupta, SK Kataria and Sons, New Delhi
9. *Electrical Measurement and Measuring Instruments* by ML Anand, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction to Electrical Measuring Instruments:	10	15
2	Ammeters and Voltmeters	8	15
3	Wattmeter	4	5
4	Energy meter	6	10
5	Miscellaneous Measuring Instruments:	12	20
6	Electronic Instruments:	6	10
7	LCR meters	4	5
8	Power Measurements in 3-phase circuits	6	10
9	Measurement of Non-electrical quantities	4	5
10	Measurement of Temperature	4	5
Total		64	100

4.3 ELECTRONICS - II

L T P
5 - 3

RATIONALE

The purpose of the introduction of electronics in the electrical engineering diploma course has been already explained in the rationale of the subject Basic Electronics in this course topic like Amplifiers, Oscillators and Wave Shape Circuits have been dealt with.

DETAILED CONTENTS

1. **Transistor Audio Power Amplifier** (12 hrs)
 - 1.1 Difference between voltage and power amplifier
 - 1.2 Important terms in Power Amplifier, collector efficiency, distortion and dissipation capability
 - 1.3 Classification of power amplifier class A, B and C
 - 1.4 Class A single-ended power amplifier, its working and collector efficiency
 - 1.5 Impedance matching in a power amplifier using transformer
 - 1.6 Heat sinks in power amplifiers
 - 1.7 Push-pull amplifier: circuit details, working and advantages (no mathematical derivations)
 - 1.8 Principles of the working of complementary symmetry push-pull amplifier

2. **Tuned Voltage Amplifier** (8 hrs)
 - 2.1 Introduction
 - 2.2 Series and parallel resonance (No mathematical derivation)
 - 2.3 Single and double tuned voltage amplifiers
 - 2.4 Frequency response of tuned voltage amplifiers
 - 2.5 Applications of tuned voltage amplifiers

3. **Feedback in Amplifiers** (8 hrs)
 - 3.1 Feedback and its importance, positive and negative feedback and their need
 - 3.2 Voltage gain of an amplifier with negative feedback $A = \frac{A}{1+\beta A}$
 - 3.3 Effect of negative feedback on voltage gain, stability, distortion, band width, output and input impedance of an amplifier (No mathematical derivation)
 - 3.4 Types of feedback circuits
 - 3.5 Effect of removing the emitter by-pass capacitor on a CE transistor amplifier
 - 3.6 Emitter follower and its applications

4. **Sinusoidal Oscillators** (8 hrs)
Sinusoidal Oscillators – positive feedback in amplifiers
 - 4.1. Difference between an oscillator and an alternator
 - 4.2. Essentials of an oscillator

- 4.3. Circuit details and working of LC oscillators viz. Tuned Collector, Hartley and Colpitt's oscillators
- 4.4. R-C oscillator circuits, phase shift and Wein bridge oscillator circuits
- 4.5. Introduction to piezoelectric crystal and crystal oscillator circuit
5. **Wave-Shaping and Switching Circuits** (15 hrs)
 - 5.1 Concept of Wave-shaping
 - 5.2 Wave-shaping circuits
 - a. R-C differentiating and integrating circuits
 - b. Diode clipping circuits
 - c. Diode clamping circuits
 - d. Applications of wave-shaping circuits
 - 5.3 Transistor as a switch (explanation using CE transistor characteristics)
 - 5.4 Collector coupled astable, monostable, bistable multivibrator circuits (explanation using wave shapes). Brief mention of uses of multivibrators
 - 5.5 Working and applications of transistor inverter circuit using power transistors
6. **Power supplies:** (5 hrs)
Working Principles of different types of power supplies viz. CVTs, UPS, Stabilizers, SMPS, IC voltage regulator (78 XX, 79XX)
7. **Operational Amplifier** (8 hrs)
 - 7.1. The basic operational amplifier. The differential amplifier. The emitter coupled differential amplifier. Offset even voltages and currents
 - 7.2. Basic operational amplifier applications, analog integrator and differentiator
 - 7.3. Familiarization with specifications and pin configuration of IC 741
 - 7.4. Block diagram and operation of 555 IC timer

LIST OF PRACTICALS

1. To measure (a) optimum load (b) output power (c) signal handling capacity of a push-pull amplifier
2. To observe the effect of negative current feedback on the voltage gain of a single stage transistor amplifier by removing emitter by-pass capacitor.
3. To measure (a) voltage gain (b) input and output impedance for an emitter follower circuit
4. To measure frequency generation in (a) Hartley (b) R-C Phase Shift oscillator
5. To observe the differentiated and integrated square wave on a CRO for different values of R-C time constant
6. Clipping of both portion of sine-wave using:
 - a) diode and dc source
 - b) zener diodes
 Clamping a sine-wave to:

- a) Negative dc voltage
 - b) Positive dc voltage
7. To generate square-wave using an astable multivibrator and to observe the wave form on a CRO
 8. To observe triggering and working of a bistable multivibrator circuit and observe its output wave form on a CRO
 9. To use the op-Amp (IC 741) as inverting one and non-inverting amplifiers, adder, comparator, integrator and differentiator
 10. To study the pin configuration and working of IC 555 and its use as monostable and astable multivibrator
 11. To realize the regulated power supply by using three terminal voltage regulator ICs such as 7805, 7905, 7915 etc.

INSTRUCTIONAL STRATEGY

The teacher should bring electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

1. *A text book of Basic Electronics and Linear Circuits by NN Bhargava and others, Tata McGraw Hill, New Delhi*
2. *Electronics Principles by SK Sahdev, Dhanpat Rai and Co., New Delhi*
3. *Electronics Principles by Albert Paul Malina, Tata McGraw Hill, New Delhi*
4. *Operational Amplifiers and Linear Circuits by Rama Kant and A. Gaykwad, Prentice Hall of India, New Delhi*
5. *Electronic Devices Circuits by Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi*
6. *Electronic Devices and Circuits by Millman and Halkias, McGraw Hill, New Delhi*
7. *Analog Electronics – II by DR Arora, Ishan Publication, Ambala*
8. *Electronic Devices and Circuits by JC Karhara, King India Publication, New Delhi*
9. *Electronic Devices and Circuits-I, Eagle Prakashan, Jalandhar*
10. *Electronic Devices Circuits by JB Gupta, SK Kataria and Sons, New Delhi*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Transistor Audio Power Amplifier	12	20
2	Tuned Voltage Amplifier	8	10
3	Feedback in Amplifiers	8	10
4	Sinusoidal Oscillators	8	10
5	Wave-Shaping and Switching Circuits	15	30
6	Power Supplies	5	10
7	Operational Amplifier	8	10
Total		64	100

4.4 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

L P
5 -

RATIONALE

A diploma holder in Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

DETAILED CONTENTS

1. **Classification:** (5 Hrs)
Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. **Conducting Materials** (15 Hrs)
 - 2.1 Introduction
 - 2.2 Resistance and factors affecting it such as alloying and temperature etc
 - 2.3 Classification of conducting material as low resistivity and high resistivity materials, Low resistance materials
 - 2.3.1 Copper:
General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Application in the field of electrical engineering.
 - 2.3.2 Aluminium:
General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications in the field of electrical engineering.
 - 2.3.3 Steel:
General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering.
 - 2.3.4. Introduction to bundle conductors and its applications.
 - 2.3.5. Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same
 - 2.4 Applications of special metals e.g. Silver, Gold, Platinum etc.
 - 2.5 High resistivity materials and their applications e.g., manganin, constantin, Nichrome, mercury, platinum, carbon and tungsten
 - 2.6 Superconductors and their applications

3. **Review of Semi-conducting Materials** (5 Hrs)
Semi-conductors and their properties, Materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.
4. **Insulating materials; General Properties:** (15 Hrs)
- 4.1 Electrical Properties:
Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant
 - 4.2 Physical Properties:
Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness
 - 4.3 Thermal Properties:
Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics
 - 4.4 Chemical Properties:
Solubility, chemical resistance, weatherability
 - 4.5 Mechanical properties, mechanical structure, tensile structure
5. **Insulating Materials and their applications:** (18 Hrs)
- 5.1 Plastics
 - 5.1.1 Definition and classification
 - 5.1.2 Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins - their important properties and applications
 - 5.1.3 Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethelene, silicones, their important properties and applications
 - 5.2 Natural insulating materials, properties and their applications
 - Mica and Mica products
 - Asbestos and asbestos products
 - Ceramic materials (porcelain and steatite)
 - Glass and glass products
 - Cotton
 - Silk
 - Jute
 - Paper (dry and impregnated)
 - Rubber, Bitumen
 - Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
 - Enamels for winding wires
 - Glass fibre sleeves
 - 5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF₆ their properties and applications

6. **Magnetic Materials:** (12 Hrs)
- 6.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect.
- 6.2 Soft Magnetic Materials:
- 6.2.1 Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
- 6.2.2 Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine
- 6.2.3 Nickel-iron alloys
- 6.2.4 Soft Ferrites
- 6.3 Hard magnetic materials
Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications
7. **Special Materials** (5 hrs)
Thermocouple, bimetals, leads soldering and fuse material, mention their applications
8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc.(5 hrs)

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electronic gadgets etc .and be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

1. *Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi*
2. *Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi*
3. *Electrical Engineering Materials by Sahdev, Unique International Publications*
4. *Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi*
5. *Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi*
6. *Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi*
7. *Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City*
8. *Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi*

**SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE
PAPERSETTER**

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Classification	5	5
2	Conducting Materials	15	20
3	Review of Semi-conducting Materials	5	5
4	Insulating materials; General Properties:	15	20
5	Insulating Materials and their Applications	18	25
6	Magnetic Materials:	12	15
7	Special Materials	5	5
8	Introduction of various Engineering Materials	5	5
	Total	80	100

4.5 ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

L T P
4 - -

RATIONALE

A diploma holder in electrical engineering should be familiar to Indian Standards and relevant Electricity Rules. Preparation of good estimates is a professional's job, which requires knowledge of materials and methods to deal with economics. The contents of this subject have been designed keeping in view developing requisite knowledge and skills of estimation and costing in students of diploma in electrical engineering.

DETAILED CONTENTS

1. **Introduction** (12hrs)
Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, tender document, net price 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. Tenders – its constituents, finalization, specimen tender.
2. **Types of wiring** (15hrs)
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)
3. **Estimating and Costing:** (25 hrs)
 - 3.1 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)
 - 3.2 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)
 - 3.3 Service line connections estimate for domestic and Industrial loads (over-head and under ground connections) from pole to energy meter.
4. **Estimating the material required for** (12 hrs)
 - 4.1 Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

- 4.2 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, Key Diagram of 66 KV/11KV Substation.

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 leading to preparation of small tender document.. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

RECOMMENDED BOOKS

1. *Electrical Installation, Estimating and Costing by JB Gupta, SK Kataria and Sons, New Delhi*
- a) *Estimating and Costing by SK Bhattacharya, Tata McGraw Hill, New Delhi*
- b) *Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., New Delhi*
- c) *Estimating and Costing by Qurashi*
- d) *Estimating and Costing by SL Uppal, Khanna Publishers, New Delhi*
- e) *Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, New Delhi*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction	12	20
2	Types of wiring	15	20
3	Estimating and Costing	25	40
4	Estimating the material required for	12	20
Total		64	100

4.6 ELECTRICAL WORKSHOP PRACTICE – II

L T P
- 6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers or artisans working under him. In addition to these persons, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, faultfinding, wiring in electrical appliances and installations.

DETAILED CONTENTS

1. To carry out pipe/plate earthing for a small house and 3-phase induction motor. Testing the earthing using earth tester
2. Connections of single phase and 3-phase motors, through an appropriate starter and to change their direction of rotation
3. Wiring, testing and fault finding of the following contactor control circuits operating on 3-phase supply:
 - a) Remote control circuits
 - b) Time delay circuits
 - c) Inter locking circuits
 - d) Sequential operation control circuits

Note: Students may be asked to study control circuit of a passenger lift, automatic milling machine, etc. using relays and limited circuits

4. Winding/re-winding of a fan (ceiling and table) and choke
5. Power cable jointing using epoxy based jointing kits
6. Demonstration of laying of underground cables at worksite
7. Dismantling/assembly of star-delta/DOL starter and slip-ring induction motor starter
8. Dismantling and assembly of voltage stabilizers
9. Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace etc.
10. Basic idea about Armature and commutator such as in Mixer Motor, Drill Machine etc.

4.7 GENERIC SKILLS AND ENTREPRENEURSHIP DEVELOPMENT

L P
3 -

RATIONALE:- *Generic Skills and Entrepreneurship Development is one of the courses from “Human Science” subject area. General skills have emerged as an important component of employability skills, which enable an individual to become and remain employable over lifetime and to lead happy and prosperous life. Entrepreneurship Development aspect of Human Resource Development has become equally important in the era, where wage employment prospects has become meagre.*

Both the areas are supplementary to each other and skill related to them are required to be developed in diploma passports for enhancing their employability for wage as well as self employment

DETAILED CONTENTS

1. **Introduction to Generic Skills** (4 hrs)
 - 1.1 Importance of Generic Skill Development (GSD)
 - 1.2 Global and Local Scenario of GSD
 - 1.3 Life Long Learning (LLL) and associated importance of GSD.

2. **Managing Self** (8 hrs)
 - 2.1 Knowing Self for Self Development
 - Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc.
 - 2.2 Managing Self - Physical
 - Personal grooming, Health, Hygiene, Time Management
 - 2.3 Managing Self – Intellectual development
 - Information Search: Sources of information
 - Reading: Purpose of reading, different styles of reading, techniques of systematic reading.
 - Note Taking: Importance of note taking, techniques of note taking
 - Writing: Writing a rough draft, review and final draft.
 - 2.4 Managing Self – Psychological
 - Stress, Emotions, Anxiety-concepts and significance
 - Techniques to manage the above

3. **Managing in Team** (6 hrs)
 - 3.1 Team - definition, hierarchy, team dynamics
 - 3.2 Team related skills- sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background
 - 3.3 Communication in group - conversation and listening skills

- 4 **Task Management** (3 hrs)
- 4.1 Task Initiation, Task Planning, Task execution, Task close out
- 4.2 Exercises/case studies on task planning towards development of skills for task management
5. **Problem Solving** (5 hrs)
- 5.1 Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving
- 5.2 Different approaches for problem solving.
- 5.3 Steps followed in problem solving.
- 5.4 Exercises/case studies on problem solving.
6. **Entrepreneurship**
- 6.1 Introduction (22 hrs)
- Concept/Meaning and its need
 - Competencies/qualities of an entrepreneur
 - Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level.
- 6.2 Market Survey and Opportunity Identification (Business Planning)
- How to start a small scale industry
 - Procedures for registration of small-scale industry
 - List of items reserved for exclusive manufacture in small-scale industry
 - Assessment of demand and supply in potential areas of growth.
 - Understanding business opportunity
 - Considerations in product selection
 - Data collection for setting up small ventures.
- 6.3 Project Report Preparation
- Preliminary Project Report
 - Techno-Economic Feasibility Report
 - Exercises regarding “Project Report Writing” for small projects

INSTRUCTIONAL STRATEGY

This subject will require a blend of different teaching and learning methods beginning with lecture method. Some of the topics may be taught using question answer, assignment, case studies or seminar. In addition, expert lectures may be arranged from within the institution or from management organizations. Conceptual understanding of Entrepreneurship, inputs by teachers and outside experts will expose the students so as to facilitate in starting ones own business venture/enterprise. The teacher will discuss success stories and case studies with students, which in turn, will develop managerial qualities in the students. There may be guest lectures by successful diploma holding entrepreneurs and field visits also. The students may also be provided relevant text material and handouts.

RECOMMENDED BOOKS

1. *Generic skill Development Manual, MSBTE, Mumbai.*
2. *Lifelong learning, Policy Brief (www.oecd.org)*
3. *Lifelong learning in Global Knowledge Economy, Challenge for Developing countries – World Bank Publication*
4. *Towards knowledge society, UNESCO Paris Publication*
5. *Your Personal Pinnacle of Success by DD Sharma, Sultan Chand and Sons, New Delhi*
6. *Human Learning Ormrod*
7. *A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)*
8. *Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi*
9. *Environmental Engineering and Management by Suresh K Dhamija, SK Kataria and Sons, New Delhi*
10. *Environmental and Pollution Awareness by Sharma BR, Satya Prakashan , New Delhi*
11. *Essentials of Environmental Studies by Joseph, Pearson Education (Singapore) Pte, Ltd. 482, FIE Patparganj, Delhi 110092*
12. *Thakur Kailash, Environmental Protection Law and policy in India: Deep and Deep Publications, New Delhi*
13. *Handbook of Small Scale Industry by PM Bhandari*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction to General skill	4	5
2	Managing Self	8	15
3	Managing in Team	6	10
4	Task Management	3	10
5.	Problem Solving	5	10
6.	Entrepreneurship	22	50
Total		48	100

ENTREPRENEURIAL AWARENESS CAMP

This is to be organized at a stretch for two to three days during or at the end of 4th semester. Lectures will be delivered on the following broad topics. There will be no examination for this subject.

1. Who is an entrepreneur?
2. Need for entrepreneurship, entrepreneurial career and wage employment
3. Scenario of development of small scale industries in India
4. Entrepreneurial history in India, Indian values and entrepreneurship
5. Assistance from District Industries Centres, Commercial Banks, State Financial Corporations, Small industries Service Institutes, Research and Development Laboratories and other financial and development corporations
6. Considerations for product selection
7. Opportunities for business, service and industrial ventures
8. Learning from Indian experiences in entrepreneurship (Interaction with successful entrepreneurs)
9. Legal aspects of small business
10. Managerial aspects of small business

5.1 ELECTRICAL MACHINES-II

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 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** (28 hrs)
 - 1.1 Different types of excitation system
 - 1.2 Generation of three phase emf
 - 1.3 Production of rotating magnetic field in a three phase winding
 - 1.4 Concept of distribution factor and coil span factor and emf equation
Armature reaction at unity, lagging and leading power factor
 - 1.5 Operation of single synchronous machine independently supplying a load - Voltage regulation by synchronous impedance method
 - 1.6 Need and necessary conditions of parallel operation of alternators
Synchronizing an alternator (Synchroscope method) with the bus bars
 - 1.7 Operation of synchronous machine as a motor –its starting methods
 - 1.8 Effect of change in excitation of a synchronous motor
 - 1.9 Concept and Cause of hunting and its prevention
 - 1.10 Rating and cooling of synchronous machines
 - 1.11 Applications of synchronous machines (as an alternator, as a synchronous condenser)

2. **Induction Motors** (24 hrs)
 - 2.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
 - 2.2 Principle of operation, slip and its significance
 - 2.3 Locking of rotor and stator fields
 - 2.4 Rotor resistance, inductance, emf and current
 - 2.5 Relationship between copper loss and the motor slip
 - 2.6 Power flow diagram of an induction motor
 - 2.7 Factors determining the torque
 - 2.8 Torque-slip curve, stable and unstable zones
 - 2.9 Effect of rotor resistance upon the torque slip relationship
 - 2.10 Double cage rotor motor and its applications
 - 2.11 Starting of 3-phase induction motors, DOL, star-delta, auto transformer
 - 2.12 Causes of low power factor of induction motors
 - 2.13 Testing of 3-phase motor on no load and blocked rotor test and to find efficiency

- 2.14 Speed control of induction motor
 - 2.15 Harmonics and its effects, cogging and crawling in Induction motors.
3. **Fractional Kilo Watt (FKW) Motors** (16 hrs)
- 3.1 Single phase induction motors; Construction characteristics and applications
 - 3.2 Nature of field produced 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.

LIST OF PRACTICALS

1. Demonstration of revolving field set up by a 3-phase wound stator
2. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
3. Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
4. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
5. Synchronization of polyphase alternators and load sharing
6. Determination of the effect of variation of excitation on performance of a synchronous motor
7. Study of ISI/BIS code for 3-phase induction motors
8. Perform at least two tests on a 3- phase induction motor as per BIS code
9. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
10. Determination of effect of rotor resistance on torque speed curve of an induction motor
11. To study the effect of a capacitor on the starting and running of a single-phase induction motor by changing 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 Mc Graw Hill, New Delhi*
- 2) *Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar*
- 3) *Electrical Machines by Nagrath and Kothari, Tata Mc Graw 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 FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Synchronous Machines	28	40
2	Induction Motors	24	30
3	Fractional Kilo Watt Motors	16	20
4	Special Purpose Machines	12	10
Total		80	100

5.2 ELECTRICAL POWER – 1 (Transmission and Distribution of Electrical Power)

L T P
4 - -

RATIONALE

The majority of the polytechnic 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.

DETAILED CONTENTS

1. **Transmission Systems** (20 hrs)
 - 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
2. **Distribution System** (12 hrs)
 - 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.
 - 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:** (12 hrs)
 - 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/400V distribution substation and various auxiliaries and equipment associated with it
4. **Faults:** (6 hrs)
Common type of faults in both overhead and underground systems, symmetrical / unsymmetrical faults. Single line to ground fault, double line to ground fault, 3-phase to ground fault open circuit.
5. **Power Factor:** (8 hrs)
5.1 Concept of power factor
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:** (6 hrs)
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. Their should be atlas 5 visits during the year. The students may be asked to prepare notes while on visit and submit the report. After that Viva-voce 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 FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Transmission Systems	20	30
2	Distribution System	12	20
3	Substations	12	20
4	Faults	6	10
5	Power Factor	8	10
6	Various Types of Tariffs	6	10
Total		64	100

5.3 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

L T P
4 - 2

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 compared to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical 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 into the usefulness and importance of the subject this has been incorporated in the curriculum.

DETAILED CONTENTS

1. **Introduction to SCR** (18 hrs)
 - 1.1. Construction and working principles of an SCR, two transistor analogy, introduction to Quadriac
 - 1.2. SCR specifications and rating
 - 1.3. Construction, working principles and V-I characteristics of SCRs, DIAC, TRIAC etc.
 - 1.4. Basic idea about the selection of heat sinks for SCR and TRIACS
 - 1.5. Methods of triggering a Thyristor. Study of triggering circuits
 - 1.6. UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator
 - 1.7. Commutation of Thyristors
 - 1.8. Series and parallel operation of Thyristors
 - 1.9. Applications of SCR, TRIACS in control circuits such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger etc.
 - 1.10. Protection of SCRs.
2. **Controlled Rectifiers** (10 hrs)
 - 2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of free wheeling diode.
 - 2.2 Single phase half controlled full wave rectifier
 - 2.3 Single phase fully controlled full wave rectifier bridge.
 - 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** (20 hrs)
 - 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, types of dual-converters, working principles and applications
 - 3.4 Cyclo-converters- introduction, types, working principles and applications

4 Uninterrupted power supplies

(8 hrs)

- (1) UPS online, off line
- (2) SMPS

LIST OF PRACTICALS

1. Identification and testing of components
2. To draw V-I characteristics of an SCR
3. To draw V-I characteristics of a TRIAC
4. To draw V-I characteristics of a DIAC
5. To draw uni-junction transistor characteristics
6. Observe the output wave of an UJT relaxation oscillator
7. Observe the wave shape across SCR and load of an illumination control circuit
8. Fan speed regulator using TRIAC and diac (fabrication of this circuit)
9. Speed-control of a DC shunt motor or universal motor
10. To observe the output wave shape on CRO of a Single phase/ half controlled/ full controlled/ full wave rectifier and three-phase uncontrolled 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 and guided industrial visits may be arranged.

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, Tata McGraw Hill, Publishing co. Ltd, New Delhi*
7. *Power Electronics by SK Sahdev, Unique International Publication, Jalandhar*
8. *Industrial Power Electronics by JC Karhava, King India Publication,*
9. *Fundamentals of Electrical Drives by Gopal K Dubey, Narosa Publishing House Pvt. Ltd, New Delhi*
10. *Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction of SCR	15	25
2	Controlled Rectifiers	15	25
3	Inverters, Choppers, Dual Converters	24	40
4	Uninterrupted power supplies	10	10
Total		64	100

5.4 Elective - I

5.4 (a) INSTRUMENTATION

L T P
4 - -

RATIONALE

This subject deals with the various instruments, their construction and working which control the various parameters and operations in any industry. Electrical supervisor employed for maintenance of electrical equipment/ machinery is required to diagnose faults, rectify them and test the total system for good performance. Thus there is a need of introducing diploma holders to the basics of Instrumentation. Basics of instrumentation has been dealt with in this subject

DETAILED CONTENTS

1. **Measurements:** (4 hrs)
Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, signal conditioning and display devices
2. **Transducers:** (8 hrs)
Theory, construction and use of various transducers (resistance, inductance, capacitance, electromagnetic, piezo electric type)
3. **Measurement of Displacement and Strain:** (10 hrs)
Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges and their different types such as inductance type, resistive type, wire and foil type etc. Gauge factor, gauge materials, and their selections, sources of errors and its compensations. Use of electrical strain gauges, strain gauge bridges and amplifiers.
4. **Force and Torque Measurement:** (10 hrs)
Different types of force measuring devices and their principles, load measurements by using elastic Transducers and electrical strain gauges. Load cells, proving rings. Measurements of torque by brake, dynamometer, electrical strain gauges, speed measurements; different methods, devices.
5. **Pressure Measurement:** (8 hrs)
Bourdon pressure gauges, electrical pressure pick ups and their principle, construction and applications. Use of pressure cells.
6. **Flow Measurement:** (6 hrs)
Basic principles of magnetic and ultrasonic flow meters
- f) **Measurement of Temperature:** (10 hrs)
Bimetallic thermometer, pressure thermometers, thermoelectric thermometers, resistance thermometers, thermocouple, thermistors and pyrometer, errors in temperature measurements in rapidly moving fluids. Temperature recorders
8. Measurement of other non electrical quantities such as humidity, pH level and vibrations (8 hrs)

INSTRUCTIONAL STRATEGY

The teacher should explain the scope of various measuring devices and their practical applications in the field. The transducers and measuring devices must be shown to the students and they should be trained in the selection, operation, maintenance and calibrations. Frequent visits to nearby process industries will be of immense help to the students.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Measurements	4	5
2	Transducers	8	15
3	Measurement of Displacement and Strain	10	15
4	Force and Torque Measurement	10	15
5	Pressure Measurement	8	10
6	Flow Measurement	6	10
7	Measurement of Temperature	10	15
8	Measurement of other non electrical quantities	8	15
Total		64	100

RECOMMENDED BOOKS

- 1) *Electronic Measurement and Instrumentation by Dr Rajendra Prasad*
- 2) *Electrical and Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co., New Delhi*
- 3) *Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick Prentice Hall of India Pvt. Ltd. New Delhi*

Elective-I
5.4(a) NON-CONVENTIONAL ENERGY SOURCES

L T P
4 - 2

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 diploma holder will have to face this 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:** (6 hrs)
Importance of Non conventional sources of energy, Present Scenario, Future Prospects, Economic Criteria
2. **Solar Energy:** (10 hrs)
Principle of conversion of Solar radiation into heat, Photo-voltaic cell, Electricity generation, Application of solar energy like Solar water heaters, Solar Furnaces, Solar cookers, Solar lighting, Solar pumping.
3. **Hydro Energy:** (6 hrs)
Hydro-electric Power Plants, Mini and Micro hydro-electric power generation.
4. **Bio-energy:** (8 hrs)
Bio-mass Conversion Technologies- wet and dry processes. Methods for obtaining energy from biomass. Power generation by using gasifier.
5. **Wind Energy:** (6 hrs)
Wind Energy Conversion, Windmills, Electricity generation from wind- Types of wind mills, local control, energy storage
6. **Geo-thermal and Tidal Energy:** (10 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. **Magneto Hydro Dynamic (MHD) Power Generation** (2 hrs)
8. **Chemical Energy Sources:** (10 hrs)
Design and operating principles of a fuel cell, conversion efficiency, work output and emf of fuel cells, applications, storage battery characteristics, types, applications, maintenance of batteries.

9. **Thermo Electric Power:** (6 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 FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction	6	5
2	Solar Energy	10	15
3	Hydro Energy	6	10
4	Bio-energy	8	15
5	Wind Energy	6	10
6	Geo-thermal and Tidal Energy	10	15
7	Magneto Hydro Dynamic	2	5
8	Chemical Energy Sources	10	15
9	Thermo Electric Power	6	10
Total		64	100

5.4 Elective-I

5.4 (b) INSTALLATIONS AND MAINTENANCE OF ELECTRICAL EQUIPMENT

L	T	P
4	-	3

RATIONALE

In his career as a supervisor, an electrical engineering technician will be called upon to inspect, test and modify the work done by skilled workers or artisans working under him. Many a times it will become necessary for him to demonstrate the correct method and procedure of doing certain operations. Normally manufacturers of heavy electrical equipment provide service manuals, instructions for installation, maintenance and fault location. Indian Electricity Rules and Indian Standard Specifications also provide enough guidelines.

This syllabus has been designed to provide certain guidelines and broad principles regarding the above activities. Appropriate field trips will reinforce the learning.

DETAILED CONTENTS

1. **Tools and Accessories** (4 hrs)
 - 1) Tools, accessories and instruments required for installation, maintenance and repair work
 - 2) Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. **Installation** (18 hrs)
 - 2.1 Installation of transmission and Distribution Lines:
Erection of steel structures, connecting jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and railway line crossings, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor, earthwire and guy wires, Testing and Commissioning.
Laying of service lines, earthing, provision of service fuses, installation of energy meters

 - 2.2 Laying of Underground Cables:
Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water, sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying, including laying of cable from the drum, laying cable in the trench, taking all measurements and making drawings, back filling of trenches with earth or sand, laying protective layer of bricks etc.) laying of cables into pipes and conduits and within

buildings, introduction to cable filling compounds, epoxy resins and hardeners, cable jointing and terminations, testing and commissioning.

- 2.3 Elementary idea regarding, inspection and handling of transformers; Pole mounted substations, plinth mounted substations, grid substation, busbars, isolation, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches.
 - 2.4 Testing of various electrical equipment such as electrical motor, transformers cables and generator and motor control centres, medium voltage distribution panels, power control centres, motor control centres, lighting arrangement, storage, pre-installation checks, connecting and starting, pre-commissioning checks, drying out
3. **Maintenance** (42 hrs)
- 3.1 Types of maintenance, maintenance schedules, procedures
 - 3.2 - Maintenance of Transmission and Distribution System
 - Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally and temporary earths cancellation of permit and restoration of supply.
 - Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections;
 - Location of faults using Meggar, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes and dim and flickering lights.
 - 3.3 Maintenance of Distribution Transformers
 - Transformer maintenance and points to be attended to in respect of various items of equipment
 - Checking of insulation resistance, transformer oil level and BDV test of oil, measurement of earth resistance
 - 3.4 Maintenance of Grid Substations
Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers
 - 3.5 Maintenance of Motors
Over hauling of motors, preventive maintenance, trouble shooting of electric motors
 - 3.6 Domestic Installation
Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors continuity or open circuit test

LIST OF PRACTICALS

1. Identification of tools and equipment
2. Giving exposure to students at actual sites in respect of above topics.
3. Study of codes and practices pertaining to various acceptable norms for electrical maintenance of power equipment

INSTRUCTIONAL STRATEGY

Since the subject has theory and practice. The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/persons with the help of HOD and the Principal of the institution.

RECOMMENDED BOOKS

1. *Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi*
- 2.. *Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPERSETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Tools and Accessories	4	5
2	Installation	18	30
3	Maintenance	42	65
Total		64	100

5.5 DIGITAL ELECTRONICS

L T P
5 - 2

RATIONALE

Digital electronics has made extremely rapid advances in the last five decades. It has important applications in communication entertainment, instrumentation, control, automation etc. Thus it appears that there is no end to its usefulness. In fact, the light and the new world belongs to it. So it is necessary to give the knowledge of digital electronics to the electrical students. Microprocessor is one of the most exciting technological advancement among the semiconductor devices in recent times. It has a tremendous impact on the Industrial processes due to its high reliability, flexibility and control capacity both at the design and the Implementation stages. The recent development of Microcontrollers has revolutionized the field of control by giving birth to embedded system. The decreasing cost with increasing facilities act as catalysts in widening their scope of applications. In addition, introduction to PLCs is also given.

DETAILED CONTENTS

1. **Number Systems** (10hrs)
 - 1.1 Decimal, binary, octal and hexa-decimal number systems and their inter-conversion
 - 1.2 Binary and Hexadecimal addition, subtraction and multiplication
 - 1.3 1's and 2's complement methods of addition/subtraction
2. **Gates** (10hrs)

Definition, symbol and truth tables for inverter, OR, AND, NAND, NOR and X-OR exclusive-AND gates
3. **Boolean Algebra** (10hrs)
 - 3.1 Boolean Relations and their applications
 - 3.2 DeMorgan's Theorems
 - 3.3 K-Map upto four variables
4. **Combinational Circuits** (10hrs)
 - 4.1 Half adder, Full adder
 - 4.2 Encoder, Decoder
 - 4.3 Multiplexer/Demultiplexer
 - 4.4 Display Devices (LED, LCD and 7-segment display)
5. **Flip-Flops** (10hrs)
 - 5.1 J-K Flip-Flop
 - 5.2 R-S Flip-Flop
 - 5.3 D-Type Flip-Flop
 - 5.4 T-Type Flip-Flop
 - 5.5 Applications of Flip-Flops
6. **Shift Registers and Counters** (10hrs)
7. **A/D and D/A Converters** (6 hrs)
 - 7.1 A/D converter (Counter ramp, successive approximation method of A/D Conversion)
 - 7.2 D/A converters (Binary weighted, R-2R D/A Converter)
8. **Semi-conductor Memories** (4 hrs)

Types, merits, demerits, and applications

9. **PLCs** (10 hrs)
- 9.1 Process Control, advantages and applications
- 9.2 Introduction to PLCs, Building blocks of PLC, Functions of various blocks
- 9.3 Working of PLC
- Basic operation and principles of PLC
 - Architectural details of processor
 - Memory structures, I/O structure
 - Programming terminal, power supply

LIST OF PRACTICALS

- 1) Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR gates
- 2) Construction of Half Adder using gates
- 3) Construction of Full Adder using gates
- 4) To verify the truth table for JK flipflop
- 5) Construction and of testing of any counter
- 6) Verification of operation of a 8-bit D/A Converter, Familiarization with the working of PLC

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), A/D, D/A converters and other Topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. More emphasis be given on practical aspects along with the theory input. Lots of programming exercises may be given to the students. Mini projects based on microprocessor operations may be identified and given to students as assignments. The students may be made familiar with applications of PLCs and Microcontrollers by arranging visits to industry.

RECOMMENDED BOOKS

1. *Modern Digital Electronics by RP Jain, Tata McGraw Hill, New Delhi*
2. *Digital Principles and Electronics by Malvino and Leach, Tata McGraw Hill, New Delhi*
3. *Digital Electronics by SN Ali*
4. *The 8051 Microcontrollers, architecture, programming and applications Kenneth J. Ayala, Thomson, Delmar learning. 2nd Edition*
5. *Microcontroller and PLC by Sanjay Attri.*
6. *Digital Electronics by Rajive Sapra, Eshan Publications, Ambala City*
7. *Digital Fundamentals by Floyd and Jain, Pearsons Education (Singapore) Pte Ltd Patparganj, Delhi 110092*
8. *Digital Electronics by KS Jamwal, Dhanpat Rai and Co. New Delhi*
9. *Microprocessors Architecture, Programming and Application with 8085/8080A, Ramesh S Gaonkar, Wiley Eastern Ltd. New Delhi*
10. *Introduction to Microprocessors by Aditya Mathur, TMH Publishing Co., New Delhi*
11. *Microprocessors and Microcontrollers by BP Singh, Galgotia Publications, New Delhi*
12. *Digital Systems by Sanjay K Bose, Wiley Eatern(P) Ltd. New Delhi*
13. *Digital Systems : principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi*
14. *Digital Integrated Circuits by AK Gautam, SK Kataria and Sons, New Delhi*

15. *Microprocessors(The 8086 and 8088) by AK Gautam and A Jaiswal; SK Kataria and Sons, New Delhi*
16. *Technicians Guide to Programmable logic controllers, by Richard Cox, Delmar Publishers, Student edition*
17. *Introduction to Programmable logic controller, by Gary Dunning Delmar Publishers*
18. *Programmatic logic controllers, by John, Hackworth, Prenties hall of India*
19. *Using the MCS-51 Microcontrollers by Han-way Huang, Oxford University Press*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Number Systems	8	5
2	Gates	5	5
3	Boolean Algebra	8	10
4	Combinational Circuits	8	10
5	Flip-Flops	6	10
6	Shift Registers and Counters	6	10
7	A/D and D/A Converters	4	5
8	Semi-conductor Memories	3	5
Controllers			
9	Microprocessor	16	20
10.	Microcontrollers	06	10
11.	PLCs	10	10
Total		80	100

5.6 PC MAINTENANCE AND REPAIR

L T P
- - 4

RATIONALE

PC is a tool that defines today current age and culture. A right understanding about any tool is required to use it effectively. There has been a complete revolution in this area because of rapid advancement in the field of electronics. The PC is the most logical and modern machine and is no more difficult to understand its functions. It is very important to learn the various components of PC and how these parts work together. All technically trained individuals must understand the general nature of PC operation of memory, I/O techniques, interfacing applications etc. Looking at the importance and usefulness, this subject has been included in the curriculum.

DETAILED CONTENTS

Note:

Since this is a practical type subject, there will be no theory examination. List of practicals are listed below:

LIST OF PRACTICALS

1. Introduction to Computer hardware and components
2. Familiarization with PC assembling and disassembling.
3. BIOS configuration and settings.
4. Installation of Hard-Disk drive including partitioning and formatting.
5. Familiarization with cables i.e. co-axial, UTP and fiber-optic cable and their installation
6. Installation and configuration of dial-up networking for Broad band internet
7. Installation of Linux OS and other Windows operating systems
8. How to make an E-mail-ID on internet.
9. Installation of a printer on different operating systems.
10. Virus – removal and use of vaccines down loads. (Symantec, Norton) etc.
11. **Installation of**
 - (a) CD or DVD Drive
 - (b) Sound card, Speaker and headphone
12. Basic idea about LAN and Computer shoring.
13. Basic idea about various by faults (common) occurring in a PC and its rectification.
14. Recognition of USB port and other parts dike thumb drive or Card Reader etc.
15.
 - (a) Replacement of RAM
 - (b) Replacement of Power Supply

RECOMMENDED BOOKS

1. *Hardware Bible ; Winn. L. Rosch, Techmedia*
2. *The complete PC upgrade and maintenance guide, Mark Minasi, BPB Publications, New Delhi*
3. *Computer Networks, A. Tanenbaum, PHI Ltd., New Delhi*
4. *PC Maintenance and Troubleshooting by “Biglow”*
5. *PC Up grading, Maintenance and Troubleshooting Guide by SK Chouhan ; SK Kataria and Sons, New Delhi*
6. *PC Maintenance and repair by Mohit Sofat; Ishan Publications.*
7. *Website Computer-repair.co.in.*

5.7 MINOR PROJECT WORK

L T P
- - 4

Minor project work aims at exposing the students to industrial/field practices so as to have an appreciation of size, scale and type of operations; and work culture in the industries. Also the students will be able to comprehend concepts, principles and practices taught in the classroom and their application in solving field/industrial problems. The work done in minor project work will also prepare them in taking up problem solving at latter stage under major project work.

Depending upon the interests of the students and location of the organization the student may be asked for:

Market study in the following cases:

1. Various types of cables available in the market, their current rating/specifications, different makes/manufacturing companies (minimum three), comparison of cost between different makes.
2. 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.
3. 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.
4. Various types of electric lamps (lumeneries) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.
5. 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)

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

The components of evaluation will include the following :

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

6.1 BASICS OF MANAGEMENT

L T P
3 - -

RATIONALE

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

DETAILED CONTENTS

1. **Introduction:** (8 Hrs)
Definition and concept of Management, functions of management viz. planning, organizing, staffing, coordinating, controlling; Various areas of management - Human Resource Management (HRM), Financial Management, Marketing Management, Material Management etc.
2. **Structure of Industrial Organization** (4 Hrs)
Concept and structure of an organization, hierarchical management structure (top, middle and lower level management) and functional management structure.
3. **Leadership** (4 Hrs)
Concept, importance, types and qualities of a good leader
4. **Motivation** (4 Hrs)
Concept and importance of motivation - drives and incentives, intrinsic and extrinsic motivation, brief about theories of motivation.
5. **Customer Relationship Management (CRM)** (6 Hrs)
Need, various types of customers, customer satisfaction, life- long customer, Customer Satisfaction Index (CSI) and its significance in playing effective role of engineers in changing scenario.
6. **Legal Aspects of Business** (12 Hrs)
 - a) Elementary knowledge of Income Tax, Sales Tax, Excise Rules, Provident Fund
 - b) Elementary knowledge of Factory Act, 1948 and Payment of Wages Act 1936, Workmen Compensation Act, Industrial Dispute act 1947, Employees State Insurance Act 1978.
 - c) Labour Welfare schemes including wage payment-types, system of wage payment and incentives.
 - d) Intellectual Property Rights (IPR): Concepts, definition, infringements and remedies related to patents, copyrights, trademarks, and designs. Introduction to registering procedure, patent rules.
 - e) Accident and Safety: Classification, precaution and treatment after accident, safety practices promotion, personal protection equipment (PPEs) for safety at work places.

7. Introduction to Total Quality Management (TQM) and steps to achieve this. (2 hrs)
8. Environmental Considerations (8 Hrs)
 - a) Concept of ecology and environment
 - b) Factors contributing to Air, Water, Noise Pollution
 - c) Pollution Control Board
 - d) Disaster Management-basic idea

INSTRUCTIONAL STRATEGY

It is observed that the diploma holders generally take up middle level managerial positions, 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

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	8	15
2.	4	10
3.	4	10
4.	4	12
5.	6	10
6.	12	15
7.	2	08
8.	8	20
Total	48	100

6.2 ENERGY MANAGEMENT

L T P
4 - 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** (12 hrs)
 - 1.1 Overview of energy management, need for energy conservation, Environmental Aspects
 - 1.2 Need for energy conservation with brief description of oil and coal crisis.
 - 1.3 Environmental aspects
 - 1.4 Alternative sources of energy.
 - 1.1 Energy efficiency- its significance

2. **Energy Conservation** (12 hrs)
 - 2.1 Energy conservation in Domestic sector- Lighting, home appliances
 - 2.2 Energy conservation in Industrial sector- Motors, Industrial lighting, Distribution system, Pumps, Fans, Blowers etc.,
 - 2.3 Energy conservation in Agriculture sector Tubewell pumps, diesel-generating sets, Standby energy sources.
 - 2.4 Macro Level approach for energy conservation at design stage.

3. **Energy Efficient Technology** (20 hrs)
 - 3.1 Energy efficient technology an overview
 - 3.2 Need for energy efficient devices
 - 3.2 Initial cost versus life cycle, cost analysis on life cycle basis
 - 3.3 Energy efficient motors as compared to standard motors.
 - 3.4 BIS specification for energy efficient motors, salient design features,
 - 3.5 Efficiency as a function of load, safety margins
 - 3.6 Energy efficient lighting system different sources, lumens/watt, LEDs, role of voltage on efficiency of the system
 - 3.7 Custom Power voltage dip, voltage sag, voltage fluctuation, voltage spikes and transients, frequency deviation, Harmonics contents. Effect of above on power quality.
 - 3.8 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** (15 hrs)
 - 4.1 Energy audit methodology
 - 4.2 Efficiency of energy conversion processes, monitoring system
 - 4.3 Specific energy consumption –three pronged approach, fine tuning, technical up gradation, avoidable losses.
 - 4.4 Case studies of energy audit of domestic installation, distribution system, and related Industries audit activities.
5. **Environmental Impact Assessment** (5 hrs)
 - 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 Luminas/Watt

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. Beet 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, fertiliser industry, cement industry. CII, Energy Management Cell etc*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Energy Management	12	20
2	Energy Conservation	12	20
3	Energy Efficient Devices	20	30
4	Energy Audit	15	25
5	Environmental Impact Assessment	5	5
Total		64	100

6.3 ELECTRICAL POWER-II (Power Generation and System Protection)

L T P
5 - 2

RATIONALE

In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma pass out have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply. The course is designed to understand the concepts, principles involved in the construction and working of generating stations and protective switch gear system so that one can handle, install, maintain them and also take decisions at his/her level in different situations. The teaching of this subject requires reinforcement in the form of visits to substations, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

DETAILED CONTENTS

1. **Power Generation** (16 hrs)
 - 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. Flow diagrams and brief details of their operation, comparison of the generating stations on the basis of running cost, site, starting, maintenance etc.
 - 1.3 Importance of non-conventional sources of energy in the present scenario. Brief details of solar energy, bio-energy, wind energy

2. **Economics of Generation** (8 hrs)
 - 2.1 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 there on.
 - 2.2 Base load and peak load power stations, inter-connection of power stations and its advantages, concept of regional and national grid.

3. **Switch gears** (20 hrs)
 - 3.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making capacity and breaking capacity of circuit breaker (only definition)
 - 3.2 Principles of Arc extinction in OCB and ACB, Constructional features of OCB, ACB, and their working,
 - 3.3 Circuit breakers. Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF₆ circuit breakers
 - 3.4 Miniature circuit breakers ACB, ELCB, MCB, for distribution and transmission system (Descriptive)

4. **Protection Devices** (16 hrs)
 - 4.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewirable, cartridge, HRC

- 4.2 Earthing: purpose of earthing, method of earthing, Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules. Methods of reducing earth resistance.
- 4.3 Relays:
- a) Introduction- types of relays. Electromagnetic and thermal relays, their construction and working
 - b) Induction type over-current, earth fault relays, instantaneous over current relay
 - c) Directional over-current, differential relays, their functions
 - d) Distance relays, their functions
 - e) Idea of static relays and their applications
5. **Protection Scheme** (10 hrs)
- 5.1 Relays for generator protection
 - 5.2 Relays for transformer, protection including Buchholtz relay protection
 - 5.3 Protection of feeders and bus bars, Over current and earth fault protection.
 - 5.4. Distance protection for transmission system
 - 5.5. Relays for motor protection
6. **Over-voltage Protection** (10 hrs)
- 6.1 Protection of system against over voltages, causes of over voltages, utility of ground wire
 - 6.2 Lightning arrestors, Rod gap, horn gap, metal oxide type.
 - 6.3 Transmission Line and substation protection against over-voltages and lightning

LIST OF PRACTICALS

Visit to power station/sub station for the conduct of following practical work:

1. Testing of the dielectric strength of transformer oil
2. Study of different types of circuit breakers and isolators
3. Working of different types of protective relays (such as IDMT, Differential Relay)
4. Working of CTs and PTs
5. Earthing of different equipment
6. Testing of MCB as per IS specifications

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of generating stations and substations be arranged and various equipment, accessories and components explained to the students. The protection schemes should be shown at the site and engineers from field may be invited for delivering expert lectures on these topics. Help of Video Films may be taken to explain the layout; construction and working of different power equipment.

RECOMMENDED BOOKS

1. *Testing, Commissioning , Operation and Maintenance of Electrical Equipment* by S Rao, Khanna Technical Publication, New Delhi
2. *Electrical Power – II* by SK Sahdev, Unique International Publications, Jalandhar (Pb)
3. *Electrical Power Systems* by CL Wadhwa, Wiley Eastern Ltd., New Delhi
4. *Textbook of Electrical Technology* by BL Theraja, S Chand and Co., New Delhi
5. *Electrical Power* by Dr. SL Uppal, Khanna Publications, Delhi
6. *A Course in Electrical Power* by ML Soni, PV Gupta and Bhatnagar, Dhanpat Rai & Sons, New Delhi
7. *Principles of Power Systems* by VK Mehta, S Chand and Co., New Delhi
8. *Preventive Maintenance of Electrical Apparatus* by SK Sharotri, Katson Publishing House, Ludhiana

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPERSETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Power Generation	16	18
2	Economics of Generation	8	12
3	Switch gears	20	24
4	Protection Devices	16	18
5	Protection Scheme	10	14
6	Over-Voltage Protection	10	14
Total		80	100

6.4 Elective – II

6.4(a) PLCs AND MICROCONTROLLERS

L T P
4 - -

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.

Microcontrollers have also assumed great significance in the field of electronics and comma 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. **Introduction to PLC** (06 hrs)
What is PLC, concept of PIC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc.

2. **Working of PLC** (08 hrs)
 - 2.1 Basic operation and principles of PLC
 - 2.2 Architectural details processor
 - 2.3 Memory structures, I/O structure
 - 2.4 Programming terminal, power supply

3. **Instruction Set** (08 hrs)
 - 3.1 Basic instructions like latch, master control self holding relays.
 - 3.2 Timer instruction like retentive timers, resetting of timers.
 - 3.3 Counter instructions like up counter, down counter, resetting of counters.
 - 3.4 Sequencers, output sequencers, input sequencers, time driven, and event driven sequencers, masking etc.
 - 3.5 Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal, mask equal limit etc.

4. **Ladder Diagram Programming** (06 hrs)
Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.
5. **Applications of PLCs** (04 hrs)
 - 5.1 Assembly
 - 5.2 CNC Machines
 - 5.3 Packaging
 - 5.4 Process controls
 - 5.5 Car parking
 - 5.6 Doorbell operation
 - 5.7 Traffic light control
 - 5.8 Sorting of objects etc
 - 5.9 Microwave Oven
 - 5.10 Washing machine
6. **Micro Controller Sense (MCS)-51 Over View** (10 hrs)
 - 6.1 Pin details
 - 6.2 I/o Port structure
 - 6.3 Memory Organisation
 - 6.4 Special function registers
7. **Instruction Set Addressing Modes** (06 hrs)
 - 7.1 Timer operation
 - 7.2 Serial Port operation
 - 7.3 Interrupts
8. **Assembly language programming** (06 hrs)
 - 8.1 Assemblers and Compilers
 - 8.2 Assembler Directives
9. **Design and Interface** (04 hrs)
Examples like: keypad interface, 7- segment interface, LCD, stepper motor. A/D, D/A, RTC interface.
10. **Introduction of PIC Micro controllers** (04 hrs)
11. **Application of Micro controllers** (02 hrs)

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLCs and Microcontrollers. The inputs shall start with theoretical inputs to architecture, instruction set, assembly language 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 PIC (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*
6. *The 8051 Micro controller by I Scot Mackenzie, Prentice Hall International, London*
7. *The 8051 Micro controllers Architecture, programming and Applications by Ayala; Penram International*
8. *Process Control Instrumentation Technology by Johnson, Curits; EE Edition, Prentice Hall of India, New Delhi*
9. *Microcontrollers by Ayala*
10. *Microcontrollers by Mazidi*
11. *Microcontrollers by Neil Makanzie*
12. *Microcontrollers by Deshmukh*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1.	Introduction to PLC	6	10
2.	Working of PLC	8	15
3.	Instruction Set	8	10
4.	Ladder Diagram Programming	6	10
5.	Applications of PLCs	4	5
6.	Micro Controller Sense (MCS)-51 Over View	10	15
7.	Instruction Set Addressing Modes	6	10
8.	Assembly language programming	6	10
9.	Design and Interface	4	5
10	Introduction of PIC Micro controllers	4	5
11	Application of Micro controllers	2	5
Total		64	100

Elective - II

6.4 (b) OPTICAL FIBER COMMUNICATION

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RATIONALE

Progressing from communication over copper wire to today's fiber optic communication, we have increased our ability to transmit larger information, more quickly covering even longer distances. This has expanded our boundaries and it finding a good slot in communication system. It has gradually replaced the old technology of electrical communication. Operational fiber optical systems are now in common and new installations and applications appear continually. The growth is expected to continue for many years. Basic concepts and techniques of optical fiber communication have been dealt with in this subject.

DETAILED CONTENTS

- 1. Introduction** (8 hrs)
Historical perspective, basic communication systems, optical frequency range, advantages optical fiber communication, application of fiber optic communication
- 2. Light Wave Fundamentals** (10 hrs)
Nature of light, acceptance angle and numerical aperture, electromagnetic waves, dielectric wave guide, modes in planar guide, dispersion and distortion in wave guide.
- 3. Optical Fiber Waveguides** (10 hrs)
Fiber structure, step-index fiber, graded – index fiber, attention, modes in step, index and graded index fibers, pulse dispersion and information rate in optical fibers, construction of optical fibers, optical fiber cables.
- 4. Light Sources** (8 hrs)
Light emitting diodes (LEDs), Operating characteristics of LEDs, Laser principles, different types of lasers, laser diodes, operating characteristics of laser-diodes, distributed feedback laser diode, optical amplifier, fiber laser.
- 5. Light Detectors** (8 hrs)
Principles of photo detection, photo multiplier semiconductor photodiode, PIN diode and Avalanche Photo Diode (APD), comparison. Between PIN diode and APD.
- 6. Optical Fiber Joints** (8 hrs)
Fiber, alignment and joint loss, fiber end preparation, splices, connectors, source coupling.

7. **Distribution Networks and Fiber Components** (10 hrs)
Distribution network, directional couplers, star couplers, switches, fiber optical isolators, attenuators, wave length division multiplexing.

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. The theory should be re-enforced by visit to sites and industries like HFCL having optical fiber .

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Introduction	8	10
2	Light Wave Fundamentals	10	15
3	Optical Fiber Wave guiders	10	15
4	Light Sources	10	15
5	Light Detectors	8	15
6	Optical Fiber Joints	8	15
7.	Distribution Networks and Fiber Components	10	15
Total		64	100

RECOMMENDED BOOKS

- Optical Fiber Communication by Joseph. C. Palais, Pearson Education Publications, Published by Addison Wesley hangman (Singapore) Pte. Ltd., Delhi.*
- Optical Fiber Communication and its Applications by S.C.Gupta, Prentice Hall India – New Delhi.*
- Fiber-Optic Communication Systems by G.P. Agrawal; John Wiley and Sons, New Delhi.*
- Optical Fibers Communication, by John M. Senior, Prentice Hall India, New Delhi.*
- Optical Communication Systems by J. Gower; Prentice Hall India, New Delhi.*
- Optical Fiber Communication by Gerd Keiser; Mc Graw Hill, International Editions.*
- Optical Communication: Components and Systems by Franz, J.H, Narosa Publishing House Pvt. Ltd. Darya Ganj New Delhi*
- Technician Guide to Fiber-Optics by Donald J Sterling, Vikas Publishing House Pvt Ltd, Jangpura, New Delhi*

Elective-II

6.4(c) MODERN ELECTRIC TRACTION SYSTEM

L T P
4 - -

RATIONALE

Now a days electrical energy finds one of its major application is in electric traction besides diesel electric locomotives. An electrical engineering diploma holder is required to have elementary knowledge of electric drives and systems used in traction and their accelerating and braking arrangements. This subject deals with the modern electric traction systems and practices.

DETAILED CONTENTS

1. **Introduction** (4 hrs)
 - 1.1. Electric Traction System.
 - 1.2. Historical background of track electrification in India.
 - 1.3. Advantages over other system
 - 1.4. Types of electric traction systems
 - 1.5. Choice of traction system in India

2. **System of Track Electrification** (6 hrs)
 - 2.1 Single phase low frequency system.
 - 2.2 Three phase low frequency system
 - 2.3 Composite System
 - 2.4 Disadvantages of Single phase to D.C. System
 - 2.5 Comparison between pure A.C. and D.C system.

3. **Track Mechanics** (8 hrs)
 - 3.1 Types of services (Urban, Suburban and Mainline)
 - 3.2 Speed time curve
 - 3.3 Tractive effort and traction effort speed characteristics
 - 3.4 Power of traction motor
 - 3.5 Specific energy consumption
 - 3.6 Mechanics of train movement, co-efficient
 - 3.7 Factors affecting slip.
 - 3.8 Simple numerical problems.

4. **Power Supply arrangement** (8 hrs)
 - 4.1 Constituents of Power supply system i.e. substation
 - 4.2 Sectioning and paralleling post.
 - 4.3 Subsection and post
 - 4.4 Sub-sectioning post and elementary sections
 - 4.5 Major control posts or switching substations
 - 4.6 Major equipment of substations.

5. **Equipment used in and outside the Locomotive** (8 hrs)
 - 5.1 Block diagram of a Locomotive
 - 5.2 Overhead equipment
 - 5.3 Section Insulator
 - 5.4 Polygon OHE
 - 5.5 Supporting structure
 - 5.6 Current collector
 - 5.7 Circuit breaker
 - 5.8 Tap changer
 - 5.9 Transformer
 - 5.10 Rectifier connections
 - 5.11 Smoothing reactors

6. **Traction Motors and Traction Motor Control** (8 hrs)
 - 6.1 Desirable characteristic of traction motors.
 - 6.2 Comparative study of characteristic of Induction motors and d.c. series motors
 - 6.3 Linear induction motors and their suitability for traction applications.
 - 6.4 Series parallel control of traction motors.
 - 6.5 Advantages of series parallel control
 - 6.6 Simple numerical problems

7. **Braking** (8 hrs)
 - 7.1 Requirements of braking system.
 - 7.2 Types of brakes (Mechanical, hydraulic, magnetic and eddy current)
 - 7.3 Electrical braking – plugging, rheostatic and regenerative braking.

8. **Train Lighting** (8 hrs)
 - 8.1 Systems of train lighting
 - 8.2 Special requirements of train lighting
 - 8.3 Single Battery system
 - 8.4 Double Battery parallel block systems
 - 8.5 Principal equipment of Double Battery system
 - 8.6 Modified Train Lighting System
 - 8.7 Silicon Blocker Rectifier
 - 8.8 End on generation.

9. **Railway Coach Air-conditioning** (6 hrs)
 - 9.1 Electrical equipment for power generation and accessories for control of air conditioning equipment.
 - 9.1.1 Motor generator set
 - 9.1.2 Star-delta starter and pre-cooling plug socket
 - 9.1.3 Compressor – condenser and air conditioning unit motors
 - 9.1.4 Main control panel.
 - 9.1.5 Batteries
 - 9.2 Circuit explanation of schematic diagram for air conditioning equipment.
 - 9.3 Starting of plant when coach is stationary and no ac supply is available.
 - 9.4 Starting the plant when coach is running and the generator is generating.

INSTRUCTIONAL STRATEGY

Since the subject is field oriented and there is no laboratory arrangement in polytechnics, the students should be taken to locomotive yard, railway workshops and shown the actual working of the system.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Introduction	4	5
2	System of Track Electrification	6	10
3	Track Mechanics	8	10
4	Power Supply Arrangement	8	10
5	Equipment used in and outside the Locomotive	8	15
6	Traction Motors and Traction Motor Control	8	15
7.	Braking	8	10
8.	Train Lighting	8	15
9.	Railway Coach Air-Conditioning	6	10
Total		64	100

RECOMMENDED BOOKS

1. *Art and Science of utilization of electrical energy by H. Partab, Dhanpat Rai and Sons, Delhi*
2. *Modern Electric Traction by Partab, Dhanpat Rai and Sons, Delhi*

6.5 UTILIZATION OF ELECTRICAL ENERGY (UEE)

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4 - 2

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:** (20 hrs)
 - 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:** (12 hrs)
 - 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 numericals
 - 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** (10 hrs)
- 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:** (8 hrs)
- 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:** (10 hrs)
- 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:** (10 hrs)
- 6.1 Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants
 - 6.2 Description of Electrical circuit used in
 - a) Refrigerator,
 - b) Air-conditioner, and
 - c) Water cooler
7. **Electric Traction:** (10 hrs)
- 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.*

Students should be taken for visits of the following during the semeste:

List of Practical

1. Study of different types of sources of light, their connections, and to measure intensity of light with lux-meter:
 - 1.1 Fluorescent lamp
 - 1.2 HP mercury vapour lamp
 - 1.3 HP sodium vapour lamp
 - 1.4 Compact Fluorescent lamp (CFL)
2. Study of induction furnace by visiting a factory and to prepare a report
3. Study of welding equipment along with its accessories
4. Study of the electroplating plant by visiting an industry and preparing a report
5. Study of refrigerator/air conditioner and to prepare a report of its electrical circuit
6. Study of an electric locomotive by visiting any locomotive repair shop at a nearby station

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 to 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.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPERSETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Electric Drives	20	25
2	Illumination	12	15
3	Electric Heating	10	15
4	Electric Welding	8	10
5	Electrolytic Processes	10	10
6	Electrical Circuits used in Refrigeration	10	10
7	Electric Traction	10	15
Total		80	100

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 Book. of 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 if Electrical Power* by CL Wadhwa, Wiley Eastern Ltd., New Delhi

6.6 MAJOR PROJECT WORK

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Project work aims at developing skills in the students whereby they apply in totality the knowledge and skills gained through the course in the solution of a practical problem undertaken as a project work. The 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. It is also essential that the faculty of the respective departments may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The students should identify themselves or be given project assignment at least two to three months in advance. The project work identified in collaboration with industry/field organization should be preferred.

Each teacher is expected to guide the project work of 5-6 students at a time. The project assignments may consist of :

- a) Projects related with repair and maintenance of machine parts
- b) Estimating and costing projects
- c) Design of components/ parts/ jigs / fixtures
- d) Projects related to quality control
- e) Project work related to increasing productivity
- f) Project connected with work study
- g) Projects relating to erection, installation, calibration and testing
- g) Projects related to wastage reduction
- h) Projects related to energy audit

For Students of Electrical Engineering Diploma Programme the project work can be grouped under the following four groups. A number of projects have been mentioned under each section. A student should take at least two projects both of which should not be from the same group. If more than two projects are taken to make up a total of 256 hours, then more than 1 may be taken from the same group as long as at least two groups are covered. A student is read to choose one project from each section.

Report for all the four project should be prepared and and will give a seminar. The same will be assessed for internal and external assessment.

NOTE: Any one from each section

SECTION A

1.1 Electrical Machines and Equipment:

- 1.1 Design and Construction of a small transformer (100 VA to 1 kVA)
- 1.2 Construction of phase sequence indicator
- 1.3 Construction of hot air drier
- 1.4 Construction of a Simple loop generator
- 1.5 Design and fabrication of Automatic curtain operator

- 1.6 Construction of Automatic Star-Delta starter
- 1.7 Construction of Automatic Water level controller
- 1.8 Balancing of load of an indoor distribution transformer
- 1.9 Construction of Choke for fluorescent tubes
- 1.10 Design and construction of fan regulators (inductance type)
- 1.11 Design and construction of fan regulators (Resistance type)
- 1.12 Design and construction of loading rheostats
- 1.13 Design and construction of Desert coolers
- 1.14 Fabrication of electric motor (FKW)
- 1.15 Rewinding of motors upto 5 HP
- 1.16 Design and construction of Geyser
- 1.17 Electroplating of small domestic gadgets
- 1.18 Erection/installation and commissioning of rotating electrical machine
- 1.19 Fault detection and repair of electrical/electronic instruments
- 1.20 Design and assembly of contactor control circuit for various applications

SECTION B

1.2 Electrical Power:

- 1.2.1 Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board. Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.
- 1.2.2 To study the laying of underground distribution cable for a small colony starting from main distribution pole
- 1.2.3 To study the erection erect a 5 pole span overhead line for a small distance for distribution of electrical energy. To energize it and prepare list of material and cost estimates.
- 1.2.4 To provide a service connection to a consumer's premises for domestic purposes
- 1.2.5 To survey the load of given area in a village, small colony, calculate the effective load and find out the sizes of the cables/conductors for the proposed distribution system
- 1.2.6 Designing of light and fan scheme for a institutional or commercial building
- 1.2.7 To study the augmentation of a nearby pole mounted sub station

SECTION C

1.3 Electronic Based Projects:

Fabrication of:

- 1.3.1 Voltage Stabilizer for refrigerator, air-conditioner
- 1.3.2 Emergency light using SCR
- 1.3.3 Power amplifier
- 1.3.4 Low cost intercom for home
- 1.3.5 Analog computer

- 1.3.6 Regulated power supply (+ 12V and + 6V) using 7812, 7912 and 7806, 7906
- 1.3.7 Automatic battery charger using SCR
- 1.3.8 Battery operated tube light
- 1.3.9 Solid state fan regulator
- 1.3.10 Burglar Alarm
- 1.3.11 Hearing aid
- 1.3.12 Automatic street light/dressing table light
- 1.3.13 Mosquito Repeller
- 1.3.14 Inverter circuit 500 watt.
- 1.3.15 Solid State Control of Traffic Lights

SECTION D

1.4 Fabrication and Testing of:

- 1.4.1 Inverter/Emergency light circuit using power transistors
- 1.4.2 SCR based automatic battery charger
- 1.4.3 SCR operated illumination controller
- 1.4.4 SCR operated automatic water level controller
- 1.4.5 SCR based speed controller for DC shunt motor
- 1.4.6 Three phase full wave rectifier using power diodes
- 1.4.7 Timer circuit using 555-IC
- 1.4.8 SCR controlled rectifier circuit
- 1.4.9 Speed control circuit of DC shunt motor using SCR
- 1.4.10 Inverting and non-inverting amplifiers using OP AMP(741)
- 1.4.11 Comparator circuits using OP AMP (741)

Note: *The quality of end-product and process adopted by the students in its execution should be taken into consideration along with other parameters while evaluating the students*

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No	Performance criteria	Max. marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of performance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self expression/communication skills	5	5	4	3	2	1

7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
Total marks		100	100	80	60	40	20

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance to improve and re-evaluated before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

	Range of maximum marks	Overall grade
i)	More than 80	<i>Excellent</i>
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.
3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.
4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project items prepared by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.

6.7 PRACTICE IN COMMUNICATION SKILLS

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RATIONALE

For successful completion of diploma programme, a student should possess adequate command on language and communication skills so that he/she is able to express himself/herself with ease and felicity. The language used by the student should be appropriate to objectives and occasion. The contents of this subject shall provide practical training to the students through language laboratory.

LIST OF PRACTICAL EXERCISES

1. Exercises on phonetics
2. Interactive session (case studies)
3. Presentation of periodic progress reports (written/oral) and maintaining daily diary
4. Exercises on self assessment using tools like SWOT analysis.
5. Communication empowerment through breaking language Barriers.
6. Internet communication
7. **Correspondence**
 - a) Resume writing
 - b) Covering letter
 - c) Follow-up correspondence
 - d) Internal and External business Correspondence
8. Practice on public relation skills with live examples.
9. Practice on listening skills.
10. Speaking exercises with emphasis on voice modulation (reading and extempore)
11. Demonstration and practice on Body language and Dress sense.
12. Exercises on etiquettes and mannerism in difficult situations like business meetings, table manners, telephone etiquettes and manners related to opposite gender.
13. Exercises on wit and humour in conversations and creating lively environment.
14. Role play for effective Communication.
15. Cross-cultural Communication
16. Group Discussion
17. Mock interviews (telephonic/personal)