

REVISED CURRICULUM

FOR

DIPLOMA PROGRAMME

IN

MECHANICAL 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 moto 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. 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.

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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 passouts 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 passouts. 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 implementors 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 H.P. 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 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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DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING
(For the State of Himachal Pradesh)

1. SALIENT FEATURES

- 1) Name of the Programme : Diploma Programme in
Mechanical Engineering
- 2) Duration of the Programme : Three years (Six Semesters)
- 3) Entry Qualification : 10 +
- 4) Intake : 30
- 5) Pattern of the Programme : Semester Pattern
- 6) Number of Semesters : Six
- 7) Ratio between theory and Practice : 40 : 60
- 8) **Industrial Training:**
Four weeks of industrial training is included after IV semester during summer vacation. Internal assessment out of 50 marks and external assessment out of another 50 are added in 5th semester. Total 100 marks are allotted to industrial training.
Distribution of Marks:
 - Daily diary and reports of training - 50 Marks
 - Viva Voce(External) - 50 Marks
- 9) **Ecology and Environment :**
As per Govt. of India directives, an awareness camp on Ecology and Environment has been incorporated during second semester.
- 10) **Entrepreneurship Development:**
An Entrepreneurial Awareness Camp and a full subject on Generic Skill and Entrepreneurship Development has been incorporated in the scheme.
- 11) **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. These 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 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.

3. EMPLOYMENT OPPORTUNITIES

After detailed discussions, the workshop group visualized the following major employment opportunities for diploma holders in Mechanical Engineering.

- 3.1 Manufacturing/Process industries in private and public sector.
- 3.2 Service Sector like Railway; Military Engineering Services; Boards and Corporations; Construction Companies; Transportation Departments; Telecommunications; P.W.D. and Rural Development Agencies.
- 3.3 In power sector i.e. power generation, transmission and in construction of power projects.
- 3.4 As programmer on CNC machines.
- 3.5 As self employed in Manufacturing and Service Sector Though the diploma holders find placement in all functional areas like R&D ;Design and Drawing; Planning; Shop Floor Production; Quality Control; Repair and Maintenance, Inventory Management; Sales and After sales service, Administration but majority of them find employment in:
 - Shop floor management, and
 - Repair and maintenance function

4. COMPETENCIES PROFILE OF DIPLOMA HOLDERS IN MECHANICAL ENGINEERING

1.	Development of knowledge and skills in communication, interpersonal relation and basic skills of management.
2.	Development of positive attitude, professional ethics and value system.
3.	Development of basic knowledge and skills in applied sciences and computers so as to develop scientific temper, continued learning skills and their application in technology subjects.
4.	Development of basic knowledge and skills in Engineering Sciences like Material Science, Engineering Graphics, Applied Mechanics, Mechanics of solids, Fluid mechanics, thermodynamics, electrical and electronics which are prerequisite to understand technology subjects.
5.	Development of competencies in preparing Mechanical engineering drawings and skills in reading and interpreting Mechanical engineering drawings and electrical/electronic, hydraulic, pneumatic circuit diagrams.
6.	Development of competencies in conducting and collection of relevant feedback/data from customers/user regarding performance of products and preparation of test/survey reports.
7.	Development of understanding about the characteristics, testing, usage and storing of various types of materials used in Mechanical engineering industry.

8.	Development of competencies in preparing raw material schedule, equipment, manpower and operational schedules.
9.	Development of knowledge and skill regarding various production processes, tools and equipment and quality control operations including the use of high-tech machines, CNC Machines and PLC (Programmable Logic Control) machines for increased productivity and quality.
10.	Development of competencies in implementing work study schedule and understanding of plant layout, material handling and various elements of production, planning and control.
11.	Development of knowledge and skills regarding inspection techniques and utilization of various measuring instruments and identification of error in system.
12.	Development of appreciation regarding team leadership, membership skills, and coordinated functioning for achieving desired targets.
13.	Development of knowledge and skills in the operation and maintenance of various plant facilities like material handling equipment/machines, compressors, pumps and power generators.
14.	Development of knowledge and skills to maintain suitable records of production and services, analyze the causes of waste and take remedial action in waste control.
15.	Development of competencies in problem solving in various functional areas, may it be prototype development, diagnostic and fault finding or repair and maintenance of plant and equipment
16.	Development of basic understanding regarding skills in installation, erection and testing of machines/equipment.
17.	Development of understanding regarding labour management and awareness regarding laws and acts for their welfare, safety and training.
18.	Development of awareness regarding statutory laws concerning pollution control techniques and equipment used
19.	Development of awareness regarding facilities and support system to promote entrepreneurship.
20.	Development of appreciation regarding housekeeping and industrial safety.

5. DERIVING CURRICULUM AREAS FROM COMPETENCY PROFILE

Sr.	Competency Profile	Curriculum Areas
1.	Development of knowledge and skills in communication, interpersonal relation and basic skills of management.	<ul style="list-style-type: none"> - Communication Techniques - Basics of Management
2.	Development of positive attitude, professional ethics and value system.	<ul style="list-style-type: none"> - Communication Techniques - Generic skills
3.	Development of basic knowledge and skills in applied sciences and computers so as to develop scientific temper, continued learning skills and their application in technology subjects.	<ul style="list-style-type: none"> - Basics of Information Technology - Applied Physics - Applied chemistry - Applied Mathematics
4.	Development of basic knowledge and skills in Engineering Sciences like Material Science, Engineering Graphics, Applied Mechanics, Mechanics of solids, Fluid mechanics, thermodynamics, electrical and electronics which are prerequisite to understand technology subjects.	<ul style="list-style-type: none"> - Applied Mechanics - Strength of Materials - Thermodynamics - Electrical Technology - Hydraulics and Pneumatics - Theory of machines
5.	Development of competencies in preparing Mechanical engineering drawings and skills in reading and interpreting Mechanical engineering drawings and electrical/electronic, hydraulic, pneumatic circuit diagrams.	<ul style="list-style-type: none"> - Engineering Drawing - Mech. Engineering Drawing
6.	Development of competencies in conducting and collection of relevant feedback/data from customers/user regarding performance of products and preparation of test/survey reports.	<ul style="list-style-type: none"> - Basics of Management
7.	Development of understanding about the characteristics, testing, usage and storing of various types of materials used in Mechanical engineering industry.	<ul style="list-style-type: none"> - Material science
8.	Development of competencies in preparing raw material schedule, equipment, manpower and operational schedules.	<ul style="list-style-type: none"> - Production Planning and Control
9.	Development of knowledge and skill regarding various production processes, tools and equipment and quality control operations including the use of high-tech machines, CNC Machines and PLC (Programmable Logic Control) machines for increased productivity and quality.	<ul style="list-style-type: none"> - Manufacturing processes - CNC Machines - Theory of Machines - Mechatronics
10.	Development of competencies in	<ul style="list-style-type: none"> - Production Planning and Control

- implementing work study schedule and understanding of plant layout, material handling and various elements of production, planning and control.
11. Development of knowledge and skills regarding inspection techniques and utilization of various measuring instruments and identification of error in system.
 - Metrology
 - Production Planning and Control
 12. Development of appreciation regarding team leadership, membership skills, and coordinated functioning for achieving desired targets.
 - Production Planning and Control
 13. Development of knowledge and skills in the operation and maintenance of various plant facilities like material handling equipment/machines, compressors, pumps and power generators.
 - Thermodynamics
 - Maintenance Engineering
 14. Development of knowledge and skills to maintain suitable records of production and services, analyze the causes of waste and take remedial action in waste control.
 - Production Planning and Control
 15. Development of competencies in problem solving in various functional areas, may it be prototype development, diagnostic and fault finding or repair and maintenance of plant and equipment
 - Automobile Engg.
 - Refrigeration and air conditioning
 - Installation, Testing and Maintenance
 16. Development of basic understanding regarding skills in installation, erection and testing of machines/equipment.
 - Installation, Testing and Maintenance
 17. Development of understanding regarding labour management and awareness regarding laws and acts for their welfare, safety and training.
 - Production Planning and Control
 18. Development of awareness regarding statutory laws concerning pollution control techniques and equipment used
 - Basics of Management
 - Environmental Awareness Camp
 19. Development of awareness regarding facilities and support system to promote entrepreneurship.
 - Entrepreneurship Development
 20. Development of appreciation regarding housekeeping and industrial safety.
 - Basics of Management
 - Production Planning and Control

6. **ABSTRACT OF CURRICULUM AREAS**

Following is the abstract of curriculum areas:

6.1 Applied Science

- Applied Mathematics
- Applied Physics
- Applied Chemistry
- Basics of Information Technology

6.2 Engineering Sciences

- Engineering Drawing
- Applied Mechanics
- Material Science
- Strength of Materials
- Electrical Technology
- Hydraulics and Pneumatics
- Thermodynamics

6.3 Mechanical Engineering/Technology

- Mechanical Engineering Drawing
- Theory of Machines
- Production Planning and Control
- Machine Design
- Manufacturing Processes
- Refrigeration and Air Conditioning
- Automobile Engineering
- Computer Aided Drafting
- Metrology and Instrumentation
- CNC Machines and Automation
- Mechatronics/Installation, testing and maintenance

6.4 Workshop Practice

- General Workshop Practice
- Industrial Training
- Project Work

6.5 Management Subjects

- Basics of Management
- English and Communication Skills
- Generic Skills and Entrepreneurship Development

6.6 Student Centred Activities

It includes industrial visits, extension lectures, seminars, library studies, hobby clubs, sports and games and cultural activities.

7. HORIZONTAL AND VERTICAL ORGANISATION

Sr. No.	Subject	Distribution of time 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	5	-	-	-	-
4.	Applied Chemistry	6	5	-	-	-	-
5.	Engineering Drawing	7	6	-	-	-	-
6.	General Workshop Practice	7	6	-	-	-	-
7.	Basics of Information Technology	-	4	-	-	-	-
8.	Applied Mechanics	-	-	6	-	-	-
9.	Electrical Technology	-	-	6	-	-	-
10.	Manufacturing Processes	-	-	9	9	9	-
11.	Mechanical Engineering Drawing	-	-	6	6	-	-
12.	Material Science	-	-	-	6	-	-
13.	Hydraulics and Pneumatics	-	-	5	-	-	-
14.	Thermodynamics	-	-	5	5	-	-
15.	Strength of Materials	-	-	-	6	-	-
16.	Generic Skills and Entrepreneurship Development	-	-	-	-	3	-
17.	Computer Aided Drafting	-	-	-	-	-	4
18.	Metrology and Instrumentation	-	-	-	-	-	5
19.	Theory of Machines	-	-	-	4	-	-
20.	Machine Design	-	-	-	-	5	-
21.	Automobile Engineering	-	-	-	-	6	-
22.	Refrigeration and Air Conditioning	-	-	-	-	-	6
23.	Elective	-	-	-	-	7	-
24.	Production Planning and Control	-	-	-	-	4	-
25.	CNC Machines and Automation	-	-	-	-	-	8
26.	Basics of Management	-	-	-	-	-	3
27.	Project Work	-	-	-	-	-	8
28.	Practice in Communication Skill	-	-	-	-	-	2
29.	Student Centered Activities	4	4	3	4	6	4
	Total	40	40	40	40	40	40

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

FIRST SEMESTER (MECHANICAL 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		
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	4	-	-	100	150	
1.6	*General Workshop Practice – I	-	7	-	100	100	-	-	50	4	50	150	
#Student Centred Activities		-	4	-	-	-	-	-	-	-	-	-	
Total		16	24	140	210	350	500	16	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.

SECOND SEMESTER (MECHANICAL 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.

THIRD SEMESTER (MECHANICAL ENGINEERING)

SR. NO.	SUBJECTS	STUDY SCHEME <i>Hrs/Week</i>		MARKS IN EVALUATION SCHEME								Total Marks
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	Int. & Ext.
3.1	*Applied Mechanics	4	2	30	20	50	100	3	50	3	150	200
3.2	**Electrical Technology	4	2	30	20	50	100	3	50	3	150	200
3.3	Thermodynamics-I	3	2	30	20	50	100	3	50	3	150	200
3.4	Manufacturing Processes-I	3	6	30	50	80	100	3	70	3	170	250
3.5	Mechanical Engineering Drawing-I	-	6	-	50	50	100	3	-	-	100	150
3.6	Hydraulics and Pneumatics	3	2	30	20	50	100	3	50	3	150	200
# Student Centred Activities including Ecology and Environmental Awareness Camp		-	3	-	25	25	-	-	-	-	-	25
Total		17	23	150	205	355	600		270		870	1225

* Common With other diploma programmes

** Common with diploma in Automobile Engineering

Will comprise of co-curricular activities like extension lectures on self employment, games, hobby clubs, including photography, seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities

FOURTH SEMESTER (MECHANICAL ENGINEERING)

SR. NO.	SUBJECTS	STUDY SCHEME Hrs/Week		MARKS IN EVALUATION SCHEME								Total Marks Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	Strength of Materials	4	2	30	20	50	100	3	50	3	150	200
4.2	Material Science	4	2	30	20	50	100	3	50	3	150	200
4.3	Thermodynamics-II	3	2	30	20	50	100	3	50	3	150	200
4.4	Manufacturing Processes-II	3	6	30	50	80	100	3	70	3	170	250
4.5	Mechanical Engineering Drawing II	-	6	-	50	50	100	3	-	-	100	150
4.6	Theory of Machines	4	-	50	-	50	100	3	-	-	100	150
# Student Centred Activities including Entrepreneurial Awareness camp		-	4	-	25	25	-	-	-	-	-	25
Total		18	22	170	185	355	600	-	220	-	820	1175

* Common With other diploma programmes

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

Industrial Training - After examination of 4th Semester, the students shall go for training in a relevant industry/ In house training should be provided 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.

FIFTH SEMESTER (MECHANICAL ENGINEERING)

SR. NO.	SUBJECTS	STUDY SCHEME <i>Hrs/Week</i>		MARKS IN EVALUATION SCHEME								Total Marks
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	Int. & Ext.
5.1	Automobile Engineering	4	2	30	20	50	100	3	50	3	150	200
5.2	Machine Design	5	-	50	-	50	100	3	-	-	100	150
5.3	Production Planning and Control	4	-	50	-	50	100	3	-	-	100	150
5.4	Manufacturing Processes-III	3	6	30	50	80	100	3	70	3	170	250
5.5	Elective-I	4	3	30	20	50	100	3	50	3	150	200
5.6	*Generic Skills and Entrepreneurship Development	3	-	-	50	50	100	3	-	-	100	150
Industrial Training		-	2	-	50	50	-	-	50	-	50	100
Student Centred Activities		-	4	-	25	25	-	-	-	-	-	25
Total		23	17	190	215	405	600	-	220	-	820	1225

* Common with other diploma programmes

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

SIXTH SEMESTER (MECHANICAL 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	
6.1	*Basics of Management	3	-	50	-	50	100	3	-	-	100	150
6.2	Refrigeration and Air Conditioning	4	2	30	20	50	100	3	50	3	150	200
6.3	Metrology and Instrumentation	3	2	30	20	50	100	3	50	3	150	200
6.4	CAD	-	4	-	50	50	-	-	100	3	100	150
6.5	CNC Machines and Automation	4	4	30	20	50	100	3	50	3	150	200
6.5	Project Work	-	8	-	100	100	-	-	100	3	100	200
6.6	Practice in Communication Skills	-	2	-	50	50	-	-	50	3	50	100
Student Centred Activities		-	4	-	25	25	-	-	-	-	-	25
Total		14	26	140	385	525	400	-	400	-	800	1225

* Common with other diploma programmes

Will comprise of co-curricular activities like writing of Detailed Project Report, games, hobby clubs, including photography, seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities

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
SEMESTER WISE SUBJECTS
MECHANICAL ENGINEERING**

1.1 ENGLISH AND COMMUNICATION SKILLS – I

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** (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	जिम्मेदारी
33.	Chief Justice	मुख्य न्यायधिश
34.	Disciplinary Action	अनुशासनिक कार्रवाई
35.	Efficiency Bar	दक्षता रोक
36.	Flying Squad	उड़न दस्ता
37.	Regret	खेद
38.	Inconvenience	असुविधा
39.	Ambiguous	अस्पष्ट
40.	Part Time	अर्धकालीन
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	शिल्पकार
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-voce	मौखिक परीक्षा
98.	Write off	बटटेखाते डालना
99.	Warning	चेतावनी
100.	Yours faithfully	भवदीय

1.2 APPLIED MATHEMATICS - I

L T P

5 - -

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*
- 13.

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 byt 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, read

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, Leeds, inserts and solder components (resistor, capacitor, diodes, transistors, IFT type oils, DIL, ICs etc) on a PCB

Job V Wiring of a small circuit on a PCB/tag strip involving lacking, 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 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*

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.*
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-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, स्वारा
5. Air Compressor	वायु - संपीडक
6. Air Conditioning	वातानुकूलन
7. Alignment	सरेखन
8. Alternating Current	प्रत्यावर्ती धारा
9. Altimeter	ऊंचाई 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, शिखराग्र
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	वंकन आघूर्ण
40. Blast Furnace	झोका 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 APPLIED MECHANICS

L T P
3 - 2

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

DETAILED CONTENTS

1. **Introduction** (06 hrs)
 - 1.1 Concept of engineering mechanics (Applied Mechanics), definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields.
 - 1.2 Definition of mass and weight basic quantities and derived quantities of basic units and derived units
 - 1.3 Concept of rigid body, scalar and vector quantities

2. **Laws of forces** (10 hrs)
 - 2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force
 - 2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position
 - 2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components
 - 2.4 Free body diagram
 - 2.5 Equilibrant force and its determination
 - 2.6 Lami's theorem (concept only)
[Simple problems on above topics]

3. **Moment** (08 hrs)
 - 3.1 Concept of moment
 - 3.2 Moment of a force and units of moment
 - 3.3 Varignon's theorem (definition only)
 - 3.4 Principle of moment and its applications (Levers – simple and compound, balance steel yard, safety valve, reaction at support)
 - 3.5 Parallel forces (like and unlike parallel force), calculating their resultant
 - 3.6 Concept of couple, its properties and effects
 - 3.7 General conditions of equilibrium of bodies under coplanar forces
 - 3.8 Position of resultant force by moment
[Simple problems on the above topics]

4. **Friction** (08 hrs)
- 4.1 Definition and concept of friction, types of friction, force of friction
 - 4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction
 - 4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane, friction in simple screw jack
 - 4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:
 - a) Acting along the inclined plane Horizontally
 - b) At some angle with the inclined plane
5. **Centre of Gravity** (06 hrs)
- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies
 - 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion
 - 5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed
[Simple problems on the above topics]
6. **Simple Lifting Machines** (10 hrs)
- 6.1. Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines
 - 6.2. Simple and compound machine (Examples)
 - 6.3. Definition of ideal machine, reversible and self locking machine
 - 6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency
 - 6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency
 - 6.6. Working principle and application of inclined plane, wheel and axle, different pulley blocks, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application
[Simple problems on the above topics]

LIST OF PRACTICALS

1. Verification of the following laws:
 - a) Parallelogram law of forces
 - b) Triangle law of forces
 - c) Polygon law of forces
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane.
5. To find the mechanical advantage (M.A), velocity ratio (V.R) and efficiency (η) of a screw jack.
6. To find the mechanical advantage, velocity ratio and efficiency of worm

- and worm wheel.
7. To find mechanical advantage, velocity ratio and efficiency of single purchase crab.
 8. To find M.A, V.R, and η of :
 - (i) First system of pulleys
 - (ii) Second system of pulleys
 9. To find out center of gravity of regular lamina and irregular lamina.
 10. To determine coefficient of friction between three pairs of given surface.

RECOMMENDED BOOKS

1. *A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.*
2. *Applied Mechanics By, Col. Harbhajan Singh, TL Singla and Parmod Kumar Singla Published By Abhishek Publication, 57-59, Sector-17, Chandigarh*
3. *A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.*
4. *Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.*
5. *Engineering Mechanics by Parsad, Standard Publications, New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	6	10
2	10	22
3	8	18
4	8	18
5	6	10
6	10	22
Total	48	100

3.2 ELECTRICAL TECHNOLOGY

L T P
4 - 2

RATIONALE

Basic knowledge of Electrical and Electronics Engineering is essential for diploma holders in Mechanical Engineering for the purpose of understanding applications of these subject areas on the shop floor and in handling machines and equipment. This subject imparts basic concepts, principles and applications to enable students to apply these principles in real live situations, may it be production, quality control or repair and maintenance.

DETAILED CONTENTS

1. **General Introduction:-** (05 hrs)
 - 1.1 Types of elect. Engg. materials; conducting semi-conducting & insulating materials and their application.
 - 1.2 Applications for electricity and Advantages of Elect. Energy over other types of energy.
 - 1.3 Concept of voltage current power and energy and their units

2. **DC Circuits:-** (05 hrs)
 - 2.1 Resistance factors affecting the resistance of conducting metals resistivity and their units.
 - 2.2 Resistances in series & parallel.
 - 2.3 Ohm's Law,
 - 2.4 Faraday's Laws,
 - 2.5 Len's Law.

3. **Principles of AC Circuits:-** (12 hrs)
 - 3.1 Concept of voltage generation advantages of three phase generation over single phase generation. Three phase star & delta connections voltage & current relationship (no derivation)
 - 3.2 Def of cycle, frequency time period instantaneous value rms & max value of sinusoidal wave (relation between rms & max value), form factor & peak factor.
 - 3.3 Concept of phase & phase difference.
 - 3.4 Concept of resistance, inductance, capacitance and impedance in ac circuits.
 - 3.5 Power factor(concept of lead, lag & unity p.f.),its importance and improvement.
 - 3.6 Measurement of three phase power using two voltmeter method.
 - 3.7 Determination of true power, current & p. f. in simple ac series circuits (simple problems)

4. **DC Machines:-** (08 hrs)
 - 4.1 Construction & principle of working of dc motor & generator.
 - 4.2 Fleming's Rules
 - 4.3 Starting of dc motors (three-point starter) & speed control.
 - 4.4 Reversing the direction of rotation of dc motors.

5. **AC Machines:-** (10 hrs)
- 5.1 Types of AC motors and their applications
 - 5.2 Construction of three phase induction motors, comparison of sq. cage and slip-ring induction motors
 - 5.3 Working principle of single phase & three-phase induction motors.
 - 5.4 Reversing the direction of rotation of single phase & three phase induction motors.
 - 5.5 Starting of three phase induction motors using star/delta & DOI, starters, starting single phase split phase motors.
6. **Transformer:-** (06 hrs)
- 6.1 Construction & working principle.
 - 6.2 Transformation ratio, emf equation, losses & efficiency.
 - 6.3 Auto transformer,
 - 6.4 Cooling of transformers.
7. **Basic Electronics:-** (10 hrs)
- 7.1 Basic idea of semiconductor products, diode, Zener diode, Transistor, SCR and their applications.

LIST OF PRACTICALS

1. Verification of Ohm's Law.
2. Series & parallel connection of resistances
3. Measurement of voltage, current & power and p.f. at various loads.
4. Measurement of transformation ratio of a single phase transformer.
5. Measurement of a cu & iron losses of transformer and to determine its efficiency by direct loading method .
6. Starting of three-phase sq. cage induction motor using star/delta starter and DOL starter.
7. Reversing the direction of three phase induction motor & single phase induction motors.
8. Measurement of terminal voltage of dc shunt generator as a function of load current and to plot the load-characteristic curve.
9. Use of multimeter for measurement of voltage & current (ac & dc both).

INSTRUCTIONAL STATREGY

- *Students may be given an assignment to prepare a chart of various electrical gadgets, their specification, rates and applications including the motors.*
- *Arrange visit to some Electrical distribution/control room.*

RECOMMENDED BOOKS

1. *Electrical Technology by B.L Theraja, S Chand and Co. New Delhi.*
2. *Basic Electrical and Electrical Engineering by S.K Sahadev, Dhanpat Rai and Sons.*
3. *Principles of Electrical Engineering by B.R Gupta, S Chand and Co.*
4. *Basic Electrical Engineering by JB Gupta, SK Kataria and Sons.*
5. *Basic Electricity by B.R. Sharma, Satya Prakashan, New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	06	10
2.	06	10
3.	15	20
4.	08	15
5.	12	18
6.	07	12
7.	10	15
Total	64	100

3.3 THERMODYNAMICS - I

L T P
3 - 2

RATIONALE

A diploma holder in Mechanical Engineering is supposed to maintain steam generators, turbines and other power plant equipment. In addition he is required to maintain various types of automobiles. Therefore, it is essential to teach him concepts, principles and applications of basic thermodynamics, steam generators, steam turbine and other power plant equipment; non conventional energy sources and about IC engines. Hence this subject.

DETAILED CONTENTS

1. **Basic Concepts and Gas Laws** (04 hrs)
 - 1.1 Gas laws: Boyle's law, Charle's law,
 - 1.2 Characteristics equation, Gas constant, Universal gas constant.
 - 1.3 Thermodynamics, property, system open and closed), surroundings, Heat and work, specific heat,

2. **Laws of Thermodynamics and Processe** (08 hrs)
 - Explanation of the Zeroth law of thermodynamics.
 - Explanation of First Law of Thermodynamics.
 - Concept of enthalpy, internal energy, specific heat, work and heat.
 - Clausius and Kelvin Plank statements of second law of thermodynamics.
 - Concept of Entropy
 - Constant Volume, Constant pressure, Isothermal, adiabatic and polytropic processes, Throttling and free Expansion, work done under these processes.

3. **Formation of Steam and its Properties** (08 hrs)
 - Steam Formation
 - Wet steam, dry steam and saturated steam; dryness fraction.
 - Super heated steam; degree of super heat.
 - Latent heat of vaporization
 - Enthalpy of steam
 - Entropy; entropy increase during evaporation.
 - Temperature Entropy diagram
 - Mollier Diagram (H-S diagram)

4. **Steam Generator** (06 hrs)
 - Uses of steam
 - Classification of boilers
 - Boiler mounting and accessories
 - Comparison of fire tube and water tube boilers.
 - Constructional features of Nestler boiler, Babcock and Wilcox boiler.
 - Introduction to modern boilers

5. **Power Cycles** (10 hrs)
 - Concept of reversibility, Carnot cycle
 - Rankine cycle and its efficiency
 - Brayton cycle
 - Otto, Diesel and Dual Combustion cycle
6. **Non Conventional Sources Of Energy** (06 hrs)
 6.1 Need of non conventional energy sources
 6.2 Solar Energy
 Sun and solar radiation
 Solar constant
 Solar collectors-flat plate collectors and focusing collectors
 Solar heating-solar cooker, solar power generation
 Solar cooling
 Industrial and agricultural application of a solar energy
 Photo voltaic cells
 Economic consideration for use of solar energy.
 6.3 Other Non Conventional Energy Sources:
 6.3.1 Wind Power
 6.3.2 Geothermal energy
7. **Elements Of Heat Transfer** (06 hrs)
 Conduction
 Convection
 Radiation
 Stefan Boltzman's law
 Simple problems of heat transfer on conduction and radiation only.

LIST OF PRACTICALS

1. Determination of Temperature by:
 - Thermocouple
 - Pyrometer
2. Study of constructional details and specifications of fire tube boiler and sketch.
3. Demonstration of mountings and accessories on a boiler for study and sketch.
4. To find out heat transfer by conduction
5. To find out heat transfer by convection and radiation
6. To verify Boltzman's law.

RECOMMENDED BOOKS

1. *Engineering Thermodynamics* by P.K. Nag, Tata McGraw Hill, Delhi
2. *Basic Engineering Thermodynamic* by Roy choudhary; Tata McGraw Hill, Delhi.
3. *Basic thermodynamics* by P.B. Joshi, Pune Vidyarthi Grah Prakashan
4. *Basic Thermodynamic* by C.P Arora; Tata McGraw Hill, Delhi.
5. *A Treatise on Heat Engineering* by V.P. Vasandani and D.S. Kumar; Metropolitan Book company.

INSTRUCTIONAL STRATEGY

- An industrial visit may be planned to show equipment in working.
- An expert from industry maybe invited to deliver a lecture.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	04	10
2.	08	15
3.	08	15
4.	06	15
5.	10	20
6.	06	15
7	06	10
Total	48	100

3.4 MANUFACTURING PROCESSES - I

L T P
3 - 6

RATIONALE

Diploma holders in Mechanical Engineering are responsible for supervising production processes with a view to adhere to the specifications, optimum utilization of resources and achieving desired production targets. They are also to handle specialized machines and equipment including CNC machines. For this purpose, knowledge and skills about various manufacturing processes are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills regarding various production processes, tools and equipment including use of high tech machines for increased productivity and quality. Due to the vastness of this subject, it has been divided into three parts. The second and third part entitled Manufacturing Processes and Practices II and III will be continued in 4th and 5th semesters respectively

DETAILED CONTENTS

1. **Turning** (16hrs)
 - 1.1 Principles of turning
 - 1.2 Description and function of main parts of lathe
 - 1.3 Specification of lathe
 - 1.4 Drives and transmission
 - 1.5 Work holding devices
 - 1.6 Lathe tools
 - 1.7 Lathe operations-Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling.
 - 1.8 Cutting parameters-speed, feed and depth of cut
 - 1.9 Speed ratio, preferred numbers of speed selection
 - 1.10 Cutting fluid- its purpose and types
 - 1.11 Lathe accessories(Steady rest, taper turning attachment, tool post grinder)
 - 1.12 Types of lathes
 - 1.12.1 Brief description of capstan and turret lathes.
 - 1.12.2 High performance lathes

2. **Drilling** (06 hrs)
 - 2.1 Principle of drilling
 - 2.2 Classification of drilling machines and their description
 - 2.3 Operations performed on drilling machines- drilling, reaming, counter boring, counter sinking, hole milling, tapping.
 - 2.4 Speeds and feeds during drilling
 - 2.5 Types of drills and their features
 - 2.6 Drill holding devices.

3. **Boring** (06 hrs)
- 3.1 Principle of boring
 - 3.2 Classification of boring machines and their description
 - 3.3 Specification of boring machine
 - 3.4 Boring tools
 - 3.5 Boring bars and boring heads
 - 3.6 Alignment of bores and its importance
4. **Shaping, Planning and Slotting** (08 hrs)
- 4.1 Working principle of shaper, planer and slotter
 - 4.2 Quick return mechanism applied to them
 - 4.3 Types of tools used and their geometry
 - 4.4 Specifications of shaper, planer and slotting machine
 - 4.5 Speeds and feeds in above processes.
5. **Foundry Practices** (12 hrs)
- 5.1 Pattern making
 - 5.1.1 Types of patterns
 - 5.1.2 Pattern material
 - 5.1.3 Pattern allowances
 - 5.1.4 Coloring of patterns
 - 5.1.5 Introduction to cores
 - 5.1.6 Core materials and types of cores.
 - 5.2 Moulding
 - 5.2.1 Introduction to moulding
 - 5.2.2 Types of moulding sand and additives, their properties
 - 5.2.3 Sand mixing and mould preparation
 - 5.2.4 Casting defects - causes and their remedies
 - 5.3 Melting and pouring
 - 5.3.1 Types of melting furnaces used.
 - Pit furnace
 - Cupola
 - Reverberatory
 - Electric melting furnace
 - 5.3.2 Closing and pouring of mould
 - 5.4 Special casting methods
 - 5.4.1 Introduction to die casting, investment, centrifugal casting.

LIST OF PRACTICALS

1. Two exercises on simple turning/step turning
2. Two exercises on composite job involving turning, taper turning, thread cutting and knurling.
3. Exercises in internal turning and threading.
4. Advanced exercises in the use of different types of tools on the lathe.
5. Marking and drilling practice on mild steel pieces.
6. Practice in drilling, reaming, counter boring and counter sinking.
7. Practice in grinding of drills to correct angles.
8. Exercise in boring with the help of a boring bar.
9. To prepare a rectangular block to required accuracy on a shaper.
10. To cut a T slot on the job made under Exercise 9
11. To cut a bevel surface/V groove on one of the faces for Exercise 9
12. To cut a curved surface on the CI rectangular block.
13. Exercise in cutting a keyway slot.
14. Exercise in cutting splines.
15. Exercise in making a square hole.
16. Preparation of a job on a planning machine.
17. Preparing pattern for open floor and split pattern.
18. Prepare an open floor mould of a simple solid pattern.
19. Prepare a floor mould of a solid pattern using cope.
20. Prepare a mould of a split pattern in cope and drag.
21. Pouring a mould with Aluminium.
22. Preparing the mould of loose piece pattern and preparing Aluminium casting.
23. Preparing the mould of a step pulley and also preparing the core for the same.
24. Prepare the cast iron casting of above mould.
25. Prepare a mould in three moulding boxes prepare the casting.
26. Study of various furnaces used in foundry shop.

INSTRUCTIONAL STATREGY

Teacher should lay emphasis in making the students conversant with concepts. Principles, procedures and practices related to various manufacturing procession.

RECOMMENDED BOOKS

1. *Workshop Technology by BS Raghuvanshi, Dhanpat Rai & Sons, Delhi*
2. *Elements of Workshop Technology by SK Chaudhary & Hajra, Asia Publishing House, Delhi*
3. *A textbook of Manufacturing Science and Technology by Dr. A. Manna, Prentice Hall of India.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	16	30
2.	06	15
3.	06	15
4.	08	15
5.	12	25
Total	48	100

3.5 MECHANICAL ENGINEERING DRAWING - I

L T P
- - 6

RATIONALE

Diploma holders in Mechanical Engineering are required to read and interpret drawings and therefore, it is essential that they have skills of preparing drawings and sketches of various components, tools, jigs and fixtures. For this purpose, knowledge and skills for preparing drawings of couplings, bearings, bracket, pulleys, pipe joint, lathe parts, boiler parts and I.C. Engine parts and tool holders, are required to be imparted for enabling them to work in the field of Mechanical Engineering - be it manufacturing, testing or work in other function areas. This subject aims at development of drawing competencies in the students. While preparing drawings, stress should be laid on layout, cleanliness, conceptualization, dimensions and specifications.

DETAILED CONTENTS

1. **Intersection of the following:** 2 sheets
 - Cylinder with cylinder(equal and different diameters) axis at right angle.
 - Cylinder with cylinder(axis inclined).
 - Cylinder with cone (Axis at right angle and inclined)
 - Practice exercises on intersection of different surfaces such as cylinder, cone and prism.

2. **Detail drawing of the following with complete dimensioning, tolerances, material and surface finish specifications:**
 - Arbor 1 sheet
 - Universal couplings: 1 sheet
 - Bearings 4 sheets
 - Simple bushed bearing
 - Ball bearing and roller bearing
 - Plummer block (detailed drawing)
 - Plummer block (assembled drawing)
 - Foot Step bearing

3. **Bracket** 1 sheet
 - 3.1 Wall Bracket

4. **Pulleys** 1 sheet
 - 4.1 Fast and loose pulley
 - 4.2 Stepped and V-belt pulley

5. **Pipe Joints** 2 sheets
 - 5.1 Flanged pipe joints, right angle bend
 - 5.2 Hydraulic pipe joints , Spigot and Socket joint
 - 5.3 Expansion pipe joint
 - 5.4 Practice of blue print reading on brackets, pulleys and pipe joints.

6. **Lathe Parts**

2 sheets

- 6.1 Tool post
- 6.2 Tail stock
- 6.3 Screw Jack

INSTRUCTIONAL STATREGY

- *Drawings should cover tolerance, whenever feasible, roughness symbols and material as per BIS / ISO.*
- *At least one sheet may be prepared tailing actual measurements.*

RECOMMENDED BOOKS

1. *Machine drawings by P.S Gill; SK. Kataria*
2. *Machine drawing by R. K Dhawan; S. Chand and Company Delhi*
3. *Machine drawing by R.B Gupta; Satya Prakashan New Delhi*
4. *Machine drawing by N.D. Bhatt; Charotar Publishing House*

3.6 HYDRAULICS AND PNEUMATICS

L T P
3 - 2

RATIONALE

Diploma holders in this course are required to deal with problems of fluid and use of hydraulics and pneumatics in power generation. For this purpose, knowledge and skills about fluid mechanics and machinery, hydraulics and pneumatics systems are required to be imparted for enabling them to perform above functions.

DETAILED CONTENTS

1. **Introduction** (03 hrs)
Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility, surface tension, kinematic viscosity and dynamic viscosity and their units.
2. **Pressure and its Measurement** (05hrs)
 - 2.1 Concept of pressure (Atmospheric Pressure, gauge pressure, absolute pressure)
 - 2.2 Pressure measuring devices: peizometer tube manometers - simple U-tube, differential single column, inverted U-tube, micromanometer including simple problems
 - 2.3 Bourdon pressure gauge, Diaphragm pressure gauge, dead weight pressure gauge
 - 2.4 Concept of static pressure, intensity of pressure and pressure head, Total pressure on a plane surface and centre of pressure.
3. **Flow of Fluids** (06 hrs)
Types of fluid flow – steady and unsteady, uniform and non-uniform, laminar and turbulent; rate of flow and their units; continuity equation of flow; potential energy of a flowing fluid; total head; Bernoulli's theorem (statement and proof) and its applications. Discharge measurement with the help of venturi-meter, orifice meter, pitot-tube, limitations of Bernoulli's theorem, simple problems.
4. **Flow through Pipes** (8 hrs)
 - 4.1 Definition of pipe flow, wetted perimeter, hydraulic mean depth, hydraulic gradient; loss of head due to friction; Chezy's equation and Darcy's equation of head loss (without proof), Reynold's number and its effect on pipe friction; siphon, Nozzle - definition, velocity of liquid flowing through the nozzle, power developed. Water hammer, anchor block, syphon, surge tank (concept only).
 - 4.2 Loss of head in pipes due to sudden enlargement, sudden contraction, obstruction on flow path, change of direction and pipe fittings (without proof)

5. **Hydraulic Machines** (05 hrs)
Description, operation and application of hydraulic machines – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press, selection of specification of above machines for different applications
6. **Hydro-Power, Water Turbines and Pumps** (08 hrs)
- 6.1 Advantages of hydropower, basic elements, dams, head works.
 - 6.2 Concept of a turbine, types of turbines –impulse and reaction type (concept only), difference between them. Construction and working of pelton wheel, Francis turbine, Propeller and Kaplan turbines. Unit speed, unit power, unit discharge, specific speed of turbines, selection of turbines based on specific speed.
 - 6.3 Concept of hydraulic pump, single acting reciprocating pump (construction and operation only), vane, screw and gear pumps.
 - 6.4 Construction, working and operation of centrifugal pump. Performance, efficiencies and specifications of a centrifugal pump. Trouble shooting and problems in centrifugal pumps and remedial measures, pitting, cavitation, priming.
 - 6.5 Hydro potential in Himachal Pradesh.
7. **Introduction to Oil Power Hydraulics and Pneumatics** (03 hrs)
- 7.1 Introduction to oil power hydraulics and pneumatic system
 - 7.2 Statement of Pascal law and its applications
 - 7.3 Industrial applications of oil power hydraulics and pneumatic system
 - 7.4 Cavitation
8. **Components of Hydraulic Systems** (05 hrs)
- 8.1 Basic components of hydraulic system, function of each component in a hydraulic circuit.
 - 8.2 Oil reservoirs, couplings, motors and pumps – definition and functions of the parts,
 - 8.3 Filters- definition and purpose, classification
 - 8.4 Seals and packing- classification of seals, sealing materials.
9. **Components of Pneumatic Systems** (05 hrs)
- 9.1 Basic components – function of each component
 - 9.2 Air compressors – type, working
 - 9.3 Air cylinder – types, function, single acting, double acting, rotating, non-rotating, piston type, diaphragm type, tandem cylinder, double ended cylinder, duplex cylinder.
 - 9.4 Air filter, regulator and lubricator – their necessity in pneumatic circuit.
 - 9.5 Installation, maintenance and application of air cylinders.

LIST OF PRACTICALS

1. Measurement of pressure head by employing.
 - i) Piezometer tube
 - ii) Single and double column manometer

2. To find out the value of coefficient of discharge for a venturimeter.
3. Measurement of flow by using venturimeter.
4. Verification of Bernoulli's theorem.
5. To find coefficient of friction for a pipe (Darcy's friction).
6. To study hydraulic circuit of an automobile brake and hydraulic ram.
7. Study the working of a Pelton wheel and Francis turbine.
8. To study a single stage centrifugal pump for constructional details and its operation to find out its normal head and discharge.
9. To draw the characteristic curves for a single stage centrifugal pump.
 - i) Head Vs Discharge
 - ii) Power Vs Discharge
 - iii) Efficiency Vs Discharge

INSTRUCTIONAL STRATEGY

- *At least 30% teaching should be done by using Computer based teaching aids for effective teaching learning.*
- *Stress on practical examples and acquaint the students with industrial practices.*

RECOMMENDED BOOKS

1. *Fluid Mechanics by KL Kumar; S Chand and Co Ltd., Ram Nagar, New Delhi.*
2. *Hydraulics and Fluid Mechanics Machine by RS Khurmi ; S.Chand & Co. Ltd., New Delhi.*
3. *Fluid Mechanics through Problems by RJ Garde; Wiley Eastern Ltd., New Delhi.*
4. *Fluid Mechanics by Dr AK Jain, Khanna Publishers, New Delhi.*
5. *Hydraulics and hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd., Delhi.*
6. *Hydraulic and Pneumatic Power and Control Design, Performance and Application by Yeaple, McGraw Hill, New York..*
7. *Pneumatic Controls by Festo Didactic; Bangalore.*
8. *Pneumatics Control: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel – Verlag.*
9. *Fluid mechanics by R.K Bansal.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	3	06
2.	5	10
3.	6	12
4.	8	16
5.	5	10
6	8	20
7	3	6
8	5	10
9	5	10
Total	48	100

ECOLOGY AND ENVIRONMENTAL AWARENESS CAMP

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the eco system and controlling pollution by pollution control measures. He should also be aware of environmental laws related to the control of pollution.

This is to be organized at a stretch for 3 to 4 days. Lectures will be delivered on following broad topics. There will be no examination for this subject.

1. Basics of ecology, eco system and sustainable development
2. Conservation of land reforms, preservation of species, prevention of advancement of deserts and lowering of water table
3. Sources of pollution - natural and man made, their effects on living and non-living organisms
4. Pollution of water - causes, effects of domestic wastes and industrial effluent on living and non-living organisms
5. Pollution of air-causes and effects of man, animal, vegetation and non-living organisms
6. Sources of noise pollution and its effects
7. Solid waste management; classification of refuse material, types, sources and properties of solid wastes, abatement methods
8. Mining, blasting, deforestation and their effects
9. Legislation to control environment
10. Environmental Impact Assessment (EIA), Elements for preparing EIA statements
11. Current issues in environmental pollution and its control
12. Role of non-conventional sources of energy in environmental protection

4.1 STRENGTH OF MATERIALS

L T P
4 - 2

RATIONALE

Diploma holders in Mechanical Engineering are required to analyze reasons for failure of different components and select the required material for different applications.

For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

DETAILED CONTENTS

1. **Stresses and Strains** (12 hrs)
 - 1.1 Concept of load, stresses and strain
 - 1.2 Tensile compressive and shear stresses and strains
 - 1.3 Concept of Elasticity, Elastic limit and limit of proportionality.
 - 1.3.1 Hook's Law
 - 1.3.2 Young Modulus of elasticity
 - 1.3.3 Nominal stress
 - 1.3.4 Yield point, plastic stage
 - 1.3.5 Strain hardening
 - 1.3.6 Ultimate strength and breaking stress
 - 1.3.7 Percentage elongation
 - 1.3.8 Proof stress and working stress
 - 1.3.9 Factor of safety
 - 1.3.10 Shear modulus
 - 1.3.11 Strain energy due to direct stresses
 - 1.3.12 Proof resilience and modulus of resilience
 - 1.3.13 Stresses due to gradual, sudden and falling load
 - 1.4 Longitudinal and circumferential stresses in seamless thin walled cylindrical shells (derivation of these formulae not required).
2. **Moment of Inertia** (10 hrs)
 - 2.1. Concept of moment of inertia and second moment of area
 - 2.2. Radius of gyration
 - 2.3. Second moment of area of common geometrical sections: Rectangle, Triangle, Circle(without derivation), Second moment of area for L,T and I section
 - 2.4. Section modulus
3. **Beams and Bending Stress** (16 hrs)
 - 3.1. Bending and shearing force
 - 3.1.1. Concept of beam, form of loading
 - 3.1.2. Concept of end supports Roller, hinged and fixed
 - 3.1.3. Concept of bending moment and shearing force

- 3.1.4. B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.
- 3.2. Bending stresses
 - 3.2.1 Concept of Bending stresses
 - 3.2.2 Bending Equation
 - 3.2.3 Theory of simple bending
 - 3.2.4 Use of the equation $f/y = M/I = E/R$
 - 3.2.5 Concept of moment of resistance
 - 3.2.6 Bending stress diagram
 - 3.2.7 Calculation of maximum bending stress in beams of rectangular, circular, I and T section.
 - 3.2.8 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.
- 3.3. Laminated Spring(Semi elliptical type only)
 - 3.3.1. Determination of number of plates
 - 3.3.2. Maximum bending stress and deflection.
- 3.4. Combined direct and bending stresses
 - 3.4.1. Simple cases of short columns of uniform section subjected to eccentric loading with stress diagram
- 4. **Columns** (08 hrs)
 - 4.1. Concept of column, modes of failure
 - 4.2. Types of columns
 - 4.3. Buckling load, crushing load
 - 4.4. Slenderness ratio
 - 4.5. Factors effecting strength of a column
 - 4.6. End restraints
 - 4.7. Effective length
 - 4.8. Strength of column by Euler Formula without derivation
 - 4.9. Rankine Gourdan formula (without derivation)
- 5. **Torsion** (10 hrs)
 - 5.1. Concept of torsion- difference between torque and torsion, Torsion equation.
 - 5.2. Use of torque equation for circular shaft
 - 5.3. Comparison between solid and hollow shaft with regard to their strength and weight.
 - 5.4. Power transmitted by shaft
 - 5.5. Concept of mean and maximum torque
- 6. **Helical Springs** (08 hrs)
 - 6.1. Closed coil helical springs subjected to axial load and impact load
 - 6.2. Stress deformation
 - 6.3. Stiffness and angle of twist and strain energy
 - 6.4. Proof resilience

PRACTICAL EXERCISES

- 1. Tensile test on bars of Mild steel and Aluminum.
- 2. Shear test on specimen of two different metals.
- 3. Bending tests on a steel bar or a wooden beam.

4. Impact test on metals:
 - Izod test
 - Charpy test
5. Torsion test on specimens of different metals for determining the angle of twist for a given torque.
6. To determine the stiffness of a helical spring and to plot a graph between load and extension.
7. Hardness test on metal and finding the Brinell, Rockwell hardness

INSTRUCTIONAL STRATEGY

1. Plan assignments so as to promote problem solving abilities.
2. Link the instructions with real life problems.

RECOMMENDED BOOKS

1. *Strength of Materials by RS Khurmi; S Chand & Co., New Delhi.*
2. *Elements Strength of Materials by DR Malhotra and HC Gupta, Satya Prakashan, New Delhi.*
3. *Strength of Materials by Birinder Singh; Katson Publishing House, New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	12	20
2.	10	15
3.	16	25
4.	08	12
5.	10	16
6.	08	12
Total	64	100

4.2 MATERIAL SCIENCE

L T P
4 - 2

RATIONALE

Lot of development has taken place in the field of materials. New materials are being developed and it has become possible to change the properties of materials to suit the requirements. Diploma holders in Mechanical Engineering are required to make use of different materials for various applications. For this purpose, it is necessary to teach them basics of metal structure, properties, usage and testing of various ferrous and non ferrous materials and various heat treatment processes. This subject aims at developing knowledge about the characteristics, testing and usage of various types of materials used in Mechanical Engineering industry.

DETAILED CONTENTS

1. **General** (04 hrs)
 - 1.1 Introduction to engineering materials.
 - 1.2 Classification of materials
 - 1.3 Thermal, chemical, electrical properties.
 - 1.4 Selection criteria for use in industry.

2. **Structure of Metals and their Deformation** (06 hrs)
 - 2.1 Metal Structure - Relation of metal structure to its properties.
 - 2.2 Arrangement of atoms in metals (Basic idea)
 - 2.3 Crystalline Structure of metals
 - 2.4 Crystal Imperfections
 - 2.5 Deformation of metal
 - 2.6 Impact of cold and hot working on metal structure

3. **Ferrous Materials** (10 hrs)
 - 3.1 Classification of iron and steel
 - 3.2 Sources of iron ore and its availability.
 - 3.3 Manufacture of pig iron, wrought iron, Cast iron and steel(Flow Diagrams only)
 - 3.4 Types of Cast Iron: White, malleable, grey, mottled, modular and alloy and their usage.
 - 3.5 Steels and alloy steel
 - 3.5.1 Classification of steels
 - 3.5.2 Different manufacturing methods of steel, open hearth, Bessemer & electric arc.
 - 3.5.3 Availability, Properties and usage of steels.
 - 3.5.4 Specification as per BIS and equivalent standards.
 - 3.5.5 Effect of various alloying element like Cr,Ni, Co,V, ,Mo,Si, Mn,S on mechanical properties of steel.
 - 3.5.6 Use of alloy steels(high speed steel stainless steel, springs teel, silicon steel.

4. **Non Ferrous Materials** (06 hrs)
 - 4.1 Important ores and properties of aluminium, copper, zinc, tin, lead.
 - 4.2 Properties and uses of Al alloys, Copper alloys, Bearing metals, solders.

5. **Composite, Ceramics and Plastics.** (06 hrs)
 - 5.1 Definitions, sources.
 - 5.2 Metal matrix composites, ceramic matrix composites, fibereinforced composites, carbon – carbon composites.
 - 5.3 Engineering ceramics, natural and artificial ceramics
 - 5.4 Various trade name of engineering plastics, thermosetting and thermoplastic.
 - 5.5 Plastic coatings
 - 5.6 Fibers and their classification: inorganic and organic fibers.
 - 5.7 Engineering application of composites, ceramics and plastics.

6. **Insulating Materials** (04 hrs)
 - 6.1 Various heat insulating material and their usage like asbestos, glass wool, thermocole, cork, puf, china clay.
 - 6.2 Various electrical insulating material and their use like China clay, leather, bakelite, ebonite, glass wool, rubber, felt.

7. **Testing of Metals and Alloys** (02 hrs)
 - 7.1 Identification tests: appearance, sound, spark, weight, magnetic, band microstructure, filing.

8. **Fundamentals Of Heat Treatment** (10 hrs)
 - 8.1 Purpose of heat treatment
 - 8.2 Theory of solid solution
 - 8.3 Iron-Carbon Diagram
 - 8.4 TTT Curve in steels and its importance.
 - 8.5 Basic idea about martensitic transformation
 - 8.6 Various heat treatment processes-hardening, tempering, annealing, normalizing, case hardening(elementary idea)
 - 8.7 Types of heat treatment furnaces

PRACTICAL EXERCISES

1. Classification of about 25 specimens of materials/parts into
 - i) Metals and non metals
 - ii) Metals and alloys
 - iii) Ferrous and non ferrous metals
 - iv) Ferrous and non ferrous alloys

2. Given a set of specimen of metals and alloys (copper, brass, aluminium, cast iron, HSS,Gun metal) ; identify and indicate the various properties possesses by them.

3. a) Study of heat treatment furnace.

- b) Study of a thermocouple/ pyrometer.
4. Study of a metallurgical microscope and a diamond polishing machine.
 5. To prepare specimens of following materials for microscopic examination and to examine the microstructure of the specimens of following materials :
 - i) Brass ii) Copper iii) Grey CI
 - iv) Malleable CI v) Low carbon steel
 - vi) High carbon steel vii) HSS
 6. To anneal a given specimen and find out difference in hardness as a result of annealing.
 7. To normalize a given specimen and to find out the difference in hardness as a result of normalizing.
 8. To temper a specimen and to find out the difference in hardness and tensile strength due to tempering.

INSTRUCTIONAL STRATEGY

Stress should be laid on identification, usage and ways and means of improving physical properties of each material. Visits to industry may also be planned to demonstrate use of various materials in industry.

RECOMMENDED BOOKS

1. *Material Sciences by R.K Rajput*
2. *Advances in material sciences by R.K Dogra*
3. *Material sciences and metallurgy by D.S. Nut*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	04	10
2.	06	10
3.	10	20
4.	06	10
5.	06	15
6.	04	10
7.	02	05
8	10	20
Total	48	100

4.3 THERMODYNAMICS-II

L T P
3 - 2

RATIONALE

Thermal energy is a major means of power in the world. Knowledge of thermal contrivances and related principles is very essential to the students of Mechanical Engineering. The subject presents sources of heat, thermodynamiaics principles and their applications to thermal contrivances.

DETAILED CONTENTS

1. **Principles of I.C. Engines:-** (10 hrs)
 - 1.1 Introduction and classification of I.C. Engines.
 - 1.2 Working principle of four stroke and two stroke cycles valve timing diagram.
 - 1.3 Petrol and diesel engines, their comparison and applications
 - 1.4 Location and functions of various parts of I.C. engines and materials used for them
 - 1.5 Concept of IC engine terms: Bore, stroke, dead centres, crank-throw, compression ratio, clearance volume, piston displacement and piston speed. Familiarity with ISI specification for I.C. engine parts.

2. **Carburation and Ignition Systems of Petrol Engine:-** (06 hrs)
 - 2.1 Concept of carburetion
 - 2.2 Airfuel ratio
 - 2.3 Simple carburettor and its limitations
 - 2.4 Description of a battery coil and magneto ignitions system.

3. **Fuel System in Diesel Engines** (07 hrs)
 - 3.1 Components of Fuel system
 - 3.2 Description and working of fuel feed pump
 - 3.3 Fuel injection pump
 - 3.4 Injector
 - 3.5 Multi Point Fuel Injection System

4. **Cooling and Lubrication** (04 hrs)
 - 4.1 Necessity of Engine Cooling
 - 4.2 Cooling systems: their main features
 - 4.3 Thermostat
 - 4.4 Defects in cooling system and their rectification
 - 4.5 Function of lubrication
 - 4.6 Types and properties of Engine lubricants
 - 4.7 Lubrication systems of I.C. engine
 - 4.8 ISI specification and brand names of Engine lubricants.
 - 4.9 Fault in cooling and lubrication system and their remedial actions.

5. **I.C. Engine Testing** (08 hrs)
 - 5.1 Engine power - indicated and Brake power.
 - 5.2 Efficiency - Mechanical, Thermal, Relative and volumetric.
 - 5.3 Methods of finding indicated and brake power.
 - 5.4 Morse Test
 - 5.5 Heat balance sheet

6. **Air Compressors** (06 hrs)
 - 6.1 Industrial uses of compressed air
 - 6.2 Classification - description of reciprocating and Rotary air compressors
 - 6.3 Fans, Blowers and supercharger
 - 6.4 Working principle of reciprocating single and two stage compressors,
 - 6.5 Intercooling, volumetric efficiency.
 - 6.6 Operation and Maintenance of reciprocating compressors.

7. **Nozzles and Steam Turbines** (07 hrs)
 - 7.1 Energy equation as applied to a nozzle
 - 7.2 Description of various types of turbines
 - 7.3 Methods of reducing rotor speed in impulse turbines
 - 7.4 Governing of steam turbines

LIST OF PRACTICALS

1. Dismantle a two stroke engine. Note the function and material of each part. Reassemble.
2. Dismantle a single cylinder diesel engine. Note the function of each part. Reassemble.
3. Dismantle solex and amal carburettors. Locate and note down the functions of various parts. Reassemble.
4. Study of battery ignition system of a multicylinder petrol engine, stressing on ignition timings, setting fixing order and contact breaker gap adjustment.
5. Study of cooling system of I.C. Engine and finding the fault in the cooling system.
6. Study of lubricating system of I.C. engine.
7. Determination of BHP by dynamometer and heat balance sheet.
8. Morse test on multicylinder petrol engine and heat balance sheet.
9. Determination of volumetric efficiency of air compressor
10. Study of steam turbines through models and visits.
11. Testing of petrol engine ignition system, fault finding and remedial action.

INSTRUCTIONAL STRATEGY

- *Models of various components/parts to be demonstrated*
- *Audio-visual aids to demonstrate I-C engines, air compressor, turbines, nozzles etc.*
- *Industrial visit to automobile workshop/thermal power plant.*

RECOMMENDED BOOKS

1. *Elements of Heat Engine by Panday and Shah, Charotar Publishing Home*
2. *Thermal Engineering by A.S. Sarao, Satya Prakashan*
3. *Thermal Engineering by P.L. Ballaney Khanna Publisher*
4. *Thermal Engineering by R.K. Prohit, Standard Publisher*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	10	20
2.	06	10
3.	07	15
4.	04	10
5.	08	15
6.	06	15
7.	07	15
Total	48	100

4.4 MANUFACTURING PROCESSES -II

L T P
3 - 6

RATIONALE

Diploma holders in Mechanical Engineering are responsible for supervising production process with a view to adhere to the specifications, optimum utilization of resources and achieving desired production targets. For this purpose, knowledge and skills about welding, jigs and fixture, metal forming processes, grinding and metal finishing processes are required to be imparted for enabling them to perform above functions.

DETAILED CONTENTS

1. **Gas Welding:-** (08 hrs)
 - 1.1. Principle of operation
 - 1.2. Oxyacetylene flame
 - 1.2.1. Types of flame
 - 1.2.2. Combustion of flame
 - 1.3. Welding Techniques
 - 1.4. Filler rods and fluxes for gas welding
 - 1.5. Gas welding equipment and accessories
 - 1.5.1. Oxygen gas cylinders
 - 1.5.2. Acetylene gas cylinders
 - 1.5.3. Acetylene gas generator
 - 1.5.4. Pressure Regulator
 - 1.5.5. Oxygen and Acetylene Hoses
 - 1.5.6. Welding Torch

2. **Electric arc Welding:-** (04 hrs)
 - 2.1 Introduction to arc welding with procedures, equipment and applications.
 - 2.2 Types of arc
 - 2.3 Types of electrode used
 - 2.4 Specifications of electrodes

3. **Resistance Welding** (04 hrs)
 - 3.1 Spot welding
 - 3.2 Seam welding
 - 3.3 Projection welding
 - 3.4 Percussion welding

4. **Jigs and Fixtures** (06 hrs)
 - 4.1 Importance and use of Jigs and fixtures.
 - 4.2 Principles of Location
 - 4.3 Locating Devices
 - 4.4 Purpose of Clamping elements
 - 4.5 Types of clamps
 - 4.6 Types of drilling jigs - Brief description
 - 4.7 Types of milling and welding fixtures (brief idea)

5. **Metal Forming Processes** (06 hrs)
- 5.1 General Idea of following processes:
- Die stamping
 - Drawing
 - Spinning
 - Rolling
 - Extruding
 - Forging
 - Tube drawing
- 5.2. Powder Metallurgy (brief idea)
6. **Grinding:-** (06 hrs)
- 6.1. Purpose of grinding
- 6.2. Types of grinding machines and their working- Cylindrical, surface, centre less, tool and cutter grinder, Jig Grinder.
- 6.3. Shapes of grinding wheels
- 6.4. Various elements of grinding wheel - abrasive, grade, structure, bond.
- 6.5. Codification of grinding wheel
- 6.6. Selection of grinding wheel
- 6.7. Dressing, truing, balancing and mounting of wheel.
- 6.8. Wheel and work speeds and feeds.
- 6.9. Defects and remedies in grinding.
7. **Metal Finishing Processes** (06 hrs)
- 7.1 Purpose of finishing surfaces
- 7.2 Surface roughness-Definition and units.
- 7.3 Honing Process: its applications
- 7.4 Description of hones
- 7.5 Brief idea of honing machines
- 7.6 Lapping Process; its application
- 7.7 Description of lapping compounds and tools.
- 7.8 Brief idea of lapping machines.
- 7.9 Super finishing process; its applications.
- 7.10 Use of super finishing attachment on Centre lathe
- 7.11 Polishing
- 7.12 Buffing
8. **Modern Machining Methods: - Principle, process details, advantages limitations and applications of the following processes.** (08 hrs)
- 8.1. Electro discharge machining
- 8.2. Wire Cut EDM
- 8.3. Electric chemical machining
- 8.4. Chemical machining
- 8.5. Ultrasonic machining
- 8.6. Laser Beam machining.
- 8.7. Plasma arc machining

LIST OF PRACTICALS

1. Study of various gas cutting and welding equipment.
2. Practice of gas welding and gas cutting (manually and by cutting machine).
3. Practice of arc cutting.
4. Practice of spot and seam welding.
5. Study of welding defects.
6. Inspection and testing of welded joints.
7. Practice of welding pipes and pipe joints.
8. Demonstration of spinning process on ordinary lathe machine and spinning a bowl on a lathe machine.
9. Staring and Maintenance of pattern.
10. Preparation of utility job by making patterns.
11. Preparation of a die (simple type)
12. Preparation of a single ended spanner by hand forging.
13. Casting of utility job of above pattern.
14. Exercise on grinding of a rectangular block to size on surface grinding machine.
15. Practice on cylindrical and centreless grinding machines.
16. Cylindrical grinding exercise on lathe with tool post grinding attachment.
17. Exercise on hand lapping job to required accuracy.
18. Buffing practice.

INSTRUCTIONAL STRATEGY

Teacher should lay emphasis in making students conversant with concepts, principles, procedures and practices related to various manufacturing processes.

RECOMMENDED BOOKS

1. *Elements of workshop Technology by SK Choudhary and Hazra, Asia Publishing House*
2. *Workshop Technology by BS Raghuwanshi, Dhanpat Rai and Sons Delhi*
3. *Workshop Technology Vol. I, II & III by Chapman; Standard Publishers & Distributors, New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	08	10
2.	04	10
3.	04	10
4.	06	15
5.	06	15
6.	06	10
7.	06	15
8.	08	15
Total	48	100

4.5 MECHANICAL ENGINEERING DRAWING -II

L T P
- - 6

RATIONALE

Mechanical diploma holders are required to read and interpret the machine parts drawing therefore it is essential that they become competent in preparing, and drawing various free hand sketches of machine parts.

Note:

1. *1st Angle projection is to be followed*
2. *SP 46-1988 should be followed*
3. *Instruction relevant to various drawings may be given along with appropriate demonstration before assigning drawing practice to the students*
4. *The drawing should include dimensions with tolerances wherever necessary and material list as per BIS/ISO specifications.*

DETAILED CONTENTS

Introduction to drawing office equipment and drawing office practice through visit of modern organizations/offices.

Introduction to the principles of working drawings, reading and interpretation of working drawings specific to industry.

1.	Boiler Parts	02 Sheets
	1.1. Steam stop valve	
	1.2. Blow off cock	
2.	I.C. Engine Parts	02 Sheets
	2.1 Piston with connecting rod assembly.	
	2.2 Crankshaft and fly wheel assembly(Car Engine)	
3.	Lathe Tool Holder	01 Sheet
4.	Vices	02 Sheets
	4.1 Bench Vice (details/ assembly)	
	4.2 Machine Vice (details/assembly)	
5.	Single Plate Clutch Assembly	01 Sheet
6.	Drill Jig (Details and assembly)	01 Sheet
7.	Fixture (Details and assembly)	01 Sheet

8. **Cams and Followers** 02 Sheets
8.1 Profile of cams for imparting following motions with knife edge and roller followers:
8.1.1 Uniform motion
8.1.2 Simple harmonic motion
9. **Gears** 02 Sheets
9.1 Use of different types of gears
9.2 Spur gears with actual profile of involute teeth.
9.3 Conventional representation of bevel gear, worm and worm wheel.

INSTRUCTIONAL STRATEGY

- *All the sheets should be working drawings complete with tolerances, types of fits and surface finish symbols.*
- *An expert from an industry may be invited to deliver expert lecture.*

RECOMMENDED BOOKS

1. *Machine Drawing by P.S. Gill, S.K. Kataria & Sons*
2. *Machine drawing by R.K. Dhawan, S. Chand and Co.*
3. *Machine drawing by R.B. Gupta, Satya Prakashan*
4. *Machine drawing by N.D. Bhatt, Charotar Publishing House.*

4.6 THEORY OF MACHINES

L T P
4 - -

RATIONALE

A diploma holder in Mechanical Engineering is required to assist in the design and development of prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machines and application of these principles for designing. Hence this subject. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

DETAILED CONTENTS

1. **Simple Mechanisms** (08 hrs)
 - 1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversions.
 - 1.2 Different types of mechanisms (with examples)
 - 1.3 Mechanical advantage of a linkage
 - 1.4 Cams and followers : Terminology and classification

2. **Friction** (12 hrs)
 - 2.1 Definition and its necessity
 - 2.2 Horizontal force required to move a body on an inclined plane both upward and downward
 - 2.3 Frictional torque in screws, both for square and V threads
 - 2.4 Screw jack (Simple numericals only)
 - 2.5 Frictional clutches (concept only)
 - 2.6 Friction in journal bearing
 - 2.7 Different types of bearings and their applications

3. **Power Transmission** (12 hrs)
 - 3.1 Transmission screw : power transmitted and efficiency
 - 3.2 Flat and V belt drive : ratio of tensions; H.P. transmitted, centrifugal tension, Condition for maximum horse power
 - 3.3 Power transmitted by chains: different types of chains and their terminology
 - 3.4 Gear terminology , types of gears and their applications ; simple and compound gear trains; power transmitted by simple spur gear.

4. **Flywheel** (08 hrs)
 - 4.1 Principle and applications of flywheel.
 - 4.2 Turning moment diagram of flywheel for different engines
 - 4.3 Fluctuation of speed and fluctuation of energy

5. **Governor** (08 hrs)
 5.1 Principal of governor
 5.2 Simple description and working of Watt, Porter and Hartnel governor(No numerical).
6. **Balancing** (08 hrs)
 6.1 Concept of balancing
 6.2 Introduction to balancing of rotating masses
7. **Vibrations** (08 hrs)
 7.1 Causes of vibrations in machines, their harmful effects and remedies

INSTRUCTIONAL STRATEGY

- Use teaching aids for class room teaching
- Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

RECOMMENDED BOOKS

1. *Theory of Mechanism and Machine* by A. Ghosh and A.. Malik, East West Press
2. *Theory of Machines* by R.S. Khurmi and J.K. Gupta, S. Chand and company Ltd.
3. *Theory of Machine* by S.S. Rattan, Tata McGraw Hill
4. *Mechanisms and Machine Theory* by JS Rao and Dukkupati, Wiley Eastern, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	08	12
2.	12	20
3.	12	20
4.	08	12
5.	08	12
6.	08	12
7.	08	12
Total	64	100

ENTREPRENEURIAL AWARENESS CAMP

This is to be organized at a stretch for two to three days during fourth 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 AUTOMOBILE ENGINEERING

L T P
4 - 2

RATIONALE

These days, automobiles have become a necessity instead of luxury. There has been phenomenal development of automobile industry. The Diploma holders in Mechanical Engineering are required to supervise production and repair and maintenance of vehicles. For this purpose, knowledge and skills are required to be imparted to them regarding automobile industry as a whole. This subject aims at developing required knowledge and skills in this area.

DETAILED CONTENTS

1. **Introduction** (04 hrs)
 - 1.1 Components of an automobile
 - 1.2 Classification of automobiles
 - 1.3 Layout of chassis
 - 1.4 Types of drives-front wheel, rear wheel, four wheel, left hand, right hand

2. **Transmission System** (24 hrs)
 - 2.1 Clutch
Function, Constructional details of single plate and multiplate friction clutches, Centrifugal and semi centrifugal clutch.

 - 2.2 Gear Box:
Function, Working of slide mesh, constant mesh and synchromesh gear box, Torque converter and overdrive

 - 2.3 Propeller shaft and rear axle
Function, Universal joint, Differential, Rear axle drives and different types of rear axles

 - 2.4 Wheels and Tyres
Types of wheels- disc wheels and wire wheel, Types of tyres used in Indian vehicles, Causes of tyre wear, Toe in, Toe out, Camber, Caster, Kingpin inclination, Tube less tyres

3. **Steering System** (06 hrs)
 - 3.1 Function and principle
 - 3.2 Ackerman and Davis steering gears
 - 3.3 Types of steering gears- worm and nut, worm and wheel, worm and roller, Rack and pinion type

4. **Braking System** (08 hrs)
 - 4.1 Constructional detail and working of mechanical, hydraulic and vacuum brake.
 - 4.2 Details of master cylinder, wheel cylinder.
 - 4.3 Concept of brake drum, brake lining and brake adjustment.
 - 4.4 Bleeding of brakes

5. **Suspension System** (04 hrs)
- 5.1 Function
 - 5.2 Types
 - 5.3 Working of coil spring, leaf spring
 - 5.4 Shock absorber
6. **Battery** (06 hrs)
- 6.1 Constructional details of lead and cell battery.
 - 6.2 Specific gravity of electrolyte
 - 6.3 Effect of temperatures, charging and discharging on specific gravity.
 - 6.4 Capacity and efficiency of battery
 - 6.5 Battery charging
 - 6.6 Maintenance of batteries
 - 6.7 Checking of batteries for Voltage and specific gravity
7. **Dynamo and Alternator** (04 hrs)
- 7.1 Dynamo, Function and details, Regulators-voltage, current and compensated type, Cutout-Construction, working and their adjustment.
 - 7.2 Alternator, Construction and working, Charging of battery from alternator
8. Diagram of a Typical Wiring System (04 hrs)
9. **Lighting System and Accessories** (04 hrs)
- 9.1 Lighting system
 - 9.2 Wiring circuit
 - 9.3 Headlight, aiming of headlights
 - 9.4 Lighting switches
 - 9.5 Direction Indicators
 - 9.6 Windscreen Wiper
 - 9.7 Horn
 - 9.8 Speedometer
 - 9.9 Heater
 - 9.10 Air-conditioning system
 - 9.11 Heavy duty vehicles (Tractors, Bulldozer, Forklift)

LIST OF PRACTICALS

1. Study and sketch of
 - i) Head Light Model
 - ii) Wiper and Indicators
2. Study and sketch of
 - i) A.C. Pump
 - ii) S.U. Pump
 - iii) Master Cylinder
3. Study and sketch of
 - i) Rear Axle
 - ii) Differential
 - iii) Steering system

4. Engine tuning of an automobile engine
5. Driving practice of four wheeler
6. Charging of automobile battery and measuring cell voltage and specific gravity of electrolyte.
7. Study of Multi Point Fuel Injection and common Rank Diesel Injection System in Automobile.
8. Checking and adjusting of clutch pedal play and brake pedal play, tightness of fan belt and brake shoe.
9. Changing of wheels and inflation of tyres; alignment of wheels.
10. Measuring spark gap, valve clearance and ring clearance. Cleaning, grinding and lapping operations for adjustment.
11. Cleaning and adjusting a carburetter.
12. Nozzle cleaning, testing and adjustment.

INSTRUCTIONAL STRATEGY

1. *Use Computer based learning aids for effective teaching*
2. *Expose students to real life problems*
3. *Plan assignments to promote problem solving abilities and to develop elementary driving knowledge.*

RECOMMENDED BOOKS

1. *Automobile Engineering by Kirpal Singh, Standard Publishers.*
2. *Automobile Engineering by GBS Narang, Khanna Publishers.*
3. *Automobile Mechanics by Joseph Heitner, CBS Publishers.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	04	08
2.	24	25
3.	06	10
4.	08	15
5.	04	08
6.	06	10
7.	04	08
8.	04	08
9.	04	08
Total	64	100

5.2 MACHINE DESIGN

L T P
5 - -

RATIONALE

A diploma holder in Mechanical Engineering is required to assist in the Design and Development of Prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. Hence this subject. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

DETAILED CONTENTS

1. **Introduction to Design** (06 hrs)
 - 1.1 Basic requirements for machine elements.
 - 1.2 General design process
 - 1.3 Mechanical properties
 - 1.4 General design considerations like fatigue, creep, fabrication methods, economic considerations, material selection and ergonomic
 - 1.5 Designing for strength

2. **Riveted and Welded Joints** (12 hrs)
 - 2.1 Types of riveted joints
 - 2.2 Possible failure of riveted joints
 - 2.3 Strength and efficiency of riveted joints
 - 2.4 Common types of welded joints
 - 2.5 Simple design for V butt welded joint
 - 2.6 Transverse fillet and parallel fillet welded joint

3. **Screwed Joints** (15 hrs)
 - 3.1 Introduction to term screw and various definitions of screw threads
 - 3.2 Advantages and disadvantages of screwed joints.
 - 3.3 Form of screw threads
 - 3.4 Common types of screw fastening; through bolt, tap bolt, stud, cap screw, machine screw and set screws.
 - 3.5 Designation of screw threads
 - 3.6 Stresses in screw fastenings
 - 3.7 Design of bolts for cylinder cover

4. **Keys and Couplings** (15 hrs)
 - 4.1 Definition of term key; its various types.
 - 4.2 Splines
 - 4.3 Forces acting on sunk keys
 - 4.4 Shaft couplings and its various types
 - 4.5 Design of flange coupling

5. **Shafts** (10 hrs)
 5.1 Various types of shafts
 5.2 Stresses in shafts
 5.3 Design of shafts (solid and hollow) subjected to torque and Bending moment.
6. **Design of Cotter Joint for Round Rod** (12 hrs)
 6.1 Design of cotter
 6.2 Design of socket
 6.3 Design of spigot
7. **Design of Knuckle Joint** (10 hrs)
 7.1 Design of rod
 7.2 Design of pin

INSTRUCTIONAL STRATEGY

While imparting instructions, the faculty should lay emphasis on concepts, derivations and numerical solutions. It should be supplemented with models, where ever possible.

RECOMMENDED BOOKS

1. *Machine Design by RS Khurmi and JK Gupta, Eurasia Publishing House Private Ltd., New Delhi.*
2. *Machine Design by VB Bhandari, Tata McGraw Hill, New Delhi.*
3. *Machine Design by RA Aggrawal, Nav Bharat Prakashion.*
4. *Machine Deisn by AP Verma, Katson Publishers*
5. *Machine Desing by Sharma and Aggrawal; Katson Publishers*
6. *Machine Design by JK Kapoor D Bharat Parkashan, Meerut.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	6	10
2.	12	15
3.	15	15
4.	15	15
5.	10	15
6.	12	15
7.	10	15
Total	80	100

5.3 PRODUCTION PLANNING AND CONTROL

L T P

4 - -

RATIONALE

Diploma holder in this course is responsible for controlling production and quality of the product on the shop floor as well as for production planning and control. He is also required to supervise erection, installation and maintenance of equipment including material handling and undertake work-study for better utilization of resources. For this purpose, knowledge and skills about these topics need to be imparted to them. This subject aims at development of competencies to prepare material, equipment schedule and production control schedules and maintain required quality levels. In addition, it will also help in developing skills in erection, installation and testing of equipment.

DETAILED CONTENTS

1. **Production Planning and Control** (06 hrs)
 - 1.1 Types of production. – Job, batch and mass production.
 - 1.2. Concept of planning, scheduling, routing, dispatching and follow up.
 - 1.3 Break even analysis and Gantt chart.

2. **Plant Location and Layout** (06 hrs)
 - 2.1 Definition
 - 2.2 Factors affecting the site selection of plant.
 - 2.3 Factors affecting plant layout.
 - 2.4 Types of layout – Process, product, combination and fixed position, layout patterns
 - 2.5 Techniques of making layout – Flow diagram, templates, distance volume matrix, travel chart.

3. **Work Study** (12 hrs)
 - 3.1 Definition, advantages and procedure of Work study.
 - 3.2 Difference between production and Productivity, measures to improve productivity.
 - 3.3 Method study – Definition, Objectives and Procedure.
 - 3.4 Symbols, Flow process chart, Flow diagram, Machine chart, Two hand chart.
 - 3.5 Principles of motion economy, Therblig symbols, Simo chart.
 - 3.6 Work Measurement – Time study, definition, principle and method of time study.
 - 3.7 Stop watch study – Number of readings, calculation of basic time, rating techniques, normal time, allowance, standard time, simple numerical problems.

4. **Inventory Control** (10 hrs)
- 4.1 Material purchasing, store keeping, functions and duties of store department.
 - 4.2 Definition of inventory, Types of inventory
 - 4.3 ABC analysis
 - 4.4 Procurement cost, carrying charges, lead-time, reorder point, economic ordering quantity, simple numerical problems.
 - 4.5 Codification and standardization.
 - 4.6 Concept of JIT
5. **Inspection and Quality Control** (08 hrs)
- 5.1 Inspection needs, types of inspection, stages of inspection.
 - 5.2 Statistical quality control.
 - 5.3 Process capability.
 - 5.4 Control charts for variables - \bar{X} and R chart, control chart for fraction defectives (P chart), control chart for number of defects (C chart) .
 - 5.5 Concept of ISO 9000, ISO 14000 and TQM.
 - 5.6 QC tools.
6. **Material Handling** (06 hrs)
- 6.1 Principles of material handling
 - 6.2 Hoisting equipment – Fork lift truck, cranes
 - 6.3 Conveying equipment – Package conveyor, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, bucket elevators, belt conveyors, and pneumatic conveyors.
 - 6.4 Work station design
7. **Repair and maintenance** (08hrs)
- 7.1 Objectives and importance of maintenance
 - 7.2 Different types of maintenance
 - 7.3 Nature of maintenance problem
 - 7.4 Range of maintenance activities
 - 7.5 Procedure of preventive maintenance
 - 7.6 Schedules of preventive maintenance
 - 7.7 Advantages of preventive maintenance
8. **Cost estimation and control:** (08 hrs)
- 8.1 Functions of cost estimation
 - 8.2 Estimation procedure
 - 8.3 Elements of cost, ladder of costs
 - 8.4 Depreciation-concept and methods of calculating depreciation
 - 8.5 Overhead expanses
 - 8.6 Cost control-capital cost control (planning and scheduling) operating cost control.

INSTRUCTIONAL STRATEGY

Efforts should be made to correlate the process of teaching with direct experiences in industry by use of computer based learning and Industrial visits.

RECOMMENDED BOOKS

1. *Industrial Engineering and Management* by T.R. Banga and SC Sharma; Khanna Publishers, Delhi.
2. *Industrial Engineering and Management* by O.P. Khanna; Dhanpat Rai and Sons, New Delhi.
3. *Production Management* by C.L. Mahajan; Satya Parkashan Company Limited, New Delhi.
4. *Mechanical Costing, Estimation and Project Planning* by CK Singh; Standard Publishers, New Delhi.
5. *A Text Book of Reliability and Maintenance Engineering* by A Manna, Prentice Hall of India

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	06	10
3	12	18
4	10	16
5	08	12
6	06	10
7	08	12
8	08	12
Total	64	100

5.4 MANUFACTURING PROCESSES-III

L T P
3 - 6

RATIONALE

This subject aims at development of knowledge and skills regarding various production processes like milling, press tools, broaching, gear cutting and advanced welding techniques Diploma holders are required to handle these machines and equipments. Hence this subject is required and is in continuation with Manufacturing Processes-II.

DETAILED CONTENTS

1. **Milling** (12 hrs)
 - 1.1 Introduction to milling
 - 1.2 Types of milling machines
 - 1.3 Constructional features of Knee and Column type milling machine
 - 1.4 Specifications of milling machine
 - 1.5 Milling operations- plain, angular, form, straddle and gang milling
 - 1.6 Milling cutters - Geometry and types
 - 1.7 Cutting speed and feeds.
 - 1.8 Indexing-simple, compound, differential and angular
 - 1.9 Job holding devices.
 - 1.10 Introduction to machining centre
2. **Presses and Press Tools** (08 hrs)
 - 2.1 Types of Presses, their applications
 - 2.2 Types of dies
 - 2.3 Types of die sets
 - 2.4 Punches
 - 2.5 Pads
 - 2.6 Die clearance
 - 2.7 Stripper plates
 - 2.8 Stops
 - 2.9 Pilots
 - 2.10 Stock Layout
3. **Broaching** (06 hrs)
 - 3.1 Introduction
 - 3.2 Types of broaching machines
 - 3.3 Types of broaches and their use
4. **Metal Coating Processes** (04 hrs)
 - 4.1 Metal spraying
 - 4.2 Galvanizing
 - 4.3 Electroplating
 - 4.4 Anodizing
5. **Gear Generating and Finishing Processes** (08 hrs)
 - 5.1 Gear tooth elements
 - 5.2 Gear milling
 - 5.3 Introduction to gear shaping
 - 5.4 Working principle of gear shaping machine
 - 5.5 Gear shaping cutters

5.6 Working principle of gear hobbing machine

5.7 Introduction to gear finishing operations

6. **Advanced Welding Techniques** (10 hrs)

6.1 Working principle, process details, equipment details, advantages, limitations and applications of:

6.2 Thermit Welding

6.3 MIG Welding

6.4 TIG Welding

6.5 Atomic hydrogen Welding

6.6 Electron beam welding

6.7 Laser beam welding.

6.8 Introduction to friction welding.

LIST OF PRACTICALS

1. Practice in producing a rectangular block by milling.
2. To prepare a slot on one face of a job with a slotting cutter/ side and face cutter.
3. Exercise on milling machine with the help of a form cutter.
4. Exercise in cutting of serrations/ gears with the help of indexing device on a milling machine.
5. Exercises on press tools
6. Milling of a spur gear.
7. Fabrication of a job using inert gas welding.
8. Practice in welding stainless steel pieces.
9. Reclamation of worn-out part by metal spray and machining.
10. Practice in electroplating a component.
11. Practice in plastic coating on a M.S. pipe

INSTRUCTIONAL STRATEGY

Teacher should lay emphasis in making the students conversants with concepts, principles, procedures and practices related to various manufacturing processes.

RECOMMENDED BOOKS

1. *Elements of workshop technology by SK Chaudhry and Hajra, Asia Publishing House.*
2. *Workshop Technology Vol I, II & III by Chapman; Standard Publishers Distributors.*
3. *Production Technology by HMT, Tata McGraw Publishers, New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	12	25
2.	08	15
3.	06	15
4.	04	10
5.	08	15
6.	10	20
Total	48	100

ELECTIVE

5.5.1 MECHATRONICS

L T P
4 - 3

RATIONALE

In this increasingly competitive environment of the day, the rapid advancements in the field of electronics engineering, information technology, automation and system engineering etc have been responsible for involving new concepts aimed at developing highly precision and sophisticated machine tools, system etc for hence productivity. Hence, the diploma holders need knowledge and skills on the multi disciplinary area and linking with the mechanical engineering. This subject e.g. Mechatronics aims at developing required knowledge and skills in this area.

DETAILED CONTENTS

1. **Introduction** (04 hrs)
 - 1.1 Introduction to Mechatronics
 - 1.2 Mechatronic system
 - 1.3 Measurement systems
 - 1.4 Control system-open Loop, Close loop and sequential
 - 1.5 Microprocessor based controllers
 - 1.6 The Mechatronics approach

2. **Sensors and Transducers** (06 hrs)
 - 2.1 Sensors and transducers
 - 2.2 Performance terminology
 - 2.3 Displacement, position and motion sensors
 - 2.4 Electromechanical sensors and transducers
 - 2.5 Force sensors
 - 2.6 Liquid flow sensors
 - 2.7 Liquid level sensors
 - 2.8 Temperature sensors
 - 2.9 Light sensors
 - 2.10 Selection of sensors
 - 2.11 Simple problems

3. **Data Presentation Systems** (06 hrs)
 - 3.1 Displays
 - 3.2 Data presentation elements
 - 3.3 Magnetic recording
 - 3.4 Data acquisition systems
 - 3.5 Measurement systems
 - 3.6 Testing and calibration
 - 3.7 Simple problems

4. **Pneumatic and Hydraulic Systems** (06 hrs)
- 4.1 Actuation systems
 - 4.2 Pneumatic and hydraulic systems
 - 4.3 Directional control valves
 - 4.4 Pressure control valves
 - 4.5 Cylinders
 - 4.6 Process control valves
 - 4.7 Rotary actuators
 - 4.8 Simple problems
5. **Mechanical Actuation Systems** (06 hrs)
- 5.1 Mechanical systems
 - 5.2 Types of motion
 - 5.3 Kinematic chains
 - 5.4 Cams
 - 5.5 Gear trains
 - 5.6 Ratchet and pawl
 - 5.7 Belt and chain drives
 - 5.8 Bearing
 - 5.9 Mechanical aspects of motor selection
 - 5.10 Simple problems
6. **Electrical Actuation System** (08 hrs)
- 6.1 Electrical systems
 - 6.2 Mechanical switches
 - 6.3 Solid-state switches
 - 6.4 Solenoids
 - 6.5 D.C. motors
 - 6.6 A.C. motors
 - 6.7 Stepper motors
 - 6.8 Problems
7. **Basic System Models** (04 hrs)
- 7.1 Mathematical models
 - 7.2 Mechanical systems building blocks
 - 7.3 Electrical system building blocks
 - 7.4 Fluid system building blocks
 - 7.5 Thermal system building blocks
 - 7.6 Simple Problems
8. **Digital Logic** (06 hrs)
- 8.1 Digital logic
 - 8.2 Number systems
 - 8.3 Logic gates
 - 8.4 Boolean algebra
 - 8.5 Karnaugh maps
 - 8.6 Applications of logic gates
 - 8.7 Sequential logic
 - 8.8 Simple Problems

- 9. Microprocessors** (06 hrs)
- 9.1 Control
 - 9.2 Microcomputer structure
 - 9.3 Microcontrollers
 - 9.4 Applications
 - 9.5 Programming problems
- 10. Input/output Systems** (06 hrs)
- 10.1 Interfacing
 - 10.2 Input/output ports
 - 10.3 Interface requirements
 - 10.4 Peripheral interface adapters
 - 10.5 Serial communications interface
 - 10.6 Examples of interfacing
 - 10.7 Simple problems
- 11. Programmable Logic Controllers** (06 hrs)
- 11.1 Programmable logic controllers- Applications
 - 11.2 Basic structure
 - 11.3 Input/output processing
 - 11.4 Programming-ladder diagrams
 - 11.5 Mnemonics
 - 11.6 Timers, internet relays and counter
 - 11.7 Shift registers
 - 11.8 Master and jump controls
 - 11.9 Data handling
 - 11.10 Analogue input/output
 - 11.11 Selection of a PLC
 - 11.12 Simple problems

LIST OF PRACTICAL

1. Study on Mechanical drive, device, switches and system selection procedure and specific application.
2. Layout of temperature sensor circuit and fabricate to sense and measure upto 250°C.
3. Study of water level control switch and fabricate to control the water level.
4. Study of strain gauge and fabricate a strain gauge to measure the force up to 100 Newton.
5. Layout a circuit for door sensing and fabricate a door sensing system to sense and buzzer the calling bell.
6. Manufacture a ratchet and pawl sensor to sense the angular displacement.
7. Study and layout circuit of D.C. Shunt motor.
8. Study on stepper motor, layout a circuit for it.

INSTRUCTIONAL STRATEGY

1. *Effort should be made to relate the actual application of various mechanical drives, device and switches in the modern manufacturing product.*
2. *Use of various electrical, electronic circuits, switches and devices in various electro-mechanical systems.*
3. *Students should be taken to industrial units for clear conception.*

RECOMMENDED BOOKS

1. *Mechatronics* by HMT, Tata McGraw Hill, New Delhi
2. *Mechatronics: Electronic Control System in Mechanical Engineering* by W. Bolton; Pearson Education, Singapore.
3. *Fundamentals of Electrical Engineering and Electronics* by BL Thareja; S. Chand and Company, New Delhi.
4. *Basic Electronics* by Gupta, NN Bhargava, Kulshreshtha, TTTI, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

<i>Topic No.</i>	<i>Time Allotted (Hrs)</i>	<i>Marks Allotted (%)</i>
1.	04	08
2.	06	09
3.	06	09
4.	06	09
5.	06	09
6.	08	12
7.	04	08
8.	06	09
9.	06	09
10.	06	09
11.	06	09
Total	64	100

5.5.2 INSTALLATION, TESTING & MAINTENANCE

L T P
4 - 3

RATIONALE

A diploma engineer comes across installation, maintenance and testing of various machines and equipment in industries. The layout of different machines, their foundations is an important phenomenon of an industry. He should know the various methods of testing & maintenance. This subject will enable the diploma holders to deal with such aspects.

DETAILED CONTENTS

- 1. Introduction** (06 hrs)
 - 1.1 Necessity of testing, repair and maintenance
 - 1.2 Economic aspects, manpower planning and materials management
 - 1.3 Fits and tolerances – common fits and tolerances used for various machine parts
- 2. Execution and Commissioning of Machines (Installation)** (06 hrs)
 - 2.1 Location, layout and positioning of machines
 - 2.2 Foundation – types of foundation, foundation plan, erection and leveling, grouping, vibration damping, vibration isolation – methods of isolation
- 3. Inspection, Servicing, Repair & Overhauling of machines and equipment** (12 hrs)
 - 3.1 Inspection of various machines and equipment
 - 3.2 Servicing of various machines and equipment
 - 3.3 Repair of various machines and equipment
 - 3.4 Overhauling of various machines and equipment
 - 3.5 Recalibration of various measuring instruments, testing the speed of machines, accuracy of machines, alignment and performance of machines.
- 4. Maintenance planning & stages of maintenance** (08 hrs)
 - 4.1 Maintenance planning
 - 4.2 Various stages of maintenance
 - 4.3 Maintenance schedules and record keeping
- 5. Reliability Centred Maintenance** (04 hrs)
 - 5.1 Reliability
 - 5.2 Availability
 - 5.3 Maintainability
- 6. Reliability Centred Maintenance** (04 hrs)

- 7. Overhauling** (08 hrs)
- 7.1 Frequent failure of common parts, their causes & remedial measures.
 - 7.2 Overhauling schedule and procedure.
 - 7.3 Parts which require frequent maintenance such as belts, couplings, nut, bolts, their repair & maintenance to avoid downtime.
 - 7.4 Fault diagnosis and action against fault. Examples of fault detection.

- 8. Maintenance** (08 hrs)
- 8.1 Meaning of maintenance, advantages & disadvantages
 - 8.2 Types of maintenance
 - 8.3 Preventive, predictive & breakdown maintenance.
 - 8.4 Maintenance organization.
 - 8.5 Centralized maintenance & decentralized maintenance.
 - 8.6 Computerization of maintenance.
 - 8.7 Greasing and lubrication schedule.

- 9. Storage of parts:** (08 hrs)
- 9.1 Storage of parts used frequently for replacement and parts which are not easily available in local market.
 - 9.2 History cards of different machines.
 - 9.3 Machines repair/replacement decision.

LIST OF PRACTICALS

- 1. Preparation of prevention maintenance check.
- 2. Condition monitoring by NDT.
- 3. Study of maintenance of utility equipment like compressors, pumps, driers, and actuator type valves.
- 4. Equipment/machine leveling and alignment.
- 5. Maintenance of material handling equipment – pulley blocks, hand operated cranes, fork fits, hydraulics jacks, mobile cranes, and winches.
- 6. Use of lubrication equipment like oil gun, grease gun.
- 7. Removing old lubricant, cleaning and replenishing and machine with fresh lubricant.
- 8. Visit to maintenance department of an industry & prepare a report

INSTRUCTIONAL STATREGY

The emphasis to be laid on the actual study of maintenance of schedules. The use of Audio visual aids and computer based maintenance. The expert may be invited from the service and maintenance organizations.

RECOMMENDED BOOKS

- 1. *Industrial Maintenance by HP Garg; S. Chand and Company.*
- 2. *Plant Maintenance Engineering by RK Jain; Khanna Publishers.*
- 3. *A Text book of Reability and Maintenance Engineering by Dr. A Manna, Prentice Hall of India.*
- 4. *Installation, Servicing and Maintenance by SN Bhattacharya; S. Chand and Company.*
- 5. *Installation, Maintenance, Servicing by AR Basu; M Dutta and Co., Calcutta.*

6. *Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt., Ltd., New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

<i>Topic No.</i>	<i>Time Allotted (Hrs)</i>	<i>Marks Allotted (%)</i>
1.	06	10
2.	06	10
3.	12	20
4.	08	10
5.	04	05
6.	04	05
7.	08	14
8.	08	14
9.	08	12
Total	64	100

5.5.3 FOUNDRY TECHNOLOGY

L T P
4 - 3

RATIONALE:-

Foundry Technology deals with the process of making castings in moulds of sand or other materials. A Diploma holder Mechanical Engineering is required to supervise production. For this, knowledge about foundry practices be imparted' to him. This subject aims at development knowledge and skills in the area of various cas processes and developments in this area.

DETAILED CONTENTS

- 1. PATTERN MAKING** (6hrs)
 - 1.1 Materials for pattern making
 - 1.2 Factors affecting selection
 - 1.3 Jointing materials for pattern construction
 - 1.4 Finishing the patterns
 - 1.5 Pattern fillets
 - 1.6 Pattern allowances
 - 1.7 Types of patterns
 - 1.8 Tools used for making pattern
 - 1.9 Core prints and core boxes
 - 1.10 Preparation of pattern and core box
 - 1.11 Machines used in pattern making
 - 1.12 Defects caused by pattern design

- 2. MOULDING AND CORE MAKING** (6hrs)
 - 2.1 Moulding sands
 - 2.2 Principle ingredients of moulding sand
 - 2.3 Specification and testing of moulding sand
 - 2.4 Sand preparation
 - 2.5 Moulding processes- Bench floor moulding, pit moulding
 - 2.6 Hand moulding
 - 2.7 Machine Moulding
 - 2.8 Core sands
 - 2.9 Types of cores
 - 2.10 Core making
 - 2.11 Gates and risers
 - 2.12 Defects making caused by moulding and core making

- 3. MOULD DRYING AND CORE MAKING** (4hrs)
 - 3.1 Mould, drying
 - 3.2 Core Drying
 - 3.3 Defects

4. **MELTING PRACTICE** (8hrs)
- 4.1 Types of furnaces- are, open hearth, air
 - 4.2 Melting of Aluminium and its alloys
 - 4.3 Melting of Copper and its alloys
 - 4.4 Steel melting practice
 - 4.5 Melting practice for cast iron
5. **CLOSING AND POURING THE MOULDS** (4hrs)
- 5.1 Coring up, venting and closing
 - 5.2 Ladles, pouring
6. **SOLIDIFICATION OF CASTING** (8hrs)
- 6.1 Nucleation
 - 6.2 Growth
 - 6.3 Directional solidification
 - 6.4 Pouring rate and temperature
 - 6.5 Padding
 - 6.6 use of chills
7. **CASTING PROCESSES** (8hrs)
- 7.1 Sand casting
 - 7.2 Permanent mould casting
 - 7.3 Slush casting
 - 7.4 Die casting
 - 7.5 Plaster mould casting
 - 7.6 Shell moulding
 - 7.7 Investment casting
 - 7.8 Centrifugal Moulding
 - 7.9 Carbon dioxide moulding
 - 7.10 Continuous casting
8. **CLEANING AND INSPECTION OF CASTING** (8hrs)
- 8.1 Shaking of moulds
 - 8.2 Removal of dry sand cores
 - 8.3 Removal of extra parts
 - 8.4 Cleaning of casting
 - 8.4.1 Chipping, burning off and grinding
 - 8.4.2 Rumbling, shot blasting and hydro blast
 - 8.4.3 surface treatment
 - 8.5 Inspection of casting
9. **HEAT TREATMENT OF CASTING** (4hrs)
- 9.1 Stress relief and annealing
 - 9.2 Treatments involving rapid cooling
 - 9.3 Defects caused by heat treatment

10 MODERNIZATION OF FOUNDRIES

(8hrs)

- 10.1 Foundry mechanization
- 10.2 Elements of mechanization
- 10.3 Sand preparation units
- 10.4 Equipment for dust and fume control
- 10.5 Equipment for moulding and core making
- 10.6 Melting, pouring and shake out units

Note:

- *An expert from industry may be invited from some industry.*
- *Industrial visit may be arranged.*

PRACTICAL EXERCISES

1. Making at least two patterns out of the following:
 - 1.1 Solid one piece pattern
 - 1.2 Split two piece pattern
 - 1.3 Split three piece pattern,
 - 1.4 Gated pattern
2. Making at least two core boxes out of the following:
 - 2.1 Straight core box
 - 2.2 Bent core box
 - 2.3 Unbalanced core
3. To find out the moisture content, clay and permeability of moulding-sand
4. To prepare sand moulds of different forms with different types of pattern using floor moulding, two box moulding and three box moulding.
5. Making and setting of cores of different types
6. Melting of cast iron in Cupola and pouring in mould.
7. Melting of non ferrous metal in a pit furnace and pouring the mould.
8. Shaking, cleaning and fettling of castings.
9. Inspection and testing of casting and to find out the causes of weld defects.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	06	10
2.	06	10
3.	04	08
4.	08	10
5.	04	08
6.	08	12
7.	08	10
8.	08	12
9.	04	08
10.	08	12
Total	64	100

5.5.4 WELDING TECHNOLOGY

L T P
4 - 3

Rationale:

Welding Processes are extensively used in industries for production as well as repair and maintenance areas. A diploma holder in Mechanical, Engg. is required to look after fabrication and repair and maintenance operations. For this knowledge and skills in the area of welding technology is required to be imparted to them. Therefore this Subject. The subject aims at development of knowledge and skills in the area of welding techniques, both conventional and modern.

DETAILED CONTENTS

1. **INTRODUCTION TO WELDING** (6hrs)
 - 1.1 Principle of welding
 - 1.2 Classification of welding processes
 - 1.3 Advantages, Limitations of welding
 - 1.4 Welding applications
 - 1.5 Weld ability

2. **GAS WELDING** (8hrs)
 - 2.1 Principle of operation
 - 2.2 Oxyacetylene flame
 - 2.2.1 Types of flame
 - 2.2.2 Combustion of flame
 - 2.3 Welding Techniques
 - 2.4 Filler rods And fluxes for gas welding
 - 2.5 Gas welding equipment and accessories
 - 2.1.1 Oxygen gas cylinders
 - 2.1.2 Acetylene gas cylinders
 - 2.1.3 Acetylene gas generator
 - 2.1.4 Pressure Regulator
 - 2.1.5 Oxygen and Acetylene Hoses
 - 2.1.6 Welding Torch

3. **ARC WELDING** (8hrs)
 - 3.1 Arc welding process
 - 3.2 Striking the arm
 - 3.3 Arc length
 - 3.4 Arc blow
 - 3.5 Arc welding machines- types and details
 - 3.6 Selection of welding machines
 - 3.7 AC and DC welding and effects of polarity
 - 3.8 Electrodes-classification, specifications and selection
 - 3.9 Coated electrodes
 - 3.10 Welding positions
 - 3.11 Welding procedures
 - 3.12 Welding defects

- 4. **RESISTANCE WELDING** (8hrs)
 - 4.1 Principle
 - 4.2 Advantages, disadvantages
 - 4.3 Applications
 - 4.4 Spot welding
 - 4.5 Seam welding
 - 4.6 Projection welding
 - 4.7 Butt Welding
 - 4.7.1. Upset butt welding
 - 4.7.2 Flash butt welding
 - 4.8. Percussion welding

- 5. **OTHER WELDING PROCESSES** (10hrs)
 - 3.1 Submerged arc welding
 - 3.2 TIG welding
 - 3.3 MIG welding
 - 3.4 Electro slag welding
 - 3.5 Plasma arc welding
 - 3.6 Ultrasonic welding
 - 3.7 Thermit welding
 - 3.8 Atomic hydrogen welding
 - 3.9 Electron beam welding
 - 3.10 Laser beam welding
 - 3.11 Automated welding

- 6. **BRAZING** (6hrs)
 - 6.1 Principle
 - 6.2 Procedure
 - 6.3 Brazing filler alloys
 - 6.4 Brazing fluxes
 - 6.5 Advantages, Limitations and applications

- 7. **SOLDERING** (6hrs)
 - 7.1 Principle
 - 7.2 Solders
 - 7.3 Soldering fluxes
 - 7.4 Soldering Methods
 - 7.5 PCB Soldering

- 8. **WELDING OF DIFFERENT MATERIALS** (6hrs)
 - 8.1 Welding Cast iron, Alloy Steel, tool Steel, Aluminium, Magnesium, Stainless, Copper

- 9. **WELD DEFECTS AND TESTING** (6hrs)
 - 9.1 Types of weld Defects; their causes and prevention.
 - 9.2 Destructive testing of welds
 - 9.3 Non Destructive tests- Fluorescent penetration test, magnetic particle test, ultrasonic test, radiographic test.

Note:

- *An expert from some industry may be invited for the lecture.*
- *Industrial visit may be planned.*

PRACTICAL EXERCISES

1. Setting of flame length and colour for welding
2. Preparation metal edges for welding
3. Gauging practice
4. Setting of appropriate current and voltage for thin and thick work pieces, electrodes selection.
5. Practice of Tacking
6. Practice of vertical and overhead welding
7. Practice of forward and backward welding
8. Practice of welding pipes by electric arc welding technique.
9. Practice of Soldering
10. Rectification of welding defects in plates and pipe jobs
11. Welding Practice for lap welding and Butt welding.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	06	10
2.	08	12
3.	08	12
4.	08	12
5.	10	14
6.	06	10
7.	06	10
8.	06	10
9.	06	10
Total	64	100

5.5.5 PRODUCT DESIGN AND DEVELOPMENT

L T P
4 - 3

Rationale:

Diploma holders in Mechanical Engineering are to provide professional assistance in design and development of prototypes, tools, jigs and fixtures. For this purpose, it is essential to impart knowledge and skills about ergonomics, engineering design, decision making and computer aided design for enabling them to perform functions.

DETAILED CONTENTS

1. **ERGONOMICS** (9 hrs)
 - 1.1 Introduction
 - 1.2 Application
 - 1.3 Approaches and models in ergonomics.
 - 1.4 Design of displays and controls.
 - 1.5 Layout of panels.

2. **DESIGN ACTIVITIES** (5 hrs)
 - 2.1 Stage of product development
 - 2.2 Feasibility study and product life cycle

3. **ELEMENTS OF ENGINEERING DESIGN** (9 hrs)
 - 3.1 Major phases of design
 - 3.2 Design codes and standards.
 - 3.3 Factor of safety and derating factor
 - 3.4 Modeling in design

4. **GENERAL CONSIDERATIONS IN MECHANICAL DESIGN**(12 hrs)

Various considerations such as function environment, life, reliability, safety, maintenance, cost, quantity manufactures, patents, appearance, packing, limits, fits and tolerances.

5. **DECISION MAKING**
 - 5.1 Decision matrix (5 hrs)
 - 5.2 Decision trees

6. **DESIGN OF MANUFACTURING** (12 hrs)
 - 6.1 Design considerations for cast components
 - 6.2 Design considerations for forged components
 - 6.3 Design of Sheet metal parts
 - 6.4 Design involving joining processes
 - 6.5 Design involving machining process.

7. **COMPUTER AIDED DESIGN** (12 hrs)
 - 7.1 Components of CAD Systems
 - 7.2 Application of Computer for design
 - 7.3 Benefit of CAD
 - 7.4 Hardware and software in CAD
 - 7.5 Function of graphics package

7.6 Simple computer Aided Drafting Exercises

Note:-

** An expert from some industry may be invited for the lecture.*

PRACTICAL EXERCISES

1. Ergonomic study and analysis of displays and control in a car/ automobile
2. Conducting a feasibility study of a consumer product
3. Collecting information on an Engineering product and suggesting improvement.
4. Case study of a product development
5. Making 2D working drawing with the help of computer software (like AUTOCAD , ROBOCAD, DRAFTPAC, MICROSTATION PC etc.)

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	09	12
2.	05	10
3.	09	13
4.	12	15
5.	05	10
6.	12	20
7.	12	20
Total	64	100

5.5.6 HEAT TREATMENT

L T P
4 - 3

RATIONALE

Heat Treatment is the process through which it is possible to bring the desired changes in material properties. Diploma holders in Mechanical Engineering are required to select material by various products. Therefore they should have knowledge about various heat treatment processes. This subjects aims at development of knowledge and skill about concept of Heat treatment, various processes and Heat treatment of tools and machine.

DETAILED CONTENTS

1. **SOLIDIFICATION OF IRON** (5 hrs)
 - 1.1 Grain Structure
 - 1.2 Nucleation and grain size.
 - 1.3 Formation of Dendrites
 - 1.4 Directional solidification.
2. **IRON-CARBON EQUILIBRIUM DIAGRAM** (5hrs)
 - 2.1 Various constituent phases.
 - 2.2 Advantages of Equilibrium Diagram.
3. **TTT CURVE** (5 hrs)
 - 3.1 Study of TTT Curve
 - 3.2 Its specifies application in Heat treatment of steel and phase transformation.
4. **HEAT TREATMENT** (5 hrs)
 - 4.1 Concept and purpose
 - 4.2 Allotropic forms of iron.
5. **TYPICAL HEAT TREATMENT PROCESSES FOR STEEL** (8 hrs)
 - 5.1 Annealing
 - 5.2 Normalizing
 - 5.3 Hardening
 - 5.4 Tempering
 - 5.5 Hardanability-only concept.
 - 5.6 Different colours and temperatures.
 - 5.7 Austempering
 - 5.8 Mar tempering
6. **SURFACE HARDENING** (8hrs)
 - 6.1 Objectives and uses
 - 6.2 Flame hardening
 - 6.3 Induction hardening
 - 6.4 Surface hardening in an electrolytic bath
 - 6.5 Cooling Medium and their effects on cooling rate.
7. **CASE HARDENING OF STEEL** (5hrs)
 - 7.1 Essence an fundamentals of case hardening
 - 7.2 Carbursing
 - 7.3 Nit riding
 - 7.4 Cyaniding

8. **HEAT TREATMENT FURNANCE** (5 hrs)
 - 8.1 Muffle, induction and salt bath furnaces
9. **HEAT TREATMENT OF TOOLS** (5 hrs)
 - 9.1 Heat Treatment of high carbon steel tools
 - 9.2 Heat treatment of high speed cutting tools
 - 9.3 Heat treatment of hammer dies and die moulds.
10. **HEAT TREATMENT OF MACHINE PARTS** (8 hrs)
 - 10.1 Heat Treatment of steel casting
 - 10.2 Heat Treatment of forgings of shafts and axles
 - 10.3 Heat treatment of springs
 - 10.4 Heat treatment of gears
11. **FINISHING OPEATIONS AFTER HEAT TREATMENTS** (5 hrs)
 - 11.1 Removal of scale
 - 11.2 Alkaline-detergent cleaning and degreasing
 - 11.3 Straightening

PRACTICAL EXPERIENCE

1. study and understanding of various types of furnaces and their uses.
2. Study and understanding of temperature measuring devices. Their locations and various types of devices used.
3. Study and sketching of various hand tools, lifting tackles, gadgets used.
4. Study and sketch of various types of quenching tanks and methods of agitation.
5. Practical work on heat treatment of small tool dies, trimming dies, coining tools and forging dies.
6. Practicals work on heat treatment of forged components and mass produced items.
7. Practicals on tempering, pack carburising, cyaniding, gas carbursing.
8. Hardness testing of tools and dies and correlating the results on other hardness testers.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	5	8
2.	5	8
3.	5	8
4.	5	8
5.	8	12
6.	8	12
7.	5	8
8.	5	8
9.	5	8
10.	8	12
11.	5	8
Total	64	100

5.5.7 TOOL ENGINEERING

L T P
4 - 3

RATIONALE

Diploma Holders in Mechanical Engineering are required to supervise production to meet production target. For that it is necessary for them to ensure that various machine tool and tooling equipments remain in working order. For this purpose, knowledge about jigs and fixture, press tools and other tooling equipments is essential. Hence this subjects. The subjects aims at development of knowledge and skills regarding press tools, jigs & Fixtures and other equipments for increased productivity and quality.

DETAILED CONTENTS

1. **CUTTING TOOLS MATERIALS** (10 hrs)
 - 1.1 Requirements of Cutting tools materials.
 - 1.2 Factor affecting selection of tools materials
 - 1.3 Various cutting tools materials used
 - 1.4 Development in cutting tool material
 - 1.5 Various cutting tools materials used
 - 1.6 Development in cutting tool material-UCON, CBN, Coated, Multi coating.

2. **JIGS & FIXTURES** (24 hrs)
 - 2.1 Definition, purpose and basic elements.
 - 2.2 Principles of designing Jigs and fixture.
 - 2.3 Work holding Devices
 - 2.4 Degree of Freedom
 - 2.5 3-2-1 Principle of location
 - 2.6 Locating Devices
 - 2.7 Various Clamping Devices
 - 2.8 Tools Guiding methods and guide bushing
 - 2.9 Types of Drill Jigs and their applications
 - 2.10 Common Types of milling fixtures.
 - 2.11 Welding Fixtures

3. **PRESS TOOLS** (30 hrs)
 - 3.1 Basic of press tool working
 - 3.2 Press tool terms and main parts
 - 3.3 Power Presses-working and classification
 - 3.4 Die Sets-Types
 - 3.5 Nomenclature of cutting dies
 - 3.6 Theory of cutting dies such as blanking, piercing, notching, cutting off, trimming.
 - 3.7 Scrap strip layout
 - 3.8 Feeding Mechanism
 - 3.9 Cutting and stripper force calculations
 - 3.10 Punches, Dies, Pilots, Strippers, stops, Knockouts-their design and material selections.

- 3.11 Forming operations such as bending, curling with exposures to embossing, coining drawing, deep drawing.
- 3.12 Working of compound and progressive tool.
- 3.13 Single action and double action presses.
- 3.14 Design of press tools for forming operation.
- 3.15 Design of press tools for forming operations
- 3.16 Design of compound and progressive type of press tools.

PRACTICAL EXPERIENCE

1. Sketch of a single point cutting tool geometry.
2. Design and drawing of a drill jig for a given components.
3. Design and drawing of a plain milling fixtures for a given job.
4. Making a cut off tool and drawing tool.
5. Making and drawing of blanking and trimming tool.
6. Drawing of compound press tool.
7. Drawing of general arrangement of progressive press tools.
8. Visits to an industry engaged in mass production. Various tools, jigs and fixtures and press tools to be shown to the students during the operations.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	10	15
2.	24	40
3.	30	45
Total	64	100

5.6 GENERIC SKILLS AND ENTREPRENEURSHIP DEVELOPMENT

L T P
3 - -

RATIONALE

Generic Skills and Entrepreneurship Development is one of the courses from “Human Science” subject area. Generic 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 aim at developing conceptual understanding for setting-up one’s own business venture/ enterprise. This aspect of Human Resource Development has become equally important in the era, when wage employment prospects have become meager.

Both the subject areas are supplementary to each other and soft skills are required to be developed in diploma passouts for enhancing their employability and self confidence.

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. *Handbook of Small Scale Industry by PM Bhandari*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1.	4	5
2.	8	15
3.	6	10
4.	3	10
5.	5	10
6.	22	50
Total	48	100

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 REFRIGERATION AND AIR CONDITIONING

L T P
4 - 2

RATIONALE

Diploma holders in Mechanical engineering are responsible for supervising production and maintenance of refrigeration and air conditioning systems. For this purpose, knowledge and skills covering principles of refrigeration and air conditioning, various refrigeration and air conditioning systems, psychometry are required to be imparted to them. Hence this subject.

DETAILED CONTENTS

1. **Principles of Refrigeration** (08 hrs)
 - 1.1 Meaning
 - 1.2 Refrigeration Methods
 - 1.3 Units of Refrigeration
 - 1.4 Reversed Carnet cycle
 - 1.5 Heat pump
 - 1.6 Coefficient of Performance
 - 1.7 Rating of refrigeration machines

2. **Refrigeration Systems** (10 hrs)
 - 2.1 Air refrigeration cycle- applications and its limitations.
 - 2.2 Vapour Compression Cycle
 - 2.3 Effect of sub cooling and super heating
 - 2.4 Departure of Actual vapour compression cycle from theoretical cycle
 - 2.5 Effect of varying condensing and suction temperature on coefficient of performance.
 - 2.6 Simple mathematical calculation with pressure-enthalpy charts.
 - 2.7 Vapour Absorption cycle.
 - 2.8 Actual vapour absorption cycle and application.

3. **Refrigerants** (08 hrs)
 - 3.1 Important properties of a refrigerant
 - 3.2 Properties and applications of commonly used refrigerants such as R11,R12, R22, NH₃ and Water.
 - 3.3 Newer Refrigerants

4. **Refrigeration System, Components and Controls** (08 hrs)
 - 4.1 Function, types, specification and constructional details of components such as compressor, condenser, throttling device, evaporator, oil separator, accumulator, header.
 - 4.2 Various controls- Solenoid Valve, thermostat, low pressure/high pressure cut out, oil safety switch

5. **Psychrometry** (08 hrs)
 - 5.1 Various terms-Dry and wet bulb temperatures, Saturation, Dew point, adiabatic saturation, temperature, Relative humidity, absolute humidity, humidity ratio.
 - 5.2 Psychrometric chart and its uses
 - 5.3 Psychrometric processes-Sensible heating and sensible cooling, humidification and dehumidification, cooling and dehumidification, heating and humidification, and their representation on psychrometric chart.
 - 5.4 Simple Problems

6. **Airconditioning** (06 hrs)
 - 6.1 Introduction
 - 6.2 Metabolism in human body
 - 6.3 Human comfort
 - 6.4 Applications of air-conditioning

7. **Heat Loads** (06 hrs)
 - 7.1 Various types of loads
 - 7.2 Sensible and latent heat load
 - 7.3 Load calculations

8. **Airconditioning System** (06 hrs)
 - 8.1 Description of room air conditioner
 - 8.2 Central air-conditioning system
 - 8.3 Round the year air conditioning system
 - 8.4 Air distribution systems: concept of filter, damper, fan, blower, air register and diffuser,

9. **Miscellaneous Topics** (04 hrs)
 - 9.1 Evaporative cooling – Principle, Desert air cooler

LIST OF PRACTICALS

1. Practice in :- i) Tube cutting ii) Tube Flaring iii) Tube bending iv) Tube joining
2. Study and sketch of domestic refrigerator.
3. Study and sketch of water cooler
4. Study and sketch window type room air conditioner
5. Testing of a refrigeration unit to find out:
 - i) Refrigeration capacity
 - ii) Power input
 - iii) COP
6. a) Charging refrigerant in an open as well as hermetically sealed units.
b) Physical detection of leakage of refrigerant by various methods.
7. To detect troubles/faults in a refrigeration system and to remove them.
8. Visit to an ice plant / cold storage plant/central conditioning plant
9. Study and sketch of various types of expansion devices & Humidity state.
10. Study and sketch of thermostat, strainer, drier, H.P. L.P. and oil safety control and service valve, Two way & three ways valves ask relays & salmid valve etc..

INSTRUCTIONAL STRATEGY

- *While imparting instructions, focus should be on conceptual understanding.*
- *Emphasis on use of Audio Visual aids should be given*

RECOMMENDED BOOKS

1. *Refrigeration & air conditioning by Domkundwar, Dhanpal Rai & Sons*
2. *Refrigeration and air conditioning by C.P Arora Tata Mc Graw Hills*
3. *refrigeration and air conditioning by R.S Kuhurmi by S Chand and Company*
4. *Refrigeration & Air condition by A.S saroq Satya prakashan*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2	10	15
3	08	12
4	08	12
5	08	15
6	06	10
7	06	12
8	06	07
9	04	05
Total	64	100

6.3 METROLOGY AND INSTRUMENTATION

L T P
3 - 2

RATIONALE

Metrology is the science of measurement. Diploma holders in Mechanical Engineering are responsible for ensuring process control and quality control by making measurements and inspection of various parameters. For this purpose, knowledge and skills about various measuring instruments is required. Hence this subject. The aim of this subject is to develop knowledge and skills regarding various measuring instruments amongst the students.

DETAILED CONTENTS

- | | | |
|-----|---|----------|
| 1. | Introduction | (03 hrs) |
| 1.1 | Meaning of metrology | |
| 1.2 | Precision and accuracy | |
| 1.3 | Interchangeability | |
| 2. | Linear Measurements | (10 hrs) |
| 2.1 | Working principle and constructional details of:- | |
| 2.2 | Engineering scale | |
| 2.3 | Vernier Caliper | |
| 2.4 | Micrometer | |
| 2.5 | Height gauge and depth gauge | |
| 2.6 | Radius gauge and feeler gauge | |
| 2.7 | Dial indicator | |
| 2.8 | Comparators (In general use only) | |
| 2.9 | Slip Gauges | |
| 3. | Angular Measurements | (08 hrs) |
| 3.1 | Working principle and constructional details of:- | |
| 3.2 | Combination set | |
| 3.3 | Vernier bevel protractor | |
| 3.4 | Sine bar | |
| 3.5 | Taper measurement by rollers | |
| 4. | Surface Measurements | (04 hrs) |
| 4.1 | Straight edge | |
| 4.2 | Try square | |
| 4.3 | Surface plate(Use and specifications) | |
| 5. | Limit Gauges | (03 hrs) |
| | GO and NO GO gauges | |

- 6. **Thread Measurements** (04 hrs)
 - 6.1 Measurement of thread elements of external and internal threads
 - 6.2 Screw pitch gauge
 - 6.3 Screw thread Micrometer
 - 6.4 Thread limit Gauges

- 7. Gear Tooth Vernier (02 hrs)

- 8. **Surface Finish Measurements** (04 hrs)
 - 8.1 Roughness and Waviness Various roughness values-CLA value, RMS value, Mean value.
 - 8.2 Surface roughness measuring instrument- principle of working

- 9. **Other Measuring Instruments** (04 hrs)
 - 9.1 Autocollimator
 - 9.2 Tool maker's Microscope
 - 9.3 Profile Projector
 - 9.4 Coordinate Measuring Machine

- 10. **Instrumentation** (06 hrs)
 - 10.1 Measurement of Mechanical quantities such as displacement, vibrations, frequency, pressure, temperature, humidity by electromechanical transducers of resistance, capacitance and inductance type.

LIST OF PRACTICALS

1. Use of linear measuring instruments like vernier caliper and micrometer.
2. Use of height gauge and depth gauge.
3. Measurements with the help of combination set and bevel protractor.
4. Angle measurement by use of sine bar and slip gauges.
5. Use of slip gauges in measurement of centre distance between two pins.
6. Use of comparator for measurement.
7. Measurement of taper by standard balls and rollers.
8. Measurement of thread parameters by using Tool makers microscope.
9. Measurement of gear elements by using gear tooth vernier.
10. Measurement of profile by profile projector.
11. Measurement of surface roughness of a surface.

INSTRUCTIONAL STRATEGY

- *Demonstrate use of various measuring instruments while imparting theoretical instructions.*
- *Stress should be on correct use of various instruments.*

RECOMMENDED BOOKS

1. *Engineering Metrology* by R.K. Jain, Khanna Publishers
2. *A Text Book of Production Engineering* by P.C Sharma
3. *Engineering Metrology* by R.K. Rajput; S.K. Kataria & Sons

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	03	05
2	10	15
3	08	10
4	04	10
5	03	10
6	04	10
7	02	05
8	04	10
9	04	10
10	06	15
Total	48	100

6.4 COMPUTER AIDED DRAFTING

L T P
- - 4

RATIONALE

The diploma holders are required to integrate the hard drawings through a soft copy to the machines during production. Thus competency in computer aided drafting is essential. Hence this subject is required.

LIST OF PRACTICALS

1. **Introduction to CAD commands**
 - 1.1 Concept of CAD, Tool bars in CAD, coordinate system, snap, grid, and ortho mode
 - 1.2 Drawing commands – point, line, arc, circle, ellipse,
 - 1.3 Editing commands – scale, erase, copy, stretch, lengthen and explode.
 - 1.4 Dimensioning and placing text in drawing area
 - 1.5 Sectioning and hatching
 - 1.6 Inquiry for different parameters of drawing entity
2. **Detail and Assembly drawing of the following using CAD**
 - 2.1 Journal Bearing
 - 2.2 Wall Bracket
 - 2.3 Stepped pulley, V-belt pulley
 - 2.4 Flanged coupling
 - 2.5 Spur gear
 - 2.6 Screw jack
3. **Isometric Drawing by CAD**

Drawings of following on computer:

 - Cone
 - Cylinder
 - Isometric view of objects
4. **Modelling**

3D modelling, Transformations, scaling, rotation, translation
5. Introduction to other CAD softwares
(Pro Engineer or CATIA/NX4 as NX5/Solid Edge/Ideas) : Salient features, simple drawing of components (2 D and 3D)

INSTRUCTIONAL STRATEGY

1. *Teachers should show model or realia of the component/part whose drawing is to be made.*
2. *Emphasis should be given on cleanliness, dimensioning and layout of sheet.*
3. *Teachers should ensure use of IS codes related to drawing.*

RECOMMENDED BOOKS

1. *Engineering Drawing with AutoCAD 2000* by T. Jeyapooran; Vikas Publishing House, Delhi.
2. *AutoCAD for Engineering Drawing Made Easy* by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
3. *AutoCAD 2000 for you* by Umesh Shettigar and Abdul Khader; Janatha Publishers, Udupi.
4. *Auto CAD 2000* by Ajit Singh, TMH, New Delhi.
5. *Designing with Pro Engineer, Sham Tickoo* by Dream Tech Publications, New Delhi.
6. *Designing with CATIA*, by Sham Tickoo, Dream Tech. Publications, New Delhi.
7. *Designing with NX4 or Solid Edge* by Shamtickoo

6.5 CNC MACHINES AND AUTOMATION

L T P
4 - 4

RATIONALE

Diploma holders are required to supervise and handle specialized machines and equipment like CNC machines. For this purpose, knowledge and skills about NC machines, part programming in NC machines and tooling for CNC machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about CNC machines, tools, equipment and use of high tech machines for increased productivity and quality.

DETAILED CONTENTS

1. **Introduction** (08 hrs)
Basic concepts of NC, CNC & DNC, adoption controls, advantages & disadvantage of CNC Machines, Application of CNC Machines, difference between conventional & CNC Machines, Profitable applications of CNC Machines. Introduction to CAM.
2. **Construction of CNC Machines** (16 hrs)
Machine control unit, NC control, PLC control, its advantages & disadvantages, Application and limitations of PLC machines, Axis designation of CNC machines, special constructional requirement of CNC machines, slide ways, bolt screw & nut assembly, Lubrication & cooling of CNC machines, Spindle & spindle motors, axis drives motor, Swarf removal & safety provision of CNC machines, Feedback mechanism in CNC machines.
3. **Tooling of CNC Machines** (08 hrs)
Introduction, various cutting tools for CNC machines, Work holding devices, automatic tool changer.
4. **Control System** (10 hrs)
Open & close loop control system, fundamental problem in control: Accuracy, resolution, repeatability, instability, response & damping, type of position control:
 - Point to point
 - Straight line
 - Continuous
5. **Part Programming** (10 hrs)
Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using canned cycles, subroutines and do loops, tool off sets, cutter radius compensation and wear compensation

6. **Common Problems in CNC Machines** (06 hrs)
Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines
7. **Industrial Automation** (06 hrs)
Meaning of automation, need of automation, different types of automation, advantages/disadvantages of automation, Components of automated system, programmable logic controllers - introduction and use, concept of FMS.

LIST OF PRACTICALS

1. Study the constructional details of CNC lathe.
2. Study the constructional details of CNC milling machine.
3. Study the constructional details and working of:
 - Automatic tool changer and tool setter
 - Multiple pallets
 - Swarf removal
 - Safety devices
4. Develop a part programme for following lathe operations and make the job on CNC lathe
 - Plain turning and facing operations
 - Taper turning operations
 - Thread cutting operations
 - Operation along contour using circular interpolation.
5. Develop a part programme for the following milling operations and make the job on CNC milling machine
 - Plain milling
 - Slot milling
 - Contouring
 - Pocket milling
6. Preparation of work instruction for machine operator
7. Preparation of preventive maintenance schedule for CNC machine.
8. Demonstration through industrial visit for awareness of actual working of FMS in production.
9. Use of software for turning operations on CNC turning center.
10. Use of software for milling operations on machine centres.

INSTRUCTIONAL STRATEGY

This is highly practice-based course. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.

RECOMMENDED BOOKS

1. *CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.*
2. *Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata Mc Graw Hill, New Delhi.*
3. *CNC Machine by Bharaj; Satya Publications, New Delhi.*

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2	16	28
3	08	12
4	10	16
5	10	16
6	06	08
7	06	08
Total	64	100

6.6 PROJECT WORK

L T P
- - 9

RATIONALE

The practical training cum project work is intended to place students for project oriented practical training in actual work situations for the stipulated period with a view to :

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

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with minimal supervision. This experience is required to be planned and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnic may establish close linkage with 8-10 relevant organization for providing such an experience. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such which are of curricular interest to students and of professional value to industrial/field organizations. Each teacher is expected to supervise and guide 5-6 students.

Effort should be made to identify actual field problems as project work for the students. Project selected should not be too complex which is beyond the level of the students. The placement of the students for such a practical cum project work should match with the competency profile of students and the project work assigned to them. Students may be assessed both by industry and polytechnic faculty. The suggested performance criteria is given below :

- (1) Punctuality and regularity
- (2) Initiative in learning/working at site
- (3) Level/proficiency of practical skills acquired
- (4) Ability of solve live practical problems
- (5) Sense of responsibility
- (6) Self expression/communication skills
- (7) Interpersonal skills/Human Relation
- (8) Report Writing Skills
- (9) Viva Voce

The projects given to students should be such for which someone is waiting for solution. Some of the suggested project activities are given below:

1. Projects connected with repair and maintenance of machine parts.
2. Estimating and costing projects
3. Design of components/parts/jigs/fixtures.
4. Projects related to quality control.
5. Project work related to increasing productivity.
6. Project connected with work study.
7. Projects relating to erection, installation, calibration and testing.
8. Projects related to wastage reduction.
9. Problem related to value analysis/value engineering
10. Project related to mistake proofing.

6.7 PRACTICE IN COMMUNICATION SKILLS

L T P
- - 2

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**
 - 7.1 Resume writing
 - 7.2 Covering letter
 - 7.3 Follow-up correspondence
 - 7.4 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)

Designed and Composed by: Sudhir Sen(CA)