

Curriculum for
Diploma Programme in
MECHANICAL ENGINEERING
For the State of Uttar Pradesh



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PREFACE

An important issue generally debated amongst the planners and educators world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by the State Board of Technical Education, UP to revise the existing curricula of 6 diploma programmes as per the needs of the industry and making them NSQF compliant, are laudable.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much needed dynamism in the system.

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Coordinator

1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

- 1) Name of the Programme : Diploma Programme in Mechanical Engineering
- 2) Duration of the Programme : Three years (Six Semesters)
- 3) Entry Qualification : Matriculation or equivalent NSQF Level as Prescribed by State Board of Technical Education, UP
- 4) Intake : 60 (or as prescribed by the Board)
- 5) Pattern of the Programme : Semester Pattern
- 6) NSQF Level : Level - 5
- 7) Ratio between theory and : 47 : 53 (Approx.)

Practice

- 8) Industrial Training:
Four weeks of industrial training is included after IV semester during summer vacation. Total marks allotted to industrial training will be 50.
- 9) Ecology and Environment :

As per Govt. of India directives, a subject on Environmental Studies has been incorporated in the curriculum.
- 10) Energy Conservation:

A subject on Energy Conservation has been incorporated in the curriculum.
- 11) Entrepreneurship Development:
A full subject on Industrial Management and Entrepreneurship Development has been incorporated in the curriculum.
- 12) Student Centred Activities:
A provision of 3-6 periods per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co-curricular activities such as expert lectures, self study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities, disaster management and safety etc.
- 13) Project work

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN MECAHNICAL ENGINEERING

The following are the major employment opportunities for diploma holders in Mechanical Engineering:

- In manufacturing industry primarily in private sector and to some extent in public sector
- In service sector like Railways, Hospitals, Military Engineering Services, Boards and Corporations, Construction Companies, Transportation Departments, Telecommunication, PWD and Rural Development Agencies.
- In marketing sector for sales and after- sales services
- As an entrepreneur

Though the diploma holders in Mechanical Engineering find placement in all functional areas like R&D, planning, shop floor production, quality control, inventory management but majority of them find employment in shop floor management.

3. LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

After undergoing this programme, students will be able to:

1.	Prepare and interpret drawings of engineering components.
2.	Use software like AutoCAD and Solid Works to prepare and analyze solid models.
3.	Prepare simple jobs as per specifications.
4.	Operate conventional machine for machining of components as per specifications
5.	Use cutting tools for machines and machine tools.
6.	Carry out casting and welding operation.
7.	Use modern machining methods for machining of components.
8.	Carry out metal forming by rolling and forging processes to produce parts.
9.	Use presses and press tools.
10.	Prepare simple jigs, fixtures, pattern, mould and press tools for production purposes.
11.	Use surface coating and protection methods.
12.	Prepare CNC part programmes and use CNC machines to make simple jobs. Interface CAD/CAM machines.
13.	Supervise operation of boilers, steam turbines, air compressors, IC engines, refrigeration and air-conditioning equipment.
14.	Use hydraulic and pneumatic equipment.
15.	Use electrical and electronic instruments to measure various engineering parameters.
16.	Use various measuring and gauging instruments.
17.	Perform material testing for its properties using traditional and nondestructive techniques (NDT)
18.	Use various instruments to measure heat/air related parameters.
19.	Use heat treatment processes.
20.	Design and modify simple machine elements.
21.	Select material as per desired application.
22.	Select and use QC tools.
23.	Identify and rectify simple and common troubles in automotive vehicles.
24.	Carry out estimation and costing of production cost for budgeting and analysis.
25.	Prepare process plan for given part.
26.	Carry out work measurement and method study to improve productivity.
27.	Use appropriate practices for conservation and prevention of environment pollution.
28.	Interpret factory acts and laws.

29.	Communicate effectively in English in oral and written form with others.
30.	Manage resources effectively at workplace.
31.	Plan and execute given task/project as a team member or leader.
32.	Prepare detailed project proposal and report.
33.	Use computer and IT tools for creating document, making spread sheet and making presentation.
34.	Solve real life problems by application of acquired knowledge and skills.
35.	Handle the customers effectively.
36.	Apply concepts of Mechanics to solve engineering problems.
37.	Apply basic principles of Mathematics and Science to solve engineering problems.
38.	Apply inventory control techniques to reduce production cost.
39.	Interpret basic hydraulic and thermodynamics processes / cycles.
40.	Manage activities related to procurement, stacking, storage and preservation of materials.
41.	Prepare maintenance schedules.

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum areas/subjects have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Prepare and interpret drawings of engineering components.	– Engineering Drawing
2.	Use software like AutoCAD and Solid Works to prepare and analyze solid models.	– Computer Aided Drafting and 3D Modelling
3.	Prepare simple jobs as per specifications.	– General Workshop Practice
4.	Operate conventional machine for machining of components as per specifications	– Workshop Technology
5.	Use cutting tools for machines and machine tools.	– General Workshop Practice – Design and Estimation
6.	Carry out casting and welding operation.	– Workshop Technology
7.	Use modern machining methods for machining of components.	– Advanced Manufacturing Processes
8.	Carry out metal forming by rolling and forging processes to produce parts.	– Production Technology – Workshop Technology
9.	Use presses and press tools.	– Production Technology
10.	Prepare simple jigs, fixtures, pattern, mechanism, mould and press tools for production purposes.	– Production Technology – Theory of Machines
11.	Use surface coating and protection methods.	– Production Technology
12.	Prepare CNC part programmes and use CNC machines to make simple jobs. Interface CAD/CAM machines.	– CNC Machines and Automation
13.	Supervise operation of boilers, steam turbines, air compressors, IC engines, refrigeration and air-conditioning equipment.	– Thermodynamics – Refrigeration and Air Conditioning
14.	Use hydraulic and pneumatic equipment.	– Hydraulics and Pneumatics
15.	Use electrical and electronic instruments to measure various engineering parameters.	– General Engineering
16.	Use various measuring and gauging instruments.	– Metrology and Measuring Instruments
17.	Perform material testing for its properties using traditional and nondestructive techniques (NDT)	– Engineering Materials
18.	Use various instruments to measure heat/air	– Refrigeration and Air

	related parameters.	Conditioning
19.	Use heat treatment processes.	– Engineering Materials
20.	Design and modify simple machine elements.	– Computer Aided Design and Manufacturing – Design and Estimation
21.	Select material as per desired application.	– Engineering Materials
22.	Select and use QC tools.	– Metrology and Measuring Instruments
23.	Identify and rectify simple and common troubles in automotive vehicles.	– Automobile Engineering – Repair and Maintenance
24.	Carry out estimation and costing of production cost for budgeting and analysis.	– Design and Estimation
25.	Prepare process plan for given part.	– Industrial Engineering and Safety
26.	Carry out work measurement and method study to improve productivity.	– Industrial Engineering and Safety
27.	Use appropriate practices for conservation of energy and prevention of environment pollution.	– Environmental Studies – Energy Conservation
28.	Interpret factory acts and laws.	– Industrial Management and Entrepreneurship Development
29.	Communicate effectively in English in oral and written form with others.	– Communication Skills – Student Centred Activities (SCA)
30.	Manage resources effectively at workplace.	– Industrial Management and Entrepreneurship Development
31.	Plan and execute given task/project as a team member or leader.	– Industrial Engineering and Safety
32.	Prepare detailed project proposal and report.	– Project Work
33.	Use computer and IT tools for creating document, making spread sheet and making presentation.	– Basics of Information Technology
34.	Solve real life problems by application of acquired knowledge and skills.	– Project Work – Repair and Maintenance
35.	Handle the customers effectively.	– Industrial Management and Entrepreneurship Development
36.	Apply concepts of Mechanics to solve engineering problems.	– Applied Mechanics – Mechanics of Solids
37.	Apply basic principles of Mathematics and Science to solve engineering problems.	– Applied Mathematics – Applied Physics – Applied Chemistry
38.	Apply inventory control techniques to reduce	– Industrial Engineering and Safety

	production cost.	
39.	Interpret basic hydraulic and thermodynamics processes / cycles.	– Thermodynamics – Hydraulics and Pneumatics
40.	Manage activities related to procurement, stacking, storage and preservation of materials.	– Industrial Engineering and Safety
41.	Prepare maintenance schedules.	– Industrial Engineering and Safety

5. ABSTRACT OF CURRICULUM AREAS**a) General Studies**

1. Communication Skills
2. Environmental Studies
3. Energy Conservation

b) Applied Sciences

4. Applied Mathematics
5. Applied Physics
6. Applied Chemistry

c) Basic Courses in Engineering/Technology

7. Engineering Drawing
8. General Workshop Practice
9. General Engineering
10. Basics of Information Technology

d) Applied Courses in Engineering/Technology

11. Engineering Materials
12. Mechanics of Solids
13. Computer Aided Drafting and 3D Modelling
14. Workshop Technology
15. Refrigeration and Air Conditioning
16. Hydraulics and Pneumatics
17. Computer Aided Design and Manufacturing
18. Industrial Management and Entrepreneurship Development
19. Theory of Machines
20. Design and Estimation
21. Production Technology
22. Advanced Manufacturing Processes
23. Industrial Engineering and Safety
24. Metrology and Measuring Instruments
25. CNC Machines and Automation
26. Automobile Engineering

e) Industrial Training

27. Project Work

f) Elective

28. Repair and Maintenance

29. Tool Engineering

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

Sr. No.	Subjects	Distribution in Periods per week in Various Semesters					
		I	II	III	IV	V	VI
1.	Communication Skills	6	-	-	6	-	-
2.	Applied Mathematics	5	5	5	-	-	-
3.	Applied Physics	7	7	-	-	-	-
4.	Applied Chemistry	7	-	-	-	-	-
5.	Engineering Drawing	8	8	-	-	-	-
6.	Basics of Information Technology	6	-	-	-	-	-
7.	General Workshop Practice	8	8	-	-	-	-
8.	Applied Mechanics	-	7	-	-	-	-
9.	General Engineering	-	8	-	-	-	-
10.	Engineering Materials	-	-	6	-	-	-
11.	Mechanics of Solids	-	-	7	-	-	-
12.	Thermodynamics	-	-	9	-	-	-
13.	Computer Aided Drafting and 3D Modelling	-	-	8	-	-	-
14.	Workshop Technology	-	-	10	-	-	-
15.	Refrigeration and Air Conditioning	-	-	-	8	-	-
16.	Hydraulics and Pneumatics	-	-	-	8	-	-
17.	Computer Aided Design and Manufacturing	-	-	-	10	-	-
18.	Environmental Studies	-	-	-	5	-	-
19.	Energy Conservation	-	-	-	5	-	-
20.	Universal Human Values				3		
21.	Industrial Management and Entrepreneurship Development	-	-	-	-	5	-
22.	Theory of Machines	-	-	-	-	7	-
23.	Design and Estimation	-	-	-	-	7	-
24.	Production Technology	-	-	-	-	13	-
25.	Advanced Manufacturing Processes	-	-	-	-	5	-
26.	Automobile Engineering	-	-	-	-	5	-
27.	Elective	-	-	-	-	-	5
28.	Industrial Engineering and Safety	-	-	-	-	-	8
29.	Metrology and Measuring Instruments	-	-	-	-	-	9
30.	CNC Machines and Automation	-	-	-	-	-	8
31.	Project Work	-	-	-	-	-	12
32.	Student Centred Activities (SCA)	1	5	3	3	6	6
Total		48	48	48	48	48	48

7. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
1.1	*Communication Skills-I	4	-	2	4	20	10	30	50	2 ½	20	3	70	100		
1.2	*Applied Mathematics - I	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
1.3	*Applied Physics – I	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
1.4	*Applied Chemistry	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
1.5	*Engineering Drawing-I	-	-	8	2	-	40	40	60	3	-	-	60	100		
1.6	*Basics of Information Technology	-	-	6	2	-	40	40	-	-	60	3	60	100		
1.7	General Workshop Practice-I	-	-	8	2	-	40	40	-	-	60	4	60	100		
#Student Centred Activities (SCA)		-	-	1	1	-	30	30	-	-	-	-	-	30		
Total		19	-	29	25	80	180	260	260		180	-	440	700		

* Common with other diploma programmes

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

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
2.1	*Applied Mathematics - II	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
2.2	*Applied Physics -II	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.3	+Applied Mechanics	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.4	General Engineering	6	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.5	*Engineering Drawing -II	-	-	8	2	-	40	40	60	3	-	-	60	100		
2.6	General Workshop Practice-II	-	-	8	2	-	40	40	-	-	60	4	60	100		
#Student Centred Activities (SCA)		-	-	5	1	-	30	30	-	-	-	-	-	30		
Total		21	-	27	24	80	140	220	260	-	120	-	380	600		

* Common with other diploma programmes

+ Common with diploma in Chemical Engg. and Civil Engg.

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

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
3.1	*Applied Mathematics-III	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
3.2	Engineering Materials	4	-	2	4	20	10	30	50	2 ½	20	3	70	100		
3.3	Mechanics of Solids	4	1	2	5	20	10	30	50	2 ½	20	3	70	100		
3.4	Thermal Engineering	5	1	3	6	20	10	30	50	2 ½	20	3	70	100		
3.5	Computer Aided Drafting and 3D Modelling	-	-	8	2	-	20	20	-	-	50	3	50	70		
3.6	Workshop Technology	4	-	6	5	20	10	30	50	2 ½	20	4	70	100		
#Student Centred Activities (SCA)		-	-	3	1	-	30	30	-	-	-	-	-	30		
Total		22	2	24	27	100	90	190	250	-	130	-	380	570		

* Common with other diploma programmes

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

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
4.1	*Communication Skill-II	4	-	2	4	20	10	30	50	2 ½	20	3	70	100	
4.2	Refrigeration and Air Conditioning	5	1	2	6	20	10	30	50	2 ½	20	3	70	100	
4.3	Hydraulics and Pneumatics	5	1	2	6	20	10	30	50	2 ½	20	3	70	100	
4.4	Computer Aided Design and Manufacturing	4	-	6	6	20	10	30	50	2 ½	20	3	70	100	
4.5	*Environmental Studies	3	-	2	3	20	10	30	50	2 ½	20	3	70	100	
4.6	*Energy Conservation	3	-	2	3	20	10	30	50	2 ½	20	3	70	100	
4.7	Universal Human Values	2	-	1	1	-	20	20	-	-	30	3	30	50	
#Student Centred Activities (SCA)		-	-	3	1	-	30	30	-	-	-	-	-	30	
Total		26	2	20	30	120	110	230	300	-	150	-	450	680	

* Common with other diploma programme

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc. Industrial training of 4 weeks duration to be organised after 4th semester exams

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
	Industrial Training (4 Weeks)	-	-	-	2	-	-	-	-	-	50	-	50	50		
5.1	*Industrial Management and Entrepreneurship Development	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
5.2	Theory of Machines	5	2	-	6	20	-	20	50	2 ½	-	-	50	70		
5.3	Machine Design	5	2	-	6	20	-	20	50	2 ½	-	-	50	70		
5.4	Production Technology	6	-	8	7	20	20	40	50	2 ½	50	4	100	140		
5.5	Production Management	4	-	2	4	20	10	30	50	2 ½	20	3	70	100		
5.6	Automobile Engineering	4	-	4	4	20	10	20	50	2 ½	20	3	70	100		
	#Student Centred Activities (SCA)	-	-	1	1	-	30	30	-	-	-	-	-	30		
	Total	29	4	15	34	120	70	190	300	-	140	-	440	630		

* Common with other diploma programme

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

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	Industrial Engineering	6	-	2	6	20	10	30	50	2 ½	20	3	70	100
6.2	Metrology and Measuring Instruments	5	-	4	7	20	10	30	50	2 ½	20	3	70	100
6.3	CNC Machines and Automation	4	-	4	5	20	10	30	50	2 ½	20	3	70	100
6.4	** Elective	5	-	-	6	20	-	20	50	2 ½	-	-	50	70
6.5	Project Work	-	-	12	4	-	40	40	-	-	60	3	60	100
#Student Centred Activities (SCA)		-	-	6	1	-	30	30	-	-	-	-	-	30
Total		20	-	28	29	80	100	180	200	-	120	-	320	500

** Any one out of the following:-
 6.4.1. Repair and Maintenance
 6.4.2. Tool Engineering

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

8. GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 30 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

- i. 10 Marks for general behavior and discipline
(by HODs in consultation with all the teachers of the department)
- ii. 5 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)
 - a) 75 - 80% 2 Marks
 - b) 80 - 85% 4 Marks
 - c) Above 85% 5 Marks
- iii. 15 Marks maximum for Sports/NCC/Cultural/Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)
 - a) 15 - State/National Level participation
 - b) 10 - Participation in two of above activities
 - c) 5 - Inter-Polytechnic level participation

Note: There should be no marks for attendance in the internal sessional of different subjects.

1.1 COMMUNICATION SKILLS – I

L T P
4 - 2

RATIONALE

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

LEARNING OUTCOMES

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

- Understand the importance of effective communication
- Describe the process of communication
- Communicate effectively in different contexts
- Identify parts of speech
- Write correct sentences using appropriate vocabulary
- Reproduce and match words and sentences in a paragraph
- Write various types of paragraphs, notices for different purposes and composition on picture with appropriate format
- Read unseen texts with comprehension

DETAILED CONTENTS

1	Basics of Communication	(13 periods)
	1.1 Definition and process of communication	
	1.2 Types of communication - formal and informal, oral and written, verbal and non-verbal	
	1.3 Communications barriers and how to overcome them	
	1.4 Barriers to Communication, Tools of Communication	
2	Application of Grammar	(18 periods)
	2.1 Parts of Speech (Noun, verb, adjective, adverb) and modals	
	2.2 Sentences and its types	
	2.3 Tenses	
	2.4 Active and Passive Voice	
	2.5 Punctuation	
	2.6 Direct and Indirect Speech	

- | | | |
|---|--|--------------|
| 3 | Reading Skill
Unseen passage for comprehension (one word substitution, prefixes, suffixes, antonyms, synonyms etc. based upon the passage to be covered under this topic) | (10 periods) |
| 4 | Writing Skill

4.1 Picture composition
4.2 Writing paragraph
4.3 Notice writing | (15 periods) |

LIST OF PRACTICALS

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

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

Listening and Speaking Exercises

1. Self and peer introduction
2. Newspaper reading
3. Just a minute session-Extempore
4. Greeting and starting a conversation
5. Leave taking
6. Thanking
7. Wishing well
8. Talking about likes and dislikes
9. Group Discussion
10. Listening Exercises.

INSTRUCTIONAL STRATEGY

Student should be encouraged to participate in role play and other student centred activities in class room and actively participate in listening exercises

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION, U.P., LUCKNOW IN MEETING HELD ON 10.07.2019 @RASHMI SONKAR

1. Communicating Effectively in English, Book-I by Revathi Srinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; DhanpatRai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. Excellent General English-R.B.Varshnay, R.K. Bansal, Mittal Book Depot, Malhotra
5. The Functional aspects of Communication Skills – Dr. P. Prasad, S.K. Katria & Sons, New Delhi
6. Q. Skills for success – Level & Margaret Books, Oxford University Press.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

Websites for Reference:

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	13	24
2	18	32
3	10	16
4	15	28
Total	56	100

1.2 APPLIED MATHEMATICS - I

L	T	P
5	-	-

RATIONALE

Contents of this course provide fundamental base for understanding elementary mathematics and their uses in solving engineering problems. Contents of this course will enable students to use basic mathematical function like logarithms, partial fractions, matrices and basic 2D, curves in solving various engineering problems of all fields.

LEARNING OUTCOMES

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

- Apply Binomial theorem to solve engineering problems
- Apply determinants properties and Cramer's rule to solve engineering problems
- Apply dot & cross product of vectors to find the solution of engineering problems
- Use complex numbers in various engineering problems
- Apply differential calculus and higher order to solve engineering problems
- Find velocity, acceleration, errors and approximation in engineering problems with application of derivatives.

DETAILED CONTENTS

1. Algebra -I (12 Periods)
 - 1.1 Series : AP and GP; Sum, nth term, Mean
 - 1.2 Binomial theorem for positive, negative and fractional index (without proof).
Application of Binomial theorem.
 - 1.3 Determinants : Elementary properties of determinant of order 2 and 3,
Multiplication system of algebraic equation, Consistency of equation,
Cramer's rule
2. Algebra- II (12 Periods)
 - 2.1 Vector algebra : Dot and Cross product, Scaler and vector triple product.
 - 2.2 Complex number.
Complex numbers, Representation, Modulus and amplitude Demoivre theorem, its application in solving algebraic equations, Mod. function and its properties..

3. Trigonometry (10 Periods)
- 3.1 Relation between sides and angles of a triangle: Statement of various formulae showing relationship between sides and angle of a triangle.
- 3.2 Inverse circular functions : Simple case only
4. Differential Calculus - I (18 Periods)
- 4.1 Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.
- 4.2 Methods of finding derivative, Trigonometric functions, exponential function, Function of a function, Logarithmic differentiation, Differentiation of Inverse trigonometric function, Differentiation of implicit functions.
5. Differential Calculus - II (18 Periods)
- 5.1 Higher order derivatives, Leibnitz theorem (without proof). Simple applications.
- 5.2 Application - Finding Tangents, Normal, Points of Maxima/Minima, Increasing/Decreasing functions, Rate, Measure, velocity, Acceleration, Errors and approximation.

INSTRUCTIONAL STRATEGY

The basic instructional strategy to teach basic mathematics, Binomial theorem, trigonometry, differential equations etc. should be conceptual with real world applications of relevant branch. More numerical and theory examples can be used for clear understanding of the content.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
- 3 Applied Mathematics-I by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-I (A) by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	12	20
2.	12	20
3.	10	12
4	18	24
5	18	24
Total	70	100

1.3 APPLIED PHYSICS – I

L T P
5 - 2

RATIONALE

Applied physics includes the study of a diversified topics related to 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 behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to learn and appreciate these concepts and principles. In all contents, SI units should be followed.

LEARNING OUTCOMES

After undergoing this course, the students must be able to:

- Identify the use of S.I. system of measurement with accuracy and how it is used in engineering
- Represent physical quantities as scalars and vectors, applying the physical laws and concepts of linear and circular motion in everyday life.
- Solve difficult problems (walking of man, horse and cart problem, flying of bird/ aircraft, etc.)
- Analyse and design banking of roads/railway tracks and apply conservation of momentum principle to Explain rocket propulsion, recoil of gun etc.
- Derive work, power and energy relationship and solve problems about work and power.
- Define work, energy and power and their units.
- Describe conservation of energy and its applications
- Understand the concept of rotational motion of a rigid body and its applications
- Apply the physical laws and concepts of gravity, its variation with longitude and latitude and its uses in space satellite etc.
- Understand the concept of elasticity, surface tension, pressure and the laws governing movement of fluids.
- Express physical work in term of heat and temperature; Measure temperature in various processes on different scales (Celsius, Kelvin, Fahrenheit etc.)
- Distinguish between conduction, convection and radiation, identify the different methods for reducing heat losses
- Understand the laws of thermodynamics, Carnot cycle and their applications.

DETAILED CONTENTS

1. Units and Dimensions (10 Periods)
 - 1.1 Need of Measurement in engineering and science, unit of a physical quantities - fundamental and derived units, systems of units (FPS, CGS and SI units)
 - 1.2 Dimensions and dimensional formulae of physical quantities.
 - 1.3 Principle of homogeneity of dimensions
 - 1.4 Dimensional equations and their applications, conversion of numerical values of physical quantities from one system of units into another, checking the correctness of physical equations and deriving relations among various physical quantities
 - 1.5 Limitations of dimensional analysis
 - 1.6 Error in measurement, accuracy and precision of instruments, random and systematic errors, absolute error, relative error, and percentage error, Estimation of probable errors in the results of measurement (combination of errors in addition, subtraction, multiplication, division and powers), rules for representing significant figures in calculation.
 - 1.7 Application of units and dimensions in measuring length, diameter, circumference, volume, surface area etc. of metallic and non metallic blocks, wires, pipes etc (at least two each).

2. Force and Motion (10 periods)
 - 2.1 Scalar and vector quantities – examples, representation of vector, types of vectors
 - 2.2 Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product.
 - 2.3 Resolution of Vectors and its application to lawn roller.
 - 2.4 Force, Momentum, Statement and Derivation of Conservation of linear momentum, its applications such as recoil of gun.
 - 2.5 Impulse and its Applications
 - 2.6 Circular motion (Uniform and Non-uniform), definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
 - 2.7 Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical)
 - 2.8 Central force, Expression and Applications of Centripetal and centrifugal forces with examples such as banking of roads and bending of cyclist, Principle of centrifuge.
 - 2.9 Application of various forces in lifts, cranes, large steam engines and turbines

3. Work, Power and Energy (10 periods)
- 3.1 Work: and its units, examples of zero work, positive work and negative work, conservative and non-conservative force,
 - 3.2 Friction: modern concept, types, laws of limiting friction, Coefficient of friction and its Engineering Applications.
 - 3.3 Work done in moving an object on horizontal and inclined plane for rough and plane surfaces with its applications
 - 3.4 Energy and its units: Kinetic energy and potential energy with examples and their derivation, work energy theorem.
 - 3.5 Principle of conservation of mechanical energy for freely falling bodies, examples of transformation of energy.
 - 3.6 Power and its units, calculation of power in numerical problems
 - 3.7 Application of Friction in brake system of moving vehicles, bicycle, scooter, car trains etc.
- 4 Rotational Motion (10 periods)
- 4.1 Concept of translatory and rotatory motions with examples
 - 4.2 Definition of torque with examples
 - 4.3 Angular momentum, Conservation of angular momentum (quantitative) and its examples
 - 4.4 Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid) (Formulae only). Concept of Fly wheel.
 - 4.5 Rotational kinetic energy, Rolling of sphere on the slant plane,
 - 4.6 Comparison of linear motion and rotational motion.
 - 4.7 Application of rotational motions in transport vehicles, and machines.
- 5 Motion of planets and satellites (08 periods)
- 5.1 Gravitational force, Kepler's law of planetary motion,
 - 5.2 Acceleration due gravity and its variation,
 - 5.3 Gravitational Potential and Gravitational potential energy,
 - 5.4 Motion of satellite, orbital velocity and time period of satellite, Total energy and Binding energy of a satellite, Escape energy and escape velocity,
 - 5.5 Types of satellites, Geo-stationary satellite, semi-synchronous, polar satellite (concept only) and their uses in science and technology,
 - 5.6 Concept of Black Holes

6. Properties of Matter (12 periods)
- 6.1 Elasticity: definition of stress and strain, different types of moduli of elasticity, Hooke's law, significance of stress strain curve
 - 6.2 Pressure: definition, its units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications
 - 6.3 Surface tension: concept, its units, angle of contact, Capillary action and determination of surface tension from capillary rise method, applications of surface tension, effect of temperature and impurity on surface tension
 - 6.4 Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems.
 - 6.5 Concept of fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem and their applications.
7. Heat and Thermodynamics (10 periods)
- 7.1 Difference between heat and temperature
 - 7.2 Modes of transfer of heat (Conduction, convection and radiation with examples)
 - 7.3 Different scales of temperature and their relationship
 - 7.4 Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them
 - 7.5 Heat conduction in a metal rod, Temperature gradient, Concept of Co-efficient of thermal conductivity, Uses and effects of Heat conduction in Daily life.
 - 7.6 Isothermal and Adiabatic process
 - 7.7 Zeroth, First and second law of thermodynamics, Heat engine (concept Only), Carnot cycle.
 - 7.8 Application of various systems of thermometry in refrigeration and air-conditioning etc.

LIST OF PRACTICALS (to perform minimum six experiments)

- 1 To find radius of wire and its volume and the maximum permissible error in these quantities by using both vernier calipers and screw gauge.
- 2 To find the value of acceleration due to gravity on the surface of earth by using a simple pendulum.
- 3 To determine the Radius of curvature of (i) convex mirror, (ii) concave mirror by spherometer
- 4 To verify parallelogram law of forces
- 5 To study conservation of energy of a ball or cylinder rolling down an inclined plane.
- 6 To find the Moment of Inertia of a flywheel about its axis of rotation
- 7 To determine the atmospheric pressure at a place using Fortin's Barometer
- 8 To determine the viscosity of glycerin by Stoke's method
- 9 To determine the coefficient of linear expansion of a metal rod
- 10 To determine force constant of spring using Hooks law

INSTRUCTIONAL STRATEGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration and animations can make the subject interesting and may develop scientific temper in the students. Teacher must plan a tour of Science Park/planetarium available in nearby areas in order to enhance the interest in this course.

MEANS OF ASSESSMENTS

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work,
- Viva Voce

RECOMMENDED BOOKS

- 1 Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi
- 2 Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
- 3 Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
- 4 B.Sc.Practical Physics by C L Arora, S. Chand Publication..
- 5 Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
- 6 Engineering Physics by DK Bhattacharya & Poonam Tandan; Oxford University Press, New Delhi
- 7 Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications
- 8 V. Rajendran, physics-I, Tata McGraw-Hill raw Hill publication, New Delhi
- 9 Arthur Beiser, Applied Physics, Tata McGraw-Hill raw Hill publication, New Delhi
- 10 Physics Volume 1, 5th edition, Haliday Resnick and Krane, Wiley publication

TOPIC WISE DISTRIBUTION OF PERIODS AND MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	15
2	10	15
3	10	15
4	10	15
5	08	10
6	12	16
7	10	14
Total	70	100

1.4 APPLIED CHEMISTRY**L T P**
5 - 2**RATIONALE**

The use of various chemicals and chemical products in diverse technical and engineering fields have repeatedly proved the importance of Applied Chemistry, which enhances its role to a new peak. On the other hand, ever increasing use of such materials will compel engineers, technocrats to acquire essential applied chemistry knowledge in order to select engineering materials, which not only suit them but also provide more environmental compatibility. This situation demands principles of Applied Chemistry in diploma-engineering courses. Principles of Applied Chemistry will enable budding engineers and technocrats to develop scientific temper and appreciate physical, chemical and engineering properties of materials. Hence the subject of Applied Chemistry.

LEARNING OUTCOMES

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

- Classify various substances based on state of aggregation
- Substantiate the laws and principles on which structure of atom is established.
- Explain and predict properties of substances.
- Explain sources of water and various characteristics of water (quantitatively).
- Explain cause and factors which can adversely affecting natural water quality and remedial measures available for water purification
- Think critically, develop and adapt water conservation techniques.
- Explain corrosion of metal and their preventive measures.
- explain chemical nature and causes of corrosion
- apply correct and efficient methods of corrosion prevention.
- explain chemistry of fuels and their relative advantages.
- select most efficient fuel for the engine and engineering applications.
- suggest how to subside air pollution caused by the use of fossil fuels
- explain the chemistry of various polymers and plastics
- verify suitability and select polymer/rubber/plastic materials for engineering applications.

DETAILED CONTENTS

1. Atomic Structure, Periodic Table and Chemical Bonding (14 periods)
 - 1.1 Fundamental particles- mass and charges of electrons, protons and neutrons with names of the scientists who discovered these fundamental particles.
 - 1.2 Bohr's model of atom and successes and limitations of atomic theory (qualitative treatment only).

- 1.3 Atomic number, atomic mass number isotopes and isobars.
 - 1.4 Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,
 - 1.5 Aufbau's principle, Pauli's exclusion principle and Hund's rule electronic configuration of elements with atomic number (Z) = 30 only. (Electronic configurations of elements with atomic number greater than 30 are excluded).
 - 1.6 Modern periodic law and periodic table, groups and periods, classification of elements into s, p, d and f blocks (periodicity in properties - excluded)
 - 1.7 Chemical bonding and cause of bonding and types such as ionic bond in NaCl sigma (σ) and pi (π) covalent bonds in H_2 , HCl, Cl_2 , elementary idea of hybridization in $BeCl_2$, BF_3 , CH_4 , NH_3 and H_2O , VSEPR, Molecular orbital Theory
 - 1.8 States of Matter: Solid, Liquid & Gas, Metallic bonding- explanation with the help of electron gas (sea) model.
2. Fuels and Lubricants (18 periods)
- 2.1 Definition of fuel, classification of fuels, characteristics of good fuel, relative merits of gaseous, liquid and solid fuels
 - 2.2 Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter and numerical examples.
 - 2.3 Coal - types of coal and proximate analysis of coal
 - 2.4 Fuel rating – Octane number and Cetane number, fuel-structural influence on Octane and Cetane numbers
 - 2.5 Gaseous fuels – chemical composition, calorific value and applications of natural gas (CNG), LPG, producer gas, water gas and biogas.
 - 2.6 Elementary ideal on – hydrogen as future fuels, nuclear fuels.
 - 2.7 Lubricants: Definition and properties, mechanism, industrial application and its function in bearings.
 - 2.8 Synthetic lubricants and cutting fluids.
3. Water (14 periods)
- 3.1 Demonstration of water resources on Earth using pie chart.
 - 3.2 Classification of water – soft water and hard water, action of soap on hard water, types of hardness, causes of hardness, units of hardness – mg per liter (mgL^{-1}) and part per million (ppm) and simple numerical, pH and buffer solutions and their applications.
 - 3.3 Disadvantages caused by the use of hard water in domestic and boiler feed water. Priming and foaming and caustic embrittlement in boilers.
 - 3.4 Removal of hardness -Permutit process and Ion-exchange process.
 - 3.5 Physico-Chemical methods for Water Quality Testing
 - a) Determination of pH using pH meter, total dissolved solids (TDS)

- b) Testing and Estimation of- alkalinity, indicator their types and application total hardness by EDTA method and O'Hener's Method. (chemical reaction of EDTA method are excluded).
 - c) Understanding of Indian Water Quality standards as per WHO
 - 3.6 Natural water sterilization by chlorine and UV radiation and reverse osmosis.
 - 3.7 Municipality waste water treatment. Definition of B.O.D and C.O.D.
4. Electrochemistry (4 periods)
- Redox Reaction, Electrode Potential, Nernst equation, Electrochemical cell (Galvanic and Electrolytes); Nernst equation.
5. Corrosion and its Control (10 periods)
- 5.1 Definition of corrosion and factors affecting corrosion rate.
 - 5.2 Theories of
 - a) Dry (chemical) corrosion- Pilling Bedworth rule
 - b) Wet corrosion in acidic atmosphere by hydrogen evolution mechanism
 - 5.3 Definition of passivity and galvanic series
 - 5.4 Corrosion control:
 - a) Metal coatings – Cathodic protection, Cementation on Base Metal Steel – Application of Metal Zn (Sheradizing),Cr (Chromozing) and Al (Calorizing), Sacrificial protection and impressed current voltage
 - b) Inorganic coatings – Anodizing and phosphating,
 - c) Organic coatings - use of paints varnishes and enamels
 - d) Internal corrosion preventive measures- alloying (with reference to passivating, neutralizing and inhibition) and heat treatment (quenching, annealing)
6. Organic compounds, Polymers and Plastics (10 periods)
- 6.1 Classification of organic compounds and IUPAC Nomenclature
 - 6.2 Definition of polymer, monomer and degree of polymerization
 - 6.3 Brief introduction to addition and condensation polymers with suitable examples (PE, PS, PVC, Teflon, Nylon -66 and Bakelite)
 - 6.4 Definition of plastics, thermo plastics and thermo setting plastics with suitable examples, distinctions between thermo and thermo setting plastics
 - 6.5 Applications of polymers in industry and daily life

LIST OF PRACTICALS

1. Estimation of total hardness of water using standard EDTA solution

2. Estimation of total alkalinity of given water sample by titrating it against standard sulfuric acid solution
3. Proximate analysis of solid fuel)
4. Estimation of temporary hardness of water sample by O' Hener's Method.
5. Determination of flash and fire point of given lubricating oil using Able's flash point apparatus

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career.

MEANS OF ASSEMENTS

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Applied Chemistry - I by Dr. P. K Vij & Shiksha Vij, Lords Publications, Jalandhar.
6. Engineering Chemistry by Dr. Himanshu Pandey, Goel Publishing House, Meerut, India

SUGGESTED DISTRIBUTION OF MARKS

Topics	Time Allotted (hrs)	Marks Allotted (%)
1.	14	20
2.	18	24
3.	14	20
4.	4	6
5.	10	15
6.	10	15
Total	70	100

1.5 ENGINEERING DRAWING - I

L T P
- - 8

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 18 sheets to be prepared and atleast 2 sheets on AutoCAD
- iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students

LEARNING OUTCOMES

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

- Identify and use of different grades of pencils and other drafting instruments which are used in engineering field
- Draw free hand sketches of various kinds of objects.
- Utilize various types of lines used in engineering drawing.
- Read and apply different dimensioning methods on drawing of objects.
- Use different types of scales and their utilization in reading and reproducing drawings of objects and maps.
- Draw 2 - dimensional view of different objects viewed from different angles (orthographic views)
- Draw and interpret complete inner hidden details of an object which are otherwise not visible in normal view
- To make projections of Solid
- Generate isometric (3D) drawing from different 2D (orthographic) views/sketches
- Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances
- Use basic commands of AutoCAD.

DETAILED CONTENTS

1. Introduction to Engineering Drawing (03 sheets)
 - 1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.
 - 1.2 Different types of lines in Engineering drawing as per BIS specifications
 - 1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.
 - 1.4 Free hand and instrumental lettering (Alphabet and numerals) – upper case (Capital Letter), single stroke, vertical and inclined at 75 degree, series of 5,8,12 mm of free hand and instrumental lettering of height 25 to 35 mm in the ratio of 7:4

2. Dimensioning Technique (01 sheet)
 - 2.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)
 - 2.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches

3. Scales (02 sheets)
 - 3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale
 - 3.2 Drawing of plain and diagonal scales

4. Orthographic Projections (06 sheets)
 - 4.1 Theory of orthographic projections (Elaborate theoretical instructions)
 - 4.2 Projection of Points in different quadrant
 - 4.3 Projection of Straight Line (1st and 3rd angle)
 - 4.3.1. Line parallel to both the planes
 - 4.3.2. Line perpendicular to any one of the reference plane
 - 4.3.3. Line inclined to any one of the reference plane.
 - 4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only
 - 4.5 Three views of orthographic projection of different objects. (At least one sheet in 3rd angle)
 - 4.6 Identification of surfaces

- 5 Projection of Solid (02 sheets)

- 5.1. Definition and salient features of Solid
 - 5.2. Types of Solid (Polyhedron and Solid of revolution)
 - 5.3. To make projections, sources, Top view, Front view and Side view of various types of Solid.
6. Sections (02 sheets)
- 6.1 Importance and salient features
 - 6.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.
 - 6.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections
 - 6.4 Orthographic sectional views of different objects.
7. Isometric Views (02 sheets)
- 7.1 Fundamentals of isometric projections and isometric scale.
 - 7.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.
8. Common Symbols and Conventions used in Engineering (02 sheets)
- 8.1 Civil Engineering sanitary fitting symbols
 - 8.2 Electrical fitting symbols for domestic interior installations
- *9. Introduction to AutoCAD (02 sheets)
- Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets on AutoCAD of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.
- * **Auto CAD drawing will be evaluated internally by sessional marks and not by final theory paper.**

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. The institute should procure AutoCAD or other engineering graphics software for practice in engineering drawings. Teachers should undergo training in AutoCAD/Engineering Graphic. Separate labs for practice on AutoCAD should be established.

MEANS OF ASSESSMENT

- Sketches

- Drawing
- Use of software

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 Pvt. Ltd., Anand
4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar
5. Engineering Drawing I by DK Goel, GBD Publication.

1.6 BASICS OF INFORMATION TECHNOLOGY

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RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. 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 using MS Office/Open Office/Libre 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:

Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises. There will not be any theory examination.

LEARNING OUTCOMES

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

- Identify Computer Hardware Components, Network Components and Peripherals.
- Explain the role of an Operating System.
- Install System and Application Software.
- Explain the function of the system components including Processor, Motherboard and Input-output devices.
- Use Word Processing Software to prepare document.
- Use Spreadsheet Software to create workbooks and automate calculation.
- Use Presentation Software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, scan, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install Antivirus.
- Safeguard against Online Frauds, threats and crimes.
- Use online office tools(Google suits)

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Introduction to Computers and Peripherals.

Components of Computer, Types of Computer, CPU, RAM, ROM, Hard disk, USB, Flash drive, CD, DVD, Blue ray, Keyboard, Mouse, Monitor, LCD, Printer, Plotter, Scanner, Modem, Sound Cards, Speakers, CMOS battery, Sharing of Printers.

2. Operation System and Application Software

System Software, Application Software, Virtualization Software, Utility Software, MS Office/Open Office/Libreoffice, Working with window, Desktop components, Menu bars, creating shortcut of program. Installation of Application softwares, Antivirus and Drivers.

3. Word Processing, Spreadsheet and Presentation

Usage and creation of word document, spreadsheets and presentation, Google Suits (Google drive, google sheet, google doc. Google presentation)

4. Internet

Basics of Networking – LAN, WAN, Wi-Fi technologies, Concept of IP Addrsses, DNS, Search Engines, e-mail, Browsing and cyber laws.

LIST OF PRACTICAL EXERCISES

1. Identify various components, peripherals of computer and list their functions.
2. Installation of various application software and peripheral drivers
3. Installation of operating system (windows/linux/others)
4. Creation and Management (Rename, delete, search of file and folders)
5. Installation of Antivirus and remove viruses
6. Scanning and printing documents
7. Browsing, Downloading, Information using Internet
8. E-Mail ID creation, comparing, sending and receiving e-mail. Attaching a file with e-mail message.
9. Word Processing (MS Office/Open Office)
 - a) 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
 - b) Page set up:
 - Setting margins, tab setting, ruler, indenting
 - c) Editing a document:
 - Entering text, cut, copy, paste using tool- bars
 - d) 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, autotext
 - Inserting date, time, special symbols, importing graphic images, drawing tools
- e) 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
- f) 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 .

10. Spread Sheet Processing (MS Office/Open Office/Libre Office)

- a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets
- b) Menu commands:
Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working
- c) 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
Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting
- d) 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
- e) Retrieve data with query:
Create a pivot table, customizing a pivot table. Statistical analysis of data
- f) Exchange data with other application:
Embedding objects, linking to other applications, import, export document.

11. PowerPoint Presentation (MS Office/Open Office/Libre office)

- a) Introduction to PowerPoint
- How to start PowerPoint
 - Working environment: concept of toolbars, slide layout & templates.
 - Opening a new/existing presentation

- Different views for viewing slides in a presentation: normal, slide sorter.
- 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 organizational chart
 - Editing objects
 - Working with Clip Art
- d) Formatting slides
 - Using slide master
 - Text formatting
 - Changing slide layout
 - Changing slide colour scheme
 - Changing background
 - Applying design template

12. Google Suits

Using Google drive, Google shut, Google docs, Google slides.

INSTRUCTIONAL STRATEGY

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office/Libre office/Google Suit in addition to working on internet. The student should be made capable of working on computers independently.

MEANS OF ASSESSMENT

- Class Tests/Quiz
- Software Installation and Use
- Viva-Voce
- Presentation

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Information Technology for Management by Henery Lucas, Tata McGraw Hills, New Delhi
3. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi

4. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
5. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
6. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, 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. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

Online Resources

1. www.tutorialspoint.com
2. www.sf.net
3. Gsuite.google.com
4. Spoken-tutorial.org
5. Swayam.gov.in

1.7 GENERAL WORKSHOP PRACTICE – I
(Common for Mechanical Engineering and Agriculture Engineering)

L T P
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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 hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

After completing the course, the students will be able to:

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS (PRACTICAL EXERCISES)

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. Carpentry Shop
2. Painting and Polishing Shop
3. Electrical Shop
4. Smithy Shop
5. Plumbing Shop

1. CARPENTRY SHOP

- 1.1 General Shop Talk
 - 1.1.1 Name and use of raw materials used in carpentry shop : wood & alternative materials
 - 1.1.2 Names, uses, care and maintenance of hand tools such as different types of Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, Marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools , measuring tools etc.
 - 1.1.3 Specification of tools used in carpentry shop.
 - 1.1.4 Different types of Timbers, their properties, uses & defects.
 - 1.1.5 Seasoning of wood.
- 1.2. Practice
 - 1.2.1 Practices for Basic Carpentry Work
 - 1.2.2 Sawing practice using different types of saws
 - 1.2.3 Assembling jack plane — Planning practice including sharpening of jack plane cutter
 - 1.2.4 Chiselling practice using different types of chisels including sharpening of chisel
 - 1.2.5 Making of different types of wooden pin and fixing methods. Marking measuring and inspection of jobs.
- 1.3 Job Practice

Job I	Marking, sawing, planning and chiselling and their practice
Job II	Half Lap Joint (cross, L or T – any one)
Job III	Mortise and Tenon joint (T-Joint)
Job IV	Dove tail Joint (Lap or Bridle Joint)
- 1.4. Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.

2. PAINTING AND POLISHING SHOP

- 2.1. Introduction of paints, varnishes, Reason for surface preparation, Advantages of Painting, other method of surface coating ie. Electroplating etc.
- 2.2. Job Practice
 - Job 1: To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare french polish for wooden surface and polish the other side.
 - Job II: To prepare metal surface for painting, apply primer and paint the same.
 - Job III: To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

The sequence of polishing will be as follows:

- i) Abrasive cutting by leather wheel
- ii) Polishing with hard cotton wheel and with polishing material
- iii) Buffing with cotton wheel or buff wheel.

3. ELECTRICAL SHOP

- 3.1 Study, demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, fuses, cleats, clamps and allied items, tools and accessories.
- 3.2 Study of electrical safety measures and protective devices.
 - Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs.
 - Job II Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping.
- 3.3 Study of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc.
- 3.4 Introduction to the construction of lead acid battery and its working.
 - Job III Installation of battery and connecting two or three batteries in series and parallel.
- 3.5 Introduction to battery charger and its functioning.
 - Job IV Charging a battery and testing with hydrometer and cell tester

4. SMITHY SHOP

- 4.1. General Shop Talk
 - 4.1.1 Purpose of Smithy shop
 - 4.1.2 Different types of Hearths used in Smithy shop
 - 4.1.3 Purpose, specifications, uses, care and maintenance of various tools and equipments used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools etc.
 - 4.1.4 Types of fuel used and maximum temperature obtained
 - 4.1.5 Types of raw materials used in Smithy shop
 - 4.1.6 Uses of Fire Bricks & Clays in Forging workshop.
- 4.2 Practice
 - 4.2.1 Practice of firing of hearth/Furnace, Cleaning of Clinkers and Temperature Control of Fire.
 - 4.2.2 Practice on different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting
 - a) Demonstration — Making cube, hexagonal cube, hexagonal bar from round bar
 - 4.2.3 Practice of Simple Heat treatment processes like Tempering, Normalizing Hardening etc

4.3. Job Practice: Job Preparation

- Job I Making a cold / hot, hexagonal / octagonal flat chisel including tempering of edges.
- Job II Production of utility goods e.g. hexagonal bolt / square shank boring tool, fan hook (long S-type) [Two jobs are to be done by the students].
- Job III To prepare a cube from a M.S. round by forging method.

5. PLUMBING SHOP

- 5.1. Use of personal protective equipments, safety precautions while working and cleaning of shop.
- 5.2. Introduction and demonstration of tools, equipment and machines used in plumbing shop.
- 5.3. Introduction of various pipes and pipe fittings of elbow, nipple, socket, union etc.
- 5.4. Job Practice
 Job 1 : Preparation of job using elbow, bend and nipple
 Job II: Preparation of job using Union, Tap, Plug and Socket.
 Job III: Threading practice on pipe with die

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi.

2.1 APPLIED MATHEMATICS - II

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RATIONALE

Basic elements of integral calculus, differential calculus, numerical methods, differential equations included in this course will play a vital role in understanding engineering problem mathematically. This will also develop analytical as well as conceptual abilities among students.

LEARNING OUTCOMES

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

- Calculate simple integration by methods of integration
- Evaluate the area under curves, surface by using definite integrals.
- Calculate the area and volume under a curve along areas
- Solve the engineering problems with numerical methods.
- Understand the geometric shapes used in engineering problems by co-ordinate geometry.

DETAILED CONTENTS

1. Integral Calculus - I (20 Periods)

Methods of Indefinite Integration :-

- 1.1 Integration by substitution.
- 1.2 Integration by rational function.
- 1.3 Integration by partial fraction.
- 1.4 Integration by parts.
- 1.5 Integration of special function

2. Integral Calculus - II: (20 Periods)

- 2.1 Meaning and properties of definite integrals, Evaluation of definite integrals..
- 2.2 Application : Length of simple curves, Finding areas bounded by simple curves Volume of solids of revolution, centre of mean of plane areas.
- 2.3 Simpsons 1/3rd and Simpsons 3/8th rule and Trapezoidal Rule : their application in simple cases. Numerical solutions of algebraic equations; Bisections method, Regula-Falsi method, Newton-Raphson's method(without proof), Numerical solutions of simultaneous equations; Gauss elimination method(without proof)

3. Co-ordinate Geometry (2 Dimension) (18 Periods)

3.1 Circle

Equation of circle in standard form, Centre - Radius form, Diameter form, Two intercept form.

4. Co-ordinate Geometry (3 Dimension) (12 Periods)

4.1 Straight lines and planes in space

Distance between two points in space, direction cosine and direction ratios, Finding equation of a straight line (without proof)

INSTRUCTIONAL STRATEGY

Basic elements of Differential Calculus, Integral Calculus and differential equations can be taught conceptually along with real engineering applications in which particular algorithm and theory can be applied. Numerical examples will be helpful in understanding the content of the subject.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3. Applied Mathematics-II by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-I (B) by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	20	28
2.	20	28
3.	18	24
4	12	20
Total	70	100

2.2 APPLIED PHYSICS – II

L T P
5 - 2

RATIONALE

Applied physics includes the study of a diversified topics related to 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 behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to learn and appreciate these concepts and principles. In all contents, SI units should be followed.

LEARNING OUTCOMES

After undergoing this subject, the student will be able to;

- Define wave motion its types (Transverse and Longitudinal), Periodic and Simple Harmonic Motion, solve simple problems.
- Define the terms: frequency, amplitude, wavelength, velocity of a wave.
- Explain various Engineering, Medical and Industrial applications of Ultrasonics.
- Apply acoustics principles to various types of buildings to get best sound effect
- Explain diffraction, interference, polarization.
- Define capacitance and its unit. They will be able to explain the function of capacitors in simple circuits, solve simple problems using $C=Q/V$
- Explain the role of free electrons in insulators, conductors and semiconductors, qualitatively the terms: potential, potential difference, electromotive force.
- Explain the concept of electric current, resistance and its measurement.
- List the effects of an electric current and their common applications, State and apply Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, determine the energy consumed by an appliance, distinguish between AC and DC electricity
- Explain Biot-Savart Law, Ampere's law, Lorenz Force.
- State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field
- Explain operation of moving coil galvanometer, simple DC motor
- Apply the knowledge of diodes in rectifiers, adapters IC's and various electronic circuits. Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Explain total internal reflection and apply this concept for optical fibre and its uses in Medical field and Communication.

DETAILED CONTENTS

1. Wave motion and its applications (12 periods)

- 1.1 Wave motion, transverse and longitudinal wave motion with examples, sound and light waves, relationship among wave velocity, frequency and wave length and its application
 - 1.2 Wave equation $y = r \sin wt$, phase, phase difference, principle of superposition of waves
 - 1.3 Simple Harmonic Motion (SHM): definition and characteristic, expression for displacement, velocity, acceleration, time period, frequency in S.H.M., Energy of a body executing S. H. M., simple pendulum, concept of simple harmonic progressive wave,
 - 1.4 Free, Damped and forced oscillations, Resonance with examples, Q-factor
 - 1.5 Definition of pitch, loudness, quality and intensity of sound waves, intensity level, Echo and reverberation, Sabine formula for reverberation time(without derivation), coefficient of absorption of sound, methods to control reverberation time and their applications, Acoustics of building defects and remedy.
 - 1.6 Ultrasonics –production, detection, properties and applications in engineering and medical applications.
2. Wave Optics (6 periods)
- 2.1 Dual nature of light, wave theory of light, laws of reflection and refraction, Snell's law, Power of lens, magnification.
 - 2.2 Two-Source Interference, Double-Slit interference, Interference due to thin films, Fresnel's biprism.
 - 2.3 use of interference making highly efficient solar panel.
 - 2.4 diffraction, Single Slit diffraction, Intensity calculation etc
 - 2.5 Polarization of electromagnetic waves, polarizing sheets, polarizing by Reflection (Brewster's law), Malus law, use of polaroids.
3. Electrostatics (12 periods)
- 3.1 Concept of charge, Coulombs law, Electric field of point charges, Electric lines of force and their properties, Electric flux, Electric potential and potential difference.
 - 3.2 Gauss law of electrostatics: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.
 - 3.3 Capacitor and its working principle, Capacitance and its units. Capacitance of parallel plate capacitor. Series and parallel combination of capacitors (numericals), charging and discharging of a capacitor.
 - 3.4 Dielectric and its effect on capacitance, dielectric break down.
 - 3.5 Application of electrostatics in electrostatic precipitation of microbes and moisture separation from air and gases in industry for pollution control (Brief explanation only)
4. Current Electricity (12 periods)
- 4.1 Electric Current, Resistance, Specific Resistance, Conductance, Specific Conductance, Series and Parallel combination of Resistances. Factors affecting Resistance, Colour coding of carbon Resistances, Ohm's law. Superconductivity.

- 4.2 Kirchoff's laws, Wheatstone bridge and its applications (meter bridge and slide wire bridge)
- 4.3 Concept of terminal potential difference and Electro motive force (EMF), potentiometer.
- 4.4 Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy
- 4.5 Examples of application of DC circuits in various electrical and electronics equipment such as C.R.O, T.V., Audio-Video System, Computers etc.
5. Magneto Statics and Electromagnetism (12 periods)
 - 5.1 Magnetic poles, force on a moving charge, circulating charges, force on a current carrying wire, Hall effect, torque on a current loop.
 - 5.2 Magnetic field due to moving charge(Biot-Savart Law), due to current (Biot-Savart Law), parallel currents, field of a solenoid, Ampere's law.
 - 5.3 Faraday's law, Lenz' law, motional emf, induced electric fields.
 - 5.4 Magnetic dipole and force on a magnetic dipole in a non-uniform field, Magnetization, Gauss' law for magnetism.
 - 5.5 Types of magnetic materials. Dia, para and ferromagnetic materials with their properties,
 - 5.6 Application of electromagnetism in ac/dc motors and generators.
6. Semiconductor physics (8 periods)
 - 6.1 Types of materials (insulator, semi conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction diode and its V-I characteristics
 - 6.2 Diode as rectifier – half wave and full wave rectifier (centre taped),
 - 6.3 Semiconductor transistor, pnp and npn (concepts only)
 - 6.4 Application of semiconductor diodes (Zener, LED) and that of transistor as amplifier and oscillator.
7. Modern Physics (8 Periods)
 - 7.1 Lasers: concept of energy levels, ionizations and excitation potentials; spontaneous and stimulated emission; laser and its characteristics, population inversion, Types of lasers; Ruby and He-Ne lasers, engineering and medical applications of lasers.
 - 7.2 Fibre optics: Total internal reflection and its applications, Critical angle and conditions for total internal reflection, introduction to optical fibers, light propagation, types, acceptance angle and numerical aperture, types and applications of optical fibre in communication.
 - 7.3 Introduction to nanotechnology, nanoparticles and nano materials,

LIST OF PRACTICALS (To perform minimum six experiments)

1. To determine the velocity of sound with the help of resonance tube.
2. To find the focal length of convex lens by displacement method.
3. To find the refractive index of the material of given prism using spectrometer.
4. To find the wavelength of sodium light using Fresnel's biprism.
5. To verify laws of resistances in series and parallel combination

6. To verify ohm's laws by drawing a graph between voltage and current.
7. To measure very low resistance and very high resistances using Slide Wire bridge
8. Conversion of Galvanometer into an Ammeter and Voltmeter of given range.
9. To draw hysteresis curve of a ferromagnetic material.
10. To draw characteristics of a pn junction diode and determine knee and break down voltages.
11. To find wave length of the laser beam.
12. To find numerical aperture of an optical fiber.

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration and animations can make the subject interesting and may develop scientific temper in the students. Teacher must plan a tour of Science Park/planetarium available in nearby areas in order to enhance the interest in this course.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Model Making,
- Actual Lab & Practical Work,
- Viva-Voice

RECOMMENDED BOOKS

1. Text Book of Physics (Part-I, Part-II); N.C.E.R.T., Delhi
2. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
3. A Text Book of Optics, Subramanian and Brij Lal, S Chand & Co., New Delhi
4. Practical Physics, by C. L. Arora, S Chand publications
5. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
6. Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications.
7. Physics Volume 2, 5th edition, Haliday Resnick and Krane, Wiley publication
8. Fundamentals of Physics by Haliday, Resnick & Walker 7th edition, Wiley publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	18
2	6	8
3	12	18
4	12	16
5	12	16
6	8	12
7	8	12
Total	70	100

2.3 APPLIED MECHANICS

L T P
5 - 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.

LEARNING OUTCOMES

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

- Interpret various types of units and their conversion from one to another.
- Analyze different types of forces acting on a body and draw free body diagrams.
- Determine the resultant of coplanar concurrent forces.
- Calculate the co-efficient of friction for different types of surfaces.
- Calculate the least force required to maintain equilibrium on an inclined plane.
- Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.
- Determine velocity ratio, mechanical advantage and efficiency of simple machines

DETAILED CONTENTS

1. Introduction (06 periods)
 - 1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.
 - 1.2 Definition, basic quantities and derived quantities of basic units and derived units
 - 1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration
 - 1.4 Concept of rigid body, scalar and vector quantities

2. Laws of forces (12 periods)
 - 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 superposition

 - 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]
 - 2.7 Type of Load, supports, Beams- analysis for simply supported, cantilever beams
3. Moment (14 periods)
- 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, 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 (14 periods)
- 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.
 - 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 (10 periods)
- 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 Machines (14 periods)

- 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 wheel and axle, Weston's Differential Pulley Block, 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 polygon law of forces using Gravesend apparatus.
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, velocity ratio and efficiency 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 out center of gravity of regular lamina.
9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

INSTRUCTIONAL STRATEGY

Applied Mechanics being a fundamental subject, the teacher are expected to emphasize on the application of "Applied Mechanics" in various subjects so that students are able to appreciate the importance of the subject. Students should also be made conversant with the use of scientific calculator to solve numerical problems

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid and end-term written tests
- Model/prototype making.

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
3. A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi..
4. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.
5. Test Book of Applied Mechanics by AK Upadhya, SK Kataria & Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	8
2	12	18
3	14	20
4	14	20
5	10	14
6	14	20
Total	70	100

2.4 GENERAL ENGINEERING

L T P
6 - 2

RATIONALE

Apart from the core subjects, some engineering subjects are included in this diploma course. One of these subjects is General Engg. which aims to impart some necessary knowledge and skill about other engg disciplines. Inclusion of the subject is further justified by the fact that in practical field, any job of technician is intermingled. As such the relevant basic topics of these disciplines are included in the content of the subject.

Some study exercises along with some field work have been suggested to give feel of jobs and equipments involved.

LEARNING OUTCOMES

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

- **Identify and able to take readings on various electrical equipments (voltmeter, ammeter, CRO, wattmeter, multi-meter)**
- **Determination of voltage-current relationship in a DC circuit under specific physical conditions**
- **Measure resistance of an ammeter and a voltmeter**
- **Verify DC circuits (Thevenin and Norton Theorem)**
- **Verify Kirchhoff's Current and Voltage Laws in a dc circuit**
- **Find the ratio of inductance of a coil having air-core and iron-core respectively and observe the effect of introduction of a magnetic core on coil inductance**
- **Test a lead - acid storage battery**
- Measure power and power factor in a single phase R-L-C Circuit and calculation of active and reactive powers in the circuit.
- Measure voltages and currents in polyphase a.c. circuits for star and delta connections.
- Identify different construction materials and check their quality
- Determine the bearing capacity of soils and select suitable foundations for heavy installations and machineries.
- Identify various types of concrete and check its quality
- Identify different structural elements in a building and the working of RCC.

DETAILED CONTENTS

SECTION A - ELECTRICAL ENGINEERING

1. Overview of DC Circuits (06 periods)
 - 1.1 Definition of basic terms, such as current, EMF, Potential Difference (PD); Ohm's Law and its limitations; Factors affecting resistors and capacitors; simple problems on series and parallel combinations of resistors with their wattage considerations.
 - 1.2 Application of Kirchhoff's current law and Kirchhoff's voltage law to simple circuits. Star – Delta connections and their conversion.
2. DC Circuit Theorems (06 periods)

Thevenin's theorem, Norton's theorem, application of network theorems in solving D.C. circuit problems.
3. Voltage and Current Sources (04 periods)
 - 3.1 Concept of voltage source, symbol and graphical representation characteristics of ideal and practical sources.
 - 3.2 Concept of current sources, symbol, characteristics and graphical representation of ideal and practical current sources.
4. Electro Magnetic Induction (08 periods)
 - 4.1 Concept of electro-magnetic field produced by flow of electric current, magnetic circuit, concept of magneto-motive force (MMF), flux, reluctance, permeability, analogy between electric and magnetic circuit.\
 - 4.2 Faraday's laws of electro-magnetic induction, principles of self and mutual induction, self and mutually induced e.m.f, simple numerical problems.
 - 4.3 Concept of current growth, decay and time constant in an inductive (RL) circuit.
 - 4.4 Energy stored in an inductor, series and parallel combination of inductors.
5. Batteries (08 periods)
 - 5.1 Basic idea of primary and secondary cells
 - 5.2 Construction, working principle and applications of Lead-Acid, Nickel-Cadmium and Silver-Oxide batteries
 - 5.3 Charging methods used for lead-acid battery (accumulator)
 - 5.4 Care and maintenance of lead-acid battery
 - 5.5 Series and parallel connections of batteries
 - 5.6 General idea of solar cells, solar panels and their applications
 - 5.7 Introduction to maintenance free batteries

6. AC Fundamentals (8 periods)
- 6.1 Concept of alternating quantities
 - 6.2 Difference between ac and dc
 - 6.3 Concepts of: cycle, frequency, time period, amplitude, instantaneous value, average value, r.m.s. value, maximum value, form factor and peak factor.
 - 6.4 Representation of sinusoidal quantities by phasor diagrams.
 - 6.5 Equation of sinusoidal wave form for an alternating quantity and its derivation
 - 6.6 Effect of alternating voltage applied to a pure resistance, pure inductance and pure capacitance.
7. AC Circuits (12 periods)
- 7.1 Concept of inductive and capacitive reactance
 - 7.2 Alternating voltage applied to resistance and inductance in series.
 - 7.3 Alternating voltage applied to resistance and capacitance in series.
 - 7.4 Introduction to series and parallel resonance and its conditions
 - 7.5 Power in pure resistance, inductance and capacitance, power in combined RLC circuits. Power factor, active and reactive power and their significance, definition and significance of power factor.
 - 7.6 Definition of conductance, susceptance, admittance, impedance and their units
 - 7.7 Introduction to polyphase a.c. systems, advantages of polyphase system over single phase system. Relations between line and phase value of voltages and currents for star and delta connections and their phasor diagram, power in polyphase circuits.
8. Various Types of Power Plants (06 periods)
- 8.1 Brief explanation of principle of power generation practices in thermal, hydro and nuclear power stations and their comparative study.
 - 8.2 Elementary block diagram of above mentioned power stations

SECTION B : CIVIL ENGINEERING

9. Construction Materials (06 periods)
- Properties and uses of various construction materials such as stones, bricks, lime, cement and timber with their properties, physical/field testing, elements of brick masonry.
10. Foundations (08 periods)
- 10.1 Bearing capacity of soil and its importance
 - 10.2 Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines.

11. Concrete (08 periods)
- Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/field testing of concrete, mixing of concrete, placing and curing of concrete..
12. RCC (04 periods)
- Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building.

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

LIST OF PRACTICALS

1. Operation and use of measuring instruments viz voltmeter, ammeter, CRO, Wattmeter, multi-meter and other accessories
2. Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions.
3. Measurement of resistance of an ammeter and a voltmeter
4. Verification of dc circuits:
 - a. Thevenin's theorem,
 - b. Norton's theorem,
5. Observation of change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.
6. Verification of Kirchhoff's Current and Voltage Laws in a dc circuit
7. To find the ratio of inductance of a coil having air-core and iron-core respectively and to observe the effect of introduction of a magnetic core on coil inductance
8. Charging and testing of a lead - acid storage battery.
9. Measurement of power and power factor in a single phase R-L-C. circuit and calculation of active and reactive powers in the circuit.
10. Verification of line to line and line to neutral voltages and current in star and delta connections.
11. Study of green energy
12. Testing of bricks
 - a) Shape and size
 - b) Soundness test
 - c) Water absorption
 - d) Crushing strength
13. Testing of concrete

- a) Slump test
 - b) Compressive Strength of concrete cube
14. The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works.

Note: Visit to a nearby Power Station(s) may be arranged to demonstrate various aspects of subject.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on basic principles and use charts in class, visits to labs and industry may be arranged to demonstrate certain materials and practices.

MEANS OF ASSESSMENT

- Sessional Tests
- End term Tests
- Practicals
- Viva-Voce

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhogal, Tata Mc Graw-Hill Education Pvt Ltd., New Delhi.
2. Experiments in Basic Electrical Engineering by SK Bhattacharya, KM Rastogi; New Age International (P) Ltd.; Publishers New Delhi.
3. Electrical Technology by BL Theraja, S Chand and Co, New Delhi.
4. Basic Electrical Engineering by JB Gupta; SK Kataria and Sons, New Delhi.
5. Basic Electrical Engineering by Asfaque Husain, Jain Book Depot, New Delhi
6. Textbook of Concrete Technology 2nd Edition, by Kulkarni, PD Ghosh TK and Phull, YR; New Age International(P) Ltd, Publishers, New Delhi
7. Materials of Construction by Ghosh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
8. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
9. Concrete Technology by J.Jha and Sinha; Khanna Publishers, Delhi
10. Building Construction by Jha and Sinha; Khanna Publishers, Delhi
11. Building Construction by Vairani and Chandola; Khanna Publishers, Delhi
12. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	06	8
2.	06	6
3.	04	4
4.	08	10
5.	08	10
6.	08	10
7.	12	14
8.	06	8
9.	06	6
10.	08	10
11.	08	8
12.	04	4
Total	84	100

2.5 ENGINEERING DRAWING - II

L T P
- - 8

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 16 sheets to be prepared. At least 2 sheets in AutoCAD.
- 3) Instructions relevant to various drawings may be given along with appropriate demonstration, before assigning drawing practice to the students.
- 4) Continuous evaluation be done by the teachers for exercises/work done on CAD software. For this proper record may be maintained for its inclusion in the internal assessment.

LEARNING OUTCOMES

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

- Draw and learn different types of wooden joints used in furniture.
- Draw the assembly from part details of objects
- Identify and draw different types of screw threads used in various machines and assemblies as per domestic and international standards
- Draw different types of nuts, bolts and washers
- Draw various locking devices and foundation bolts
- Draw different section of various types of keys and cotter joints
- Draw various riveted joints
- Draw various types of couplings used in power transmission.
- Prepare drawing of given joints/couplings using AutoCAD

DETAILED CONTENTS

1. Detail and Assembly Drawing (02 sheets)

Principle and utility of detail and assembly drawings

- 1.1 Wooden joints i.e. corner mortice and tenon joint, Tee halving joint, Mitre faced corner joint, Tee bridle joint, Crossed wooden joint, Cogged joint, Dovetail joint,

Through Mortice and Tenon joint, furniture drawing - freehand and with the help of drawing instruments.

2. Screw Threads (03 sheets)
 - 2.1 Thread Terms and Nomenclature
 - 2.1.1 Types of threads-External and Internal threads, Right and Left hand threads (Actual and Conventional representation), single and multiple start threads.
 - 2.1.2 Different Forms of screw threads-V threads (B.S.W threads, B.A thread, American National and Metric thread), Square threads (square, Acme, Buttress and Knuckle thread)

3. Nuts and Bolt (02 sheets)
 - 3.1 Different views of hexagonal and square nuts. Square and hexagonal headed bolt
 - 3.2 Assembly of Hexagonal headed bolt and Hexagonal nut with washer.
 - 3.3 Assembly of square headed bolt with hexagonal and with washer.

4. Locking Devices (02 sheets)
 - 4.1 Different types of locking devices-Lock nut, castle nut, split pin nut, locking plate, slotted nut and spring washer.
 - 4.2 Foundations bolts-Rag bolt, Lewis bolt, curved bolt and eye bolt.
 - 4.3 Drawing of various types of studs

5. Keys and Cotters (03 sheets)
 - 5.1 Various types of keys and cotters - their practical application, drawings of various keys and cotters showing keys and cotters in position
 - 5.2 Various types of joints
 - Spigot and socket joint
 - Gib and cotter joint
 - Knuckle joint

6. Rivets and Riveted Joints (04 sheets)
 - 6.1 Types of general purpose-rivets heads
 - 6.2 Caulking and fullering of riveted joints
 - 6.3 Types of riveted joints
 - (i) Lap joint-Single riveted, double riveted (chain and zig-zag type)
 - (ii) Single riveted, Single cover plate butt joint
 - (iii) Single riveted, double cover plate butt joint
 - (iv) Double riveted, double cover plate butt joint(chain and zig-zag type)

7. Couplings (02 sheets)

- 7.1 Introduction to coupling, their use and types
- 7.2 Flange coupling (protected)
- 7.3 Flexible Coupling

*8. Use of CAD software (02 sheets)

Draw any two joints/coupling using CAD software from the following:

- i) Sleeve and cotter joint
- ii) Knuckle joint
- iii) Spigot and socket joint
- iv) Gib and cotter joint
- v) Flange coupling
- vi) Muff coupling

* **Auto CAD drawing will be evaluated internally by sessional marks and not by final theory paper.**

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. The institute should procure AutoCAD or other engineering graphics software for practice in engineering drawings. Teachers should undergo training in AutoCAD/Engineering Graphic. Separate labs for practice on AutoCAD should be established.

MEANS OF ASSESSMENT

- Sketches
- Drawing
- Use of software

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 (Pvt. Ltd.), Anand
4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar

5. AutoCAD 2010: For Engineers & Designers by Prof. Sham Tickoo & D. Sarvanan; Wiley India Pvt. Ltd., Delhi.

2.6 GENERAL WORKSHOP PRACTICE –II

(Common for Mechanical Engineering and Agriculture Engineering)

L T P
- - 8

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 hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

After completing the course, the students will be able to:

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS (PRACTICAL EXERCISES)

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

- 1 Fitting Shop
- 2 Sheet Metal Shop
- 3 Welding Shop
- 4 Foundry Shop

5 Machine Shop

1. FITTING SHOP

- 1.1 Use of personal protective equipment and safety precautions while working.
- 1.2 Basic deburring processes.
- 1.3 Introduction to fitting shop tools, marking and measuring devices/equipment.
- 1.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)
- 1.5 Identification of various steel sections (flat, angle, channel, bar etc.).
- 1.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).
- 1.7 Job Practice
 - Job I Marking of job, use of marking tools, filing and use of measuring instruments. (Vernier caliper, Micrometer and Vernier height gauge).
 - Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of $\pm .25$ mm.
 - Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping
 - Job IV Drilling and tapping practice on MS Flat.

2. SHEET METAL SHOP

- 2.1 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.
- 2.2 Introduction and demonstration of hand tools used in sheet metal shop.
- 2.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine,
- 2.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.
- 2.5 Study of various types of nuts, bolts, rivets, screws etc.
- 2.6 Job Practice
 - Job I: Shearing practice on a sheet using hand shears.
 - Job II: Practice on making Single riveted lap joint/Double riveted lap Joint.
 - Job III: Practice on making Single cover plate chain type, zig-zag type and single rivetted Butt Joint.

3 WELDING SHOP – I

- 3.1 Introduction and importance of welding as compared to other material joining processes. Specifications and type of welding machines, classification and coding of electrodes, welding parameters, welding joints and welding positions. Materials to be welded, safety precautions.

3.2 Job Practice

- Job I Practice of striking arc (Minimum 4 beads on 100 mm long M.S. flat).
 Job II Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level).
 Job III Preparation of lap joint using arc welding process.
 Job IV Preparation of T-joint using gas welding or arc welding on 100 mm x 6 mm MS Flat

4 FOUNDRY SHOP

- 4.1 Study of metal and non metals
 4.2 Study and Sketch of the Foundry tools
 4.3 Study and sketch of Cupola and pit furnace
 4.4 To prepare green moulding sand and to prepare moulds (single piece and double piece pattern sweep mould)
 4.5. Casting of non ferrous (lead or aluminium)

5 MACHINE SHOP

- 5.1 Study and sketch of lathe machine
 5.2 Study and Sketch of grinders, milling machine, drilling machine and CNC machine.
 5.3 Plain and step turning and knurling practice.
 5.4 Study and sketch of planning/shaping machine and to plane a rectangle of cast iron.

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapooan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi.

3.1 APPLIED MATHEMATICS –III

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RATIONALE

Contents of this course provide understanding of some elementary and advanced mathematics algorithms and their applications of solving engineering problems. Content of this course will enable students to use some advanced techniques like Beta-Gamma function, Fourier series, Laplace transform and probability distributions in solving complex engineering problems.

LEARNING OUTCOMES

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

- understand matrix operations and uses of matrix in different problems.
- apply elementary row and column operations in finding inverse of a matrix.
- find Eigen values, Eigen vectors of a matrix and their different properties.
- understand degree/order of differential equations and their solution techniques.
- use differential equations in engineering problems of different areas.
- find Fourier series expansion of a function
- apply Laplace transform and their applications in solving engineering problems.
- understand concept of probability distribution and their applications.

DETAILED CONTENTS

1. Matrices

(16 Periods)

1.1 Algebra of Matrices

Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, Skew symmetric, Hermitian, Skew hermitian, Orthogonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix.

Definition and Computation of inverse of a matrix.

1.2 Elementary Row/Column Transformation

Meaning and use in computing inverse and rank of a matrix.

1.3 Linear Dependence

Linear dependence/independence of vectors, Definition and computation of rank of matrix. Computing rank through determinants, Elementary row transformation and through the concept of a set of independent vectors, Consistency of equations.

1.4 Eigen Pairs

Definition and evaluation of eigen values and eigen vectors of a matrix of order two and three, Cayley-Hamilton theorem (without Proof) and its verification, Use in finding inverse and powers of a matrix.

2. Differential Calculus (15 Periods)
 - 2.1 Function of two variables, identification of surfaces in space, conicoids
 - 2.2 Partial Differentiation :
Directional derivative, Gradient, Use of gradient f , Partial derivatives, Chain rule, Higher order derivatives, Euler's theorem for homogeneous functions, Jacobians.
 - 2.3 Vector Calculus :
Vector function, Introduction to double and triple integral, differentiation and integration of vector functions, gradient, divergence and curl, differential derivatives.

3. Differential Equation (15 Periods)
 - 3.1 Formation, Order, Degree, Types, Solution :
Formation of differential equations through physical, geometrical, mechanical and electrical considerations, Order, Degree of a differential equation, Linear, nonlinear equation.
 - 3.2 First Order Equations :
Variable separable, equations reducible to separable forms, Homogeneous equations, equations reducible to homogeneous forms, Linear and Bernoulli form exact equation and their solutions.
 - 3.3 Higher Order Linear Equation :
Property of solution, Linear differential equation with constant coefficients (PI for $X = e^{ax}$, $\sin ax$, $\cos ax$, X^n , $e^{ax}V$, XV)
 - 3.4 Simple Applications
LCR circuit, Motion under gravity, Newton's law of cooling, radioactive decay, Population growth, Force vibration of a mass point attached to spring with and without damping effect. Equivalence of electrical and mechanical system

4. Integral Calculus (12 Periods)
 - 4.1 Beta and Gamma Functions :
Definition, Use, Relation between the two, their use in evaluating integrals.
 - 4.2 Fourier Series :
Fourier series of $f(x)$, $-n < x < n$, Odd and even function, Half range series.

- 4.3 Laplace Transform :
Definition, Basic theorem and properties, Unit step and Periodic functions, inverse laplace transform, Solution of ordinary differential equations
5. Probability and Statistics (12 Periods)
- 5.1 Probability :
Introduction, Addition and Multiplication theorem and simple problem.
- 5.2 Distribution :
Discrete and continuous distribution, Binomial Distribution, Poisson Distribution, Normal Distribution..

INSTRUCTIONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples. The basic elements of Laplace transform, differential equations and applications of differential equations can be taught with engineering applications of relevant branch.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3. Applied Mathematics-III by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-II by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	16	24
2.	15	20
3.	15	20
4	12	18
5	12	18
Total	70	100

3.2 ENGINEERING MATERIALS

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 this course 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 industries.

LEARNING OUTCOMES

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

- distinguish between metals and non metals and ferrous and non ferrous materials.
- explain the arrangement of atoms in various crystals.
- carry out various heat treatment processes.
- analyze microstructure and changes in microstructure due to heat treatment.
- classify various types of plastics and rubber.
- explain properties and applications of composites, ceramics and smart materials.
- select suitable material to be used for various engineering applications.
- perform destructive and non-destructive testing of materials.

DETAILED CONTENTS

1. Introduction (06 Periods)

Material, History of Material Origin, Scope of Material Science, Overview of different engineering materials and applications, Classification of materials, Thermal, Chemical, Electrical, Mechanical properties of various materials, Present and future needs of materials, Overview of Biomaterials and semi-conducting materials, Various issues of Material Usage-Economical, Environment and Social.

2. Crystallography (08 Periods)

Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals, Number of atoms per unit Cell, Atomic Packing Factor.

Deformation: Overview of deformation behavior and its mechanism, behavior of material under load control and strain control.

Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep.

3. Metals And Alloys (12 Periods)

Ferrous Materials: Different iron ores, Raw materials in production of iron and steel, Basic process of iron-making and steel-making, Classification of iron and steel.

Cast Iron: Different types of Cast Iron, manufacture and their use. Classification of Grey cast iron and S.G. iron

Steels: Steels and alloy steel, Classification of plain carbon steels, Properties and usage of different types of Plain Carbon Steels, Effect of various alloys on properties of steel, Uses of alloy steels (high speed steel, stainless steel, spring steel, silicon steel)

Non Ferrous Materials: Properties and uses of Aluminum, Copper and Zinc and their alloys

4. Heat Treatment (06 Periods)

Purpose of heat treatment, Solid solutions and its types, Formation and decomposition of Austenite, Martensitic Transformation – Simplified Transformation Cooling Curves. Various heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening, Hardenability of steels, Selection of case carburizing and induction hardening steels. Types of heat treatment furnaces (only basic idea)

5. Plastics (06 Periods)

Important sources of plastics, Classification-thermoplastic and thermoset and their uses, Various trade names of plastics, Plastic coatings, food grade plastics. Applications of plastics in automobile and domestic use.
Rubber classification - Natural and synthetic. Selection of rubber

6. Advanced Materials (06 Periods)

Composites-Classification, properties, applications
Ceramics-Classification, properties, applications
Adhesives – Classification, properties and applications
Smart materials - properties and applications.

7. Miscellaneous Materials (06 Periods)

Overview of -Tool and Die materials, Materials for bearing metals, Materials for Nuclear Energy, Refractory materials.

8. Identification and Testing of Materials (Destructive and NDT) (06 Periods)

Identification of metal by giving mini projects.

Destructive testing: Stress testing, Harness testing

Non-destructive testing: Eddy-current, Magnetic-particle, Liquid penetration, radiographic, Ultrasonic and visual testing

LIST OF PRACTICALS

1. Use of diamond polishing apparatus.
2. To perform following heat treatment process on materials of known carbon percentage and checking the change in the properties
 - a) Annealing
 - b) Normalising
 - c) Case hardening
3. Preparation of specimens and study of micro structure of given metals and alloys on metallurgical microscope
 - a) Brass
 - b) Bronze
 - c) Grey Cast Iron
 - d) Low Carbon Steel
 - e) High Carbon Steel
 - f) High Speed Steel
4. To prepare specimen for microscope examination for polishing
5. To determine composition of alloy steel by steeloscope

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Small projects
- Viva-voce

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of engineering materials to the students. Students should be asked to collect samples of various materials available in the market. Visits to industry should be planned to demonstrate use of various types of materials or Heat Treatment Processes in the industry.

RECOMMENDED BOOKS

1. Text book of Material Science by R.K. Rajput; Katson Pubs, Ludhiana
2. Text book of Material Science by V.K. Manchanda; India Publishing House, Jalandhar.
3. Introduction to Material Science by A.R. Gupta, Satya Prakashan, New Delhi.
4. Material Science by Hazra, Chaudhary
5. Material Science and Engineering Raghuan by Raghvaan PHI
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

Website for Reference

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	06	10
2.	08	16
3.	12	22
4.	06	12
5.	06	10
6.	06	10
7.	06	10
8.	06	10
Total	56	100

3.3 MECHANICS OF SOLIDS

L T P

4 1 2

RATIONALE

Diploma holders in this course 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 and columns. 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.

LEARNING OUTCOMES

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

- interpret various concepts and terms related to strength of materials
- calculate stresses in bars of various cross-section.
- calculate energy stored by materials subjected to axial loads.
- calculate moment of inertia of different sections.
- interpret the concept of bending and torsion and calculate stresses on different section of materials.
- draw and calculate shear force and bending moment diagrams of beam under given loading
- calculate stresses in thin cylindrical shells.
- determine the diameter of a shaft under combined bending and torsion.
- calculate critical axial loads on column under different end constraints.

DETAILED CONTENTS

- | | | |
|--------|--|--------------|
| 1. | Stresses and Strains | (08 Periods) |
| 1.1. | Basic assumptions; Concept of load, stress 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. | Nominal and true stress-strain diagrams. | |
| 1.3.2. | Hook's Law | |
| 1.3.3. | Young Modulus of elasticity | |
| 1.3.4. | Nominal stress | |
| 1.3.5. | Yield point, plastic stage | |
| 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 Poisson's Ratio
 - 1.3.11 Shear modulus
 - 1.3.12 Deflection and stiffness
 - 1.4. Concepts of fatigue, creep and stress concentration
 - 1.5. Thermal stresses
2. Resilience (04 Periods)
- 2.1 Resilience, proof resilience and modulus of resilience
 - 2.2 Strain energy due to direct stresses
 - 2.3 Stresses due to gradual, sudden and falling load.
3. Moment of Inertia (05 Periods)
- 3.1. Concept of moment of inertia and second moment of area
 - 3.2 Radius of gyration
 - 3.3 Theorem of perpendicular axis and parallel axis (without derivation)
 - 3.4 Second moment of area of common geometrical sections :Rectangle, Triangle, Circle (without derivation); Second moment of area for L,T and I section
 - 3.5 Section modulus
4. Bending Stresses (06 Periods)
- 4.1 Concept of Bending stresses
 - 4.2. Theory of simple bending
 - 4.3. Use of the equation $\sigma/y = M/I = E/R$
 - 4.4. Concept of moment of resistance
 - 4.5. Bending stress diagram
 - 4.6. Calculation of maximum bending stress in beams of rectangular, circular, and T section.
 - 4.7 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.
5. Torsion (06 Periods)
- 5.1. Concept of torsion- difference between torque and torsion.
 - 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
 - 5.6 Concept of Principal stresses, principal planes and max. shear stress.
 - 5.7 Determination of shaft diameter under combined bending and torsion.

6. Shear Force and Bending Moment (10 Periods)
- 6.1 Concept of beam and form of loading
 - 6.2 Concept of end supports-Roller, hinged and fixed
 - 6.3 Concept of bending moment and shearing force
 - 6.4 S.F. and B.M. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated load and U.D.L.
7. Columns (05 Periods)
- 7.1. Concept of column, modes of failure
 - 7.2. Types of columns
 - 7.3. Buckling load, crushing load
 - 7.4. Slenderness ratio
 - 7.5. Factors effecting strength of a column
 - 7.6 End restraints
 - 7.7 Effective length
 - 7.8 Strength of column by Euler Formula without derivation
 - 7.9. Rankine Gourdan formula (without derivation)
8. Thin Cylinder and Spherical Shells (04 Periods)
- 8.1 Introduction to longitudinal stresses, circumferential or hoop stresses and radial stresses
 - 8.2 Longitudinal and circumferential stresses in thin cylinder
 - 8.3 Longitudinal and circumferential stresses in thin Spherical shells
9. Slope and Deflections of Beams: (08 Periods)
- 9.1 Definition of slope and deflection, sign convention. Circular bending. Calculation of maximum slope and deflection for the following standard cases by double integration or moment area method.
- a) Cantilever having point load at the free end
 - b) Cantilever having point load at any point of the span
 - c) Cantilever with uniformly distributed load over the entire span
 - d) Cantilever having U.D.L. over part of the span from free end
 - e) Cantilever having U.D.L. over a part of span from fixed end
 - f) Simply supported beam with point load at centre of the span.
 - g) Simply supported beam with U.D. L. over entire span.

Note: All examples will be for constant moment of inertia without derivation of formula.

LIST OF PRACTICALS

1. To find the shear force at a given section of simply supported beam for different loading.

2. To find the value of 'E' for a steel beam by method of deflection for different loads.
3. To determine the Max-Fiber stress in X-section of simply supported beam with concentrated loads and to find the neutral axis of the section.
4. To determine the ultimate tensile strength, its modulus of Elasticity, stress at yield point, Elongation and contraction in X-sectional area of the specimen by U.T.M. through necking phenomenon.
5. To determine the ultimate crushing strength of materials like steel and copper and compare their strength.
6. To determine Rockwell Hardness No. and Brinell Hardness No. of a sample.
7. To estimate the Shock Resistance of different qualities of materials by Izod's test and Charpy test.
8. To determine the bending moment at a given section of a simply supported beam for different loading.
9. To determine the various parameters of helical coil spring.
10. To determine the angle of twist for a given torque by torsion apparatus and to plot a graph between torque and angle of twist.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Small projects
- Viva-voce

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignments so as to promote problem solving abilities and develop continued learning skills.

RECOMMENDED BOOKS

1. SOM by Birinder Singh; Katson Publishing House, New Delhi.
2. SOM by RS Khurmi; S.Chand & Co; New Delhi
3. Mechanics of Materials by Dr. Kirpal Singh; Standard Publishers Distribution, New Delhi.
4. Elements of SOM by D.R. Malhotra and H.C.Gupta; Satya Prakashan, New Delhi.
5. Mechanics of Solids by Karmveer Saini, Krishna Publication House, Meerut.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	12
2	04	08
3	05	08
4	06	12
5	06	10
6	10	16
7	05	10
8	04	08
9	08	16
Total	56	100

3.4 THERMAL ENGINEERING

L	T	P
5	1	3

RATIONALE

A diploma holder in this course is supposed to maintain steam generators, turbines, compressors and other power plant equipment. Therefore, it is essential to impart him basic concepts of thermodynamics, steam generators, steam turbines, compressors and about IC engines.

LEARNING OUTCOMES

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

- apply thermodynamic laws.
- solve basic problems of gas equation using perfect gas laws.
- determine enthalpy, specific heat capacity and P-V-T surface of an ideal and real gas.
- explain the working, construction and applications of steam boilers and steam generators
- explain the functions and uses of air compressors.
- interpret different modes of heat transfer.
- explain the working of IC engine.
- assist in testing an IC engine.
- explain the functioning of steam turbine, gas turbine and jet propulsion.

DETAILED CONTENTS

1. Fundamental Concepts (06 Periods)
 Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy.
2. Laws of Perfect Gases (03 Periods)
 Definition of gases, explanation of perfect gas laws – Boyle’s law, Charle’s law, Avagadro’s law, Regnault’s law, Universal gas constant, Characteristic gas constants, derivation Specific heat at constant pressure, specific heat at constant volume of gas, simple problems on gas equation
3. Thermodynamic Processes on Gases (05 Periods)

Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, equations representing the processes
Derivation of work done, change in internal energy, rate of heat transfer for the above processes

4. Laws of Thermodynamics (06 Periods)

Laws of conservation of energy, first law of thermodynamics (Joule's experiment), Application of first law of thermodynamics to non-flow systems – Constant volume, constant pressure, Adiabatic and polytropic processes.
Steady flow energy equation, Application of steady flow energy to equation, turbines, pump, boilers, nozzles.
Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Clausius statement, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility, entropy, ideal and real gases.

5. Properties of Steam (05 Periods)

Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of steam, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes
Quality of steam (dryness fraction),

6. Steam Generators (04 Periods)

Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction features of Lancashire boiler, Nestler boiler, Babcock & Wilcox Boiler. Introduction to modern boilers.

7. Air Standard Cycles (04 Periods)

Meaning of air standard cycle – its use, condition of reversibility of a cycle
Description of Carnot cycle, Otto cycle, Diesel cycle, simple problems on efficiency, calculation for different cycles
Reasons for highest efficiency of Carnot cycle over all other cycles working between same temperature limits

8. Air Compressors (05 Periods)

Functions of air compressor – uses of compressed air, type of air compressors

Single stage reciprocating air compressor, its construction and working, representation of processes involved on P – V diagram, calculation of work done.

Rotary compressors – types, descriptive treatment of centrifugal compressor, axial flow compressor, vane type compressor

9. Introduction to Heat Transfer (04 Periods)

Modes of heat transfer, Fourier's law, steady state conduction, composite structures, Natural and forced convection, thermal radiation

10. IC Engines (12 Periods)

Introduction, Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, diesel cycle and dual cycle, Location and functions of various parts of IC engines and materials used for them. Testing of IC

Engines: Engine power - indicated and brake power, Efficiency - mechanical, thermal. relative and volumetric, Methods of finding indicated and brake power, Morse test for petrol engine, Heat balance sheet, simple numerical problems, Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers - EURO - 1, EURO – 2.

11. Steam Turbines and Steam Condensers (08 Periods)

Function and use of steam turbine, Steam nozzles - types and applications

Steam turbines - impulse, reaction, construction and working principle

Governing of steam turbines, Function of a steam condenser, elements of condensing plant, Classification - jet condenser, surface condenser, Cooling pond and cooling towers

12. Gas Turbines and Jet Propulsion (08 Periods)

Classification, open cycle gas turbine and closed cycle gas turbine, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbine. Open cycle constant pressure gas turbines - general layout, PV and TS diagram and working of gas turbine.

Closed cycle gas turbines, PV and TS diagram and working.

Principle of operation of ram-jet engine and turbo jet engine - application of jet engines

LIST OF PRACTICALS

1. Demonstration of mountings and accessories on a boiler.
2. Demonstrate the working of air compressor.
3. Demonstration of heat transfer through conduction, convection and Radiation
4. Study of working of high pressure boiler
5. Study the working of Lancashire boiler and Nestler boiler

6. Dismantle an IC engine and note down the condition of various parts, removal and fitting of piston, rings, measuring of bore size, crank shaft ovality and assemble it.
7. Servicing of petrol injection system
8. Valve servicing, grinding, lapping and fitting mechanism and tappet adjustment.
9. Inspection of ignition system of a multi-cylinder engine stressing ignition timings, setting, fixing order and contact breaker; gap adjustment, spark plug cleaning.
10. Service of cooling & lubrication system of IC engine and note down the functioning/testing of various components.
11. Determination of BHP by dynamometer.
12. Morse test on multi-cylinder petrol engine.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Small projects
- Viva-voce

RECOMMENDED BOOKS

1. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi.
2. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi.
3. Engineering Thermodynamics by CP Arora; Tata McGraw Hill, Delhi.
4. A Treatise on Heat Engineering by VP Vasandani and DS Kumar; Metropolitan Book Company.
5. Internal Commercial Engine by V. Ganeshan; Tata McGraw Hill, Education
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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3	05	08
4	06	08
5	05	08
6	04	06
7	04	06
8	05	08
9	04	06
10	12	16
11	08	12
12	08	10
Total	70	100

3.5 COMPUTER AIDED DRAFTING AND 3D MODELLING

L T P
- - 8

RATIONALE

Computer Aided Design plays a very important role in designing products with exact determines for manufacturing industries. Modellings helps to achieve the designed shape and size of products for the manufacturing sector. After studying this subject the students will be able to know Drafting, Designing and Modelling techniques which helps a manufacturer machines sound for better product development.

LEARNING OUTCOMES

After completion of this course, the students will be able to :

- know the advantages of using CAD in comparison with conventional method.
- draw and interpret CAD drawings using drawing, editing and viewing in CAD software.
- create easy and complex solids and assemblies using various tools in Solid works software.
- can understand exploded views and assembled views

DETAILED CONTENTS

1. Introduction to AutoCAD commands (6 drawing sheets)
 - 1.1 Concept of AutoCAD, Tool bars in Auto CAD, coordinate system, snaps, Grid, and ortho mode (Absolute, Relative and Polar)
 - 1.2 Drawing commands – point, line, arc, circle, ellipse, parabola.
 - 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
 - 1.7 Create layers within a drawing
 - 1.8 Specifying Geometrical Dimensioning & Tolerancing (GD&T) parameters in drawing

2. Detail and assembly drawing of the following using AUTOCAD (4 sheets)
 - 2.1 Plummer Block
 - 2.2 Wall Bracket
 - 2.3 Stepped pulley, V-belt pulley
 - 2.4 Flanged coupling
 - 2.5 Machine tool Holder (Three views)
 - 2.6 Screw jack or knuckle joint
 - 2.7 Foot step bearing

3. Isometric Drawing by CAD using Auto CAD (one sheet)

ISO Commands, User Co-ordinate System, View points, Viewports Elevation, World Co-ordinate System X/Y/Z Filter

Drawings of following on computer:

- Cone
- Cylinder
- Isometric view of objects

4. Introduction to Solid works

Introduction to Sketcher: Sketch Entities, Sketch Tools, Blocks, Dimensioning

4.1 Part modeling (4 models)

Part Modeling Tools:-

- 4.1.1 Creating reference planes
- 4.1.2 Creating Extrude features, Creating Revolve, Creating Swept features-
- 4.1.3 Creating Loft features
- 4.1.4 Creating Reference - points, axis, coordinates
- 4.1.5 Creating curves
- 4.1.6 Creating Fillet features
- 4.1.7 Inserting Hole types
- 4.1.8 Creating Chamfer
- 4.1.9 Creating Shell
- 4.1.10 Creating Rib
- 4.1.11 Creating Pattern Advanced Modeling Tools
- 4.1.12 Inserting Fastening features,
- 4.1.13 Environment& Utilities - Working with views and manipulating views,

4.2 Assembly (4 models)

Assembly Modeling Tools:-

Introduction to Assembly Modeling & Approaches – Top down and Bottom up approach, Applying Standard Mates- Coincident, Parallel, Perpendicular, Tangent, Concentric, Lock, Distance, Angle. Applying Advanced Mates – Symmetric, Width, Path Mate, Linear/Linear Coupler, Limit Mate. Applying Mechanical Mates – Cam, Hinge, Gear, Rack Pinion, Screw, and Universal Joint. Manipulating Components - Replacing Components, Rotating Components, Move Components, Collision Detection, Physical Dynamics, Dynamic Clearance, Detecting Interference Creating Pattern - Assembly Pattern, Mirror, Creating Explode Views

1. Lathe tool past assembly
2. Shaper tool assembly
3. Valve assembly
4. Screw Jack

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, & 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. NageswaraRao; Tata McGraw Hill, New Delhi.
3. AutoCAD 2000 for you by UmeshShettigar 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. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR

Website for Reference:

<http://swayam.gov.in>

3.6 WORKSHOP TECHNOLOGY

L T P
4 - 6

RATIOANELE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various manufacturing processes is required to be imparted. Hence the subject of workshop technology.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Fabricate welding joints using gas welding arc welding, TIG and MIG welding of mild steel and stainless steel materials.
- Select suitable (most appropriate) process electrodes, various parameters of process for given job.
- Explain principle of operations of modern welding processes.
- Inspect various welding joints and castings.
- Prepare pattern for given job.
- Select material and type of patterns, cores.
- Prepare sand moulds manually and on machine.
- Select type of moulding sand, adhesives, compact, strength and parameters of sand for given job.
- Cast a mould.
- Identify a suitable furnace, alloying elements
- Carry out deburring of castings.
- Test the properties of moulding sand (permeability, Strength, refractoriness, adhesiveness, cohesiveness).

DETAILED CONTENTS

1. Welding (14 Periods)
 - 1.1 Welding Process
Principle of welding, Classification of welding processes, Advantages and limitations of welding, Industrial applications of welding, Welding positions and techniques, symbols. Safety precautions in welding.

- 1.2 Gas Welding
Principle of operation, Types of gas welding flames and their applications, Gas welding equipment - Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes
- 1.3 Arc Welding
Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes: Classification, B.I.S. specification and selection, Flux for arc welding. Requirements of pre heating, post heating of electrodes and work piece. Welding defects and their testing methods.
- 1.4 Other Welding Processes
Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding, Atomic hydrogen welding, Shielded metal arc welding, submerged arc welding, Welding distortion, welding defects, methods of controlling welding defects and inspection of welded joints. Welding defects and inspection.
- 1.5 Modern Welding Methods
Methods, Principle of operation, advantages, disadvantages and applications of, Tungsten inert gas (TIG) welding, other welding process, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding, Robotic welding
2. Pattern Making (10 Periods)
Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S., Introduction to cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores
3. Moulding and Casting (14 Periods)
- 3.1 Moulding Sand
Properties of moulding sand, their impact and control of properties viz. permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility, Various types of moulding sand, Testing of moulding sand. Safety precautions in foundry.

- 3.2 Mould Making
Types of moulds, Step involved in making a mould, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floor molding, pit molding and machine molding, Molding machines squeeze machine, jolt squeeze machine and sand slinger.
- 3.3 Casting Processes
Charging a furnace, melting and pouring both ferrous and non ferrous metals, cleaning of castings, Principle, working and applications of Die casting: hot chamber and cold chamber, Investment and lost wax process, centrifugal casting.
- 3.4 Gating and Riser System
Elements of gating system, Pouring basin, sprue, runner, gates, Types of risers, location of risers, Directional solidification
- 3.5 Melting Furnaces
Construction and working of Pit furnace, Cupola furnace, Crucible furnace – tilting type, Electric furnace
- 3.6 Casting Defects
Different types of casting defects, Testing of defects: radiography, magnetic particle inspection and ultrasonic inspection.
4. Metal Farming Process (10 Periods)
- 4.1 Press Working- Types of presses, type of dies, selection of press die, die material. Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping.
- 4.2 Forging- Open die forging, closed die forging, Press forging, upset forging, swaging, up setters, roll forging, Cold and hot forging.
- 4.3 Rolling- Elementary theory of rolling, Types of rolling mills, Thread rolling, roll passes, Rolling defects and remedies.
- 4.4 Extrusion and Drawing- Type of extrusion- Hot and Cold, Direct and indirect, pipe drawing, tube drawing, wire drawing.

5. Plastic Processing (08 Periods)
- 5.1 Industrial use of plastics, situation where used.
 - 5.2 Injection moulding-principle, working of injection moulding machine.
 - 5.3 Compression moulding-principle, and working of compression moulding machine.
 - 5.4 Potential and limitations in the use of plastics

LIST OF PRACTICALS

General introduction to hand tools used in foundry, welding and pattern making and smithy shop.

WELDING SHOP

- Job 1. Preparing gas welding joint in vertical/Horizontal position joining M.S. Plates
- Job 2. Exercise on gas cutting of mild steel plate with oxy-acetylene gas torch.
- Job 3. Exercise on gas welding of cast iron and brass part or component.
- Job 4. Exercise on preparation of T Joint by arc welding
- Job 5. Exercise on spot welding/seam welding
- Job 6. Exercise on MIG and TIG welding
- Job 7. Exercise on arc welding pipe joint MS.

PATTERN MAKING

- Job 1. Preparation of solid/single piece pattern.
- Job 2. Preparation of two piece/split pattern
- Job 3. Preparation of a pattern on wooden lathe
- Job 4. Preparation of a self cored pattern
- Job 5. Preparation of a core box.

FOUNDRY SHOP

- Job 1. Preparation of mould with solid pattern on floor.
- Job 2. Preparation of floor mould of solid pattern using cope.
- Job 3. Preparation of floor mould of split pattern in cope and drag of moulding box.
- Job 4. Moulding and casting of a solid pattern of aluminum
- Job 5. Preparing a mould of step pulley and also preparing core for the same.
- Job 6. A visit to cast iron foundry should be arranged to have firsthand knowledge of cast iron melting pouring and casting.
- Job 7. Testing of moisture contents and strength of moulding sand.

FORGING SHOP/FITTING SHOP/SHEET METAL SHOP

- Job 1. Preparation of single ended spanner by hand/machine forging.
- Job 2. Preparation of simple die
- Job 3. Demonstration of spinning process on lathe and spinning a bowl on a lathe machine.
- Job 4. Demonstration of grinding process on lathe machine and grinding a job on a lathe machine
- Job 5. Preparation of utility item out of G.I. sheet.
- Job 6. Preparation of drilling Jig.

INSTRUCTIONAL STRATEGY

1. Teachers should lay special emphasis in making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.
2. Focus should be laid in preparing jobs using various machines/equipment in the workshop.
3. Use of audio-visual aids/video films should be made to show specialized operations.
4. Foreman Instructor should conduct classes of each Workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

RECOMMENDED BOOKS

1. Workshop Technology by BS Raghuvanshi : Dhanpat Rai and Sons Delhi
2. Elements of Workshop Technology by SK Choudhry and Hajra : Asia Publishing House
3. Welding Engineering by RL Aggarwal and T Manghnani; Khanna Publishers, Delhi
4. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi
5. Foundry Technology by KP Sinha and DB Goel; Roorkee Publishing House, Roorkee.
6. A Text Book of Manufacturing Science and Technology by A Manna, Prentice Hall of India, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	14	25
2	10	20
3	14	25
4	10	20
5	08	10
Total	100	100

4.1 COMMUNICATION SKILLS – II

L T P
4 - 2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Functional Grammar (16 periods)
 - 1.1 Prepositions
 - 1.2 Framing Questions
 - 1.3 Conjunctions
 - 1.4 Tenses

- 2 Reading (16 periods)
 - 2.1 Unseen Passage for Comprehension (Vocabulary enhancement - Prefixes, Suffixes, one word substitution, Synonym and Antonym) based upon the passage should be covered under this topic.

- 3 Writing Skill (24 periods)
 - 3.1. Correspondence
 - a) Business Letters- Floating Quotations, Placing Orders, Complaint Letters.

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

LIST OF PRACTICALS

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

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

Speaking and Listening Skills

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

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

SUGGESTED DISTRIBUTION OF MARKS

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

4.2 REFRIGERATION AND AIR CONDITIONING

L	T	P
5	1	2

RATIONALE

The diploma holders in Mechanical Engineering are responsible for supervising and maintenance of RAC system. For this purpose, the knowledge and skill covering basic principles of refrigeration and air conditioning is required to be imparted to the students. Moreover, RAC industry is expanding and employment opportunities in this field are good.

LEARNING OUTCOMES

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

- explain the working and construction features of refrigeration and air conditioning systems
- draw and interpret various refrigeration cycles.
- make basic calculation of psychometric properties and processes.
- calculate heating and cooling load requirements of a room.
- explain latest developments in the field of refrigeration and air conditioning.
- calculate the properties of air by using psychometric chart.
- detect faults in an air-conditioner/refrigerator.
- carry out charging of air conditioner.

DETAILED CONTENTS

REFRIGERATION

1. Fundamentals of Refrigeration (07 Periods)

Introduction to refrigeration, air conditioning, necessity of refrigeration meaning of refrigerating effect, units of refrigeration, COP, difference between COP and efficiency, methods of refrigeration, Reversed carnot cycle and its representation on P-V and T-S diagram. Major application areas of refrigeration and air conditioning.

2. Vapour Compression System (10 Periods)

Introduction, principle, function, parts and necessity of vapour compression system, T- S and p- h charts, dry, wet and superheated compression. Effect of sub cooling, super heating, mass flow rate, entropy, enthalpy, work done, Refrigerating effect and COP. actual vapour compression system

3. Refrigerants (07 Periods)

Functions, classification of refrigerants, Nomenclature of refrigerant, Desirable properties of refrigerant, selection of refrigerant

4. Air Refrigeration System (08 Periods)

Introduction, advantages and disadvantages of air-refrigeration system over vapour compression system, bell – Collemann cycle, Boot strap system, calculation of mass flow rate, work done and COP

5. Vapour Absorption System (08 Periods)

Introduction, principle and working of simple absorption system and domestic electrolux refrigeration systems. Solar power refrigeration system, advantages and disadvantages of solar power refrigeration system over vapour compression system.,

6. Refrigeration Equipment (08 Periods)

6.1 Compressors- Function, various types of compressors

6.2 Condensers - Function, various types of condensers

6.3 Evaporators- Function, types of evaporators

6.4 Expansion Valves - Function, various types such as capillary tube, thermostatic expansion valve, low side and high side float valves, application of various expansion valves

6.5. Safety Devices-Thermostat, overload protector LP, HP cut out switch.

AIR CONDITIONING

7. Psychrometry (08 Periods)

Definition, importance, specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT, sensible heat, latent heat, Total enthalpy of air.

8. Applied Psychrometry and Heat Load Estimation. (08 Periods)

Psychrometric chart, sensible heating and cooling, Adiabatic cooling, Humidification and dehumidification, cooling and humidification, cooling and dehumidification, heating and humidification, heating and dehumidification, by pass factor, room sensible heat factor, effective room sensible heat factor, grand sensible heat factor, ADP, room DPT. Heating and cooling load calculation.

Heating and humidification, cooling and dehumidification, window air-conditioning, split type air-conditioning, car air-conditioning, central air-conditioning.

9. Latest development in refrigeration and air conditioning:- (06 Periods)
Inverter technology, auto-defrosting, blast cooling, star rating.

LIST OF PRACTICALS

1. Demonstration of various refrigeration tools and equipment.
2. Practice in cutting, bending, flaring, swaging and brazing of tubes.
3. Study of thermostatic switch, LP/HP cut out overload protector filters, strainers and filter driers.
4. Identify various parts of a refrigerator and window air conditioner.
5. To find COP of Refrigeration system
6. To measure air flow using anemometer.
7. Charging of a refrigerator/ air conditioner.
8. To detect faults in a refrigerator/ air conditioner
9. Visit to an ice plant or cold storage plant. or central air conditioning plant.
10. Demonstration and working of window type air-conditioner.
11. Demonstration and working of split type air-conditioner.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Report Writing
- Viva-voce

INSTRUCTIONAL STRATEGY

1. Teachers should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components.
2. While imparting instructions, focus should be on conceptual understanding.
3. Training slides of “Carrier Fundamentals of Refrigeration Air Conditioning” to be shown to students.

RECOMMENDED BOOKS

8. Refrigeration and Air Conditioning by Domkundwar; Dhanpat Rai and Sons, Delhi.
9. Refrigeration and Air Conditioning by CP Arora; Tata McGraw Hill, New Delhi.
10. Refrigeration and Air Conditioning by R.S Khurmi and J.K. Gupta; S Chand and Company Limited, New Delhi.
11. Refrigeration and Air Conditioning by Dr.Harjeev Khanna; Dhanpat Rai and Sons, Delhi.

12. Refrigeration and Air Conditioning by Dr. R.K Rajput; S.K. Kataria and Sons, Ludhiana.
 13. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	07	09
2	10	14
3	07	09
4	08	12
5	08	12
6	08	12
7	08	12
8	08	12
9	06	08
Total	70	100

4.3 HYDRAULICS AND PNEUMATICS

L T P
5 1 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.

LEARNING OUTCOMES

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

- Explain fluid properties, their units and conversion.
- Measure different types of pressures.
- Maintain different types of pressure gauges.
- Calculate flow and discharge of various liquids.
- Apply Bernoulli's theorem for calculating pipe diameter and height of pipe from ground.
- Calculate pipe friction and losses in pipelines.
- Specify hydraulic machines for different applications.
- Apply Pascal's law in practical applications.
- Explain the functions of various components used in hydraulic and pneumatic system.
- Maintain hydraulic and pneumatic system.

DETAILED CONTENTS

1. Introduction (06 Periods)

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 (07 Periods)

- 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

3. Flow of Fluids (09 Periods)
- 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 (10 Periods)
- 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, power developed. Water hammer, anchor block, siphon, 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 System (05 Periods)
- Description, operation and application of hydraulic systems – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press.
6. Water Turbines and Pumps (14 Periods)
- 6.1 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, Cavitations.
- 6.2 Concept of hydraulic pump, single acting reciprocating pump (construction and operation only), vane, screw and gear pumps.
- 6.3 Construction, working and operation of centrifugal pump. Performance, efficiencies and specifications of a centrifugal pump, pitting, cavitation, priming.
7. Introduction to Oil Power Hydraulics and Pneumatics (05 Periods)
- 7.1 Introduction to oil power hydraulic and pneumatic system
- 7.2 Statement of Pascal law and its applications
- 7.3 Industrial applications of oil power hydraulic and pneumatic system

8. Components of Hydraulic Systems (06 Periods)
- 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 (08 Periods)
- 9.1 Basic components – function of each component
 - 9.2 Air compressors - Introduction
 - 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. Direct operation of single and double acting cylinder.
10. Automatic operation of double acting cylinder in single cycle using limit switch.
11. Operation of double acting cylinder with quick exhaust valve.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching-learning
2. Expose students to real life problems
3. Plan assignments so as to promote problem solving abilities and develop continued

learning skills

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. Hydraulic and Pneumatic Control by K Shammuga Sundaram, S. Chand & Co. Ltd., New Delhi
6. Hydraulics and Hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd., Delhi.
7. Hydraulic and Pneumatic Power and Control Design, Performance and Application byYeaple, McGraw Hill, New York..
8. Pneumatic Controls by Festo Didactic; Bangalore.
9. Pneumatics Control: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel – Verlag.
10. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	08
2	07	10
3	09	12
4	10	15
5	05	08
6	14	20
7	05	07
8	06	08
9	08	12
Total	70	100

4.4 COMPUTER AIDED DESIGN AND MANUFACTURING

L T P
4 - 6

RATIONALE

Manufacturing of this century belongs to computerized equipment & machine tools to manufacture a variety of components with high quality, high precision & low cost at a faster rate. Computer Aided Designing, Computer Aided Manufacturing, & Flexible Manufacturing Systems-all are the part of Computer Integrated Manufacturing which help to achieve the desired goals in manufacturing. After studying the subject, the students will be able to know about these integrated techniques which help a manufacturer to achieve his goal with in stipulated time.

LEARNING OUTCOMES

At the end of the course, the students will be able to:

- know about Computer aided design and manufacturing.
- know the process of 2D & 3D transformations
- know the method of viewing objects in 3D space.
- know about CNC operations for turning and milling.
- understand about tool path generation and verification.
- know about flexible manufacturing system.
- know about Rapid Prototype additive manufacturing
- know about robotics.

DETAILED CONTENTS

1. Introduction (08 periods)
 - 1.1 Introduction to CAD/CAM/CIM
 - 1.2 Advantages of CAD/CAM
 - 1.3 Product Cycle and CAD/CAM
 - 1.4 Automation and CAD/CAM
 - 1.5 Reasons for implementation of CAD/CAM
 - 1.6 Steps involved in CAM operation

2. Surface / Solid Modelling Using CAD/CAM (08 periods)
 - 2.1 Introduction to parametric and non-parametric surfaces
 - 2.2 Creation of simple surfaces using revolved surface, ruled surface and 3D surfaces commands
 - 2.3 Designing Software used in creation of solid models
 - 2.4 Concept of solid models
 - 2.5 Solid Primitives- Box, cylinder, Cone, Sphere, Wedge and torus
 - 2.6 Construction of solid using Region, Extrude and Revolved feature

- 2.7 Creation of Composite solid using Boolean function e.g. Union, Subtraction and Intersection.
 - 2.8 Sectioning of Solids and modification of solid Edges and faces using solid editing commands. Shell, Separate commands.
 - 2.9 Performing 3D operations like 3D array, mirror and rotate
 - 2.10 Creation of fillets and chamfers
 - 2.11 Dimensioning of solids
 - 2.12 2D and 3D transformation: Translation, Scaling, rotation, mirror, zooming, panning and clipping.
- 3. Viewing Objects in 3D Space (08 periods)**
- 3.1 Viewing the objects in different views.
 - 3.2 Concept of SW, SE, NE and Isometric Views.
 - 3.3 View Ports
 - 3.4 Layout, changing from Model to Paper space Layout
 - 3.5 Arranging the Drawing showing different views to get the hard copy
 - 3.6 Plotting the drawing
- 4. CAM (Computer Aided Manufacturing) (10 periods)**
- 4.1 Setting up the jobs, defining the operation, creating geometry
 - 4.2 Specifying the tools, machining parameters and type of machining
 - 4.3 Back plotting and verification of operation
 - 4.4 Post processing - Converting the generated tool path in NC code depending on the system
 - 4.5 Setting up the parameter relating to communication like transfer of programs to CNC machine
 - 4.6 Transfer of drawing data from any CAD software to CNC MIC and generation of G-codes, M-codes.
- 5. Flexible Manufacturing System (08 periods)**
- 5.1 Introduction to FMS.
 - 5.2 Principles of flexibility, changes in manufacturing system - external changes and internal changes job flexibility, machine flexibility.
 - 5.3 Features of FMS – production equipment, support system, material handling system, computer control system.
 - 5.4 Advantages & limitations of FMS.

6. Manufacturing Applications- Rapid Prototyping (06 periods)
- 6.1 3D printing
 - 6.2 Fused deposition modeling
 - 6.3 Laminated object manufacturing
 - 6.4 Selective laser sintering
 - 6.5 Stereo lithography
 - 6.6 Ball 3 to 2 particle manufacturing
7. Robotics (08 periods)
- 7.1 Introduction to robot
 - 7.2 Robot configuration
 - 7.3 Robot motions
 - 7.4 Robot programming languages
 - 7.5 Work cell, control and interlock, robot sensors
 - 7.6 Robot applications

LIST OF PRACTICALS

1. Performing 3D operations like Array, mirror, rotation, translation using solid works.
2. Performing 3D operation- panning, zooming, clipping etc.
3. CNC Programming for turning operation
4. CNC Programming for pocket milling
5. CNC Programming for profile milling
6. CNC Programming for facing and drilling
7. Performing operation on trainer Lathe
8. Designing of Simple machine components
9. Designing of Crank shaft (Connecting Rod)
10. Performing simple assembly operations like- nut, bolt, coupling etc.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching learning.
2. Students should be taken to various industrial units for clear conception of topics.
3. Efforts should be made to relate the process of teaching with direct experiences in the industry.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests,
- Model/prototype making
- Practical tasks

RECOMMENDED BOOKS

1. CAD/CAM by Mikell Groover and Zimmers; Prentice Hall of India Pvt. Ltd., Delhi.
2. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
3. Introduction to Robotics by John J. Craig; Pearson Education Asia, Singapore.
4. Industrial Robot by Groover; Prentice Hall of India Pvt. Ltd., Delhi.
5. Robotics by YoremKorem; McGraw Hill International. Book Co., New Delhi.
6. CAD/CAM – Theory and Practice by Zeid; Tata McGraw Hill Publishers, New Delhi.
7. CAD/CAM/CIM by S. Radha Krishan.
8. CNC Machines by Dr. B.S. Pabla – New Age Publications.
9. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	15
2	08	15
3	08	15
4	10	16
5	08	15
6	06	09
7	08	15
Total	56	100

4.5 ENVIRONMENTAL STUDIES

L T P
3 - 2

RATIONALE

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 ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

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

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

DETAILED CONTENTS

1. Introduction (04 Periods)
 - 1.1 Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.
2. Air Pollution (04 Periods)
 - 2.1 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.
3. Water Pollution (08 Periods)
 - 3.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O₂, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.
4. Soil Pollution (06 Periods)

- 4.1 Sources of soil pollution
 - 4.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
 - 4.3 Effect of Solid waste
 - 4.4 Disposal of Solid Waste- Solid Waste Management
5. Noise pollution (06 Periods)
- Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.
6. Environmental Legislation (08 Periods)
- Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).
7. Impact of Energy Usage on Environment (06 Periods)
- Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

LIST OF PRACTICALS

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies

like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	10
2	04	10
3	08	20
4	06	14
5	06	14
6	08	20
7	06	12
Total	42	100

4.6 ENERGY CONSERVATION

L T P
3 - 2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

2. Energy Conservation and EC Act 2001

- 2.1 Introduction to energy management, energy conservation, energy efficiency and its need
 - 2.2 Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance. Prominent organizations at centre and state level responsible for its implementation.
 - 2.3 Standards and Labeling: Concept of star rating and its importance, Types of product available for star rating
3. Electrical Supply System and Motors
 - 3.1 Types of electrical supply system
 - 3.2 Single line diagram
 - 3.3 Losses in electrical power distribution system
 - 3.4 Understanding Electricity Bill: Transformers Tariff structure, Components of power (kW, kVA and kVAR) and power factor, improvement of power factor, Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)
 - 3.5 Transformers: Introduction, Losses in transformer, transformer Loading, Tips for energy savings in transformers
 - 3.6 Electric Motors
Types of motors, Losses in induction motors Features and characteristics of energy efficient motors, Estimation of motor loading, Variation in efficiency and power factor with loading, Tips for energy savings in motors
4. Energy Efficiency in Electrical Utilities
 - 4.1 Pumps: Introduction to pump and its applications, Efficient pumping system operation, Energy efficiency in agriculture pumps, Tips for energy saving in pumps
 - 4.2 Compressed Air System: Types of air compressor and its applications, Leakage test, Energy saving opportunities in compressors.
 - 4.3 Energy Conservation in HVAC and Refrigeration System: Introduction, Concept of Energy Efficiency Ratio (EER), Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.
5. Lighting and DG Systems
 - 5.1 Lighting Systems: Basic definitions- Lux, lumen and efficacy, Types of different lamps and their features, Energy efficient practices in lighting
 - 5.2 DG Systems: Introduction, Energy efficiency opportunities in DG systems, Loading estimation

6. Energy Efficiency in Thermal Utilities

- 6.1 Thermal Basics: Thermal energy, Energy content in fuels, Energy Units and its conversions in terms of Metric Tonne of Oil Equivalent (MTOE)
- 6.2 Energy Conservation in boilers and furnaces : Introduction and types of boilers, Energy performance assessment of boilers, Concept of stoichiometric air and excess air for combustion, Energy conservation in boilers and furnaces, Do's and Don'ts for efficient use of boilers and furnaces
- 6.3 Cooling Towers: Basic concept of cooling towers, Tips for energy savings in cooling towers
- 6.4 Efficient Steam Utilization

7. Energy Conservation Building Code (ECBC)

- 7.1 ECBC and its salient features
- 7.2 Tips for energy savings in buildings: New Buildings, Existing Buildings

8. Waste Heat Recovery and Co-Generation

- 8.1 Concept, classification and benefits of waste heat recovery
- 8.2 Concept and types of co-generation system

9. General Energy Saving Tips

Energy saving tips in:

- 9.1 Lighting
- 9.2 Room Air Conditioner
- 9.3 Refrigerator
- 9.4 Water Heater
- 9.5 Computer
- 9.6 Fan, Heater, Blower and Washing Machine
- 9.7 Colour Television
- 9.8 Water Pump
- 9.9 Cooking
- 9.10 Transport

10. Energy Audit

- 10.1 Types and methodology
- 10.2 Energy audit instruments
- 10.3 Energy auditing reporting format

PRACTICAL EXERCISES

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

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
2. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
3. Guide book on Energy Efficiency in Thermal Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015

4. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition

Important Links:

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

4.7 Universal Human Values

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Course Objectives

This introductory course input is intended

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

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

Course Methodology

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

The syllabus for the lectures is given below:

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

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

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

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

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

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

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

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

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

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

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

1. Natural acceptance of human values

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

Practical Session also Includes Different Yogic Exercises and Meditation Session

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

Reference Material

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

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

b. The teacher's manual (Latest Edition)

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

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

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

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

Relevant websites, movies and documentaries

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

SUGGESTED DISTRIBUTION OF MARKS

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

INDUSTRIAL TRAINING

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

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

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

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

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

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

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

5.1 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

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RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mindset with managerial skills helps the student in the job market. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

LEARNING OUTCOMES

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

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of the organization.
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, JIT and CRM.

DETAILED CONTENTS

SECTION – A

ENTREPRENEURSHIP

- | | | |
|-----|--|--------------|
| 1. | Introduction | (04 Periods) |
| 1.1 | Concept /Meaning and its need | |
| 1.2 | Qualities and functions of entrepreneur and barriers in entrepreneurship | |

- 1.3 Sole proprietorship and partnership forms and other forms of business organisations
 - 1.4 Schemes of assistance by entrepreneurial support agencies at National, State, District–level, organisation: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks
2. Market Survey and Opportunity Identification/Ideation (04 Periods)
 - 2.1 Scanning of the business environment
 - 2.2 Salient features of National and Haryana State industrial policies and resultant business opportunities
 - 2.3 Types and conduct of market survey
 - 2.4 Assessment of demand and supply in potential areas of growth
 - 2.5 Identifying business opportunity
 - 2.6 Considerations in product selection
 - 2.7 Converting an idea into a business opportunity
 3. Project report Preparation (06 Periods)
 - 3.1 Preliminary project report
 - 3.2 Detailed project report including technical, economic and market feasibility
 - 3.3 Common errors in project report preparations
 - 3.4 Exercises on preparation of project report
 - 3.5 Sample project report

SECTION –B

MANAGEMENT

4. Introduction to Management (06 Periods)
 - 4.1 Definitions and importance of management
 - 4.2 Functions of management: Importance and process of planning, organising, staffing, directing and controlling
 - 4.3 Principles of management (Henri Fayol, F.W. Taylor)
 - 4.4 Concept and structure of an organisation
 - 4.5 Types of industrial organisations and their advantages
 - 4.6 Line organisation, staff organisation

- 4.7 Line and staff organisation
- 4.8 Functional Organisation

5. Leadership and Motivation (08 Periods)

- 5.1 Leadership: Definition and Need, Qualities and functions of a leader, Manager Vs leader, Types of leadership, Case studies of great leaders
- 5.2 Motivation: Definition and characteristics, Importance of self motivation, Factors affecting motivation, Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas (14 Periods)

- 6.1 Human Resource Management: Introduction and objective, Introduction to Man power planning, recruitment and selection, Introduction to performance appraisal methods
- 6.2 Material and Store Management: Introduction functions, and objectives, ABC Analysis and EOQ
- 6.3 Marketing and sales: Introduction, importance, and its functions, Physical distribution, Introduction to promotion mix, Sales promotion
- 6.4 Financial Management: Introductions, importance and its functions, knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture (08 Periods)

- 7.1 Introduction and importance of Healthy Work Culture in organization
- 7.2 Components of Culture
- 7.3 Importance of attitude, values and behavior
- 7.4 Behavioural Science – Individual and group behavior.
- 7.5 Professional ethics – Concept and need of Professional Ethics and human values.

8. Basic of Accounting and Finance (10 Periods)

- 8.1 Basic of Accounting: Meaning and definition of accounting, Double entry system of book keeping, Trading account, PLA account and balance sheet of a company
- 8.2 Objectives of Financial Management: Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics (10 Periods)

- 9.1 Total Quality Management (TQM): Statistical process control, Total employees Involvement, Just in time (JIT)
- 9.2 Intellectual Property Right (IPR) : Introduction, definition and its importance, Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/Prototype making.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development and Management by J.S.Narang; Dhanpat Rai & Sons, Delhi.
3. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
4. Handbook of Small Scale Industry by PM Bhandari
5. Entrepreneurship Development and Management by MK Garg
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	06
2	04	06
3	06	08
4	06	08
5	08	12
6	14	20
7	08	12
8	10	14
9	10	14
Total	70	100

5.2 THEORY OF MACHINES

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5 2 -

RATIONALE

A diploma holder in this course 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. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

LEARNING OUTCOMES

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

- explain working of different types of mechanisms and draw their inversion.
- solve problems on power transmission.
- determine ratio of driving tension for flat and V-belt drive.
- identify various types of gears and their applications.
- construct turning moment diagram of flywheel for different types of engine.
- construct Cam Profile.
- calculate balancing of rotating mass and its position.
- identify different type of vibrations, their causes, harmful effect and remedies.

DETAILED CONTENTS THEORY

- | | | |
|----|--|--------------|
| 1. | Simple Mechanisms | (06 Periods) |
| | 1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversions. | |
| | 1.2 Different types of mechanisms (with examples) | |
| 2. | Kinematic Analysis and synthesis | (12 Periods) |
| | 2.1 Displacement, velocity and acceleration of plane mechanism | |
| | 2.2 Graphical and analytical techniques. | |
| 3. | Dynamics of Machine | (12 Periods) |
| | 3.1 Static and dynamic force analysis graphical and analytical approaches | |
| | 3.2 Gyroscopic action in machines. | |
| 4. | Power Transmission | (12 Periods) |
| | 4.1 Introduction to Belt and Rope drives | |

- 4.2 Types of belt drives and types of pulleys
 - 4.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
 - 4.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
 - 4.5 Different types of chains and their terminology
 - 4.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear
5. Flywheel (06 Periods)
- 5.1 Principle and applications of flywheel
 - 5.2 Turning - moment diagram of flywheel for different engines
 - 5.3 Fluctuation of speed and fluctuation of energy - Concept only
 - 5.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy
6. Cam and follower (08 Periods)
- Introduction, types of Cam and follower, construction of Cam profile for constant velocity motion, constant acceleration motion and simple harmonic motion
7. Balancing (06 Periods)
- 7.1 Concept of balancing
 - 7.2 Introduction to balancing of rotating masses (simple numericals)
8. Vibrations (08 Periods)
- 8.1 Types-longitudinal, transverse and torsional vibrations (simple numericals)
 - 8.2 Dampening of vibrations
 - 8.3 Causes of vibrations in machines, their harmful effects and remedies

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching
2. Give assignments for solving numerical problems
3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives
4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

RECOMMENDED BOOKS

1. Theory of Machines by D.R. Malhotra; SatyaPrakashan, New Delhi.
2. Theory of Machines by V.P Singh; Dhanpat Rai and sons, New Delhi.
3. Theory of Machines by Jagdish Lal; Metropolitan Publishers, New Delhi.

4. Theory of Machine by B.S Ubhi; S.K. Kataria and Sons, New Delhi.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in> .

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	08
2	12	16
3	12	16
4	12	18
5	06	08
6	08	14
7	06	08
8	08	12
Total	70	100

5.3 MACHINE DESIGN

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5 2 -

RATIONALE

A diploma holder in this course 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. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

LEARNING OUTCOMES

At the end of this course, students will be able to:

- explain the terms related to design.
- understand Man- machine relationship.
- use codes and standards for designing a component.
- select material for designing a component.
- interpret the various causes of design failures.
- design shaft on the basis of strength and rigidity.
- design various machine elements (key, joint, flange coupling and screwed joints)

DETAILED CONTENTS

- 1. Introduction (08 Periods)**
- 1.1 Design – Definition, Type of design, necessity of design
 - 1.1.1 Comparison of designed and undesigned work
 - 1.1.2 Design procedure
 - 1.1.3 Characteristics of a good designer
 - 1.2 Design terminology: , factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.
 - 1.2.1 General design consideration
 - 1.2.2 Codes and Standards (BIS standards)
 - 1.2.3 Selection of materials, criteria of material selection
 - 1.3 Ergonomics and Aesthetic Consideration in design
 - 1.3.1 Ergonomics of design-man-machine relationship. Design of equipment for control, environment and safety.
 - 1.3.2 Aesthetic consideration regarding shape, size, color and surface finish.
- 2. Design Failure (08 Periods)**
- 2.1 Theories of failure.
 - 2.2 Classification of loads

2.3 Design under tensile, compressive and torsional loads.

3. Design of Shaft (12 Periods)

- 3.1 Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available
- 3.2 Shaft subjected to torsion only, determination of shaft diameter (hollow and solid shaft) on the basis of :
- Strength criterion
 - Rigidity criterion
- 3.3 Determination of shaft diameter (hollow and solid shaft) subjected to bending
- 3.4 Determination of shaft diameter (hollow and solid shaft) subjected to combined torsion and bending .

4. Design of Key (08 Periods)

- 4.1 Types of key, materials of key, functions of key
- 4.2 Failure of key (by Shearing and Crushing).
- 4.3 Design of key (Determination of key dimension)
- 4.4 Effect of keyway on shaft strength. (Figures and problems).

5. Design of Joints (02 Periods)

Types of joints - Temporary and permanent joints, utility of various joints

- 5.1 Temporary Joint:
- 5.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems).
- 5.1.2 Cotter Joint – Different parts of the spigot and socket joints, Design of spigot and socket joint.
- 5.2 Permanent Joint:
- 5.2.1 Welded Joint - Welding symbols. Type of welded joint, strength of parallel and transverse fillet welds.
- 5.2.2 Strength of combined parallel and transverse weld.
- 5.2.3 Riveted Joints. : Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering.
- 5.2.4 Different modes of rivet joint failure.
- 5.2.5 Design of riveted joint – Lap and butt, single and multi riveted joint.

6. Design of Flange Coupling (10 Periods)

Necessity of a coupling, advantages of a coupling, types of couplings, design of muff coupling, design of flange coupling. (Both protected type and unprotected type).

7. Design of Screwed Joints (12 Periods)
- 7.1 Introduction, Advantages and Disadvantages of screw joints, location of screw joints.
 - 7.2 Important terms used in screw threads, designation of screw threads
 - 7.3 Initial stresses due to screw up forces, stresses due to combined forces
 - 7.4 Design of power screws (Press, screw jack, screw clamp)

- Note :** a) Use of design data book during the examination is allowed.
 b) The paper setter should normally provide all the relevant data for the machine Design in the question paper.

INSTRUCTIONAL STRATEGY

1. Use moulds of various parts/components.
2. Presentation should be arranged for various topics.

MEANS OF ASSESSMENT

- Design and drawing

RECOMMENDED BOOKS

1. Machine Design by R.S. Khurmi and JK Gupta, Eurasia Publishing House (Pvt.) Limited, New Delhi.
2. Machine Design by V.B.Bhandari, Tata McGraw Hill, New Delhi.
3. Engineering Design by George Dieter; Tata McGraw Hill Publishers, New Delhi.
4. Mechanical Engineering Design by Joseph Edward Shigley; McGraw Hill, Delhi.
5. Machine Design by Sharma and Agrawal; Katson Publishing House, Ludhiana.
6. Design Data Handbook by D.P. Mandali, SK Kataria and Sons, Delhi.
7. Machine Design by A.P.Verma; SK Kataria and Sons, Delhi
8. Machine Design by AR Gupta and BK Gupta ; Satya Parkashan, New Delhi.
9. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	10
2	08	10
3	12	18
4	08	12
5	12	18
6	10	14
7	12	18
Total	70	100

5.4 PRODUCTION TECHNOLOGY

L T P
6 - 8

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes, modern machining methods, tools, jigs and fixtures is required to be imparted. Hence the subject of production technology.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Perform turning, step turning, taper turning, threading and knurling operation on lathe machine.
- Resharpen/grind single point tool.
- Select material and tool geometry for cutting tools on lathe.
- Explain uses of lathe accessories and different types of lathes.
- Perform drilling, reaming, counter boring, counter sinking and tapping operations on drilling machine.
- Explain the nomenclature of a drill and milling cutter.
 - Describe the features of various types of Milling machines
 - Use milling machine accessories and attachments.
 - Perform milling machine operations on vertical and horizontal milling machine.
- Perform keyway cutting and angular/step surface shaping on shaper.
- Explain geometry of single point cutting tool, various types of lathe tools and tool materials.
- Explain boring operation, features of boring machine and boring tool.
- Explain the features of locating devices, clamping devices, jigs and fixtures.
- Select cutting fluid for different materials and operations.
- Describe the features of various types of broaching machines.
 - Operate tool and cutter grinder
 - Operate cylindrical grinder, surface grinder, internal grinder.
 - Explain the working and use of modern machining methods.

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (06 Periods)
 - 1.1. Cutting Tools - Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect, Heat produced during cutting and its effect, Cutting speed, feed and depth of cut and their effect
 - 1.2. Cutting Tool Materials - Properties of cutting tool material, Study of various cutting tool materials viz. High-speed steel, tungsten carbide, cobalt steel cemented carbides, stellite, ceramics and diamond.

2. Lathe (12 Periods)
 - 2.1 Principle of turning
 - 2.2 Description and function of various parts of a lathe
 - 2.3 Classification and specification of various types of lathe
 - 2.4 Drives and transmission
 - 2.5 Work holding devices
 - 2.6 Lathe tools: Parameters/Nomenclature and applications
 - 2.7 Lathe operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning.
 - 2.8 Cutting parameters – Speed, feed and depth of cut for various materials and for various operations, machining time.
 - 2.9 Speed ratio, preferred numbers of speed selection.
 - 2.10 Lathe accessories:-Centers, dogs, different types of chucks, collets, face plate, angle plate, mandrel, steady rest, follower rest, taper turning attachment, tool post grinder, milling attachment, Quick change device for tools.
 - 2.11 Brief description of capstan and turret lathe, comparison of capstan/Turret lathe, work holding and tool guiding devices in capstan and turret lathe.

3. Milling (10 Periods)
 - 3.1 Specification and working principle of milling machine
 - 3.2 Classification, brief description and applications of milling machines
 - 3.3 Details of column and knee type milling machine
 - 3.4 Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment shover chuck and rotary table.
 - 3.5 Milling methods - up milling and down milling
 - 3.6 Identification of different milling cutters and work mandrels
 - 3.7 Work holding devices

- 3.8 Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.
- 3.9 Cutting speed and feed, simple numerical problems.
- 4. Drilling (06 Periods)
 - 4.1 Principle of drilling.
 - 4.2 Classification of drilling machines and their description.
 - 4.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
 - 4.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
 - 4.5 Types of drills and their features, nomenclature of a drill
 - 4.6 Drill holding devices.
 - 4.7 Types of reamers.
- 5. Boring (06 Periods)
 - 5.1 Principle of boring
 - 5.2 Classification of boring machines and their brief description.
 - 5.3 Specification of boring machines.
 - 5.4 Boring tools, boring bars and boring heads.
 - 5.5 Description of jig boring machine.
- 6. Shaping and Planing (08 Periods)
 - 6.1 Working principle of shaper and planer
 - 6.2 Type of shapers
 - 6.3 Type of planers
 - 6.4 Quick return mechanism applied to shaper and planer machine.
 - 6.5 Work holding devices used on shaper and planer
 - 6.6 Types of tools used and their geometry.
 - 6.7 Specification of shaper and planer .
 - 6.8 Speeds and feeds in above processes.
- 7. Broaching (04 Periods)
 - 7.1 Introduction
 - 7.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.
 - 7.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.

8. Jigs and Fixtures (10 Periods)
- 8.1 Importance and use of jigs and fixture
 - 8.2 Principle of location
 - 8.3 Locating devices
 - 8.4 Clamping devices
 - 8.5 Types of Jigs – Drilling jigs, bushes, template jig, plate jig, channel jig, leaf jig.
 - 8.6 Fixture for milling, turning, welding, grinding
 - 8.7 Advantages of jigs and fixtures
9. Cutting Fluids and Lubricants (06 Periods)
- 9.1 Function of cutting fluid
 - 9.2 Types of cutting fluids
 - 9.3 Difference between cutting fluid and lubricant
 - 9.4 Selection of cutting fluids for different materials and operations
 - 9.5 Common methods of lubrication of machine tools.
10. Grinding (08 Periods)
- 10.1 Purpose of grinding
 - 10.2 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
 - 10.3 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
 - 10.4 Truing, dressing, balancing and mounting of wheel.
 - 10.5 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
 - 10.6 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
 - 10.7 Selection of grinding wheel
11. Modern Machining Processes (08 Periods)
- 11.1 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
 - 11.2 Electro Chemical Processes - Electro chemical machining (ECM) – Fundamental principle, process, applications
 - 11.3 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid, applications
 - 11.4 Laser beam machining (LBM) – Introduction, machining process and applications
 - 11.5 Plasma arc machining (PAM) and welding – Introduction, principle process and applications

PRACTICAL EXERCISES

TURNING SHOP

- Job 1. Grinding of single point turning tool.
- Job 2. Exercise of simple turning and step turning.
- Job 3. A composite job involving, turning, taper turning, external thread cutting and knurling.

ADVANCE FITTING SHOP

- Job 1. Exercise on drilling, reaming, counter boring, counter sinking and tapping
- Job 2. Dove tail fitting in mild steel
- Job 3. Radius fitting in mild steel
- Job 4. Pipe threading with die

MACHINE SHOP

- Job 1. Prepare a V-Block up to ± 0.5 mm accuracy on shaper machine
- Job 2. Exercise on key way cutting and spline cutting on shaper machine.
- Job 3. Produce a rectangular block by facing on a slotting machine
- Job 4.. Produce a rectangular slot on one face with a slotting cutter
- Job 5. Produce a rectangular block using a milling machine with a side and face cutter
- Job 6. Prepare a slot on one face using milling machine

FORGING SHOP/FITTING SHOP/SHEET METAL SHOP

- Job 1. Preparation of single ended spanner by hand, machine forging
- Job 2. Preparation of simple die
- Job 3. Demonstration of spinning process on lathe and spinning a bowl on a lathe machine
- Job 4. Demonstration of grinding process on lathe machine and grinding a job on a lathe machine
- Job 5. Preparation of utility item out of G.I. sheet
- Job 6. Preparation of drilling jig

ADVANCE TURNING SHOP

- 1. Exercise of boring with the help of boring bar
- 2. Exercises on internal turning on lathe machine
- 3. Exercises on internal threading on lathe machine
- 4. Exercises on external turning on lathe machine
- 5. Resharpener of single point cutting tool with given geometry

MACHINE SHOP

- 1. Job on grinding machine using a surface grinder
- 2. Prepare a job on cylindrical grinding machine.
- 3. Exercise on milling machine with the help of a form cutter

4. Exercise on milling machine to produce a spur gear
5. Grinding a drill-bit on tool and cutter grinder
6. Exercise on dressing a grinding wheel

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis in making students conversant with concepts and principles, produces and practices related to various manufacturing processes.
2. Focus should be laid in preparing jobs using various machines/equipment in the workshop.
3. Use of audio-visual aids/video films should be made to show specialized operations.
4. Foreman Instructor should conduct classes of each workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practical's.
5. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing process.
6. Focus should be on preparing jobs using various machines in the workshop.

RECOMMENDED BOOKS

1. Manufacturing Technology by Rao; Tata McGraw Hill Publishers, New Delhi
2. Workshop Technology Vol. I, II, III by Chapman; Standard Publishers Distributors. New Delhi.
3. Production Engineering and Science by Pandey and Singh; Standard Publishers Distributors, New Delhi.
4. A Text Book of Production Engineering by P.C. Sharma; S. Chand and Company Ltd., New Delhi.
5. Workshop Technology Vol. III, by R. P. Dhiman, Ishan Publications Jalandhar
6. Production Technology by HMT; Tata McGraw Publisher, New Delhi
7. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons; Delhi
8. Elements of Workshop Technology by SK Choudhry and Hajra; Asia Publishing House
9. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	06	08
2.	12	14

3.	10	12
4.	06	08
5.	06	16
6.	08	09
7.	04	05
8.	10	12
9.	06	06
10.	08	10
11.	08	10
Total	84	100

5.5 PRODUCTION MANAGEMENT

L T P
4 - 2

RATIONALE

Diploma holder 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.

Learning Outcomes

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

- Solve planning, scheduling and sequencing problems for shop floor
- Interpret different kinds of production systems
- Prepare break-even analysis and Gantt chart.
- Explain the importance of inspection.
- Prepare various control charts.
- Apply different techniques to improve quality of products and processes.
- Carryout estimating and costing of production cost
- Explain the objective, importance and types of maintenance.
- Explain the salient features of labour legislation Acts.

DETAILED CONTENTS.

- | | | |
|----|--|--------------|
| 1. | Production Planning and Control (PPC) | (12 Periods) |
| | 1.1 Introduction. | |
| | 1.2. Objectives and factors affecting PPC | |
| | 1.3. Functions (Elements) of PPC - Planning, Routing, Loading, scheduling, dispatching, progressing and inspection | |
| | 1.4. Types of production system - Flow or continuous production, Intermittent Production | |
| | 1.5. Production Control - Objectives and fields of production control, Production control system | |
| | 1.6 Break even analysis and Gantt chart. | |

2. Inspection and Quality Control (14 Periods)
- 2.1. Inspection – Introduction, Need and Importance
 - 2.1.1. Types of Inspection
 - 2.1.2. Role of operator and inspector in inspection
 - 2.2. Quality Control
 - 2.2.1. Introduction, Need and Importance
 - 2.2.2. Factors affecting product quality
 - 2.3. Quality Assurance
 - 2.4. Statistical Quality Control (SQC)
 - 2.4.1. Acceptance Sampling, Sampling Plan- Single and double sampling plan
 - 2.4.2. Operating Characteristics Curve
 - 2.4.3. Control Charts – Introduction, advantages, Types of control charts(X, R, p and c charts)
 - 2.4.4. Concept of ISO 9000, ISO 14000 and TQM.
 - 2.4.5. QC tools
 - 2.4.6. 6σ Approach
3. Cost Estimation (14 Periods)
- 3.1. Definition and functions of cost estimation
 - 3.2. Estimation procedure
 - 3.3. Elements of cost, ladder of costs (simple numericals)
 - 3.4. Overhead expenses and its distribution
 - 3.5. Depreciation- Concept and Definition, Methods of calculating depreciation- Straight line method, Diminishing Balance Method, Sinking fund method (Numerical problems).
 - 3.6. Cost control- definition and objectives, Capital cost control (planning and scheduling), operating cost control.
 - 3.7. Cost estimation for machining processes like turning, drilling, and milling. Cost estimation of forming processes like forging, pattern making, and casting.
4. Repair and Maintenance (08 Periods)
- 4.1. Objectives and importance of Maintenance
 - 4.2. Different types of maintenance- Corrective or Breakdown maintenance, Scheduled Maintenance, Preventive Maintenance, Predictive Maintenance
 - 4.3. Nature of maintenance problems
 - 4.4. Range of maintenance problems
5. Labour Legislation and Pollution Control Acts (08 Periods)
- 5.1. Factory Act 1948.
 - 5.2. Workmen's compensation Act 1923.

- 5.3 Apprentices Act 1961.
- 5.4 Water Pollution Control Act 1974 and 1981.
- 5.5 Air Pollution Control Act 1981.
- 5.6 Environmental protection Act 1986.
- 5.7 PF Act, Employee's State Insurance (ESI) Act
- 5.8 Pollution control provision in Motor Vehicle Act.

LIST OF PRACTICALS

1. Prepare a flow diagram
2. Prepare a Gantt chart
3. Draw X, R, p and c charts
4. Estimate the cost of turning
5. Estimate the cost of drilling
6. Prepare maintenance schedule

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching-learning.
2. Students should be taken to various industrial units for clear conception of various topics.
3. Efforts should be made to relate the process of teaching with direct experiences in the industry.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/prototype making

RECOMMENDED BOOKS

1. Production Management by C.L. Mahajan; Satya Parkashan Company Limited, New Delhi.
2. Mechanical Costing, Estimation and Project Planning by CK Singh; Standard Publishers, New Delhi.
3. Industrial Engineering and Management by T.R. Banga and SC Sharma; Khanna Publishers, Delhi.
4. Industrial Engineering and Management by O.P. Khanna; Dhanpat Rai and Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted	Marks Allotted
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	(Hrs)	(%)
1	12	22
2	14	25
3	14	25
4	08	14
5	08	14
Total	56	100

5.6 AUTOMOBILE ENGINEERING

L T P
4 - 4

RATIONALE

These days, automobile has become a necessity instead of luxury. The diploma holders in this course 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.

LEARNING OUTCOMES

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

- Explain the functions of different chassis components and drive types.
- Explain the working of transmission system.
- Explain the working principle of steering system.
- Carry out routine servicing of brake system and bleeding of hydraulic brakes.
- Explain the function and types of suspension systems.
- Carry out testing and charging of lead-acid battery.
- Interpret Bharat norms of exhaust emissions.

DETAILED CONTENTS

- | | | |
|----|--|--------------|
| 1. | Introduction | (06 Periods) |
| | <ul style="list-style-type: none"> 1.1 Automobile and its development 1.2 Various types of automobiles manufactured in India, their manufacturer and location of their manufacturing unit. 1.3 Classification of automobiles 1.4 Layout of chassis 1.5 Types of drives-front wheel, rear wheel, four wheel. 1.6 Introduction to electric and hybrid vehicles. 1.7 Governing of fuel- carburettor, electronic control module (ECM i.e, 8 bit,16 bit and 32 bit computers) 1.8 Concept of double overhead cam, single overhead cam, Twin cam 16 valvetechology in 4 cylinder engine. | |
| 2. | Transmission System | (12 Periods) |
| | <ul style="list-style-type: none"> 2.1 Clutch - Function, Constructional details of single plate and multi plate friction clutches, Centrifugal and semi centrifugal clutch, Cone clutch, Hydraulic clutch 2.2 Gear Box - Function, Working of sliding mesh, constant mesh and synchromesh gear box, Torque converter and overdrive, Introduction to Automated Manual Transmission, Automatic transmission and Continuously Variable Transmission. | |

- 2.3 Propeller shaft and rear axle - Function, Universal joint, Differential, Different types of rear axles and rear axle drives.
- 2.4 Wheels and Tyres - Types of wheels, Types and specifications of tyres used in Indian vehicles, Toe in, toe out, camber, caster, kingpin inclination, Wheel balancing and alignment, Factors affecting tyre life.
3. Steering System (06 Periods)
- Function and principle, Ackerman and Davis steering gears, Types of steering gears - worm and wheel, rack and pinion, Power steering-Hydraulic and Electrical.
4. Braking system (08 Periods)
- Constructional details and working of mechanical, hydraulic, air and vacuum brake, Relative merits and demerits. Details of master cylinder, wheel cylinder, Concept of brake drum, brake lining/pad and Brake adjustment, Introduction to Anti-lock Brake System and its working.
5. Suspension System (08 Periods)
- Function and types of Coil spring, leaf spring, Air suspension, Shock absorber –Function, construction and working of Telescopic type.
6. Battery (10 Periods)
- Constructional details of lead acid cell battery, Specific gravity of electrolyte -effect of temperature on specific gravity, Specification of battery-capacity, rating, number of plates, selection of battery for particular use, Battery charging, chemical reactions during charge and discharge, Maintenance of batteries, Checking of batteries for voltage and specific gravity. Batteries for electric and hybrid vehicles.
7. Exhaust Emissions (06 Periods)
- Types and use of catalytic converters, selective catalytic reduction methods for emission control, emission norm standards i.e. Bharat norms.

LIST OF PRACTICALS

- 1 Fault and their remedies in Battery Ignition system
- 2 Adjustment of Head Light Beam (ii) Wiper and Indicators.
- 3 Dismantling and inspection of (i) AC Pump (ii) SU Pump
- 4 Dismantle (i) rear axle (ii) differential and find out the gear ratio of crown wheel & driven sun gear and planet pinion..
- 5 Fault finding practices on an automobile - four wheelers (petrol/ diesel vehicles).
6. Servicing/Tuning of a 2 wheeler/4 wheeler.
7. Servicing of hydraulic brakes :

a) adjustment of brakes

b) bleeding of brakes

c) fitting of leather pads

- 8 Tuning of an automobile engine.
- 9 Testing and Charging of an automobile battery and measuring cell voltage and specific gravity of electrolyte.
- 10 Changing of wheels and inflation of tyres, balancing of wheels.
- 11 Measuring spark gap, valve clearance and ring clearance; carrying out cleaning operations for adjustment.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching-learning
2. Expose the students to real life problems
3. Plan assignments so as to promote problem solving abilities and develop continued learning skills

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid- Semester Examination
- Group discussion
- Semester Examination
- Presentation

RECOMMENDED BOOKS

1. Automobile Engineering by GBS Narang; Khanna Publishers, Delhi.
2. Automobile Engineering by Dr.Kirpal Singh; Standard Publishers and Distributors, Delhi.
3. Automotive Mechanics, by W.Crouse and Anglin; Tata McGraw Hill, Delhi.

4. Automobile Engineering by G. S. Aulakh; Eagle Prakashan, Jalandhar
7. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	6	10
2	12	20
3	6	10
4	8	15
5	8	15
6	10	20
7	06	10
Total	56	100

6.1 INDUSTRIAL ENGINEERING

L T P
6 - 2

RATIONALE

A diploma holder in this course will have to conduct time and motion study to improve the methods/system. For this, knowledge and related skills in method study and work measurement are essential. Knowledge of industrial safety is also required. Hence this subject.

LEARNING OUTCOMES

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

- use industrial engineering concepts to improve productivity
- use resources optimally and economically.
- apply work study techniques for improving production
- explain various incentive plans
- maintain inventory optimally and classify different types of inventory
- take preventive measures to avoid accidents use of safety device.

DETAILED CONTENTS

1. Productivity (10 Periods)
Introduction to productivity, factors affecting productivity, practical measurement of productivity, difference between production and productivity, causes of low productivity and methods to improve productivity, contribution of standardization in improving productivity.
2. Work Study (10 Periods)
Definition and scope of work study; factors for selection of work study job, uses and limitations of work study, Inter-relation between method study and work measurement; Human aspects of work study; Role of work study in improving productivity.
3. Method Study (10 Periods)
Definition, Objectives and procedure for Method study analysis; Information collection and recording techniques through various diagrams.
4. Motion Analysis (10 Periods)
Principles of Motion analysis; Therbligs and SIMO charts; Normal work area (Principle of motion economy), design and arrangement of work place. Ergonomics, design of tools and equipments.
5. Work Measurement (14 Periods)
Objectives; work measurement techniques, stop watch time study; principle, equipment used and procedure; systems of performance rating; standard elements of time, calculation of basic times; various allowances; guide for rest allowance in Indian conditions, calculation of standard time, work sampling, standard data and its usage. Work sampling.
6. Wages and Incentive Schemes (08 Periods)
Introduction to wages, Wage payment for direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour.
7. Stores Management: (10 Periods)

- Different Layout and structures of stores, Inventory control, calculation of EOQ, Bin cards and various forms required in stores for documentation. Purchase procedures.
8. Industrial Safety (10 Periods)
- 8.1 Accident- causes, types, results and control.
 - 8.2 Mechanical and electrical hazards- types, causes and preventive steps/procedure.
 - 8.3 Describe salient points of Factories Act 1948 for health and safety- wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels etc.
 - 8.4 Safety colour codes.
 - 8.5 Fire prevention and fire fighting, equipment and methods.

LIST OF PRACTICALS

1. Stop watch time study on any machine like lathe, drilling machine or milling machine
2. Method improvement - Assembly of bolt, nut and 3 washers
3. Determination of standard time for assembly of electrical switch
4. Preparation of flow process chart
5. Preparation of SIMO chart
6. Preparation of flow diagram
7. Preventive measure in case of electrocution
8. Preventive measures in case of snake/poisonous creature sitting
9. Use of first aid in case of minor accidents
10. Use of five extenuates/five drill

INSTRUCTIONAL STRATEGY

1. Teacher should use models and encourage students to develop some other suitable model.
2. The teacher should observe and redress the difficulties faced by students in performing the work while working on ergonomically good and poorly designed workstation.
3. The teacher should show them real forms to be filled from stores and record keeping.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

- Model/prototype making
- Preparation of different charts
- Viva-voce

RECOMMENDED BOOKS

1. Work Study and Ergonomics by S Dalela and Sourabh
2. Industrial Engineering and Management by O.P. Khanna, Dhanpat Rai and Sons, Delhi.
3. Industrial Engineering and Management by M. Mahajan; Dhanpat Rai and Sons, New Delhi.
4. Introduction to Work Study, ILO Publication
5. Production and costing by GBS Narang; Khanna Publishers, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	12
2	10	12
3	10	12
4	10	12
5	14	16
6	08	10
7	10	12
8	12	14
Total	84	100

6.2 METROLOGY AND MEASURING INSTRUMENTS

L T P
5 - 4

RATIONALE

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

LEARNING OUTCOME

After undergoing the subject, students will be able to :

- use vernier calliper, micrometer, Height gauge for linear internal and external measurement.
- use bore gauge, radius gauge, taper gauge, plug gauge, ring gauge, snap gauge for measurements.
- use bevel protector, sine bar, slip gauge, dial indicator, angle deckor, poppy dial for angular measurements.
- measure spur gear characteristics using gear tooth vernier, outside diameter over dovel pins.
- use tool makers microscope
- measure surface roughness parameters.
- use profile projector, auto collimeter, angle deckor.
- select and measure variables using electrical and electronics comparators and measuring instrument, sensors, transducers.
- select and use non destructive testing methods.
- explain the use of coordinate measuring machine.
- use the concept of limits, fits and tolerance in assembly of components

DETAILED CONTENTS

- | | | |
|-----|--|--------------|
| 1. | Introduction | (08 Periods) |
| 1.1 | Definition of metrology | |
| 1.2 | Standard of measurement | |
| 1.3 | Types of Errors - Controllable and random errors | |
| 1.4 | Precision, accuracy, sensitivity, hysteresis, response time, repeatability, calibration, uncertainty of measurement, interchangeability. | |
| 1.5 | Standardization and standardizing organizations | |

2. Linear and Angular Measurement (20 Periods)
- 2.1 Construction features and use of instruments for non precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block.
 - 2.2 Construction features and use of instruments for precision measurements :verniercalipers, vernier height and depth gauges, micrometers.
 - 2.3 Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges.
 - 2.4 Cylinder bore gauges, feeler and wire gauges. Checking flatness, roundness and squareness
 - 2.5 Comparators – Characteristics, uses, working principles of different types of comparators: mechanical, electrical, electronics and pneumatic .
 - 2.6. Construction and use of instruments for angular measurements: bevel protector, sine bar, angle gauges, clinometer, angle dekker. Optical instruments for angular measurement, auto collimator.
3. Measurement of Surface Finish (12 Periods)
- 3.1 Terminology of surface roughness.
 - 3.2 Concept of primary texture and secondary texture.
 - 3.3 Factors affecting surface finish.
 - 3.4 CLA, RMS and RA value.
 - 3.5 Principle and operation of stylus probe instruments. Tomlinson surface meter and Taylor surface talysurf.
4. Limits, Fits and Tolerance (05 Period)
5. Measurements of Screw threads and Gauges (10 Periods)
- 5.1 Measurement of screw threads- Introduction, measurements of external and core diameters, checking of pitch and angle of threads with gauges.
 - 5.2 Measurements of gears (spur) – Measurement of tooth thickness, pitch, Gear Ball tester, Lead and Profile Testers.
 - 5.3 Profile projector, Coordinate Measuring Machine (CMM), Tool maker's microscope.
6. Instrumentation (15 Periods)
- 6.1 Various types of instruments used for mechanical quantities such as displacement, velocity, acceleration, speed and torque. Use of transducers and electronic counters, stroboscope, vibrating reeds and tachometers.

- 6.2 Strain gauge – use of strain gauge and load cells
- 6.3 Various types of temperature measuring instruments such as thermometers, Thermistor, Bimetallic strip, Pyrometers

Note: There should be a visit to established metrology lab to familiarize students with purpose and need of metrology.

LIST OF PRACTICALS

1. Internal and external measurements with vernier calliper and microscope
2. Measurement of linear dimensions with height gauge and depth gauge.
3. Measurement of flatness, concentricity with dial indicator
4. Use of feeler gauge, wire gauge, radius gauge and fillet gauges for checking of standard parameters.
5. Use of plain plug and ring gauge, taper plug and ring gauge, thread plug and ring gauge and snap gauges.
6. Measurement of Angle using;
 - i) Cylindrical rollers and spherical balls and slip gauges
 - ii) Bevel protector
 - iii) Sine Bar/Sine Table, Slip Gauges, Height Gauge and dial indicator.
 - iv) Angle deckor.
7. Measurement of thread parameters by using tool maker's microscope.
8. Measurement of cylindrical bore using cylinder bore gauge for bore diameter, ovality and taper.
9. Measurement of surface roughness using surface roughness tester.
10. Measurement of a profile using profile projector.
11. Study and use of Auto-Collimator.
12. Determination of temperature of thermocouple, pyrometer, Infrared thermometer.

INSTRUCTIONAL STRATEGY

1. Demonstrate use of various measuring instruments while imparting theoretical instructions.
2. Stress should be laid on correct use of various instruments.

RECOMMENDED BOOKS

1. Engineering Metrology by RK Jain; Khanna Publishers, New Delhi.
2. A Text Book of Production Engineering by RC Sharma; S Chand and Company, New Delhi.
3. Metrology Laboratory Manual by M Adithan and R Bahl; NITTTR, Chandigarh.
4. Engineering Metrology by RK Rajput; SK Kataria and Sons, Ludhiana.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	12
2	20	28
3	12	18
4	05	08
5	10	14
6	15	20
Total	70	100

6.3 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.

LEARNING OUTCOMES

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

- explain the construction and tooling of CNC machine.
- prepare simple part programme for different operations.
- operate a CNC lathe.
- operate a CNC milling machine.
- diagnose common problems in CNC machines.
- explain the trends in the field of automation.

DETAILED CONTENTS

1. Introduction (06 Periods)
Introduction to NC, CNC & DNC, their advantages, disadvantages and applications, Machine Control Unit, input devices, serial communication and Ethernet techniques, selection of components to be machined on CNC machines, Problems with conventional NC, New developments in NC, Axis identification, PLC Control and its components.
2. Constructional details and Tooling (08 Periods)
Design features, specification Chart of CNC machines, use of slideways, balls, rollers and coatings, motor and leadscrew, swarf removal, safety and guarding devices, various cutting tools for CNC machines, overview of tool holder, different pallet systems and automatic tool changer system, management of a tool room.
3. Part Programming (12 Periods)
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.

4. System Devices (08 Periods)

Actuators, Transducers and Sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder and decoder, axis drives, open loop system, close loop system.

5. Problems in CNC Machines (06 Periods)

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.

6. Automation and NC system (06 Periods)

Role of computer in automation, emerging trends in automation, automatic assembly, manufacture of magnetic tape, manufacture of printed circuit boards, manufacture of integrated Circuits, Overview of FMS, Group technology, CAD/CAM and CIM.

7. CNC operations involved in Turning and Milling (10 Periods)

7.1 Introduction to operations involved in turning machines- Facing OD and ID Rough cut, Finish cut, Taper turning, Drilling, Threading, Grooving and cut-off (parting).

7.2 Introduction to operations involved in Milling-contouring, pocketing, Drilling, Facing, Circular tools paths.

7.3 Different terms like clearance, Retract, Feed plane, Depth of cut, lead in, lead out, overlap.

7.4 Simple programmes in Milling and Turning involving different operations.

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 and CNC turning center.
 - Plain turning and facing operations

- Taper turning operations
 - Operation along contour using circular interpolation.
5. Develop a part programme for the following milling operations and make the job on CNC milling
 - 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 McGraw Hill, New Delhi.
3. CNC Machine by Bharaj; Satya Publications, New Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE,NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	10
2	08	14
3	12	22

4	08	14
5	06	10
6	06	10
7	10	20
Total	56	100

6.4.1 REPAIR AND MAINTENANCE

L T P
5 - -

RATIONALE

A diploma holder is involved in supervision and maintenance jobs. He must know the various processes carried out during testing, repair and maintenance and material handling. Hence this subject.

LEARNING OUTCOMES

On completion of the course, the students will be able to:

- explain the concept of testing, repair and maintenance.
- comprehend the procedure for erection and commissioning of machines.
- comprehend the procedure for testing of machines.
- explain various lubrication systems.
- comprehend the procedure of repair and maintenance.

DETAILED CONTENTS

1. Introduction (06 Periods)

Necessity and advantages of testing, repair and maintenance, common instruments required for testing, significance of B-T curve in life span of machine tool, Acceptance test for machine tools, Economic aspects, manpower planning and materials management

2. Plant Layout, Erection and Commissioning of Machines (Installation) (10 Periods)

Location, layout of machines in Plant Layout, Principles of Plant layout, types of plant layout and positioning of machines, grouping of machines.

Foundation – types of foundation, various considerations for machine foundations, foundation plan, types of foundation bolts, erection and leveling, grouting

Vibration, damping, vibration isolation – methods of isolation, anti vibration mounts.

3. Testing of Machines (10 Periods)

Testing equipment – dial gauge, mandrel, spirit level, straight edge, auto collimator.

Recalibration of measuring instruments like vernier calliper.

Testing methods – geometrical/alignment test, performance test, testing under load, run test, vibrations, noise

4. Maintenance (10 Periods)

Definition, advantages, limitations, functions and types of maintenance organisation. Types of maintenance viz. emergency, preventive, breakdown/corrective, predictive
Introduction to computerized maintenance record like facility register, maintenance request.

ISO standards for maintenance documentation

Introduction to machine history card – purpose and advantages

Preparation of scheduled yearly plan for preventive maintenance, difference of work content of servicing, repairs and overhauling. MTBF and MTTR. Maintainability

Spare parts- Need of frequently needed spare parts inventory, Make provision of spares for parts not available in market

5 Repairing (08 Periods)

Common parts which are prone to failure, reasons of failure

Repair schedule Parts that commonly need repair such as belts, couplings, nuts, and bolts repairing the engines, compressors and boilers.

6 Lubrication Systems (09 Periods)

Lubrication methods and periodical lubrication chart for various machines (daily, weekly, monthly)

Handling and storage of lubricants

Lubricants conditioning and disposal

Lubricant and their grades needed for specific components such as gears, bearings, and chains

Purpose and procedure of changing oil periodically (like gear box oil)

7 Material Handling Systems (09 Periods)

Basic principles of material handling, Basic types of material handling equipments and its characteristic, Uses and limitations, forklift trucks, Selection of material handling equipment, Unit load: pallet sizing and loading. Conveyor models, AGV Systems, Automated Storage & Retrieval System (ASRS), Carousels.

8 Maintenance Manuals and Reports (08 Periods)

Types of manuals need for maintenance contents of manuals, manual writing and reporting, action- taken report (ATR)

Fitter common tools: Appliances and devices, handling facilities and measuring instruments.

INSTRUCTIONAL STRATEGY

1. Lay greater emphasis on practical aspects of maintenance.
2. Make use of transparencies, video films and CD's.
3. Expose the students to real life situation.
4. Promote continued learning through properly planned assignments.
5. Demonstrate sample of all types of gear and bearings.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/prototype making

RECOMMENDED BOOKS

1. Industrial Maintenance by HP Garg; S. Chand and Company, Delhi.
2. Installation, Testing and Maintenance by JS Narang, Dhanpat Rai & Sons, New Delhi.
3. Plant Maintenance Engineering by RK Jain; Khanna Publishers, Delhi.
4. Installation, Servicing and Maintenance by SN Bhattacharya; S Chand and Company, Delhi.
5. Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt. Ltd., New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Time Allotted (Periods)	Marks allotted (%)
1.	06	08
2.	10	14
3.	10	14
4.	10	16
5.	08	12
6.	09	12
7.	09	12
8.	08	12
Total	70	100

6.4.2 TOOL ENGINEERING

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RATIONALE

A diploma holder should have complete knowledge of basic tools, their materials and their optimal utilization. This subject imparts skill and awareness of quality production in minimum time by using jigs and fixtures.

LEARNING OUTCOMES

After completion of this course, the students will be able to :

- List various properties of cutting tools.
- Explain the geometry of cutting tools.
- Explain the principles of location.
- Describe the functions of various locating devices.
- Explain the working of various types of clamps.
- Explain the functioning of various types of drilling jigs.
- Discuss features of various types of fixtures

DETAILED CONTENTS

1. Cutting Tools (24 Periods)
 Mechanical property and uses of high-speed steel, stellite, cemented carbide, ceramics diamond, study of commercially available cutting tools. Tool geometry of single point cutting tools, multipoint cutting tools, reamer, drill, milling cutter, throw-away inserts, chip breaker, tool and cutter maintenance, regrinding and lapping of tools.
2. Location and Clamping (16 Periods)
 Principles of location, 3-2-1 principle, Location with previous machined hole, different locating devices, V-location, conical locations. Purpose of Clamping elements, types of clamps.
3. Jigs and Fixtures (30 Periods)
 Need for jigs and fixtures, fundamental principles of jigs and fixtures design.
 Types of bushes, advantages of bushings.
 Types of drilling jigs- template jig, channel jig, latch jig, quick acting jig, indexing jig, box jig.
 Types of fixtures-simple fixture, milling fixture, welding fixture, turning fixture, assembly fixture & inspection fixture.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Production Engineering by P.C. Sharma; S. Chand & Company Ltd., Delhi.
2. Tool Design by Donaldson and Lecain; Tata McGraw Hill Company, New Delhi
3. Production Engineering & Design by Dr. Surender Kumar and Umesh Chandra
4. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Time Allotted (Periods)	Marks allotted (%)
1.	24	36
2.	16	22
3.	30	42
Total	70	100

6.5 PROJECT WORK

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- - 12

RATIONALE

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

LEARNING OUTCOMES

After undergoing the project work, students will be able to:

Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- 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
- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work **should not be considered** as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is

necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

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 machines.
2. Estimating and costing projects.
3. Design of jigs / fixtures.
4. Projects related to quality control.
5. Project work related to increasing productivity.
6. Projects relating to installation, calibration and testing of machines.
7. Projects related to wastage reduction.
8. Project, related to fabrication.
9. Energy efficiency related projects.
10. Projects related to improving an existing system

NOTE: Each student has to take one project individually and one to be shared with a group of four-five students depending upon cost and time involved. There is no binding to take up the above projects as it is only a suggestive list of projects.

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

Sr. No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2
Total marks		100	100	80	60	40	20

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

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

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

Important Notes

- 1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**
- 2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**
- 3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**
- 4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

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

It is proposed that the institute may organize an annual exhibition of the project work

10. RESOURCE REQUIREMENT

10.1 PHYSICAL RESOURCES

(A) Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

(B) Equipment requirement:

Following Laboratories are required for Diploma Programme in Mechanical Engineering:

- Communication Laboratory
- Applied Physics Laboratory
- Applied Chemistry Laboratory
- Engineering Drawing
- Applied Mechanics
- Basics of Information Technology/Computer Laboratory
- Carpentry Shop
- Painting and Polishing Shop
- Electrical Shop
- Smithy Shop
- Fitting and Plumbing Shop
- Sheet Metal Shop
- Welding Shop
- Foundry Shop
- Machine Shop
- Material and Metallurgy Laboratory
- Mechanical Engineering Drawing
- Strength of Material Laboratory
- Electrical and Electronics Engineering Laboratory
- Mechanical Workshop
- Hydraulic and Pneumatic Laboratory
- Thermal Engineering Laboratory
- Metrology Laboratory
- Refrigeration and Air Conditioning Laboratory
- Theory of Machine Laboratory

- Automobile Engineering Lab
- Environmental Engineering Lab
- Energy Conservation Lab

EQUIPMENT REQUIREMENT FOR MECHANICAL ENGG.

Sr. No.	Description	Qty	Total Price (Rs)
COMMUNICATION LABORATORY			
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	Miscellaneous	LS	1,500
APPLIED PHYSICS LABORATORY			
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000
6.	Gravesand's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil weston-type ammeter with ebonite stand	10	3,500
12.	DC Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700
15.	DC Millivoltmeters	10	2,000
16.	Sensitivity Galvanometer	2	800
17.	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
Sr. No.	Description	Qty	Total Price (Rs)

20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4,000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	2	14,000
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00
30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	Miscellaneous	LS	3,000
APPLIED CHEMISTRY LABORATORY			
1.	Digital Balance	1	80,000
2.	Burette 50ml	30	3,000
3.	Pipette 25ml	60	4,000
4.	Beakers 100ml	60	4,000
5.	Burette stand	30	30,000
6.	Glazed tile	30	1,000
7.	Conical flask 50ml (Titration flask)	60	4,000
8.	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000
9.	Able's Flash Point apparatus	2	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	1	18,000
14.	Decicators	06	8,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	2,000

Sr. No.	Description	Qty	Total Price (Rs)
16.	Chemicals - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH ₃ - 2.5 ltr, NH ₄ Cl – 1 kg) - Zinc sulphate- 500g - H ₂ SO ₄ - 2.5 ltr - Phenolphthalein indicator (as per requirement) - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene- 1 ltr	LS	20,000
17.	Miscellaneous	LS	2,000
ENGINEERING DRAWING			
1.	Drawing Boards (700 x 500mm)	60	25,000
2.	Draughtsman Tables	60	1,80,000
3.	Draughtsman Stools	60	40,000
4.	Computer Aided Drawing (CAD) Software	30 User	5,00,000
5.	Model of different wooder joints	1	1,000
6.	Model of different screw threads	1	1,000
7.	Model of various locking devices	1	1,000
8.	Model of various joints	1	1,000
9.	Cut section Model of various couplings	1	3,000
10.	Miscellaneous	LS	5,000
APPLIED MECHANICS LABORATORY			
1.	Polygon law of forces apparatus	1	2,000
2.	Jib crane	1	4,000
3.	Apparatus for reaction at supports	1	5,000
4.	Inclined plane and friction apparatus	1	2,500
5.	Screw jack	1	1,000
6.	Worm and worm wheel	1	3,500
7.	Single Purchase Winch Crab	1	4,000
8.	Miscellaneous	LS	1,000
BASICS OF IT LABORATORY/COMPUTER LABORATORY			
1.	Computer System with latest configuration	30	8,00,000
2.	Printer (MFP)	1	25,000
3.	Printer (Laser)	1	35,000
4.	Plotter	1	75,000
5.	Digitiser	1	50,000
6.	Antivirus Software	LS	10,000

7.	Internet Facility on Computers	LS	2,00,000
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Sr. No.	Description	Qty	Total Price (Rs)
8.	AutoCAD/Solid Works/Unigraphics/Pro-C (any one software)	30 user	5,00,000
9.	LCD Projector	1	35,000
10.	UPS	60	1,20,000
11.	Software (latest windows, latest MS Office)	1	1,00,000
12.	Scanner	1	10,000
13.	Miscellaneous	LS	5,000
CARPENTRY SHOP			
1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	5,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000
8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	Miscellaneous	LS	1,500
PAINTING AND POLISHING SHOP			
1.	Spray gun with hose pipe	1	1,000
2.	Paint brushes	20	2,000
3.	Paint/Varnish	LS	2,000
4.	Air Compressor with 2 hp motor	1 set	10,000
5.	Miscellaneous	LS	2,000
ELECTRICAL SHOP			
1.	Tool kit (Plier, Srew driver, Knife, Steel rule, hammer, sciber, pincer steel tape etc.)	20	20,000
2.	Fuses, Switches, Plugs, Sockets, Ceiling rose, Wires, cleats, Clamps, Test lamp, Tester.(as per requirement)		8,000
3.	Electric Iron	1	1,500
4.	Electric kettle	1	1,500
5.	Ceiling fan/table fan	1	2,500
6.	Desert cooler	1	5,000
7.	Lead acid battery	2	8,000
8.	Battery Charger	1	6,000

9.	Miscellaneous		3,000
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Sr. No.	Description	Qty	Total Price (Rs)
SMITHY SHOP			
1.	Black smithy forge (with open hearths, accessories to match the forge)	20	40,000
2.	Wrought iron anvils	20	20,000
3.	Swage blocks	4	8,000
4.	Blower with accessories, motor switch etc	1	6,000
5.	Work benches with vices	2	6,000
6.	Power hammer	1	20,000
7.	Tools and accessories – hammers, swages, tongs, pokers, pullers etc	20	10,000
8.	Miscellaneous	LS	1,500
FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribers	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribers	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000
6.	Tool kits – chisels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	2	12,000
8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1,250
10.	Ring spanner set	5	600
11.	Pipe die set 2"	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	Miscellaneous	LS	1,500
SHEET METAL			
1.	Hammers	8	3,000

2.	Mallets (Hard & Soft)	5	2,000
3.	Sheet and wire Ganges	LS	8,00

Sr. No.	Description	Qty	Total Price (Rs)
4.	Shearing Machine	1	20,000
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminium)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	Miscellaneous	LS	1,000

WELDING SHOP

1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas Cutting Unit	1	3,000
3.	Work benches with vices	3	5,000
4.	Welding generator set	1	10,000
5.	Oxy acetylene welding set with accessories	1	7,000
6.	Acetylene generating set	1	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	1	15,000
9.	Brazing equipment with accessories	1	10,000
10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	10,000
12.	Metal spraying gun	1	10,000
13.	Spot welder	1	25,000
14.	TIG welding set	1	1,00,000
15.	MIG welding set	1	1,00,000
16.	Welding Partition Screen	5	2,500

17.	Miscellaneous	LS	3,000
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Sr. No.	Description	Qty	Total Price (Rs)
FOUNDRY SHOP			
1.	Moulding boxes	40	8,000
2.	Ladles	5	2,000
3.	Tool Kits	10 set	5,000
4.	Quenching tanks	2	5,000
5.	Portable grinder	1	3,000
6.	Pit furnace with blower	1	10,000
7.	Miscellaneous	LS	1,000
MACHINE SHOP			
1.	Centre lathes	10	6,00,000
2.	Grinder	1	10,000
3.	Universal milling machine	1	1,25,000
4.	Shaper	2	1,20,000
5.	Plainer	2	1,20,000
6.	Work bench	3	10,000
7.	Precision instruments	1	10,000
8.	Hand tools and accessories	2	8,000
9.	CNC trainer lathe	1	4,00,000
10.	Miscellaneous	LS	5,000
MATERIAL AND METALLURGY LABORATORY			
1.	Electric furnace muffle type	1	60,000
2.	Forced circulation tempering furnace	1	30,000

3	Quenching tank	2	5,000
4.	Grinder	2	4,000
5.	Pyrometers	1	10,000
6	Specimen Kit (Ferrous and Non-ferrous Metals (25 Nos)	1	5,000
7.	Metallurgical microscope	3	35,000 each
8	Abrasive cut off machine	1	50,000
9	Specimen Polishing Machine	1	50,000
10	Thermocouples	2	5,000
11	Set of Specimen of different alloys	1	5,000
12	Brinell Hardness Tester	1	80,000

Sr. No.	Description	Qty	Total Price (Rs)
MECHANICAL ENGINEERING DRAWING			
1	Working Model of Oldham's Coupling	1	3,000
2	Working Model of Universal Coupling	1	3,000
3	Plummer Block	1	2,000
4	Screw Jack	1	3,000
5	Connecting Rod	1	3,000
6	Set of Ball and Roller bearing	01 set	1,000
STRENGTH OF MATERIALS LABORATORY			
1.	Brinell and Rockwell hardness tester	1	60,000
2.	Impact testing machine	1	50,000
3.	Microprocessor based universal testing machine	1	4,00,000
4.	Torsion testing machine (fully computerized)	1	2,00,000
5	Spring Stiffness Tester	1	50,000
ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY			
1.	Wattmeter	5	10,000
2.	Ammeter	5	10,000
3.	Voltmeter	5	7,500
4.	DC shunt motor	1	5,000
5.	Single phase variac	1	2,500
6.	Single phase transformer	1	5,000
7.	Resistive load	1	4,000
8.	Multimeter	1	4,000

9.	CRO	1	15,000
10.	Regulated supply	1	8,000
11.	Signal generator	1	5,000
12.	3-phase inductor motor	1	5,000
13.	3-phase variac	1	8,000
14.	DC shunt generator coupled with motor and starter	1	25,000
15.	Rheostat	2	2,500
16.	Tachometer	1	5,000
MECHANICAL WORKSHOP			
1.	Centre lathes	10	5,00,000
2.	Tool room lathe	1	1,00,000

Sr. No.	Description	Qty	Total Price (Rs)
3.	Lathe with copy turning attachment and other attachments	1	1,50,000
4.	Universal milling machine	1	1,25,000
5.	Vertical milling machine	1	75,000
6.	Shapers	2	1,00,000
7.	Radial drilling machine	1	25,000
8.	Upright drilling machine	1	20,000
9.	Gear Shaper	1	75,000
10.	Centreless grinder	1	80,000
11.	Universal cylindrical grinder	1	75,000
12.	Hydraulic surface grinder	1	50,000
13.	Tool and Cutter grinder	1	50,000
14.	Power hacksaw	1	25,000
15.	Pedestal grinder	1	5,000
16.	Electro discharge machine	1	4,00,000
17.	Work bench	3	6,000
18.	Precision instruments	1	5,000
19.	Surface plates	2	15,000

20.	Hand tools and accessories	2	6,000
21.	CNC trainer lathe	1	3,00,000
22.	CNC trainer milling machine	1	4,00,000
23.	PC Computer	2	1,00,000
24.	Computer based NC Programming Software	1	1,50,000
25.	CNC Simulation software	1	1,00,000
26.	CNC Milling machine accessories and holding devices	LS	1,00,000
HYDRAULICS & PNEUMATIC LABORATORY			
1.	Piezometer tube	2	100
2.	U tube differential manometer	2	2,000
3.	Bourdon's Tube pressure gauge	1	1,000
5.	Hydraulic jack	1	4,000
6.	Hydraulic press Working Model	1	5,000
7.	Bernoulli's apparatus	1	15,000
Sr. No.	Description	Qty	Total Price (Rs)
8.	Venturimeter apparatus with differential manometer	1	10,000
9.	Pipe friction apparatus	1	15,000
10.	Reciprocating pump- Cut Section Model	1	20,000
11.	Centrifugal pump	1	25,000
12.	Working Model of Pelton Wheel Turbine	1	20,000
13.	Working Model of Francis Turbine	1	20,000
14.	Working Model of Kaplan Turbine	1	20,000
15.	Hydraulic Circuit Trainer Kit	1	50,000
16.	Pneumatic Circuit Trainer Kit	1	50,000
17.	Working Model of Hydraulic Brake system	1	50,000
18.	Working Model of Hydraulic Ram	1	5,000
THERMAL ENGINEERING LABORATORY			
1.	Throttling Calorimeter	2	10,000
2.	Testing for Determination of Dryness fraction of steam	1	50,000
3.	Cut section model of 4-stroke single cylinder Petrol and Diesel engine	1	30,000

4.	Gravimetric Analysis	1 each	20,000 each
5.	Model of Various Boiler Mounting and Accessories -Steam Stop Valve, Safety Valves, Blow off Cock, Water Level Indicator, Low Water High Pressure Safety Valve, Pressure Gauge, Economiser, Pre Heater (Air), Super Heater Model only.	1 each	10,000
6.	Exhaust Analyser for Petrol and Diesel engine	1 each	25,000 each
7.	Single Stage Reciprocating Air Compressor	1	50,000
8.	Rotary Compressor, Air Compressor	1	25,000
9.	Flash Point Apparatus	1	10,000
10.	Pyrometer, Infrared, Thermocouple	2	5,000 each
11.	Lancashire boiler model	1	10,000
12.	Model of impulse turbine	1	5,000
13.	Model of reaction turbine	1	5,000
14.	Model of surface condenser	1	5,000
15.	Bab Cox & Wilcox Boiler Model	1	10,000
Sr. No.	Description	Qty	Total Price (Rs)
16.	Single cylinder 2 stroke petrol engine test rig	1	45,000
17.	Single cylinder 4 stroke petrol engine test rig	1	50,000
18.	Multicylinder petrol engine test rig (Morse test rig)	1	2,00,000
METROLOGY LABORATORY			
1.	Digital vernier calliper	3	5,000
2.	Digital micrometer	3	5,000
3.	Height gauge	2	1,500
4.	Depth gauge	2	1,000
5.	Combination set	1	1,000
6.	Bevel protractor	1	1,000
7.	Sine bar	1	1,000
8.	Precision balls and rollers	1	500
9.	Surface plate	2	15,000

10.	Slip gauges set	1	10,000
11.	Comparator – Mechanical , Pneumatic	2	40,000
12.	Gear tooth vernier	1	2,000
13.	Snap and ring gauges	1	1,500
14.	Feeler gauge, radius gauge	1	1,000
15.	Angle plate	1	1,000
16.	Tool makers microscope	1	40,000
17.	Profile projector	1	75,000
18.	Surface roughness tester	1	60,000

REFRIGERATION AND AIR CONDITIONING LABORATORY

1.	Refrigeration trainer to determine C.O.P.	1	6,000
2.	Air conditioner trainer	1	10,000
3.	Water cooler	1	6,000
5.	Refrigeration compressor	1	3,000
6.	Safety controls (HP, LP Cut outs, oil pressure controls), solenoid valve, expansion valves, thermostats, charging board	1 set	3,000
7.	Gas charging equipment kit	1	15,000
8.	Vacuum pump	1	3,000
9.	Cut-Section model of thematically sealed compressor	1	6,000

Sr. No.	Description	Qty	Total Price (Rs)
THEORY OF MACHINES LABORATORY			
1	Working Model of Four bar mechanism	1	2,000
2.	Working Model of Slider Crank Mechanism	1	3,000
3.	Working Model of Double Slider Crank Mechanism	1	3,000
4.	Working Model of Various kinds of belt drives		3,000
5.	Working Model of Simple walt governor	1	5,000
6.	Working Model of Porter governor	1	5,000
7.	Working model of Hartnell Governor	1	5,000
8	Balancing Maching for Rotating mass	1	5,000
9.	Working Model of Simple Gear train	1	5,000

10	Working Model of Compound Gear train	1	5,000
11	Working Model of Epicyclic Gear Train	1	5,000
12	Working Model of Flywheel apparatus to find moment of inertia gear train	1	10,000
13	Working Models of Different types of cams and followers	1	5,000
AUTOMOBILE ENGINEERING LAB.			
1.	Battery Charger 0-12 V, 0-6 Amp.	1	2,000
2	Batteries 6 V & 12 V	1each	4,000
3	Hydrometer	1	1,000
4	Cell Tester	1	1,000
5.	Working Model of Battery Ignition System, Magneto Ignition System Fitted on board	1	2,000
6.	Fuel Injection Pump	1	15,000
7	Calibration Machine with Fuel Injection Pump & Coupling	1	25,000
8.	Electrical Testing Bench	1	2,000
9	Condemned petrol engine of light petrol vehicle	1	5,000
10.	Condemned Diesel engine of medium and heavy vehicles	1	5,000
11	Tyre inflator with twin hose assembly and small hose assembly	1	2,500
12	Spark plug cleaning machine and Testing machine	1	5,000
13	Condemned chassis frame of any light motor vehicle	1	5,000
14	Sectioned working model of a single cylinder two stroke petrol engine	1	1,000
15	Sectioned working model of single cylinder two stroke diesel engine	1	1,000
16	Sectioned working model of a single cylinder four stroke diesel engine	1	1,000
17	Sectioned working model of a single cylinder four stroke petrol engine fitted with ignition system		
	Hand Operated	1	4,000
	Motor Operated	1	6,000
18	Work bench	2	2,500
19	Mechanical Jack	2	3,000

20	Tool Kit (Spanner, socket set, screw driver, plier, file, wrench, drill, tap set, hammer etc.)	4 sets	2,000
21	Miscellaneous	LS	4,000

ENVIRONMENT ENGINEERING LABORATORY			
1.	pH Meter	01	500
2.	Turbidity Meter	01	5000
3.	Oven with Temperature Controller and Forced Air Circulation Type	01	20000
4.	B.O.D. Incubator	01	25000
5.	Water Analysis Kit	01	5000
6.	High Volume Sampler	01	40000
7.	Electrical Balance for weighing upto 1/10 of milligram (capacity)	01	1000
ENERGY CONSERVATION LABORATORY			
1	Clamp meter	02	5000
2	Multimeter	02	2000
3	Power Analyser	01	20000
4	Different types of lamps (LS) – 60 W lamp, 230 V , 100 V – 200 W lamp – 500 W lamp – 100 W lamp, 110 V, 150 V	10	500
5	Lux meter	02	5000
6	Centrifugal pump, 1 kW	1	15,000
7	Standard window A.C.	01	20000
8	Anemometer	02	5000
9	Thermometer	03	2000
10	Flow meter	02	10000
11	Pumping set with at least two pumps of different capacity.	1 set	10000
12	Pressure gauge fitted on discharge lines	1 set	2000
13	Variable Frequency Drive	02	50000
14	A small compressor with a small network of pipe line fitted with suitable pipeline, pressure gauge, safety valve and loading / unloading pressure switch.	1	3000
15	Stop watch	2	1000
16	Small blower (1.5 kW motor) with inlet and outlet ducts of approximately one meter length on both sides	1	10000
17	Black Box (for checking lamp efficacy including stand and luxmeter)	1	25000

Note:

1. The specifications and price of equipment mentioned above used as broad guidelines for purchase of equipment.
2. Any other items not mentioned in the list of equipment can be purchased as provision has been made for purchase under the item miscellaneous for each lab/shop.
3. Any additional equipment, already available in the institute, may be used for demonstration to the students.

NOTE:

In addition to the above, laboratories in respect of physics, chemistry, Computer Centre etc will be required for effective implementation of the course. Provision for photocopiers, PC facilities along with LCD Projection System etc. has also to be made.

(C) Furniture Requirement

Norms and standards laid down by AICTE be followed for working out furniture requirement for this course.

10.2 Human Resources Development:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE.

11. EVALUATION STRATEGY**11.1 INTRODUCTION**

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor is to ensure the quality of the product which can be assessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and to get feedback for curriculum improvement. It helps the teachers in determining the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students. Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

11.2 STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

- Theory
- Practical Work (Laboratory, Workshop, Field Exercises)
- Project Work
- Professional Industrial Training

A. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work,

seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-I should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II : Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned
Knowledge	10-30 percent
Comprehension	40-60 percent
Application	20-30 percent
Higher than application i.e. Analysis, Synthesis and Evaluation	Upto 10 percent

B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals/field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to

performance on task, quality of product, general behaviour and it should be followed by viva-voce.

C. Project Work

The purpose of evaluation of project work is to assess students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

D. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general behaviour, quality of report and presentation during viva-voce.

12. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

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

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

(A) Broad Suggestions:

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.
2. An academic plan needs to be prepared and made available to all polytechnics well in advance. The Principals have a great role to play in its dissemination and, percolation upto grass-root level. Polytechnics, in turn are supposed to prepare institutional academic plan.
3. HOD of every Programme Department along with HODs and incharges of other departments are required to prepare academic plan at department level referring to institutional academic plan.
4. All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B) Course Level Suggestions

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

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of time. It is essential for them to use the given time judiciously by planning all above activities properly and ensure execution of the plan effectively.

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

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

7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive feed back to every student
8. The student centred activities may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.
9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.
10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.
11. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.
12. Students may be given relevant and well thought out project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment.
13. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, research institutes and other relevant field organizations in the state.

13. LIST OF PARTICIPANTS

The following experts participated in workshop for Developing the Curricula Structure and Contents of various Diploma Programmes for UP State on 5-6 April, 2018 at NITTTR, Chandigarh:

1. Sh. Pankaj Yadav, Assistant Director, Directorate of Technical Education, Kanpur
2. Sh. Lal Ji Patel, Text Book Officer/CDC Officer, IRDT, Kanpur
3. Mohd. Qamruzzaman, Lecturer English, Government Polytechnic, Kanpur
4. Sh. Anjani Kumar Sharma, HOD, Chemical Engg. Government Polytechnic, Chandari
5. Dr. Balram, Lecturer Maths, Government Polytechnic, Lucknow
6. Sh. Sanjay Kumar Singh, Lecturer, Electronics, Government Polytechnic, Aurai, Bhadohi, UP.
7. Sh. Nirdosh Kumar, Lecturer, Electrical Engg. Government Polytechnic, Naraini, Banda
8. Sh. Vinod Sonthwal, Lecturer, Civil Engg. NITTTR, Chandigarh
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19. Mohd. Rizwanullah Siddiqui, HOD, Electrical Engg. Government Polytechnic, Lucknow
20. Sh. O.P. Choudhary, Lecturer, Electrical Engg. Government Polytechnic, Lucknow
21. Sh. Tushar Kiran, Lecturer, Mechanical Engg. Government Polytechnic, Lucknow
22. Sh. HeeraSiddiqui, Lecturer, Chemical Engg. Government Polytechnic, Lakhaurpur
23. Sh. R.P. Bhardwaj, Workshop Superintendent, Aryabhat Institute of Technology, Delhi-33.
24. Dr. AB Gupta, HOD, CDC, NITTTR, Chandigarh

The following experts participated in workshop for Developing Curriculum Contents for 1st year of 6 diploma programmes for UP State on 4th May, 2018 at State Board of Technical Education, Lucknow:

1. Sh. S.K. Govil, Ex Secretary, SIMT, JEEC
2. Dr. Amrita Mishra, Lecturer, Chemistry, Government Polytechnic, Lucknow
3. Sh. Ashok Kushwaha, Head, Computer, Government Polytechnic, Lucknow
4. Sh. Faizan Ahmad, Lecturer, Chemical Engg., Sanjay Gandhi Polytechnic, Jagdishpur, Amethi
5. Dr. Kalpana Singh, Lecturer, Physics, Government Polytechnic, Lucknow
6. Sh. Alok Srivastava, HOD, Civil Engg. Government Polytechnic, Shahjahanpur
7. Dr. Vinod Kashyap, Lecturer, English, Government Polytechnic, Lucknow
8. Sh. Rakesh Kumar, Lecturer, Electronics, Government Polytechnic, Barabanki
9. Sh. Subhash Chandra Misra, Retired Sr. DDG, BSNL, DOT, GOI
10. Sh. Brijesh Mishra, Softpro India
11. Sh. Ajay Choudhary, Softpro India
12. Sh. FR Khan, JEEC, UP
13. Sh. K. Ram, Joint Director, (CZ)
14. Sh. Manish Kumar, Lecturer, Government Polytechnic, Unnao

15. Sh. Prabhakar Tiwari, HOD, Electrical Engg. Government Polytechnic, Premdharpatti, Pratapgarh
16. Sh. RK Singh, HOD, Electronics, Government Polytechnic, Pratapgarh
17. Ms. Rashmi Sonkar, HOD, IT, Government Girls Polytechnic, Faizabad
18. Sh. Ankit Gupta, Lecturer, Mechanical Engg. Government Polytechnic, Lucknow
19. Ms. Meenu Dwivedi, Lecturer, Mechanical Engg. Government Polytechnic, Lucknow
20. Sh. Sanjay Kumar Srivastava, Tata Motors Ltd., Lucknow
21. Sh. Kamal Kumar, Lecturer, Computer, Government Girls Polytechnic, Lucknow
22. Sh. Manoj Kumar, Director, IRDT, Technical Education, Kanpur
23. Sh. RC Rajput, Director, Technical Education, Kanpur
24. Sh. Sanjeeva Kumar Singh, Secretary, Board of Technical Education, Lucknow
25. Sh. Pravesh Verma, Electrical Engg. Board of Technical Education, Lucknow
26. Sh. Lal Ji Patel, Text Book Officer/CDC Officer, IRDT, Kanpur
27. Sh. Ashrapal, Principal, Government Polytechnic, Tundla, Firozabad
28. Sh. Sandeep Kumar, Lecturer, Computer, Government Polytechnic, Allahabad
29. Sh. Umesh Chand Yadav, Government Polytechnic, Lucknow
30. Sh. OP Chaudhari, Lecturer, Government Polytechnic, Lucknow
31. Dr. AB Gupta, HOD, CDC, NITTTR, Chandigarh

The following experts participated in workshop for Developing Curriculum Contents of 2nd year and 3rd year subjects of diploma course in Mechanical Engineering for UP State on 4-5 September, 2018 at NITTTR, Chandigarh:

1. Sh. Ankit Gupta, Lecturer, Mechanical Engg. Government Polytechnic, Lucknow
2. Sh. Tushar Kiran, Lecturer, Mechanical Engg. Government Polytechnic, Lucknow
3. Sh. Karmveer, Lecturer, Mechanical Engg., Government Girls Polytechnic Arnia, Bulandshahar
4. Sh. Ashish Kumar, Head, Mechanical Engg., Government Polytechnic, Mawana Khurd
5. Sh. Ashok Kushwaha, Head, Computer, Government Polytechnic, Lucknow
6. Sh. Narendra Kumar, Workshop Superintendent, Government Polytechnic, Kanpur.
7. Ms. Meenu Dwivedi, Lecturer, Mechanical Engg. Government Polytechnic, Lucknow
8. Dr. Pal Dinesh Kumar, Scientist 'F' & Joint Director, TBRL, Chandigarh.
9. Dr. P. Sudhakar Rao, Assistant Professor, Mechanical Engg. NITTTR, Chandigarh
10. Dr. Chaman Chandel, Deputy Director, SASE, DRDO, Chandigarh

11. Sh. Pankaj Yadav, Assistant Director, Directorate of Technical Education, Kanpur

12. Dr. AB Gupta, HOD, CDC, NITTTR, Chandigarh