

NSQF ALIGNED CURRICULUM
DIPLOMA IN MECHANICAL ENGINEERING

**PUNJAB STATE BOARD OF TECHNICAL EDUCATION
&
INDUSTRIAL TRAINING**



Developed By
Curriculum Development Center
National Institute of Technical Teachers Training & Research
(Ministry of Education, Government of India)
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FOREWORD

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 of standard of life 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 cultures and environments together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the license-based closed economy to knowledge and market based 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, Punjab to revise the existing curricula of diploma programmes as per the needs of the industry and making them National Skill Qualification Framework (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 effective implementation of its curricula. Howsoever best the curriculum document is designed, if it 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 that the polytechnics 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 get the faculty members regularly trained and upskilled. So that it can infuse the much needed dynamism in the system. They are welcome to reach NITTTR Chandigarh whenever they want to train the faculty members and get the curricula revised.

Director
National Institute of Technical Teachers
Training & Research, Chandigarh

ACKNOWLEDGEMENTS

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- i) Chairperson, Punjab State Board of Technical Education and Industrial Training, Chandigarh for entrusting this project of curriculum revision to NITTTR, Chandigarh.
- ii) Secretary, Board of Technical Education, Punjab for initiating this project of review of curriculum.
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- v) All the participants from industry/field organizations, universities, engineering colleges, polytechnics and other technical institutions for their professional inputs during curriculum workshops.
- vi) Faculty from different departments of NITTTR, Chandigarh for content updation.

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, Punjab
- 4) Intake : 40/60 (or as prescribed by the Board)
- 5) Pattern of the Programme : Semester Pattern
- 6) NSQF Level : Level - 5
- 7) Ratio between theory and Practice : 37 : 63
- 8) Industrial Training:
Six weeks of industrial training is included after IV semester during summer vacation
- 9) Ecology and Environment :
As per Govt. of India directives, a subject on Environmental Studies has been incorporated in the curriculum.
- 10) Energy Conservation:
An Energy Conservation Awareness Camp has been included in the curriculum to sensitize the students about significance and various aspects of energy conservation. Concepts of Energy Conservation have also been included in the subject of Environmental Studies.
- 11) Entrepreneurship Development:
An Entrepreneurial Awareness Camp and a full subject on Generic Skills and Entrepreneurship Development have been incorporated in the curriculum.
- 12) Camps on “Traffic Awareness and Road Safety” have been added in semester I & II under Student Centered Activities.
- 13) “Drugs Use and Abuse Awareness Camp” have been added in IIIrd Semester under Student Centered Activities.

14) Personality Development

A camp focusing on personality development of students has been incorporated in the curriculum.

15) Student Centred Activities:

A provision of 3-6 hrs per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co-curricular activities such as expert lectures, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities etc.

16) 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.

After first year, the NSQF Level – 3 pass out students have avenues to work as semi skilled employee. Similarly, after second year, the NSQF Level – 4 pass out students have wide scope to work as skilled employee in Mechanical Engineering related industries.

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 SolidWorks 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.
13.	Use 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
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 work place
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.	Explore interest and passion in areas other than professional stream

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum areas have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Prepare and interpret drawings of engineering components	<ul style="list-style-type: none"> – Engineering Drawing – Mechanical Engineering Drawing
2.	Use software like AutoCAD and SolidWorks to prepare and analyze solid models.	<ul style="list-style-type: none"> – Computer Aided Drafting and Modelling
3.	Prepare simple jobs as per specifications	<ul style="list-style-type: none"> – General Workshop Practice
4.	Operate conventional machine for machining of components as per specifications	<ul style="list-style-type: none"> – Workshop Technology – II, III
5.	Use cutting tools for machines and machine tools.	<ul style="list-style-type: none"> – Workshop Technology – II
6.	Carry out casting and welding operation	<ul style="list-style-type: none"> – Workshop Technology – I
7.	Use modern machining methods for machining of components	<ul style="list-style-type: none"> – Workshop Technology – III
8.	Carry out metal forming by rolling and forging processes to produce parts	<ul style="list-style-type: none"> – Workshop Technology – III
9.	Use presses and press tools.	<ul style="list-style-type: none"> – Workshop Technology – III
10.	Prepare simple jigs, fixtures, pattern, mould and press tools for production purposes.	<ul style="list-style-type: none"> – Workshop Technology – II, III
11.	Use surface coating and protection methods.	<ul style="list-style-type: none"> – Workshop Technology – III
12.	Prepare CNC part programmes and use CNC machines to make simple jobs.	<ul style="list-style-type: none"> – CNC Machines
13.	Use boilers, steam turbines, air compressors, IC engines, refrigeration and air-conditioning equipment	<ul style="list-style-type: none"> – Thermodynamics
14.	Use hydraulic and pneumatic equipment	<ul style="list-style-type: none"> – Hydraulics and Pneumatics

15.	Use electrical and electronic instruments to measure various engineering parameters	– Elements of Electrical and Electronics Engineering
16.	Use various measuring and gauging instruments	– Metrology and Instrumentation
17.	Perform material testing for its properties	– Strength of Materials
18.	Use various instruments to measure heat/air related parameters.	– Refrigeration and Air-conditioning
19.	Use heat treatment processes	– Engineering Materials
20.	Design and modify simple machine elements	– Machine Design
21.	Select material as per desired application	– Engineering Materials
22.	Select and use QC tools	– Production Management
23.	Identify and rectify simple and common troubles in automotive vehicles.	– Automobile Engineering
24.	Carry out estimation and costing of production cost for budgeting and analysis.	– Production Management
25.	Prepare process plan for given part.	– Production Management
26.	Carry out work measurement and method study to improve productivity.	– Production Management
27.	Use appropriate practices for conservation and prevention of environment pollution	– Environmental Studies
28.	Interpret factory acts and laws	– Production Management
29.	Communicate effectively in English in oral and written form with others	– English and Communication Skills
30.	Manage resources effectively at work place	– Basics of Management
31.	Plan and execute given task/project as a team member or leader	– Generic Skills and Entrepreneurship Development
32.	Prepare detailed project proposal and report.	– Generic Skills and Entrepreneurship Development
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	<ul style="list-style-type: none">– Project Work– Industrial Training
35.	Handle the customers effectively	<ul style="list-style-type: none">– Basics of Management
36.	Apply concepts of mechanics to solve engineering problems	<ul style="list-style-type: none">– Applied Mechanics
37.	Apply basic principles of mathematics and science to solve engineering problems	<ul style="list-style-type: none">– Applied Physics– Applied Chemistry– Applied Mathematics
38.	Explore interest and passion in areas other than professional stream	<ul style="list-style-type: none">– Open Elective

5. ABSTRACT OF THE CURRICULUM AREAS

a) Humanities and Social Science Courses

1. English and Communication Skills
2. Generic Skills and Entrepreneurship Development
3. Basics of Management
4. Environmental Studies

b) Basic/Applied Science Courses

5. Applied Mathematics
6. Applied Physics
7. Applied Chemistry

c) Engineering Science Courses

8. Engineering Drawing
9. Elements of Electrical and Electronics Engineering
10. Basics of Information Technology
11. General Workshop Practice

d) Core Courses in Engineering/Technology

12. Engineering Materials
13. Applied Mechanics
14. Metrology and Instrumentation
15. Workshop Technology
16. Mechanical Engineering Drawing
17. Hydraulics and Pneumatics
18. Strength of Materials
19. Thermodynamics
20. Refrigeration and Air-conditioning
21. Theory of Machines
22. Computer Aided Drafting and Modelling
23. Production Management

- 24. Machine Design
- 25. Automobile Engineering
- 26. CNC Machines
- e) **Electives**
 - 27. Program Electives
 - 28. Open Electives
- f) **Project Work, Seminar and Industrial Training**
 - 29. Project Work
 - 30. Industrial Training

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hours/Week			MARKS IN EVALUATION SCHEME									Total Marks of Int. & Ext.
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
1.1	*English and Communication Skills - I	3	2	4	20	10	30	50	3	20	3	70	100	
1.2	*Applied Mathematics – I	4	-	4	50	-	50	50	3	-	-	50	100	
1.3	* Applied Physics-I	3	2	4	20	10	30	50	3	20	3	70	100	
1.4	* Applied Chemistry	3	2	4	20	10	30	50	3	20	3	70	100	
1.5	*Basics of Information Technology	-	2	1	-	40	40	-	-	60	3	60	100	
1.6	*Engineering Drawing-I	-	6	3	-	50	50	50	3	-	-	50	100	
1.7	*General Workshop Practice – I	-	6	3	-	50	50	-	-	50	3	50	100	
	#Student Centred Activities including Traffic Awareness and Road Safety Camp (I)	-	2	-	-	-	-	-	-	-	-	-	-	
	Total	13	22	23	110	170	280	250	-	170	-	420	700	

* Common course with other diploma programmes

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hours/Week			MARKS IN EVALUATION SCHEME									Total Marks of Int. & Ext.
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
2.1	*English and Communication Skills - II	3	2	4	20	10	30	50	3	20	3	70	100	
2.2	*Applied Mathematics – II	3	-	3	50	-	50	50	3	-	-	50	100	
2.3	* Applied Physics-II	2	2	3	20	10	30	50	3	20	3	70	100	
2.4	*Environmental Studies	2	-	2	50	-	50	50	3	-	-	50	100	
2.5	+Applied Mechanics	3	2	4	20	10	30	50	3	20	3	70	100	
2.6	*Engineering Drawing-II	-	6	3	-	50	50	50	4	-	-	50	100	
2.7	*General Workshop Practice – II	-	6	3	-	50	50	-	-	50	3	50	100	
#Student Centred Activities including Traffic Awareness and Road Safety Camp (II)		-	4	-	-	-	-	-	-	-	-	-	-	
Total		13	22	22	160	130	290	300	-	110	-	410	700	

* Common Course with other diploma programmes

+ Common with diploma programmes in Automobile Engineering, Mechanical Engg.(Production)/Production and Industrial Engg. and Civil Engg.

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING
THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hours/Week		Credits Cr	MARKS IN EVALUATION SCHEME									Total Marks of Int. & Ext.
		L/T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
					Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
3.1	*Engineering Materials	3	2	4	20	10	30	50	3	20	3	70	100	
3.2	*Elements of Electrical and Electronics Engineering	2	2	3	20	10	30	50	3	20	3	70	100	
3.3	Metrology and Instrumentation	3	2	4	20	10	30	50	3	20	3	70	100	
3.4	*Mechanical Engineering Drawing-I	-	6	3	-	50	50	50	4	-	-	50	100	
3.5	**Workshop Technology – I	3	6	6	10	20	30	50	3	20	3	70	100	
3.6	Open Elective (Online/Offline)	2	-	2	50	-	50	50	3	-	-	50	100	
# Student Centred Activities including Energy Conservation Awareness Camp; Drug Use and Abuse Awareness Camp		-	4	-	-	-	-	-	-	-	-	-	-	
Total		13	22	22	120	100	220	300	-	80	-	380	600	

* Common with diploma programmes in Production and Industrial Engineering

** Common with diploma programmes in Automobile Engineering and Mechanical Engg. (Production)/ Production and Industrial Engineering

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

FOURTH SEMESTER

Sr. No	SUBJECTS	STUDY SCHEME		Credits	MARKS IN EVALUATION SCHEME								Total Marks of Int. & Ext.
		Hours/Week			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	*Generic Skills and Entrepreneurship Development	3	-	3	50	-	50	50	3	-	-	50	100
4.2	Hydraulics and Pneumatics	3	2	4	20	10	30	50	3	20	3	70	100
4.3	**Strength of Materials	3	2	4	20	10	30	50	3	20	3	70	100
4.4	Thermodynamics-I	3	2	4	20	10	30	50	3	20	3	70	100
4.5	Mechanical Engineering Drawing - II	-	6	3	-	50	50	50	4	-	-	50	100
4.6	**Workshop Technology – II	3	6	6	10	20	30	50	3	20	3	70	100
# Student Centred Activities including Entrepreneurial Awareness camp		-	2	-	-	-	-	-	-	-	-	-	-
Total		15	20	24	120	100	220	300	-	80	-	380	600

* Common with other diploma programmes

** Common with diploma programmes in Automobile Engineering and Mechanical Engg.(Production)/Production and Industrial Engineering

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

Industrial Training - After examination of 4th Semester, the students shall go for training in a relevant industry/field organisation for a minimum period of 6 weeks and shall prepare a diary. It shall be evaluated during 5th semester by his/her teacher for 50 marks. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated for another 50 marks. This evaluation will be done by HOD and lecturer incharge – training in the presence of one representative from training organizations.

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hours/Week			MARKS IN EVALUATION SCHEME									Total Marks of Int. & Ext.
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hr	Tot		
-	Industrial Training during vacations after 4 th Semester	-	-	2	-	50	50	-	-	50	3	50	100	
5.1	*Basics of Management	3	-	3	50	-	50	50	3	-	-	50	100	
5.2	CNC Machines	1	4	3	20	10	30	50	3	20	3	70	100	
5.3	Thermodynamics-II	3	2	4	20	10	30	50	3	20	3	70	100	
5.4	Theory of Machines	3	-	3	50	-	50	50	3	-	-	50	100	
5.5	Computer Aided Drafting and Modelling	-	6	3	-	50	50	-	-	50	3	50	100	
5.6	Workshop Technology - III	3	6	6	10	20	30	50	3	20	3	70	100	
Student Centred Activities including Personality Development Camp		-	4	-	-	-	-	-	-	-	-	-	-	
Total		13	22	24	150	140	290	250	-	160	-	410	700	

* Common with other diploma programmes

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Hours/Week			MARKS IN EVALUATION SCHEME									Total Marks of Int. & Ext.
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L/T	P	Cr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
6.1	Production Management	3	-	3	50	-	50	50	3	-	-	50	100	
6.2	Machine Design	3	-	3	50	-	50	50	3	-	-	50	100	
6.3	Automobile Engineering	3	2	4	20	10	30	50	3	20	3	70	100	
6.4	Refrigeration and Air Conditioning	3	2	4	20	10	30	50	3	20	3	70	100	
6.5	Programme Elective	3	-	3	50	-	50	50	3	-	-	50	100	
6.6	Project Work	-	12	3	-	50	50	-	-	50	3	50	100	
#Student Centred Activities		-	4	-	-	-	-	-	-	-	-	-	-	
Total		15	20	20	190	70	260	250	-	90	-	340	600	

Programme Elective - Any one out of following : 6.5.1 Industrial Automation & Robotics 6.5.2 Material Handling Equipment
6.5.3 Installation & Maintenance of Equipment 6.5.4 Power Plant Engineering

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and other activities to promote experiential learning.

1.1 ENGLISH AND COMMUNICATION SKILLS – I

L	P
3	2

RATIONALE

Communication skills play 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.

LEARNING OUTCOMES

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

- Pronounce properly.
- Overcome communication barriers.
- Write legibly and effectively.
- Listen in proper prospective.
- Read various genres adopting different reading techniques.
- Converse logically.

DETAILED CONTENTS

- | | | |
|----|--|----------|
| 1. | Basics of Communication | (12 hrs) |
| | 1.1 Definition and process of communication | |
| | 1.2 Introduction to types of communication - formal and informal, oral and written, verbal and non-verbal | |
| | 1.3 Objectives of communication | |
| | 1.4 Essentials of communication | |
| | 1.5 Introduction to channels of communication - formal (upward, downward, diagonal, horizontal), informal (grapevine, consensus) | |
| | 1.6 Barriers to communication | |
| 2. | Functional Grammar and Vocabulary | (12 hrs) |
| | 2.1 Parts of speech | |
| | 2.2 Article | |
| | 2.3 Tenses | |
| | 2.4 Subject verb agreement sentences | |
| | 2.5 Active and passive voice | |
| | 2.6 Synonyms and antonyms | |
| | 2.7 Pair of words | |
| | 2.8 Correction of incorrect sentences | |

3. Listening (04 hrs)
- 3.1 Meaning of listening
 - 3.2 Listening and hearing
 - 3.3 Importance of listening
 - 3.4 Active listening – Meaning and strategies
 - 3.5 Methods to improve listening skills
4. Speaking (03 hrs)
- 4.1 Importance
 - 4.2 Methods to improve speaking
5. Reading (12 hrs)
- 5.1 Meaning
 - 5.2 Techniques of reading: skimming, scanning, intensive and extensive reading
 - 5.3 Comprehension, vocabulary enrichment and grammar exercises based on following readings:
- Section - I
- My Struggle for an Education – Booker T. Washington
 - Abraham Lincoln’s letter to his son’s headmaster – Abraham Lincoln
 - Gateman’s Gift – R.K Narayan
 - The Selfish Giant - Oscar Wilde
- Section - II
- Say Not, the Struggle Nought Availeth – A H Clough
 - Stopping by Woods on a Snowy Evening – Robert Frost
 - Where the Mind is Without Fear – Rabindranath Tagore
6. Writing (02 hrs)
- 6.1 Significance and effectiveness of writing
 - 6.2 Paragraph writing – Word choice, sentence formation and construction of paragraph.

LIST OF PRACTICALS

1. Self and peer introduction
2. Newspaper reading
3. Just a Minute session – extempore
4. Situational conversation and role play
5. Language learning using open source software.

6. Greetings for different occasions
7. Improving pronunciation through tongue twisters.

INSTRUCTIONAL STRATEGY

Open source software should be used to help the students in developing listening skills. Student centred activities such as group discussions, role play should be used to ensure active participation of students in the classroom.

RECOMMENDED BOOKS

1. Revathi, Srinivas, “Communicating Effectively in English, Book-I”, Abhishek Publications, Chandigarh.
2. Mohan, Krishna & Meera Banerji, “Developing Communication Skills (2nd Edition)”, Published by Macmillan Publishers India Ltd; New Delhi.
3. Eastwood, John, “Oxford Practice Grammar”, Oxford University Press, London
4. Chadha, R. K., “Communication Techniques and Skills”, Dhanpat Rai Publications, New Delhi.
5. Wren & Martin, “High School English Grammar and Composition”, S. Chand & Company Ltd., Delhi.
6. Kumar, Sanjay & Pushp Lata, “Communication Skills”, Oxford University Press, New Delhi

WEBSITES FOR REFERENCE

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	12	12
2	12	12
3	04	6
4	03	3
5	12	15
6	02	2
Total	45	50

1.2 APPLIED MATHEMATICS - I

L	P
4	-

RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like binomial theorem, partial fractions, etc. for solving complex engineering problems with exact solutions in a way which involve less computational task. The analytical capabilities will enable the students to solve problems in engineering field.

LEARNING OUTCOMES

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

- Apply Complex Number and its representation for two dimensional designing and related calculations.
- Apply the basic concepts of permutation and combination to find out various ways or arrangements possible for a particular problem.
- Apply binomial theorem to find approximate value of certain expressions and extracting roots of certain expressions.
- Apply basics concepts of partial fractions to simplify the concept of rational expression.
- Solve engineering problems that are in matrix format by applying the basic understanding of matrices and their properties,
- Solve problems related to height, distance, elevation by making use of trigonometry.
- Write the equation of straight line and circle by using coordinate geometry.
- Optimize the utilization of resources by applying concepts of linear programming.

DETAILED CONTENTS

1. Algebra (20 hrs)
 - 1.1 Complex Numbers: Complex number, representation, modulus and amplitude.
 - 1.2 Partial fractions (linear factors, repeated linear factors, non-reducible quadratic factors excluding repeated factors).
 - 1.3 Meaning of ${}^n P_r$ & ${}^n C_r$ (mathematical expression). Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof), first and second binomial approximation with applications to engineering problems.
 - 1.4 Introduction to Matrices and Determinants – Addition, subtraction and multiplication (upto 3×3 matrices), Determinants, simple properties, Crammer Rule.

2. Trigonometry (15 hrs)
 - 2.1 Introduction to T ratios, T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T-Ratios of multiple angles, sub-multiple angles ($2A, 3A, A/2$).
 - 2.2 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

3. Co-ordinate Geometry (18 hrs)
 - 3.1 Cartesian and Polar coordinates (two dimensional), conversion from Cartesian to Polar coordinates and vice-versa
 - 3.2 Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, symmetric form, normal form, general form), inter section of two straight lines, concurrency of lines, angle between straight lines.
 - 3.3 General equation of a circle and its characteristics. To find the equation of a circle, given:
 - * Centre and radius
 - * Three points lying on it
 - * Coordinates of end points of a diameter

4. Operations Research (7 hrs)

4.1 Linear Programming Problems formulations.

4.2 Graphical Method

INSTRUCTIONAL STATREGY

Basic of algebra, trigonometry, coordinate geometry, operations research can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students.

RECOMMENDED BOOKS

1. Grewal, BS, "Elementary Engineering Mathematics", Khanna Publishers, New Delhi
2. Sabharwal, SS & Dr Sunita Jain, "Applied Mathematics, Vol. I & II", Eagle Parkashan, Jalandhar
3. Sastry, SS, "Engineering Mathematics, Vol I & II", Prentice Hall of India Pvt. Ltd.,
4. Pal, Srimanta and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	20	16
2.	15	12
3.	18	16
4	7	06
Total	60	50

1.3 APPLIED PHYSICS – I

L	P
3	2

RATIONALE

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

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

LEARNING OUTCOMES

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

- Select units of various physical quantities for use in engineering solutions.
- Represent physical quantities as scalar and vector.
- Use the concepts of force and motion to solve problems.
- Solve problems related to friction, work, power and energy,
- Comprehend properties of matter.
- Comprehend modes of heat transfer.
- Make measurements with accuracy.

DETAILED CONTENTS

- | | | |
|-----|--|---------|
| 1. | Units and Dimensions | (9 hrs) |
| 1.1 | Physical quantities Units - fundamental and derived units, systems of units (FPS, CGS and SI units) | |
| 1.2 | Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface tension, stress, strain) | |
| 1.3 | Principle of homogeneity of dimensions | |
| 1.4 | Dimensional equations and their applications, conversion of units from one system to another for density, force, pressure, work, power, velocity and acceleration. Checking of dimensional equations | |
| 1.5 | Limitations of dimensional analysis | |

2. Force and Motion (10 hrs)
- 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
 - 2.4 Force, Momentum, Statement of Conservation of linear momentum, its applications
 - 2.5 Impulse and its Applications
 - 2.6 Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
 - 2.7 Relation between linear and angular velocity, linear acceleration and angular acceleration (Only Formula), Angular momentum and torque (definition only)
 - 2.8 Concept of centripetal and centrifugal forces and their applications with examples such as banking of roads
3. Work, Power and Energy (8 hrs)
- 3.1 Work: and its units, examples of zero work, positive work and negative work
 - 3.2 Friction: concept, types, laws of limiting friction
 - 3.3 Energy and its units: Kinetic energy and gravitational potential energy with examples and their derivation
 - 3.4 Principle of conservation of mechanical energy for freely falling bodies, examples of transformation of energy.
 - 3.5 Power and its units, calculation of power in numerical problems
4. Properties of Matter (9 hrs)
- 4.1 Elasticity: definition of stress and strain, Moduli of elasticity (Only definition, No derivation) , Hooke's law, significance of stress strain curve
 - 4.2 Pressure: definition, its units, atmospheric pressure, gauge pressure, absolute pressure
 - 4.3 Surface tension: concept, its units, angle of contact, applications of surface tension, effect of temperature on surface tension
 - 4.4 Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law

5. Thermometry (9 hrs)
- 5.1 Difference between heat and temperature
 - 5.2 Modes of transfer of heat (Conduction, convection and radiation with examples)
 - 5.3 Different scales of temperature and their relationship
 - 5.4 Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them
 - 5.5 Concept of Co-efficient of thermal conductivity

LIST OF PRACTICALS (to perform minimum 8 experiments)

1. To find volume of solid sphere using a vernier caliper.
2. To find internal diameter and depth of a beaker using a vernier caliper and hence find its volume.
3. To find the diameter of wire using a screw gauge
4. To determine the thickness of glass strip using a spherometer
5. To verify parallelogram law of forces
6. To study conservation of energy of a ball or cylinder rolling down an inclined plane.
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 STATREGY

Teacher may use various teaching aids like 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 can make the subject interesting and develop scientific temper in the students.

RECOMMENDED BOOKS

1. “Text Book of Physics for Class XI (Part-I, Part-II)”, N.C.E.R.T., Delhi
2. “Applied Physics, Vol. I and Vol. II”, TTTI Publications, Tata McGraw Hill, Delhi
3. Verma, HC, “Concepts in Physics Vol. I & II”, Bharti Bhawan Ltd. New Delhi
4. “Comprehensive Practical Physics, Vol, I & II”, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
5. Naik, PV, “Engineering Physics”, Pearson Education Pvt. Ltd, New Delhi
6. Banwait, RA & R, Dogra, “Applied Physics I & II”, Eagle Parkashan, Jalandhar
7. Bhattacharya, DK & Poonam Tandan, “Engineering Physics”, Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	9	10
2.	10	12
3.	8	8
4.	9	10
5.	9	10
Total	45	50

1.4 APPLIED CHEMISTRY

L P

3 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 diploma holders to develop scientific temper and appreciate importance of chemistry. Hence the subject of Applied Chemistry.

LEARNING OUTCOMES

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

- Interpret both qualitative and quantitative aspects of simple chemical substances.
- Substantiate the laws and principles on which structure of atom is established.
- Understand types of bonds in chemical substance and their influence on the properties of chemical substances.
- Prepare solution of required concentrations.
- Understand qualitatively and quantitatively pH and buffer solutions.
- Significance of pH and buffer solutions and their industrial applications (in the process such as electrolysis, electrochemical machining of materials etc).
- Explain cause and factors adversely affecting natural water quality and remedial measures available for water purification to achieve water quality standards required for domestic, agricultural and industrial applications.
- Appreciate and practice the water conservation techniques.
- Identify and classify the substance based on the electric behavior.
- Realize the laws/principles efficiently used in development of electrochemical cells towards the greener energy.
- Identify most efficient fuel for the engine and engineering applications.
- Understand the elementary idea of polymers and plastics
- Distinguish different type of plastics and their applications.

DETAILED CONTENTS

1. Basic Concept of Chemistry (2 hrs)
 - 1.1 Symbols of elements and valency, writing of chemical formulae of simple compounds.
 - 1.2 Calculation of molecular masses of CaCO_3 , NaCl , CuSO_4 , NaOH , Ca(OH)_2 , H_2SO_4 , $\text{C}_2\text{H}_2\text{O}_4$. (Atomic mass of elements should be provided)

2. Atomic Structure and Chemical Bonding (8 hrs)
 - 2.1 Bohr's model of atom (qualitative treatment only).
 - 2.2 Atomic number, atomic mass number isotopes and isobars.
 - 2.3 Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,
 - 2.4 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).
 - 2.5 Chemical bonding and cause of bonding and types of chemical bonding; Ionic bond (example NaCl) and Covalent bond (sigma (σ) and pi (π) bonds) with examples of H_2 , O_2 , N_2 and CH_4 Metallic bonding.

3. Solutions (05 hrs)
 - 3.1 Definition of solution, solute and solvent with examples
 - 3.2 Methods to express the concentration of solution- molarity (M) and molality (m), mass percentage, volume percentage and mole fraction and related simple numericals.
 - 3.3 Arrhenius concept of acids and bases. pH of solution, simple numericals on pH and industrial applications of pH.
 - 3.4 Definition of buffer solution and types of buffer solutions with examples and industrial applications of buffers solutions.

4. Water (10 hrs)
 - 4.1 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 numericals.
 - 4.2 Disadvantages caused by the use of hard water in domestic industry and boiler feed water.
 - 4.3 Removal of hardness -Permutit process and Ion-exchange process.
 - 4.4 Drinking water and characteristics of drinking water.
 - 4.5 Natural water sterilization by chlorine and UV radiation and reverse osmosis (elementary idea).

5. Electro Chemistry (6 hrs)
- 5.1 Electronic concept of oxidation, reduction and redox reactions
 - 5.2 Definition of terms: electrolytes, non-electrolytes with suitable examples
 - 5.3 Faradays laws of electrolysis and simple numerical problems.
 - 5.4 Industrial Application of Electrolysis – Electroplating.
 - 5.5 Application of redox reactions in electrochemical cells (qualitative idea only excluding reactions) - commercial dry cell (Primary) and elementary idea of secondary cell (Only lead storage battery)
6. Chemistry of Fuels and Lubricants (12 hrs)
- 6.1. Definition of fuel, classification of fuels (primary and secondary), characteristics of good fuel.
 - 6.2 Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter and numerical examples.
 - 6.3 Coal - proximate analysis of coal
 - 6.4 Fuel rating – Octane number and Cetane number, fuel-structural influence on Octane and Cetane numbers
 - 6.5 Gaseous fuels – chemical composition, calorific value and applications of natural gas (CNG), LPG, producer gas, water gas and biogas. (preparation/manufacture excluded)
 - 6.6 Definition of Lubricant and characteristics of good lubricant
 - 6.7 Classification of lubricants –liquid lubricants, solid lubricants, semi-solid lubricants with examples
 - 6.8 Properties of lubricant: Physical properties –viscosity and viscosity index, cloud point and pour point, flash point and fire point, oiliness. Chemical properties- Total Acid Value or Number (TAV or TAN), carbon residue, saponification value.
7. Polymers and Plastics (02 hrs)
- 7.1 Definition of polymer, monomer and degree of polymerization
 - 7.2 Brief introduction of plastics - thermo plastics and thermo setting plastics with suitable examples (PVC, PS, PTFE, Nylon 6, Nylon 66, bakelite) distinction between thermo and thermo setting plastics
 - 7.3 Applications of polymers in industry and daily life
 - 7.4 Introduction to nano materials and nano technology

LIST OF PRACTICALS

1. Preparation of standard solution of oxalic acid.
2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.

3. To determine TDS in given sample of water.
4. To prepare Mohr's salt from ferrous sulfate and ammonium sulfate.
5. Determination of pH of given solution using pH meter.
6. Estimation of total alkalinity of given water sample by titrating it against standard sulfuric acid solution.
7. Gravimetric estimation of moisture in the given coal sample (proximate analysis).
8. Gravimetric estimation of ash content in the given coal sample (proximate analysis).
9. Determination of viscosity of given liquid using Redwood viscometers
10. To construct simple Daniel cell and measure its e.m.f. using voltmeter.
11. To estimate hardness of water using EDTA method.

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.

RECOMMENDED BOOKS

1. Kuricose, J.C. and J. Rajaram, "Chemistry in Engineering", Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Jain, P.C. & Monika Jain, "Engineering Chemistry", Dhanapat Rai Publishing Company, New Delhi.
3. Ahuja, S. C. and G. H. Hugar, "Eagle's Applied Chemistry (I and II)", Eagle Prakashan, Jalandhar.
4. Rao, C N R, "Understanding Chemistry", Universities Press (India) Pvt Ltd., 2011
5. Chopra, H. K. & A. Parmar, "Engineering Chemistry – A Text Book", Narosa Publishing House, New Delhi.
6. Pandey, Dr. Himanshu, "Engineering Chemistry", Goel Publishing House, Meerut, India.

SUGGESTED DISTRIBUTION OF MARKS

Topics	Time Allotted (hrs)	Marks Allotted (Out of 50)
1.	02	03
2.	08	08
3.	05	06
4.	10	12
5.	06	06
6.	12	12
7.	02	03
Total	45	50

1.5 BASICS OF INFORMATION TECHNOLOGY

L	P
-	2

RATIONALE

Information technology has great influence on all aspects of life. 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 office automation tools using MS Office/Open Office/Libre Office, and internet concepts. This exposure will enable the students to enter their professions with confidence.

LEARNING OUTCOMES

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

- Identify computer hardware components, network components and peripherals.
- Install application and utility software.
- Use word processing software to prepare document.
- Use spreadsheet software to create workbook and automate calculation.
- Use presentation software to create interactive presentation.
- Browse information on the Web.

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.

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Basic Concepts of IT and Its Application

Information Technology concept and scope, applications of IT.

2. Computer Hardware:

Block diagram of a computer, components of computer system, CPU, Memory, Input devices; keyboard, Scanner, mouse etc; Output devices; VDU, LCD, Printers etc. Primary and Secondary Memory: RAM, ROM, tracks and sectors, optical disk (CD , DVD & Blue Ray Disk.), USB/Flash Drive, HDD, SSD

3. Software Concepts and Programming:

System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Application software, Features of OPEN OFFICE/MS OFFICE(MS word, Excel, PowerPoint).
Flow chart using algorithm development, Input Output statement, Control structures

4. Internet Concepts:

Basics of Networking – LAN, WAN, PAN, MAN, and sharing of printers and other resources, Concept of IP addresses, introduction of internet, applications of internet like: e-mail and browsing, concept of search engine and safe searching. Various browsers like Internet explorer/Microsoft Edge, Mozilla Firefox, WWW (World Wide Web), hyperlinks, introduction to Anti-virus.

LIST OF PRACTICAL EXERCISES

1. Given a PC, identify its basic hardware components, network components and peripherals. List their functions .
2. Installation of various application software and utility software.
3. Installation of I/O devices like scanner, printer and plotter.
4. Practice on various features/functions of Windows Operating System..

Word Processing (MS Word/Open Office Writer/Libre Office Writer)

5. Creating/opening, saving and printing a document
6. Editing and formatting a document
7. Setting paragraph and page margins.
8. Adding header, footer and page numbering
9. Creating, inserting and formatting a table.
10. Spell checker, inserting date, time, special symbols, importing graphic images, drawing tools.

Spread Sheet Processing (MS Excel/Open Office Calc/Libre Office Calc)

11. Creating/opening, saving and printing a worksheet.
12. Editing and formatting of worksheets including changing colour, size, font, alignment of text and cell formatting.
13. Using statistical functions like sum, avg, min, max, if, count and countif, lookup.
14. Creating and formatting a chart, Using charts to analyse data. Use of filters.

Presentation Software (MS Power Point/Open Office Impress/Libre Office Impress)

15. Creating, saving, opening and printing a presentation.
16. Different views of a slide.
17. Using slide layout and template.
18. Editing and formatting slides by adding titles, subtitles, text, background, watermark, table, charts, images and sound.
19. Viewing the slide show with slide transition, animation effect, timing and order.

Programming

20. Printing of name 100 times using loop statement.

Internet and its Applications

21. Creating an e mail account. Sending and receiving e-mail.
22. Browsing and down loading of information from internet.
23. Surfing different websites like institute website, State Board PSBTE website, DTE website, NITTTR, Chandigarh website, AICTE website, various search engines like google, bing etc.

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 in addition to working on internet. The student should be made capable of working on computers independently.

RECOMMENDED BOOKS

1. Arora, Vipin, "Computer Fundamentals and Information Technology", Eagle Parkashan, Jalandhar
2. Sinha, PK, "Computer Fundamentals", BPB Publication, New Delhi
3. Rajaraman V, "Fundamentals of Computer", Prentice Hall of India Pvt. Ltd., New Delhi
4. Saxena, Sanjay, "MS Office for Everyone", Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. Leon and Leon, "Fundamentals of Information Technology", Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi

1.6 ENGINEERING DRAWING - I

L P
- 6

RATIONALE

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

Note:

- i) First angle projection is to be followed.
- ii) Minimum of 16 sheets to be prepared and at least 3 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
- 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-CUM- PRACTICAL EXERCISES

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. Sections (02 sheets)
- 5.1 Importance and salient features
- 5.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.
- 5.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections
- 5.4 Orthographic sectional views of different objects.
6. Isometric Views (02 sheets)
- 6.1 Fundamentals of isometric projections and isometric scale.
- 6.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.
7. Common Symbols and Conventions used in Engineering (02 sheets)
- 7.1 Civil Engineering sanitary fitting symbols
- 7.2 Electrical fitting symbols for domestic interior installations
- *8. Introduction to Computer Aided Drafting (03 sheets)
- Basic introduction and operational instructions of various commands in Computer Aided Drafting. At least three 2 D drawings using Computer Aided Drafting of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.
- * Computer aided 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.

RECOMMENDED BOOKS

1. Singh, Surjit, "A Text Book of Engineering Drawing", Dhanpat Rai & Co., Delhi
2. Gill, PS, "Engineering Drawing", SK Kataria & Sons, New Delhi
3. Bhatt, ND, "Elementary Engineering Drawing in First Angle Projection", Charotar Publishing House Pvt. Ltd., Anand
4. Layall, JS, "Engineering Drawing I & II", Eagle Parkashan, Jalandhar
5. Goel, DK, "Engineering Drawing I", GBD Publication.

1.7 GENERAL WORKSHOP PRACTICE – I

L P
- 6

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practical. General workshop practical included in the curriculum in order to provide hands-on practical knowledge of different tools and basic manufacturing processes. Basic knowledge of workshop technology and practical in various workshops develop the attitude of team working, safety awareness and development of right attitude. This subject provides miniature industrial environment in the educational institute.

LEARNING OUTCOMES

After completing the course the students will be able to:

- Identify shop wise tools and equipment, their types, specifications and use with proficiency.
- Identify different types of materials, their uses and to maintain tools, equipment etc.
- Use and take measurements with the help of basic measuring tools/instrument.
- Select proper tools for a particular operation and use hand tools in different workshops with predefined outcome.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same according to drawing.
- Operate various tools and equipment in different workshops with predefined outcome, performance, standards.
- Follow the safety procedures and precautionary measures in different workshop with zero accidents.

DETAILED CONTENTS-CUM- PRACTICAL EXERCISES

Note: The students are supposed to come in proper workshop uniform 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 workshops will be explained for conduct of practical. The students should prepare sketches of various tools/jobs sequence of operations etc. in their practical notebook.

The following shops are included in the syllabus:

1. Welding Shop – I
2. Fitting Shop – I
3. Sheet Metal Shop – I
4. Electric Shop-I
5. Carpentry Shop – I
6. Smithy Shop – I or Additive Manufacturing Shop- I

1. WELDING SHOP – I

- a. Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction and importance of welding as compared to other material joining processes. Classification of welding processes. Specifications and type of welding machines, welding parameters, welding methods, welding joints and welding positions. Classification and coding of electrodes and functions of electrode coating ingredients.
 - b. Demonstration of hand tools, arc welding machines, equipment and materials to be welded.
- 1.3 Jobs to be prepared:
- | | |
|---------|--|
| Job I | Practice of striking arc (Minimum 4 beads on 100 mm long M.S. flat) and Practice of depositing beads at different current levels. (Minimum 4 beads on M.S. flat at four different setting of current level). |
| Job II | Making a lap joint using arc welding (SMAW) on MS Flat. |
| Job III | Making a butt joint using arc welding (SMAW) on MS Flat. (100 mm long). |
| Job IV | Making a T shape Joint using arc welding (SMAW) on M.S. Flat (100mm x 6 mm). |

2. FITTING SHOP – I

- 2.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction, functions, classification, specification and use of various types of holding, cutting, marking and measuring tools used in fitting shop like-Bench vice, V block, C clamp, Ball peen hammer, scriber, punches, files, hacksaw, surface plate, try square, calipers, steel rule, Vernier calliper, Micrometre and Vernier height gauge etc. Identification of materials like-Iron, Copper, Stainless Steel, Aluminium etc.), Identification of various steel sections like-flat, angle, channel, bar etc.). Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).

2.2 Demonstration of various types of holding, cutting, marking and measuring tools used in fitting shop.

2.3 Jobs to be prepared:

Job I To make a rectangular job by performing the operations: Sawing, Marking, filing on MS work piece (75 x 50 x 6 mm) by making sides at 90 degree and surface flatness at 180 degrees and to maintain dimensions within an accuracy of ± 0.25 mm.

Job II To make a job by performing the operations: Sawing, Marking, corner circular/radius filing on MS work piece (75 x 50 x 6 mm) by measuring dimensions with the help of Vernier Calipers within the tolerance of ± 0.1 mm.

Job III To Make 'V' type cut-out profile from a square piece of MS flat using hand hacksaw, filing, marking and measuring operations.

3. SHEET METAL SHOP – I

3.1. Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction and functions of various types of tools used in sheet metal shop: - snips, hand shearing, measuring tools, marking tools, striking tools and bending tools including types of stakes. Introduction and importance to different types of joints and fasteners used in sheet metal work. Introduction and purpose of different metals used in sheet-metal work-black iron, galvanized iron, aluminium and stainless steel. Introduction of different types of Rivets, types of riveted joints, advantages, disadvantages and applications.

3.2 Demonstration of various types of holding, cutting, marking and bending tools used in fitting shop. demonstration of various raw materials used in sheet metal shop e.g. black-iron sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.

3.3 Jobs to be prepared:

Job I Shearing and bending practice on a sheet using hand shears/snips and stakes.

Job II To fabricate different types of sheet metal joint such as lap joint-single seam/double seam.

Job III To fabricate riveted lap joint (chain or zig zag type).

Job IV To fabricate single cover plate chain type, zig-zag type and single rivetted butt Joint.

4. ELECTRIC SHOP - I

4.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction, functions and specifications of different

types of tools, wires, cables, switches, fuses, cleats, clamps, allied items, and accessories used in Electric shop. Introduction to battery charger and its functioning. Introduction to common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Introduction to lead acid battery and nickel cadmium battery.

- 4.2 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. Demonstration of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Demonstration of lead acid battery and nickel cadmium battery.

4.3 Job Practice:

Job I Identification of phase, neutral, earth wires for connection to domestic electrical appliances and their connections to three pin plugs.

Job II Practice in making series and parallel circuit. Make one lamp control by one switch circuit.

Job III Practice on house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping, conduit and concealed wiring.

Job IV Installation of battery and connecting two or three batteries in series and parallel.

Job V Charging a battery and testing with hydrometer and cell tester

5. CARPENTRY SHOP – I

- 5.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to wood, timber their properties, uses & defects and their joints. Seasoning of wood and its advantages. Introduction, specifications and function of various types of tools used in carpentry (such as different types of Saws, C-Clamp, Chisels, Carpenter's vice, Mallets, Marking gauges, Scriber, Try-square, Steel tape, Wooden plane, Metallic Jack plane, Rulers) by segregating as cutting tools, supporting tools, holding tools, measuring tools etc. Types of wooden joints. Techniques/method of sharpening of jack plane cutter/blade.

- 5.2 Demonstration of wood/timber, seasoning, various types of tools used in carpentry shop. Types of wooden joints.

5.3 Jobs to be Prepared :

Job I To make a rectangular wooden piece involving operations like-planing, marking, sawing and measuring.

Job II Iron jack plane blade/cutter sharpening and Chisel sharpening practice.

Job III To make a Half Lap Joint (cross, L or T shape – any one)

Job IV To make a Mortise and Tenon joint (T- shape Joint)

6. SMITHY SHOP – I

- 6.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to Smithy shop, different types of Hearths, its purpose, specifications, uses, types of various tools and equipment used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools etc. Types of fuel used and maximum temperature obtained, types of raw materials used in Smithy Shop , uses of Fire Bricks and Clays in Forging workshop.
- 6.3 Demonstration of different fuels used and maximum temperature obtained. Use of fire brick and clay in forging/ smithy shop. Practice of firing of hearth/Furnace, Temperature Control of Fire. Demonstration of different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting. Demonstration of Simple Heat treatment processes like Tempering, Normalizing Hardening etc
- 6.3 Jobs to be prepared:
- Job I Making a job of square shape from a M.S. rod by forging method.
- Job II Making a square shape L hook from M.S. rod.
- Job III Making a ring from MS rod by cold or hot forging process
- Job IV Making a job using drawing down operation on round or flat section.

6. ADDITIVE MANUFACTURING SHOP - I

- 6.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to digital design, Computer Aided Drafting (2D drawing) and Computer Aided Design (3D modelling), various CAD packages, basic 2D and 3D commands, basic geometrical shapes (both regular and irregular) etc. Introduction to Additive Manufacturing, identification of different types of materials used, applications and advantages. Identification of different types of geometrical shapes: regular shapes like sphere, prisms, pyramids, solids of revolution, irregular shapes like I section, L section, C section and T section etc.

6.2 Demonstration of 3D CAD package including software interphase, basic commands for drawing, editing, modelling etc., fabrication of 3D models, saving in .PRT file, conversion to .STL file, error identification and its rectification, working of 3D printer, 3D printing of simple components.

6.3 Jobs to be performed

Job I: 3D modelling of basic right regular geometrical shapes:

Prisms: Triangular, square. Rectangular, pentagonal and hexagonal

Pyramids: Triangular, square. Rectangular, pentagonal and hexagonal

Job II: 3D modelling of solids of revolution: Sphere, cylinder, cone and torus

Job III: 3D modelling of special shapes like I section, L section, C section and T section

Job IV: 3D modelling of machined parts using various 3D commands.

Note :

1. Workshop instructors will guide and help the students throughout the practical class in order to explain and complete the job according to syllabus and for providing necessary facilities to the students during performance of practical by observing the safety precautions
2. The Workshop Superintendent or Foreman Instructor or Foreman will demonstrate and deliver the theoretical instructions with regard to introduction, functions, classification and specification of tools, instruments, equipment, apparatus etc. of all the topics covered in the syllabus.
3. The Workshop Superintendent or Foreman Instructor will also conduct the mid-term test and final practical exam of this subject.

RECOMMENDED BOOKS

1. Singh, Swaran, "Workshop Practice", S. K. Kataria and Sons, New Delhi.
2. Bawa, H.S., "Workshop Practice", Tata McGraw Hill Publishers, New Delhi.
3. Hajra, SK, "Workshop Technology I, II, III", Choudhary and AK Choudhary Media Promoters and Publishers Pvt. Ltd. Mumbai.
4. Manchanda, "Workshop Technology Vol. I, II, III", India Publishing House, Jalandhar.
5. Raghuvanshi, B.S., "Workshop Technology", Dhanpat Rai and Co., New Delhi

TRAFFIC AWARENESS & ROAD SAFETY CAMP (I)

A diploma holder must have knowledge of various types of traffic rules and regulations. Road safety education is vital for people of all ages. As a responsible citizen, you should be aware of each and every road safety rules. Observation is the key skill you need in ensuring road safety. By obeying safety rules and regulations, you can save yourself and others on the road. This camp covers the basic concepts of traffic rules and safety. Lectures will be delivered on following broad topics with the coordination of Distt. Traffic police. There will be no exam for this camp.

1. Road safety Scenario
2. School bus and traffic management
3. Awareness of Traffic Signs
4. Speeding Limit
5. Always Wear your Shields
6. Overtaking
7. Awareness through Hoardings
8. Walking & Safe cycling

2.1 ENGLISH AND COMMUNICATION SKILLS - II

L	P
3	2

RATIONALE

Communication skills play 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.

LEARNING OUTCOMES

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

- Make proper oral presentations.
- Speak confidently.
- Debate properly.
- Write accurate official/business letters.
- Respond to telephone calls effectively.
- Overcome communication barriers.

DETAILED CONTENTS

1. Functional Grammar and Vocabulary (12 hrs)

Theory and Practical exercises on following:

- 1.1 One word substitution
- 1.2 Functional Grammar and Vocabulary
- 1.3 Prefixes and Suffixes
- 1.4 Punctuation
- 1.5 Narration
- 1.6 Idioms and Phrases

2. Reading (9 hrs)

Comprehension, Vocabulary enrichment and grammar exercises based on the following readings:

Section-I

- The Last Leaf - O' Henry
- Sparrows - K A Abbas
- The Postmaster - Rabindra Nath Tagore

Section-II

- Night of the Scorpion - Nissim Ezekiel
- All the World is a Stage - William Shakespeare
- Success – Emily Dickenson
- Daffodils – William Wordsworth

3. Writing (24 hrs)

- 3.1 Writing Resume and Cover letter
- 3.2 Correspondence: Business and Official
- 3.3 Report Writing – Introduction and features of good report.
- 3.4 Press Release
- 3.5 Memos and Circulars
- 3.6 Notices (lost, found, and auction)
- 3.7 Agenda and Minutes of Meetings
- 3.8 Filling-up different forms such as bank form and on-line form for placement etc.
- 3.9 Precis Writing
- 3.10 E mail writing

LIST OF PRACTICALS

1. Group discussion on some current topic of interest.
2. Small speech using voice modulation.
3. Debate
4. Manners and Etiquette
5. Power point presentation
6. Telephonic conversation: General etiquette for making and receiving calls.
7. Mock interviews

INSTRUCTIONAL STRATEGY

Open source software should be used to help the students in developing listening skills. Student centred activities such as group discussions, role play should be used to ensure active participation of students in the classroom.

RECOMMENDED BOOKS

1. Revathi, Srinivas, “Communicating Effectively in English, Book-I”, Abhishek Publications, Chandigarh.
2. Mohan, Krishna & Meera Banerji, “Developing Communication Skills (2nd Edition)”, Published by Macmillan Publishers India Ltd; New Delhi.
3. Eastwood, John, “Oxford Practice Grammar”, Oxford University Press, London

4. Chadha, R. K., “Communication Techniques and Skills”, Dhanpat Rai Publications, New Delhi.
5. Wren & Martin, “High School English Grammar and Composition”, S. Chand & Company Ltd., Delhi.
6. Kumar, Sanjay & Pushp Lata, “Communication Skills”, Oxford University Press, New Delhi

WEBSITES FOR REFERENCE

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	12	12
2	9	12
3	24	26
Total	45	50

2.2 APPLIED MATHEMATICS – II

L P
3 -

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Apply differential calculus to solve max/min and related rate measure problems.
- Apply concepts of definite integrals to calculate the area of a curve bounded by axes.
- Evaluate complex integrals in a simpler way by applying definite integral.
- Solve engineering problems by making use of ordinary differential equations.

DETAILED CONTENTS

- | | | |
|-----|---|----------|
| 1. | Differential Calculus | (18 hrs) |
| 1.1 | Definition of function; Introduction to limit and continuity (definition only). | |
| 1.2 | Standard differentiation of algebraic, trigonometric, inverse trigonometric functions, logarithmic function and exponential function. | |
| 1.3 | Differentiation of sum, product and quotient of functions, Differentiation of function of a function, differentiation of implicit functions and parametric functions. | |
| 1.4 | Logarithmic differentiation and successive differentiation (excluding nth order). | |
| 1.5 | Application of differential calculus in: | |
| (a) | Rate Measures | |
| (b) | Maxima and minima (single variable functions) using second order derivative only | |
| (c) | Equation of tangent and normal to a curve (for explicit functions only) | |

2. Integral Calculus (22 hrs)
- 2.1 Indefinite integrals, Integration as inverse operation of differentiation with simple examples.
- 2.2 Standard integrals and related simple problems
- 2.3 Simple integration by substitution, by parts and by partial fractions (for linear factors only)
- 2.4 Evaluation of definite integrals (simple problems)
 Evaluation of $\int_0^{\pi/2} \sin^n x \, dx$, $\int_0^{\pi/2} \cos^n x \, dx$, $\int_0^{\pi/2} \sin^m x \cos^n x \, dx$
 using formulae without proof (m and n being positive integers only).
- 2.5 Applications of integration for evaluation of area bounded by a curve and axes (Simple problems).
3. Differential Equations (5 hrs)
- 3.1 Definition, order, degree of ordinary differential equations.
- 3.2 Formation of differential equation (up to 2nd order). Solution of Differential equations with Variable separation and Linear Differential equations.

INSTRUCTIONAL STATREGY

Basic elements of Differential Calculus, Integral Calculus, and Differential Equations can be taught in the light of their applications in the field of engineering and technology. By laying more stress on applied part, teachers can also help in providing continuing education base to the students.

RECOMMENDED BOOKS

1. Grewal, BS, "Elementary Engineering Mathematics", Khanna Publishers, New Delhi
2. Engineering Mathematics by Vol. I & II by S Kohli, IPH, Jalandhar
3. Sabharwal, SS & Dr Sunita Jain, "Applied Mathematics, Vol. I & II", Eagle Parkashan, Jalandhar

4. Engineering Mathematics, Vol I, II & III by V Sundaram et al, Vikas Publishing House (P) Ltd., New Delhi
5. Sastry, SS, “Engineering Mathematics, Vol I & II”, Prentice Hall of India Pvt. Ltd.,
6. Pal, Srimanta and Subodh C. Bhunia, “Engineering Mathematics”, Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	18	20
2	22	25
3	5	05
Total	45	50

2.3 APPLIED PHYSICS – II

L	P
2	2

RATIONALE

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

LEARNING OUTCOMES

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

- Apply the concept of wave motion
- Illustrate laws of reflection and refraction of light.
- Comprehend the phenomenon related to electrostatics
- Comprehend the terms and laws related to electricity and magnetism.
- Make use of laser for engineering applications.

DETAILED CONTENTS

- | | | |
|----|--|---------|
| 1. | Wave motion and its Applications | (6 hrs) |
| | 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 Free, forced and resonant vibrations with examples | |
| | 1.3 Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications | |
| | 1.4 Ultrasonics – Introduction and applications. | |
| 2. | Optics | (6 hrs) |
| | 2.1 Laws of reflection and refraction, refractive index, lens formula for thin lenses, power of lens, magnification | |
| | 2.2 Total internal reflection and its applications, Critical angle and conditions for total internal reflection | |
| | 2.3 Simple and compound microscope, astronomical telescope in normal adjustment, magnifying power (Only formula). | |

3. Electrostatics (6 hrs)
- 3.1 Coulombs law, unit of charge,
 3.2 Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference
 3.3 Capacitor and its working principle, Capacitance and its units. Capacitance of parallel plate capacitor (No derivation), Series and parallel combination of capacitors (numericals)
 3.4 Dielectric and its effect on capacitance, dielectric break down
4. Electricity and Magnetism (9 hrs)
- 4.1 Electric Current and its Unit, Direct and alternating current,
 4.2 Resistance and its Units, Specific Resistance, Conductance, Specific Conductance, Series and Parallel combination of Resistances. Factors affecting Resistance, Superconductivity (concept only)
 4.3 Ohm's law and its verification
 4.4 Kirchoff's laws, Wheatstone bridge principle
 4.5 Heating effect of current, Electric power, Electric energy and its units (related numerical problems)
 4.6 Introduction to magnetism, Types of magnetic materials. Dia, para and ferromagnetic materials with their properties,
 4.7 Magnetic field and its units, magnetic lines of force, magnetic flux and their units
 4.8 Concept of electromagnetic induction, Faraday's Laws and Lenz's law, Galvanometer and its use.
5. Modern Physics (3 hrs)
- 5.1 Lasers: its characteristics, spontaneous and stimulated emission, population inversion; Principle, construction and working of Ruby laser, engineering applications of lasers.

LIST OF PRACTICALS (To perform minimum 8 experiments)

1. To find the time period of a simple pendulum
2. To determine and verify the time period of cantilever
3. To verify laws of reflection from a plane mirror.
4. To find the focal length of convex lens by parallax method.
5. To determine the magnifying power of an astronomical telescope
6. To verify ohm's laws by drawing a graph between voltage and current.
7. To verify laws of resistances in series and parallel combination.
8. To find resistance of galvanometer by half deflection method
9. To measure very low resistance and very high resistances using Slide Wire bridge
10. Use of CRO in plotting AC and DC waveforms.
11. To find wave length of the laser beam.

INSTRUCTIONAL STATREGY

Teacher may use various instructional media like models, charts and graphs while imparting instructions. The field application should be made clear before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

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. Practical Physics by C. L. Arora, S Chand Publications
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (hrs)	Marks Allotted (Out of 50)
1	06	10
2	06	10
3	06	10
4	09	15
5	03	05
Total	30	50

2.4 ENVIRONMENTAL STUDIES

L P
2 -

RATIONALE

Engineering activities require the use of natural resources which results in wide-ranging adverse effects on the environment. Natural replenishment of these resources is practically impossible. These necessities that all technicians should know about the basics of ecology, environment and its functions, environmental pollution and management and environmental legislation which will enable them to accomplish their professional work with environmental compatibility. Hence this subject.

LEARNING OUTCOMES

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

- Comprehend the importance of ecosystem and environment.
- Demonstrate interdisciplinary nature of environmental issues.
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of environmental pollutions.
- Compute the impact of human activities on the environment.
- Understand purpose of 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.

DETAILED CONTENTS

1. Introduction: (4 hrs)
Basics of ecology, eco system and environment. Review of carbon, nitrogen, sulphur and water cycle)
2. Conservation of land reforms: (3 hrs)
Desertification, Causes, effects and prevention. rain water harvesting, maintenance of ground water, deforestation – its effects and control measures
3. Environmental Pollution: (10 hrs)
Sources of pollution - natural and man made, causes, effects and control measures of pollution (air, water, noise, soil and radioactive). Concept of BOD, COD and AQI, Prevention of Pollution- Introduction to Cleaner Production Technologies, Waste Minimization Techniques, Concept of Zero Discharge, Impact of Energy

Usage on Environment: Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain.

4. Solid Waste management (3 hrs)
Classification of refuse material, sources, effects and control measures. Introduction to E-waste Management
5. Environmental Legislation (4 hrs)
Introduction to Water (prevention and control of pollution) Act, Air (Prevention and Control of Pollution) Act and Environmental Protection Act, Role and Function of State Pollution Control Board, Introduction to Energy Conservation Act & its importance, Concept of Environmental Impact Assessment (EIA)
6. Energy Conservation and Sustainable Development (6 hrs)
Introduction to Energy Management, Energy Conservation, Energy efficiency and its need. Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio mass energy, hydro energy) in environmental protection. Sustainable development, Concept of Green building and eco friendly materials.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits etc. may also be organized.

RECOMMENDED BOOKS

1. Sharma, BR, "Environmental and Pollution Awareness", Satya Prakashan, New Delhi.
2. Khitoliya, Dr. RK, "Environmental Pollution", S Chand Publishing, New Delhi.
3. Deswal and Deswal, "Environmental Science", Dhanpat Rai and Co. (P) Ltd. Delhi.
4. Bharucha, Erach, "Environmental Studies", University Press (India) Private Ltd., Hyderabad.
5. Dhamija, Suresh K, "Environmental Engineering and Management", SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	4	06
2	3	05
3	10	16
4	3	05
5	4	06
6	6	12
Total	30	50

2.5 APPLIED MECHANICS

L	P
3	2

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, laws of motion, moment, friction, centre of gravity, 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.
- Solve problems by using principle of moment.
- 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 | (2 hrs) |
| | 1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields.
Definition of Applied Mechanics. | |
| | 1.2 Concept of rigid body, scalar and vector quantities | |
| 2. | Laws of forces | (10 hrs) |
| | 2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, contact and non contact forces, effects of force, characteristics of a force | |
| | 2.2 Newton's laws of motion, Newton's laws of gravitation, Difference between mass and weight | |
| | 2.3 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position | |

- 2.4 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
- 2.5 Free body diagram
- 2.6 Equilibrant force and its determination
- 2.7 Lami's theorem (concept only)
[Simple problems on above topics]
3. Moment (9 hrs)
- 3.1 Concept of moment
- 3.2 Moment of a force and units of moment
- 3.3 Varignon's theorem (definition only)
- 3.4 Principle of moment and its applications (Levers – simple and compound, 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 (9 hrs)
- 4.1 Definition and concept of friction, types of friction, force of friction
- 4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction
- 4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.
- 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 (6 hrs)
- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies
- 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion
- 5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed
[Simple problems on the above topics]
6. Simple Machines (9 hrs)
- 6.1. Definition of effort, velocity ratio, mechanical advantage and efficiency of - a machine and their relationship, law of machines
- 6.2. Simple and compound machine (Examples)
- 6.3. Definition of ideal machine, reversible and self locking machine
- 6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency
- 6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency
- 6.6. Working principle and application of 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.

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	2	2
2	10	12
3	9	10
4	9	10
5	6	6
6	9	10
Total	45	50

2.6 ENGINEERING DRAWING - II

L P
- 6

RATIONALE

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

Note:

- 1) First angle projection is to be followed.
- 2) Minimum 16 sheets to be prepared and at least 3 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-CUM- PRACTICAL EXERCISES

1. Detail and Assembly Drawing (02 sheets)
 - 1.1 Principle and utility of detail and assembly drawings
 - 1.2 Wooden joints i.e. corner mortise and tenon joint, Tee halving joint, Mitre faced corner joint, Tee bridle joint, Crossed wooden joint, Cogged joint, Dovetail joint, Through Mortise 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 Bolts (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 (03 sheets)

Draw any three 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

*** CAD drawings 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.

RECOMMENDED BOOKS

1. Singh, Surjit, "A Text Book of Engineering Drawing", Dhanpat Rai & Co., Delhi
2. Gill, PS, "Engineering Drawing", SK Kataria & Sons, New Delhi
3. Bhatt, ND, "Elementary Engineering Drawing in First Angle Projection", Charotar Publishing House Pvt. Ltd., Anand
4. Layall, JS, "Engineering Drawing I & II", Eagle Parkashan, Jalandhar
5. Goel, DK, "Engineering Drawing I", GBD Publication.
6. AutoCAD 2010: For Engineers & Designers by Prof. Sham Tickoo and D. Sarvanan; Wiley India Pvt. Ltd., Delhi.

2.7 GENERAL WORKSHOP PRACTICE - II

L P
- 6

RATIONALE

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

LEARNING OUTCOMES

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

- Select materials, sequence of operations, select tools to make a given job based on interpretation of drawing as per given specification with close tolerances using at least the resources of three shops.
- Prepare a job as per given specifications for a given shop.
- Specify and read/understand specifications of different types of tools, equipment and machines used in various shops.
- Inspect visually to identify various types of defects in different type of materials.
- Analyze a given job and identify various operations required to make it.
- Follow safety procedures and measures.
- Maintain good housekeeping practices.

DETAILED CONTENTS-CUM- PRACTICAL EXERCISES

Note: The students are supposed to come in proper workshop uniform 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 workshops will be explained for conduct of practical. The students should prepare sketches of various tools/jobs sequence of operations etc. in their practical notebook.

The following shops are included in the syllabus.

- 1 Welding Shop – II
- 2 Fitting Shop – II
- 3 Sheet Metal Shop – II
- 4 Electric Shop -II
- 5 Carpentry Shop – II
- 6 Smithy Shop – II or Additive Manufacturing Shop - II

1. WELDING SHOP - II

- 1.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to gas welding (Oxy-acetylene welding, Air acetylene welding, Oxy-hydrogen welding). Introduction to gas welding equipment: - Gas welding torch, cylinders, Blow pipe and Pressure regulators etc. Types of gas welding flames. Functions of filler materials and fluxes. Introduction to soldering and brazing. Difference between welding, soldering and brazing. Introduction to resistance welding.
- 1.2 Demonstration of Gas welding equipment, TIG, MIG and spot-welding machines. Demonstration of brazing and soldering.
- 1.3 Jobs to be prepared:

Job I	Making a lap joint on 75 mm × 35 mm × 3mm M.S. plate using gas welding (Oxy-acetylene).
Job II	Making a butt joint on 75mm×35mm×3mm M.S. flat using gas welding (Oxy-acetylene).
Job III	Making a square pyramid from M.S. rod by welding (Oxy-acetylene Gas welding).
Job IV	Making a simple job on spot welding machine.

2. FITTING SHOP – II

- 2.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction, function and specification of different types of cutting tools (chisels and scrapers etc.), tightening tools (pliers, screw driver, wrenches etc.) types of drill and drilling machines used in fitting shop. Classification of files: according to cut, grade, and shape. Measuring devices (Fillet/radius gauge, screw pitch gauge, wire gauge, telescopic gauge), Vernier height gauge. Surface gauge and universal surface gauge. Description of drill, reamer, tap and die set. Selection of dies for threading, selection of drill size for tapping.
- 2.2 Demonstration on use of various measuring tools (Vernier caliper, Vernier height gauge and outside and inside micrometers etc.), finding least count and checking of zero error. Demonstration of various types of drills, taps and dies.
- 2.3 Jobs to be prepared:

Job I	To make a job by drilling and tapping (manually) process on soft metals- Aluminum or Copper or Bronze.
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Job II To Make 'U' type cut-out profile from a square piece of MS flat using hand hacksaw, filing, marking, drilling and measuring operations up to an accuracy of ± 0.1 mm.

Job III Making external threads by die on a job (GI Pipe, PVC pipe, Steel bars etc.) and assembly of different types of elbows, tee, union, socket.

3. SHEET METAL SHOP - II

3.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction and functions of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Wood Turning Machine, Wiring Machine, Setting Down Machine, Forming Machine, Fly press etc. Introduction to various metal forming processes e.g. Spinning, Punching, Blanking, cup drawing, Introduction to metal spinning process. Introduction of various types of nuts, bolts, screws etc.

3.2 Demonstration of various machines and types of nuts, bolts, screws etc.

3.3 Jobs to be prepared:

Job I To prepare a utility job like soap case/tray/canister box.

Job II To prepare a job involving soldering or brazing process.

Job III To prepare a cup with the help of simple die and punch on fly press.

Job IV To fabricate a funnel/conduit pipe from GI sheet.

4. ELECTRIC SHOP - II

4.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE), Introduction and use of single phase and three phase supply, its wiring system and importance. Introduction and function of an electric motor for any three-phase electric machine. Estimating and costing of power consumption. Identification and familiarization with the following tools: Tweezers, Screw Drivers (Different sizes), Insulated pliers, Cutters, Sniper, Philips Screw driver (star screw driver), L-Keys.

4.2 Demonstration of dismantling, servicing and reassembling of table/ceiling fan, air-cooler, auto electric iron, heater etc. Testing and reversing direction of rotation of single phase and three phase motors and their wiring methods.

4.3 Job Practice :

Job I Laying 3 phase wiring for an electric motor or any three phase machine.

Job II Connection of single-phase energy meter with supply and load including reading and working out power consumption and cost of energy.

Job III Finding faults in electric circuits, machines, with series testing lamp and multimeter.

- Job IV Assembly, dismantling and servicing of any electrical appliances.
- Job V Practice on testing single phase and three phase motors by using voltmeter, ammeter and tachometer.
- Job VI Connection and wiring practice for reversing direction of rotation of single phase and three phase motors.

5. CARPENTRY SHOP – II

- 5.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction, parts and functions of Jig saw and radial saw wood working machine, Band saw, Circular saw and Electric Planer. Introduction and basic functions of Wood working lathe and its tools. Saw re-sharpening machine, wood working lathe, Saw Brazing unit.
- 5.2 Demonstration of Rip Saw, dovetail saw and Tenon saw. Method of sharpening various saws. Demonstration on Band Saw and Circular Saw, Chain and Chisel, Universal wood working machine, Saw re-sharpening machine, Saw Brazing unit.
- 5.3 Jobs to be prepared:
- Job I Preparation of single dovetail joint.
- Job II Preparation of mitre joint.
- Job III Preparation of a lengthening joint
- Job IV Practice of form turning on wood working lathe.

6. SMITHY SHOP – II

- 6.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE), Introduction to various heat treatment processes e.g annealing, hardening, case hardening, tempering, normalizing etc. Description of various types of power hammers and their usage (Demonstration only).
- 6.2 Demonstration of power hammer and various types of furnaces.
- 6.3 Jobs to be prepared
- Job I To forge a hook (long ‘S’ type).
- Job II To forge a chisel and acquaint the students with simple idea of hardening and tempering.
- Job III To forge square shape on both ends of a circular rod.
- Job IV To prepare a job of upset forging process.

6. ADDITIVE MANUFACTURING SHOP – II

- 6.1 Safety precautions of concerned shop and use of Personal Protective Equipment (PPE). Introduction to Additive Manufacturing, Distinction between Additive Manufacturing and Subtractive Manufacturing, Steps involved in the process of Additive Manufacturing, Classification/types of Additive Manufacturing processes (VAT Photo polymerisation, Material

jetting, binder jetting, Material Extrusion-Fuse deposition modelling, The Powder Bed Fusion, Sheet lamination, Directed Energy Deposition (DED) etc.), Advantages of Additive Manufacturing and types of materials used for Additive Manufacturing (PLA-Polylactic acid, ABS-Acrylonitrile Butadiene Styrene, PET-Polyethylene terephthalate, Nylon, TPU-Thermoplastic polyurethane (Flexible) and PC- Polycarbonate etc.), applications of additive manufacturing.

- 6.2 Demonstration of Fused Deposition Modelling (FDM) process of additive manufacturing (particularly 3D printing) and the steps involved (concept, drawing, modelling, exporting CAD data to required format for printing, 3D printing), post processing of parts if required (Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement etc.), Basic maintenance, material (spool) loading, nozzle setting, nozzle cleaning, machine bed preparation
- 6.3 Jobs to be performed
 Job I: Preparation of 3D model of a part using suitable CAD package and saving it in .PRT file format.
 Job II: Conversion of .PRT file to .STL file and introduction to processing software (Flashprint)
 Job III: Identification of .STL file problems and application of repair algorithms to make the model error-free using suitable software package.
 Job IV: Preparation of a simple assembly component by 3D printing the individual parts and post processing if required.

Note :

1. Workshop instructors will guide and help the students throughout the practical class in order to explain and complete the job according to syllabus and for providing necessary facilities to the students during performance of practical by observing the safety precautions
2. The Workshop Superintendent or Foreman Instructor or Foreman will demonstrate and deliver the theoretical instructions with regard to introduction, functions, classification and specification of tools, instruments, equipment, apparatus etc. of all the topics covered in the syllabus.
3. The Workshop Superintendent or Foreman Instructor will also conduct the mid-term test and final practical exam of this subject.

RECOMMENDED BOOKS

1. Singh, Swaran, “Workshop Practice”, S. K. Kataria and Sons, New Delhi.
2. Bawa, H.S., “Workshop Practice”, Tata McGraw Hill Publishers, New Delhi.
3. Hajra, SK, “Workshop Technology I, II, III”, Choudhary and AK Choudhary Media Promoters and Publishers Pvt. Ltd. Mumbai.
4. Manchanda, “Workshop Technology Vol. I, II, III”, India Publishing House, Jalandhar.
5. Raghuwanshi, B.S., “Workshop Technology”, Dhanpat Rai and Co., New Delhi

TRAFFIC AWARENESS & ROAD SAFETY CAMP (II)

A diploma holder must have knowledge of various types of traffic rules and regulations. Road safety education is vital for people of all ages. As a responsible citizen, you should be aware of each and every road safety rules. Observation is the key skill you need in ensuring road safety. By obeying safety rules and regulations, you can save yourself and others on the road. This camp covers the basic concepts of traffic rules and safety. Lectures will be delivered on following broad topics with the coordination of Distt. Traffic police. There will be no exam for this camp.

1. Time management
2. Traffic light signals
3. Speed limits of vehicles
4. Schedule of offences
5. Dividing lines
6. Proper road Maintenance and Warnings
7. Test yourself

3.1 ENGINEERING MATERIALS

L P
3 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.
- Analyze microstructure and changes in microstructure due to heat treatment.
- Carryout various heat treatment processes such as annealing, normalizing, tempering and hardening.
- Draw and interpret iron-carbon diagram.
- 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.

DETAILED CONTENTS

1. Introduction (05 hrs)
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, Various issues of Material Usage-Economical, Environment and Social.
2. Crystallography (05 hrs)
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
3. Metals and Alloys (14 hrs)
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 Aluminium, Copper and Zinc and their alloys

4. Heat Treatment (08 hrs)

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 (04 hrs)

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 (03 hrs)

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

7. Miscellaneous Materials (04 hrs)

Overview of -Tool and Die materials, Materials for bearing metals, Refractory materials. Overview of Biomaterials and semi-conducting materials,

8. Corrosion and its Control (2 hrs)

Corrosion and factors affecting corrosion rate, Corrosion control – metal coatings, inorganic coatings, organic coatings, internal corrosion preventive measures

LIST OF PRACTICALS

1. Classification of about 25 specimens of materials/machine parts into
 - (i) Metals and non metals
 - (ii) Metals and alloys
 - (iii) Ferrous and non ferrous metals
 - (iv) Ferrous and non ferrous alloys
2. Given a set of specimen of metals and alloys (copper, brass, aluminium, cast iron, HSS, Gun metal); identify and indicate the various properties possessed by them.
3.
 - a) Study of heat treatment furnace.
 - b) Study of a thermocouple/pyrometer.
4. Study of a metallurgical microscope and a specimen polishing machine.
5. To prepare specimens of following materials for microscopic examination and to Examine the microstructure of the specimens of following materials:
 - i) Brass ii) Copper iii) Grey iv) Malleable v) Low carbon steel vi) High carbon steel vii) HSS
6. To anneal a given specimen and find out difference in hardness by analyzing microstructure as a result of annealing.
7. To normalize a given specimen and to find out the difference in hardness by analyzing microstructure as a result of normalizing.
8. To harden and temper a specimen and to find out the difference in hardness by analyzing microstructure due to tempering.

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. Rajput, R.K., "Text book of Material Science", Katson Pubs, Ludhiana.
2. Manchanda, V.K., "Text book of Material Science", India Publishing House, Jalandhar.
3. Gupta, A.R., "Introduction to Material Science", Satya Prakashan, New Delhi.
4. Hazra, Chaudhary, S. K., "Material Science and Processes", Indian Book Distributing Co.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	05	05
2.	05	06
3.	14	16
4.	08	10
5.	04	04
6.	03	03
7.	04	04
8.	02	02
Total	45	50

3.2 ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L	P
2	2

RATIONALE

The objective of this subject is to impart fundamental knowledge and skills regarding basic electrical and electronics engineering, which diploma holders will come across in their professional life. This course will provide the students to understand the basic concepts and principles of D.C. and A.C. fundamentals, electromagnetic induction, batteries, transformer, motor and generator, transmission and distribution system, domestic installation, electrical safety etc. The students will also learn basic electronics including diodes and transistors and their applications.

LEARNING OUTCOMES

After completing the course the student should be able to:

- Measure basic electrical quantities.
- Measure and improve power factor in a given circuit.
- Explain the construction, working principle, performance and applications of transformer.
- Draw layout of generation, transmission and distribution system.
- Explain the working and applications of electric motor and generator.
- Follow electrical safety measures.
- Describe the characteristics and applications of diode, rectifier, inverter and transistor.

DETAILED CONTENTS

1. Basic Electrical Quantities (2 hrs)
 - Definition of voltage, current, power and energy with their units
 - Difference between ac and dc
 - Advantages & application of electrical energy over other types of energy

2. AC Fundamentals (5 hrs)
 - Alternating emf, Definition of cycle, frequency, and amplitude and time period.
 - Instantaneous, average, r.m.s and maximum value of sinusoidal wave. Form factor and Peak Factor. Concept of phase and phase difference
 - Concept of resistance, inductance and capacitance in ac circuits containing resistor only, capacitor only and inductor only
 - Power factor and improvement of power factor by use of capacitors.

3. Transformer (6 hrs)
- Construction, principle and working of single phase transformer.
 - Transformer ratio, emf equation, losses and efficiency, cooling of transformer
 - Concept of three phase system, star and delta connection voltage and current relationship (No derivation),
 - Difference between three-phase and single-phase supply
 - Isolation transformer, CVT, auto transformer (brief idea), applications.
4. Transmission & Distribution System (5 hrs)
- Basic Idea of Transmission and Distribution system.
 - Layout of Generation, Transmission and Distribution system
 - Three phase three & three phase four wire system with neutral & earth wire.
 - Basic idea on line voltage, line current, phase voltage, phase current in star and delta connected three phase system
5. Electric Motor & Generators (6 hrs)
- Basic idea on DC generator & DC motor.
 - Brief idea on separately excited & series excited dc generator, applications of DC motors.
 - Fundamental of AC generator (synchronous generator).
 - Basic idea of three phase induction motor & single phase induction motor and their applications.
 - Motors used for driving pumps, compressors and Submersible pumps.
 - Applications of stepper motor.
6. Electrical Safety (2 hrs)
- Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application,
 - Concept of earthing and various types of earthing,
 - Applications of MCB's and ELCBs
7. Basic Electronics (4 hrs)
- Basic idea of semiconductors – P and N type; diodes, Zener diode and their applications,
 - Basic idea & applications of rectifier and inverters.
 - Transistor PNP and NPN, their characteristics and uses.

LIST OF PRACTICALS

1. Use of instruments used for measuring electrical quantities and its connections in an electric circuit.
2. Connection of a three-phase motor and starter with fuses and reversing of direction of rotation.
3. Connection of a single-phase induction motor with supply and reversing of its direction of rotation.
4. Connection and reading of an electric energy meter.
5. Use of ammeter, voltmeter, wattmeter and multi-meter.
6. Measurement of power and power factor in a given single phase ac circuit
7. Connection of different types of switches, fuses, MCB's and ELCBs in electrical circuit.
8. Draw V-I characteristics of Zener diode.
9. Practice of earthing for electrical equipment.
10. To draw V-I characteristics of NPN transistor.
11. Working of stepper motor.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of concept and various terms used in the subject. Practical exercises will reinforce various concepts.

RECOMMENDED BOOKS

1. Dhogal, PS, "Basic Electrical Engineering", Tata McGraw Hill Publishers, New Delhi.
2. Thareja, BL, "A Text Book of Electrical Technology, Vol. I and II", S Chand and Co., New Delhi.
3. Dargan, C R, "Elements of Electrical Engineering", Dhanpat Rai Publications, Delhi.
4. Mehta, VK, "Basic Electronics", S Chand and Co., New Delhi.
5. Bhargava, NN, "Basic Electronics and Linear Circuits", Kulshreshtha, Tata McGraw Hill, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (Out of 50)
1.	02	4
2.	05	8
3.	06	10
4.	05	8
5.	06	10
6.	02	4
7.	04	6
TOTAL	30	50

3.3 METROLOGY AND INSTRUMENTATION

L	P
3	2

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 OUTCOMES

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 dekkor, dial indicator 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 and angle dekkor.
- 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.

DETAILED CONTENTS

- | | | |
|----|--------------------|--|
| 1. | Introduction | (06 hrs) |
| | 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 Measurement | (12 hrs) |
| | 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 : vernier calipers, 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 .
3. Angular Measurement (06 hrs)
- Construction and use of instruments for angular measurements: bevel protector, sine bar, angle gauges, clinometer, angle dekkor. Optical instruments for angular measurement, auto collimator.
4. Measurement of Surface Finish (06 hrs)
- 4.1 Terminology of surface roughness.
 - 4.2 Concept of primary texture and secondary texture.
 - 4.3 Factors affecting surface finish.
 - 4.4 CLA, RMS and RA value.
 - 4.5 Principle and operation of stylus probe instruments. Tomlinson surface meter and Taylor surface talysurf.
5. Thread and Gear Measurements (08 hrs)
- 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, PCD, addendum and dedendum
 - 5.3 Profile projector, Coordinate Measuring Machine (CMM), Tool maker's microscope.
6. Instrumentation (07 hrs)
- 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

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 micrometer (mechanical and digital)
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 dekkor
7. Measurement of spur gear characteristics.
8. Measurement of thread parameters by using tool maker's microscope.
9. Measurement of effective diameter of external threads by 2-wire and 3-wire method.
10. Measurement of cylindrical bore using cylinder bore gauge for bore diameter, ovality and taper.
11. Measurement of surface roughness using surface roughness tester.
12. Measurement of co-ordinates of two or more than two holes using surface plate, angle plate, Height Gauge, dial indicator and slip gauges.
13. Measurement of a profile using profile projector.
14. Measurement of rotational speed of a shaft using stroboscope.

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. Jain, RK, "Engineering Metrology", Khanna Publishers, New Delhi.
2. Sharma, RC, "A Text Book of Production Engineering", S Chand and Company, New Delhi.
3. Adithan, M, and R Bahl, "Metrology Laboratory Manual", NITTTR, Chandigarh.
4. Rajput, RK, "Engineering Metrology", SK Kataria and Sons, Ludhiana.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	12	14
3	06	07
4	06	06
5	08	10
6	07	07
Total	45	50

3.4 MECHANICAL ENGINEERING DRAWING-I

L P
- 6

RATIONALE

Diploma holders in Mechanical Engineering are required to interpret drawings and therefore it is essential that they have skills of preparing drawings and sketches of mechanical components. This subject aims at development of drawing skills in the students.

LEARNING OUTCOMES

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

- Interpret different limits and fits of components
- Draw intersection of cylinders and their profile
- Draw different kind of machine components like bearings, brackets, pulleys, pipe joints and lathe tool holder.
- Draw electrical circuit diagram of simple household electrical circuits and home appliances
- Read and interpret drawings of mechanical components

DETAILED CONTENTS-CUM- PRACTICAL EXERCISES

1. Limits, Fits and Tolerances (03 sheets)

Maximum limit of size, minimum limit of size, tolerance, allowance, deviation, upper deviation, lower deviation, fundamental deviation, clearance, maximum clearance, minimum clearance. Fits – clearance fit, interference fit, transition fit. Hole basis system, shaft basis system, tolerance grades, calculating values of clearance, interference, hole tolerance, shaft tolerance with given basic size for common assemblies like H₇/g₆, H₇/m₆, H₈/p₆.

2. Intersection of following solids:- (02 sheets)

- (a) Cylinder with cylinder (equal and different diameters; axis at right angles)
(b) Cylinder with cylinder (axis inclined)

3. Drawing of the following with complete dimensions, tolerances, materials and surface finish marks.

3.1 Universal coupling (Assembly) (01 Sheets)

3.2 Bearings (05 sheets)

3.2.1 Bushed Bearing (Assembled Drawing)

3.2.2 Ball Bearing and Roller Bearing (Assembled Drawing)

3.2.3 Plummer Block (Detailed Drawing)

3.2.4 Plummer Block (Assembled Drawing)

3.2.5 Foot step Bearing (Assembled Drawing)

3.3	Bracket	(01 sheets)
	3.3.1 Wall bracket (orthographic views)	
3.4	Pulleys	(03 sheets)
	3.4.1 Stepped Pulley	
	3.4.2 V. Belt Pulley	
	3.4.3 Fast and loose pulley (Assembled Drawing)	
3.5	Pipe Joints	(02 sheets)
	3.5.1 Expansion pipe joint (Assembly drawing)	
	3.5.2 Flanged pipe and right angled bend joint (Assembly Drawing)	
3.6	Lathe Tool Holder (Assembly Drawing)	(01 sheets)
3.7	Reading of mechanical component drawing	(01 sheets)
3.8	Sketching practice of bearings, bracket and pulleys.	(02 sheets)

- Note:-** (1) First angle projection should be followed, 20% of drawings may be prepared in third angle projection.
- (2) SP-46-1988 should be followed
- (3) The drawing should include discussion with tolerances, whenever necessary and material list as per BIS / ISO specifications.

INSTRUCTIONAL STRATEGY

1. Teachers should show model or realia of the components/part whose drawing is to be made
2. Emphasis should be given to cleanliness, dimensioning, layout of sheet
3. Teachers should ensure use of IS codes related to drawing
4. Focus should be on the proper selection of drawing instrument and its proper use

RECOMMENDED BOOKS

1. Gill, P.S., "Machine Drawing", S.K. Kataria and Sons, Ludhiana.
2. Dhawan, R.K., "A Text Book of Machine Drawing", S. Chand and Co. Ltd New Delhi.
3. Bhatt, N.D., "Machine Drawing", Charotar Book Depot. Anand.

3.5 WORKSHOP TECHNOLOGY-1

L	P
3	6

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 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, MIG/MAG 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, castings, forgings.
- 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).
- Operate forging machine, press, and spinning machine.
- Explain the principle of rolling, extrusion and drawing process.

DETAILED CONTENTS

1. Welding (18 hrs)

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 & welding standards. 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. Oxy-Acetylene gas welding, Oxy-Acetylene gas cutting.
- 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, flash butt welding, projection welding, Shielded metal arc welding, submerged arc welding, welding defects and their remedies, inspection of welded joints.
- 1.5 Modern Welding Methods
Methods, Principle of operation, advantages, disadvantages and applications of Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding, Plasma arc welding, Friction welding, Robotic welding,
2. Pattern Making (03 hrs)
Concept of Pattern, Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S, Introduction to cores, purpose of making cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores
3. Moulding and Casting (16 hrs)
- 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. Different hazards associated with foundry practice and safety precautions to be followed.
- 3.2 Mould Making Process and Equipment
Types of moulds, Step involved in making a mould, Moulding boxes, hand tools used for mould making, Moulding processes: Bench

molding, floor moulding, pit moulding and machine moulding, Moulding machines squeeze machine, jolt machine, jolt squeeze machine and sand slinger.

3.3 Casting Processes and Equipment

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 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: Visual inspection, radiography, magnetic particle inspection and ultrasonic inspection.

4. Metal Forming Processes (5 hrs)

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, roll forging, Cold and hot forging, Forging operations - swaging, upsetting, Fullering, bending, edging, drifting etc.

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. Type of drawing: Deep drawing, shallow drawing, bar drawing, Pipe drawing, tube drawing, wire drawing.

5. Plastic Processing (3 hrs)

5.1 Industrial use of plastics and situations 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 Principle, construction and working of Blow Moulding Machine.

LIST OF PRACTICALS

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

Welding Shop

- Job 1. Preparation of gas welding joint in vertical/horizontal position by M.S. flats
- Job 2. Gas welding of cast iron and brass part or component.
- Job 3. Preparation of a joint by spot welding.
- Job 4. Preparation of a joint by Seam welding
- Job 5. Preparation of a T joint by MIG welding while keeping in check the perpendicularity between the plates.
- Job 6. Preparation of a T joint by TIG welding while keeping in check the perpendicularity between the plates.
- Job 7. Preparation of MS pipe joint by arc welding. Or
Preparation of a joint by Flash Butt Welding.

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 woodworking 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 or using cope.
- Job 2. Preparation of a core and core prints.
- Job 3. Preparation of floor mould of split pattern in cope and drag of moulding box.
- Job 4. Preparation of a mould of step pulley with provision of core.
- Job 5. Sand testing (Testing of moisture content, clay content, shatter index, green compressive strength etc.).

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 grinding process on lathe machine and grinding a job on a lathe machine
- Job 4. Preparation of drilling Jig.
- Job 5. Preparation of utility item out of G.I. sheet.
- Job 6. Demonstration of spinning process on lathe and spinning a bowl on a spinning lathe machine.
- Job 7. Preparation of a job by hand moulding machine.

Note : A visit to cast iron foundry should be arranged to have first hand knowledge of cast iron melting pouring and casting.

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.

LIST OF RECOMMENDED BOOKS

1. Raghuvanshi, BS, “Workshop Technology Vol I and II”, Dhanpat Rai and Sons, Delhi.
2. Choudhry, SK, and Hajra, “Elements of Workshop Technology”, Asia Publishing House.
3. Aggarwal, RL, and T Manghnani, “Welding Engineering”, Khanna Publishers, Delhi.
4. Sharma, PC, “A Text Book of Production Engineering”, S Chand and Company Ltd., Delhi.
5. Rao, P. N., “Manufacturing Technology Vol I, II, III”, McGraw Hill Publications, Noida, UP.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	18	20
2	03	4
3	16	16
4	05	6
5	03	4
Total	45	50

3.6 OPEN ELECTIVE

L	P
2	-

RATIONALE

Open Elective refers to a course that students can opt for in addition to their primary area of study. The open elective is from an unrelated discipline with the intention to provide exposure in that discipline. It provides the students the opportunity to select and learn a subject related to his/her interest, thus allowing them to explore their passion..

LIST OF SUGGESTED OPEN ELECTIVES

The student can opt one course out of the following :

- 1 Foreign Language
- 2 National Cadet Corps (NCC)
- 3 Yoga
- 4 First Aid
- 5 Creative Writing
- 6 Sketching, Drawing and Colour Studies
- 7 Gardening
- 8 Photography
- 9 Legal Studies
- 10 Event Management
- 11 Diet and Nutrition

Open elective can be offered online or offline.

3.6.1 FOREIGN LANGUAGE (French, Japanese, German, Spanish)

L P
2 -

RATIONALE

This course is an introduction to the specific language. Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of the language as a cultural space are the overall objectives of the course. The student should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

LEARNING OUTCOMES

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

- Enhance the level of vocabulary in specific language.
- Manage situational communication in specific language.

DETAILED CONTENTS

- | | | |
|----|--|----------|
| 1. | Introduction | (06 hrs) |
| | Self introduction, Numbers, Days, Months, Date, Time, and Counting | |
| 2. | Vocabulary | (06 hrs) |
| | My home, My family, My friend, Daily routine, Hobbies, Food, Greeting and Thanking | |
| 3. | Grammar | (12 hrs) |
| | Verb and Verb forms, Articles, Possessive pronouns, Auxiliary verbs, Questions, Present and Past tense | |
| 4. | Theme | (06 hrs) |
| | Means of transport, Basic directions, Food, Drink, Family, Groceries and Meals | |

RECOMMENDED BOOKS

1. Annie Berthet, Hugot et al, “Alter Ego - Méthode de Français”, Hachette.
2. 3 A Corporation, “Minna no Nihongo”, Goyal Publishers, New Delhi.
3. Stefanie Dengler, “NETZWERK Deutsch als Fremdsprache A1”, Goyal Publishers, New Delhi.
4. Jaime Corpas et.al, “Aula International 1”, Difusión, Madrid.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	10
2	06	10
3	12	20
4	06	10
Total	30	50

3.6.2 NATIONAL CADET CORPS (NCC)

L P
2 -

RATIONALE

This course is structured to instil in the students qualities like nationalism, patriotism, discipline, team spirit, esprit-de-corps, leadership, self-confidence, national integration and improve their personality. The objective of the course is to expose the students to a regimental way of life, which is essential to inculcate in them the values of discipline, duty, punctuality, orderliness, smartness, and respect for authority, correct work ethos and self-confidence. In addition, it will inculcate defence services work ethos, which is characterized by hard work, sincerity of purpose, honesty, ideals of selfless service, dignity of labour, secular outlook, comradeship, spirit of adventure and sportsmanship.

LEARNING OUTCOMES

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

- Explain aims and objectives of NCC.
- Understand the importance of national integration.
- Assist Civil Administration in performance of selective duties during disasters.
- Perform drill without arms.
- Contribute towards nation building.
- Provide voluntary social service.

DETAILED CONTENTS

1. Introduction (08 hrs)

Aims and objectives of NCC, Organisation structure and training, NCC Song, National Integration and awareness, Religions, Culture, Traditions and Customs of India, National Integration: Importance and Necessity. Freedom Struggle and Nationalist Movement in India, Problems/ Challenges of national integration, Unity in diversity, Famous leaders of India, Images/ Slogans for national integration, Contribution of youth to nation building

2. Civil Affairs (04 hrs)
- Civil Defence Organization and its duties/ NDMA, Types of emergencies/ Natural Hazards, Role of NCC during Natural Hazards/ Calamities
3. Drill Without Arms (08 hrs)
- General and Words of Command, Attention, Stand at Ease and Stand Easy, turning and inclining at the halt, Sizing, forming up in three ranks and numbering, open and close order march and Dressing, Saluting at the halt, Getting on parade, dismissing and falling out, Marching, length of pace and time of marching in quick time and halt, slow march and halt, Turning on the march and wheeling, Saluting on the March Individual word of command
4. Personality Development and Leadership (04 hrs)
- Personality development, self-awareness, Leadership, life/soft skills, time management and character building.
5. Social Service (06 hrs)
- Basics of Social service, and its needs, Social/ Rural Development Projects: MNREGA, SGSY, NSAP; Literacy enhancement and poverty alleviation, Social evils, Contribution of youth towards social welfare.

RECOMMENDED BOOKS

- 1 “Cadet Hand Book (Common Subjects)”, published by DG, NCC.
- 2 “Grooming Tomorrow’s Leaders”, published by DG, NCC.
- 3 “Youth in Action”, published by DG, NCC.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	08	14
2	04	06
3	08	14
4	04	06
5	06	10
Total	30	50

3.6.3 YOGA

L **P**
2 **-**

RATIONALE

Yoga is a practice that connects the body, breath, and mind. It uses physical postures, breathing exercises, and meditation to improve overall health. It not only improves physical health but also mental and spiritual well-being, which are the foundations of life. The course is aimed at developing skills in yoga for strength, flexibility and relaxation.

LEARNING OUTCOMES

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

- Explain the importance of yoga and its effect on health
- Perform yoga in various forms and combinations
- Understand the philosophy of heartfulness meditation.
- Promote positive health and holistic wellness through yoga and meditation.

DETAILED CONTENTS

1. Yoga (4 hrs)

Concept, need and importance, Yogic principles, Rules and precautions to be followed by yoga practitioners, Introduction to Ashtanga yoga and Yoga sutra

2. Asanas and Mudras (14 hrs)

Basic asanas, Asanas in different postures - Sukshma Vayayam, Pawan Muktasana, Surya Namaskar, Hasta Utthanasana, Padahasthasana, Tadasana, Vrikshasana, Tirayak Tadasana, Natarajasana, Vajrasana, Padmasana, Bhujangasana.

Mudras - Concept, Important mudras - Prana Mudra, Varuna Mudra, Prithvi Mudra, Aakash Mudra, Gyana Mudra.

3. Pranayama (6 hrs)

Kapalbhati Pranayama, Nadi Shodhan Pranayama (Anulom Vilom), Bhastrika Pranayama, Ujjayi Pranayama.

4. Meditation (3 hrs)

Heartfulness meditation, Practice on meditation

5. Health Benefits of Yoga and Meditation (3 hrs)

Benefits and effect of Asanas, Mudras and Pranayama on various systems and organs of human body. Relaxation and wellness through meditation

RECOMMENDED BOOKS

1. Saraswati, Swami Satyananda, "Asana, Pranayama, Mudra and Bandha", Yoga Publication Trust, Bihar.
2. BKS Iyengar, "Light on Yoga", George Allen and Unwin.
3. Mudras by Heartfulness; Heartfulness Education Trust.
4. Kamlesh D Patel, "The Way of the Heart", Spiritual Hierarchy Publication Trust
5. Goel, Aruna, "Yoga Education: Philosophy and Practice", Deep & Deep Publications, New Delhi.
6. Nagendra, H R, and R Nagarathna, "Yoga for Promotion of Positive Health". Swami Vivekananda Yoga Prakashan.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	06
2	14	24
3	06	10
4	03	05
5	03	05
Total	30	50

3.6.4 FIRST AID

L **P**
2 **-**

RATIONALE

First aid is a valuable and life-saving course. The objective of this course is to impart knowledge and skills to the students necessary in an emergency to help sustain life, reduce pain, and minimize the consequences of injury or sudden illness until professional medical help arrives.

LEARNING OUTCOMES

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

- Administer basic life support skills including cardiopulmonary resuscitation
- Provide first aid of simple and multiple system trauma.

DETAILED CONTENTS

1. Basics of First Aid (4 hrs)

First aid, importance of first aid, first aider, laws of first aid, contents of an ideal first aid kit, dealing with an emergency.

2. Emergency Response (10 hrs)

CPR, steps for performing CPR, CPR for newborns and infants, recovery position, first aid in drowning, fractures of bones, causes and types of fractures, dislocation.

3. First Aid in Burns (4 hrs)

Types of burns, danger of burns, first aid in dry burns and scalds, electrical burns, chemical burns, sunburn, heatstroke.

4. First Aid in Wounds and Injuries (6 hrs)

Types of wounds- small cuts and abrasions, Head injury- nose bleed, bleeding gums, bleeding from varicose veins, Shocks- causes of shock and its first aid.

5. First Aid in Poisoning (3 hrs)

Poisoning by swallowing, gases, injections, skin absorption, Animal bites, snake bites and insect stings.

6. First Aid in Foreign Objects Entering the Sense Organs: (3 hrs)

Foreign body in the eye, ear, nose, skin, swallowing of foreign objects.

Note : Persons from Civil Defence/ National Disaster Response Force (NDRF) etc. can be invited for conduct of first aid classes and demonstration of first aid practices.

RECOMMENDED BOOKS

1. Gauri Goyal, Dr. Kumkum Rajput, Dr. Manjul Mungali,, “First Aid and Health”, SBPD Publishing House
2. Williamson, Swapna Naskar and Goswami Mala, “First Aid and Emergency Care”, Kumar Publishing House, New Delhi.
3. Mahopatra, R., “First Aid for You and Me”, Academic Publishers, New Delhi.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	06
2	10	18
3	04	06
4	06	10
5	03	05
6	03	05
Total	30	50

3.6.5 CREATIVE WRITING

L P
2 -

RATIONALE

Creative writing is a written art form that uses the imagination to tell stories and compose essays, poetry, screenplays, novels, lyrics, and more. The objective of this course is to acquaint the students with ideas related to creative writing including art, craft and basic skills required for a creative writer.

LEARNING OUTCOMES

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

- Distinguish between literary genres.
- Practice various forms of creative writing.
- Write for various media.

DETAILED CONTENTS

1. Fundamentals of Creative Writing (06 hrs)

Meaning and significance of creative writing, Genres of creative writing: poetry, fiction, Non-fiction, Drama and other forms, Research for creative writing
2. Elements of Creative Writing (10 hrs)

Plot, Setting, Character, Dialogue, Point of view, Literary devices and figurative language, Elements of style, Grammar and the structure of language, Proof reading and editing
3. Traditional Forms of Creative Writing (10 hrs)

Fiction: short story, novella and novel, Poetry, Drama, Essay, Fable, Biography, Memoire and autobiography, Travelogues, Diaries, Self-narrative writing

4. Writing for Media (04 hrs)

Print media, Broadcast media, Internet - Web content writing and blog writing, Advertising

RECOMMENDED BOOKS

1. Anjana Neira Dev. Anuradha Marwah, Swati Pal, “Creative Writing: A Beginner’s Manual”, Pearson Longman, Delhi
2. Robert Scholes, Nancy R. Comley, Carl H. Klaus, Michael Silverman, “Elements of Literature: Essay, Fiction, Poetry, Drama, Film”, Delhi
3. Bell, Julia and Magrs, Paul, “The Creative Writing Course-Book”, Macmillan, London
4. Gardner, John, “The Art of Fiction”, Vintage, New York

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	6	10
2	10	16
3	10	16
4	4	08
Total	30	50

3.6.6 SKETCHING, DRAWING AND COLOUR STUDIES

L	P
2	-

RATIONALE

This course is aimed to develop aesthetic sense of students. It also encompasses training in sketching, drawing and colouring to develop their mental faculties of observation, imagination and creation.

LEARNING OUTCOMES

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

- Sketch common objects and various geometrical and non-geometrical forms found in life and nature.
- Use different medium and materials.
- Use colour judiciously in creation of visual work.
- Prepare collage using various paper and materials.

DETAILED CONTENTS

1. Sketching of Objects and Nature (8 hrs)

Sketching of objects at home like cup, plate, glass, book, pencil box etc.
Sketching of tree, mountain, hills, vegetables flower etc. for Nature study using Pencil, colour Pencil
2. Drawing of Human and Animal Figures (10 hrs)

Drawing of Human and animal form with the help of Basic Geometrical shapes
3. Collage Making (4 hrs)

Creating Collage with the help of coloured cut out papers, picture from a magazine or any easily available materials

4. Colours (8 hrs)

Water colour, Poster colour, Colour theory – Colour system, Colour wheel, Colour dimensions, Drawing with oil pastel colour and dry pastel.

RECOMMENDED BOOKS

1. Betty Edwards, “Color: A Course in Mastering the Art of Mixing Colors”, Penguin Group Inc., New York
2. Feisner, E., “Colour Studies”, Fairchild Publications, USA

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	08	14
2	10	16
3	04	06
4	08	14
Total	30	50

3.6.7 GARDENING

L **P**
2 **-**

RATIONALE

Gardening activities are fantastic for helping students engage in a way that is more difficult in the classroom. Watching plants grow is a fun and educational experience for them. Their enormous curiosity and excitement over anything new makes them natural for gardening. Growing plant seeds teaches them how nature works and adds to their interest in environmental sustainability.

LEARNING OUTCOMES

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

- Explain various techniques of gardening, cultivation, multiplication, raising of seedlings of garden
- Discuss new and modern techniques of plant propagation.
- Develop interest in nature and plant life.

DETAILED CONTENTS

1. Gardening (6 hrs)
 Definition, objectives and scope. Different types of gardening - landscape and home/ terrace gardening, parks and its components. Plant materials and design.
2. Gardening Operations (14 hrs)
 Soil laying, manuring, watering, management of pests and diseases and harvesting.
3. Sowing/Raising of Seeds and Seedlings (10 hrs)
 Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification. Transplanting of seedlings.

RECOMMENDED BOOKS

1. Bose T.K., Mukherjee, D., “Gardening in India”, Oxford & IBH Publishing Co. New Delhi.
2. Kumar, N., “Introduction to Horticulture”, Rajalakshmi Publications. Nagercoil, Tamil Nadu.
3. Sandhu, M.K., “Plant Propagation”, New Age International Publishers.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	10
2	14	24
3	10	16
Total	30	50

3.6.8 PHOTOGRAPHY

L	P
2	-

RATIONALE

Photography is a unique and creative medium of self-expression that requires aesthetic sense as well as technical expertise. Students who are highly passionate about learning the workings of cameras and different technologies based on them can pursue this course. The objective of this course is to enable the candidates to understand the utility of different camera parts and the art of taking candid shots.

LEARNING OUTCOMES

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

- Explain the principles of photography.
- Handle various cameras for taking photographs.
- Apply aesthetics of photography.

DETAILED CONTENTS

- | | | |
|----|--|----------|
| 1. | Basic Photography | (04 hrs) |
| | Meaning and definition of photography, Basic principle in the film and digital photography, History of photography. | |
| 2. | Camera Function and Accessories | (04 hrs) |
| | Basic camera, Different parts of camera and their basic functions, Camera Accessories | |
| 3. | Main Controls of Camera | (10 hrs) |
| | Parts of Camera, Types of lenses, Shutter, Diaphragm, Exposure, Film and digital image sensor, Depth of field, Lighting, Photography with flash, Filters in photography. | |

4. Digital Camera (05 hrs)

Process of digital imaging, Types of digital cameras, Menu operations of digital cameras, Introduction to colors.

5. Aesthetics of Photography (07 hrs)

Definition of lighting, Principles of lighting, Reflection, Light characteristics, Color, Direct light and indirect light, Light and subject, Light as subject, Shadow as subject, Light sources, Natural light and artificial light, Principles of visualization, Composition guidelines

RECOMMENDED BOOKS

1. Dilwali, Ashok, "All about Photography", National Book Trust, New Delhi.
2. Sharma, O.P., "Practical Photography", Hind Pocket Books.
3. Freeman, "The Photographer's Guide to Light", John Collins & Brown

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	06
2	04	08
3	10	16
4	05	08
5	07	12
Total	30	50

3.6.9. LEGAL STUDIES

L	P
2	-

RATIONALE

The course introduces the students to Indian legal system, contracts management, and legal documentation. Further, the course familiarizes students with basic knowledge of labour laws that would be useful.

LEARNING OUTCOMES

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

- Understand the Indian Legal System.
- Discuss Indian Contract Act.
- Explore labour laws and laws related to women.

DETAIL CONTENTS

- | | | |
|----|---|----------|
| 1. | Introduction to Indian Legal System | (4 hrs) |
| | Constitution of India, Sources of Law and Judicial system. | |
| 2. | The Indian Contract Act | (6 hrs) |
| | Contract – meaning and kinds. Essentials of a valid contract, Discharge of a contract, Contract of Agency | |
| 3. | Legal Documentation | (10 hrs) |
| | Drafting of legal documents including Non-Disclosure Agreements (NDA), Request for Proposal (RFP), collaboration agreements, joint venture agreements, tendering and subcontracting | |
| 4. | Labour Laws | (6 hrs) |
| | Provident Fund, ESIC, Gratuity and Bonus | |

5. Legislation Related to Women (4 hrs)

Sexual harassment at Work place (Prevention, Prohibition and Redressal), Protection of Women from Domestic Violence Act, Criminal Law (Amendment) Act, The Indecent Representation of Women (Prohibition) Act.

RECOMMENDED BOOKS

1. Joseph Minattur, "Indian Legal System", Indian Law Institute, New Delhi.
2. Srivastava, S.C., "Industrial Relations and Labour Laws", Vikas Publishing House Pvt. Ltd.
3. Aggarwal, S K, "Business Law", Galgotia Publishers, Delhi.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	07
2	06	10
3	10	16
4	06	10
5	04	07
Total	30	50

3.6.10 EVENT MANAGEMENT

L P
2 -

RATIONALE

Event Management is a course which deals with the planning, coordinating, and organising of events for people and communities. It is a part of the mass communication course which is offered by many prestigious colleges in India. Event management course aims to imbibe knowledge on analysing, marketing, planning and strategies in business administration to its students.

LEARNING OUTCOMES

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

- Explain the purpose of special events in an organization.
- Use techniques and strategies required to plan successful special events.
- Promote and conduct special events.
- Assess the quality and success of special events.

DETAILED CONTENTS

1. Principles of Event Management (04 hrs)

Introduction to event management, size & type of event, event team, code of ethics, principles of event management, role of event manager – planning, organising, leading and controlling an event

2. Event Planning (08 hrs)

Objective of event, use of planning tools, protocols, dress codes, staging, staffing.

3. Event Marketing (04 hrs)

Advertising, publicity, event marketing process, even hospitality

4. Event Leadership (06 hrs)

Teambuilding & work distribution, managing team, managing meetings, written & verbal communication.

5. Event Safety and Security (04 hrs)

Role of Security, Safety, Crowd management, Risk management.

6. Event Accounting (04 hrs)

Budget, Cash flow analysis, Profit & loss statement, Balance sheet.

RECOMMENDED BOOKS

1. Singla, Sita Ram, "Event Management", ATH Publishers, New Delhi.
2. Sharma, Divakar, "Event Planning and Management", Deep & Deep Publication.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	4	06
2	8	12
3	4	08
4	6	10
5	4	08
6	4	06
Total	30	50

3.6.11 DIET AND NUTRITION

L **P**
2 **-**

RATIONALE

The objective of this course is to help the students to understand the concept of diet and nutrients and provide knowledge about causes and symptoms of Nutrition-related disorders.

LEARNING OUTCOMES

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

- Comprehend the nutritional value of different food items.
- Explain the need of nutrition during the normal stages of life.
- Calculate normal dietary requirements and balanced diet.

DETAILED CONTENTS

1. Introduction (04 hrs)

Basic concepts of health, Nutrition, Nutrients, Nutrition requirement, Balanced diet. Relationship between health & nutrition, Assessment of nutritional status.
2. Nutrients (16 hrs)

Nutrients & their classification. Macro Nutrients –Sources, Functions and Effects on the Body; Micro nutrients - sources, Functions and effects on the Body; Fat soluble nutrients - sources, Functions and effects on the body, Water soluble nutrients - Sources, Functions and effects on the body, Digestion, Absorption of carbohydrates, Lipids, Proteins and energy.
3. Energy and Nutrition-related Disorders (06 hrs)

Basic concepts, Definition and components of energy requirement, Protein malnutrition, Iodine deficiency disorders, Disease and disorder caused by imbalance of nutrients, Food allergies.

4. Nutritional Needs (04 hrs)

Nutritional need during normal stages of life - Infancy, Childhood, Adolescence, Pregnancy, Lactation and Old age, Disease management with diet.

RECOMMENDED BOOKS

1. Antia, F.P., "Clinical Dietetics and Nutrition", Oxford University Press.
2. Swaminathan, "Essentials of Food and Nutrition", Ganesh and Co., Madras.
3. Subhangini Joshi, "Nutrition and Dietetics", McGraw Hill Publishers.
4. B.S. Narsinga Rao et al, "Nutritive Value of Indian Foods", National Institute of Nutrition, Hyderabad.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop necessary knowledge in the students for comprehending basic concepts and principles of the subject so that they may pursue their passion. As far as possible, the teaching of subject shall be supplemented by demonstration and practices to enhance the relevant skills.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	06
2	16	28
3	06	10
4	04	06
Total	30	50

ENERGY CONSERVATION AWARENESS CAMP

A diploma holder must have knowledge of various tips of energy conservation. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This camp covers the basic concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in household appliances and star rating. Lectures will be delivered on following broad topics. There will be no exam for this camp.

1. Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy
2. Introduction to energy management, energy conservation, energy efficiency and its need
3. Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance
4. Standards and Labeling
 - Concept of star rating and its importance
 - Types of product available for star rating
5. Salient Features of Punjab Energy Conservation Building Code (ECBC)
6. General Energy Saving Tips in:
 - Lighting System
 - Room Air Conditioners
 - Refrigerators
 - Water Heater
 - Computers
 - Fans, Heaters, Blowers and Washing Machines
 - Colour Television
 - Water Pumps
 - Kitchens
 - Transport

DRUGS USE AND ABUSE AWARENESS CAMP

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

1. Drugs Use and Abuse in Society
 - b. Concept and overview
 - c. Extent of the problem
 - d. Drug use as a social problem
 - e. Causes of Drug Use: Biological, Socio-cultural, psychological

2. Types of Dugs and identification of Abuse
 - a. Familiar drugs: Tabacco, Caffeine, over the counter drugs
 - b. Restricted Drugs: Opiates, Hallucinogens, Marijuana
 - c. Reformance enhancing drugs
 - d. Uppers and Downers: Stimulants and Depressants

3. Impact of Drug Abuse
 - a. Individual level biological and psychological
 - b. Family social, National

4. Management and Prevention of Drug Abuse
 - a. Medical and psychological
 - b. Role of family School , Media and Legislation

4.1 GENERIC SKILLS AND ENTREPRENEURSHIP DEVELOPMENT

L P
3 -

RATIONALE

Generic Skills and Entrepreneurship Development is one of the courses from “Human Science” subject area. Generic skills have emerged as an important component of employability skills, which enable an individual to become and remain employable over lifetime and to lead happy and prosperous life. Entrepreneurship development aims at developing conceptual understanding for setting-up one’s own business venture/enterprise. This aspect of Human Resource Development has become equally important in the era, when wage employment prospects have become meager. Both the subject areas are supplementary to each other and soft skills are required to be developed in diploma pass-outs for enhancing their employability and self confidence.

LEARNING OUTCOMES

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

- Explain the importance of generic skills
- Manage himself/herself physically, intellectually and psychologically
- Work effectively as a team member
- Manage tasks effectively
- Develop an entrepreneurial mindset.
- Identify entrepreneurial support system for new ventures and small businesses.
- Recognize a business opportunity.
- Conduct market survey and prepare project report.

DETAILED CONTENTS

1. Introduction to Generic Skills (04 hrs)
 - 1.1 Importance of Generic Skill Development
 - 1.2 Life Long Learning and associated importance of Generic Skill Development
2. Managing Self (07 hrs)
 - 2.1 Knowing Self for Self Development
 - Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc.
 - 2.2 Managing Self - Physical
Personal grooming, Health, Hygiene, Time Management
 - 2.3 Managing Self – Intellectual development
 - Information Search: Sources of information
 - Communication: Official & business correspondence, Job application covering letter and resume

- 2.4 Managing Self – Psychological
- Stress, Emotions, Anxiety-concepts and significance
 - Techniques to manage stress
3. Managing in Team (06 hrs)
- 3.1 Team - definition, team dynamics
- 3.2 Team related skills- sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background
4. Task Management (03 hrs)
- 4.1 Task Initiation, planning, execution, close out
- 4.2 Exercises/case studies on task planning towards development of skills for task management
5. Problem Solving (05 hrs)
- 5.1 Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving
- 5.2 Different approaches for problem solving.
- 5.3 Steps followed in problem solving.
- 5.4 Exercises/case studies on problem solving.
6. Entrepreneurship (20 hrs)
- 6.1 Introduction
- Concept/Meaning and its need
 - Qualities of an entrepreneur
 - Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level.
- 6.2 Obtaining financial assistance through various government schemes like Prime Minister Employment Generation Program (PMEGP) Pradhan Mantri Mudra Yojana (PMMY) , Make in India, Start up India, Stand up India , National Urban Livelihood Mission (NULM); Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).
- 6.3 Market Survey and Opportunity Identification (Business Planning)
- How to start a small scale unit/ industry
 - Procedures for registration of small-scale unit /industry
 - Assessment of demand and supply in potential areas of growth.
 - Understanding business opportunity
 - Considerations in product selection

6.4 Project Report Preparation

- Preliminary Project Report
- Techno-Economic Feasibility Report
- Exercises on preparation of Detailed Project Report

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. Balasubramanian, S., “Soft Skills for Interpersonal Communication”, Orient Black Swan, New Delhi.
2. “Lifelong learning”, Policy Brief (www.oecd.org).
3. Rathore, BS, and Dr JS Saini, “A Handbook of Entrepreneurship”, Aapga Publications, Panchkula (Haryana).
4. Gupta, CB, and P Srinivasan, “Entrepreneurship Development”, Sultan Chand and Sons, New Delhi.
5. “Entrepreneurship Development”, Tata McGraw Hill Publishing Company Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	04	06
2.	07	08
3.	06	06
4.	03	04
5.	05	06
6.	20	20
Total	45	50

4.2 HYDRAULICS AND PNEUMATICS

L	P
3	2

RATIONALE

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

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.
- Select maintain and resolve troubles in pumps.
- Apply Pascal's law in practical applications.
- Maintain hydraulic and pneumatic system.

DETAILED CONTENTS

1. Introduction (03 hrs)

Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility, surface tension, vapour pressure, kinematic viscosity and dynamic viscosity and their units.
2. Pressure and its Measurement (06 hrs)
 - 2.1 Concept of pressure (Atmospheric Pressure, gauge pressure, absolute pressure)
 - 2.2 Pascal's law and its applications
 - 2.3 Pressure measuring devices: peizometer tube manometers - simple U-tube, differential single column, inverted U-tube, micromanometer including simple problems
 - 2.4 Bourdon pressure gauge, Diaphragm pressure gauge, dead weight pressure gauge

3. Flow of Fluids (07 hrs)
- Types of fluid flow – steady and unsteady, uniform and non-uniform, laminar and turbulent; rate of flow and their units; continuity equation of flow; potential energy of a flowing fluid; total head; Bernoulli's theorem (statement and proof) and its applications. Discharge measurement with the help of venturi-meter, orifice meter, pitot-tube, limitations of Bernoulli's theorem simple problems.
4. Flow through Pipes (10 hrs)
- 4.1 Definition of pipe flow, wetted perimeter, hydraulic mean depth, hydraulic gradient; loss of head due to friction; Chezy's equation and Darcy's equation of head loss (without proof), Reynold's number and its effect on pipe friction; siphon, Nozzle - definition, velocity of liquid flowing through the nozzle, power developed. Water hammer, anchor block, syphon, surge tank (concept only).
- 4.2 Loss of head in pipes due to sudden enlargement, sudden contraction, obstruction on flow path, change of direction and pipe fittings (without proof)
5. Hydraulic System (05 hrs)
- Description, operation and application of hydraulic systems – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press, selection of specification of above systems for different applications
6. Water Turbines and Pumps (14 hrs)
- 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. Cavitation in turbine, Unit speed, unit power, unit discharge, specific speed of turbines, selection of turbines based on specific speed.
- 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. Trouble shooting and problems in centrifugal pumps and remedial measures, pitting, cavitation, priming.
7. Hydraulic System (08 hrs)
- 7.1 Basic components of hydraulic system, function of each component in a hydraulic circuit.
- 7.2 Oil reservoirs, couplings, motors and pumps – definition and functions of the parts,
- 7.3 Filters- definition and purpose, classification
- 7.4 Seals and packing- classification of seals, sealing materials.
- 7.5 Industrial applications of hydraulic system

8. Pneumatic System (08 hrs)
- 8.1 Basic components – function of each component
 - 8.2 Air compressors – type, working
 - 8.3 Air cylinder – types, function, single acting, double acting, rotating, non-rotating, piston type, diaphragm type, tandem cylinder, double ended cylinder, duplex cylinder.
 - 8.4 Air filter, regulator and lubricator – their necessity in pneumatic circuit.
 - 8.5 Industrial applications of pneumatic system

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 the venturimeter and measure the flow.
3. To find out the value of coefficient of discharge for orifice meter and measure the flow.
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.

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. Kumar, KL, "Fluid Mechanics", S Chand and Co Ltd., Ram Nagar, New Delhi.
2. Khurmi, RS, "Hydraulics and Fluid Mechanics Machine", S.Chand & Co. Ltd., New Delhi.
3. Jain, Dr AK, "Fluid Mechanics", Khanna Publishers, New Delhi.

4. Shammuga Sundaram, K, “Hydraulic and Pneumatic Control”, S. Chand & Co. Ltd., New Delhi.
5. Lal, Dr. Jagadish, “Hydraulics and Hydraulic Machinery”, Metropolitan Book Company Ltd., Delhi.
6. Deppert, Werner and Kurt Stoll, “Pneumatics Control: An Introduction to the Principles”, Vogel – Verlag.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	02	02
2	05	06
3	05	05
4	08	09
5	04	04
6	12	14
7	05	06
8	04	04
Total	45	50

4.3 STRENGTH OF MATERIALS

L	P
3	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, columns and springs. 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 thin cylindrical shells.
- Calculate energy stored by materials subjected to axial loads.
- Calculate moment of inertia of different sections.
- Draw and calculate bending moment and shear force diagrams of beam under given loading
- Interpret the concept of bending and torsion and calculate stresses on different section of materials.
- Determine the diameter of a shaft under combined bending and torsion.
- Calculate critical axial loads on column under different end constraints.
- Determine the various parameters in closed coil helical and laminated springs
- Determine conformance of given materials sample to the prescribed Indian standards.

DETAILED CONTENTS

- | | | |
|------|---|----------|
| 1. | Stresses and Strains | (08 hrs) |
| 1.1. | Basic assumptions; Concept of load, stress and strain | |
| 1.2. | Tensile compressive and shear stresses and strains | |
| 1.3. | Stress strain diagram | |
| 1.4 | Concept of Elasticity, Elastic limit, Hooke's law, Poisson's ratio, elastic constants and their relationship, limit of proportionality. | |
| 1.5 | Percentage elongation, factor of safety, strength and rigidity criteria of design | |

- 1.6 Strain energy due to direct stresses
 - 1.7 Resilience, proof resilience and modulus of resilience
 - 1.8 Stresses due to gradual, sudden and falling load.
2. Thin Cylindrical Shells
- Longitudinal and circumferential stresses in seamless thin walled cylindrical shells.
3. Moment of Inertia (10 hrs)
- 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 Moment and Shearing Force (10 hrs)
- 4.1 Concept of beam and form of loading
 - 4.2 Concept of end supports-Roller, hinged and fixed
 - 4.3 Concept of bending moment and shearing force
 - 4.4 B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.
5. Bending stresses (06 hrs)
- 5.1 Concept of Bending stresses
 - 5.2. Theory of simple bending
 - 5.3. Use of the equation $f/y = M/I = E/R$
 - 5.4. Concept of moment of resistance
 - 5.5. Bending stress diagram
 - 5.6. Calculation of maximum bending stress in beams of rectangular, circular, and T section.
 - 5.7 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.

- 6 Columns (08 hrs)
- 6.1. Concept of column, modes of failure
 - 6.2. Types of columns
 - 6.3. Buckling load, crushing load
 - 6.4. Slenderness ratio
 - 6.5. Factors effecting strength of a column
 - 6.6 End restraints
 - 6.7 Effective length
 - 6.8 Strength of column by Euler Formula without derivation
 - 6.9. Rankine Gordon formula (without derivation)
7. Torsion (10 hrs)
- 7.1. Concept of torsion- difference between torque and torsion.
 - 7.2. Use of torque equation for circular shaft
 - 7.3. Comparison between solid and hollow shaft with regard to their strength and weight.
 - 7.4. Power transmitted by shaft
 - 7.5 Concept of mean and maximum torque
 - 7.6 Concept of Principal stresses, principal planes and max. shear stress.
 - 7.7 Determination of shaft diameter under combined bending and torsion.
8. Springs (8 hrs)
- 8.1. Closed coil helical springs subjected to axial load - Stress deformation, Stiffness and angle of twist and strain energy, Proof Resilience
 - 8.2 Determination of number of plates of laminated spring (semi elliptical type only)

LIST OF PRACTICALS

1. Tensile test on bars of Mild steel and Aluminium.
2. Bending tests on a steel bar or a wooden beam.
3. Impact test on metals
 - a) Izod test
 - b) Charpy test
4. Torsion test of solid specimen of circular section of different metals for determining modulus of rigidity.

5. To determine the stiffness of a helical spring and to plot a graph between load and extension.
6. Hardness test on different metals.

Note : All the tests need to be done as per prescribed Indian Standards.

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. Singh, Birinder, “SOM”, Katson Publishing House, New Delhi.
1. Khurmi, RS, “SOM”. S.Chand & Co; New Delhi.
2. Singh, Dr. Kirpal, “Mechanics of Materials”, Standard Publishers Distribution, New Delhi.
3. Malhotra, D.R., and H.C.Gupta, “Elements of SOM”, Satya Prakashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	03	03
3	08	10
4	07	08
5	06	06
6	05	06
7	05	06
8	05	05
Total	45	50

4.4 THERMODYNAMICS - I

L	P
3	2

RATIOANLE

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 and compressor.

LEARNING OUTCOMES

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

- Apply thermodynamic law.
- Solve basic problems of gas equation using perfect gas laws.
- Explain the properties of a ideal gas through P-V-T relationships
- Analyze various thermodynamic processes using Mollier diagram
- Explain the working, construction and applications of steam boilers.
- Explain the working, construction and applications of steam boilers.
- Analyze performance of various air standard cycles
- Explain the working of air compressor.
- Interpret different modes of heat transfer.

DETAILED CONTENTS

1. Fundamental Concepts (04 hrs)

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 (04 hrs)

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, derivation of an expression for specific heats with characteristics, simple problems on gas equation, Triple point, Vander-Wall’s equation.
3. Thermodynamic Processes on Gases (06 hrs)

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, change in entropy, rate of heat transfer for the above processes

4. Laws of Thermodynamics (07 hrs)
- 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, compressors, nozzles, evaporators, limitations.
- Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Clausius statement, equivalence of statements, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility, entropy.
5. Ideal and Real Gases (03 hrs)
- Concept of ideal gas, enthalpy and specific heat capacities of an ideal gas, $P - V - T$ surface of an ideal gas, real gases.
6. Properties of Steam (04 hrs)
- Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of steam, entropy of water, entropy of steam, $T - S$ diagrams, Mollier diagram ($H - S$ Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes
- Quality of steam (dryness fraction),
7. Steam Generators (04 hrs)
- 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.
8. Air Standard Cycles (06 hrs)
- 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
- Comparison of Otto, Diesel cycles for same compression ratio or same peak pressure developed
- Reasons for highest efficiency of Carnot cycle and all other cycles working between same temperature limits

9. Air Compressor (06 hrs)

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.

Multistage compressor – advantages over single stage compressor, use of air cooler – condition of minimum work in two stage compressor (without proof), simple problems

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

10. Introduction to Heat Transfer (01 hrs)

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

LIST OF PRACTICALS

1. Determination of temperature by
 - 1.1 Thermocouple
 - 1.2 Pyrometer
 - 1.3 Infrared thermometer
2. Demonstration of mountings and accessories on a boiler.
3. Study of boilers (through industrial visit)
4. Demonstrate the working of air compressor.
5. Demonstration of heat transfer through conduction, convection and Radiation
6. Study of working of high pressure boiler (any one)
7. Study the working of Lancashire boiler and Nestler boiler

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignment so as to promote problem solving abilities.

RECOMMENDED BOOKS

1. Nag, PK, "Engineering Thermodynamics", Tata McGraw Hill, Delhi.
2. Chaudhary, Roy, "Basic Engineering Thermodynamics", Tata McGraw Hill, Delhi.
3. Arora, CP, "Engineering Thermodynamics", Tata McGraw Hill, Delhi.
4. Vasandani, VP and DS Kumar, "A Treatise on Heat Engineering", Metropolitan Book Company.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	04	04
2	04	05
3	06	07
4	07	08
5	03	03
6	04	04
7	04	04
8	06	07
9	06	07
10	01	01
Total	45	50

4.5 MECHANICAL ENGINEERING DRAWING-II

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- 6

RATIONALE

Diploma holders are required to interpret drawings and therefore it is essential that they have skills of preparing drawings and sketches of mechanical components. This subject aims at development of skills and understanding of mechanical engineering drawings.

LEARNING OUTCOMES

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

- Interpret and draw the drawings of mechanical machine parts like jig, vices and screw jack
- Interpret and prepare the drawings of boiler and J.C. engine parts.
- Interpret and draw different types of cams for different kinds of motions.
- Interpret gear terminology and draw spur gear teeth profile.

DETAILED CONTENTS-CUM- PRACTICAL EXERCISES

1.	Drilling Jig (Detail and Assembly)	2 sheets
2.	Vices	3 sheets
	2.1 Machine vice (Detailed and Assembly drawing)	
3.	I.C. Engine Parts	3 sheets
	3.1 Piston	
	3.2 Connecting rod (Assembly drawing)	
	3.3 Crankshaft and flywheel assembly	
4.	Boiler Parts	2 sheets
	4.1 Steam Stop Valve (Assembled drawing)	
	4.2 Blow off cock. (Assembled drawing)	
5.	Mechanical Screw Jack (Assembled Drawing)	1 sheet
6.	Cams	4 sheets
	6.1 Types of cams and followers (Theoretical)	
	6.2 Profile of cams for imparting following motions with knife edge and roller followers :	
	<ul style="list-style-type: none"> • Uniform motion • Simple Harmonic Motion • Uniformity accelerated and retarded motion 	

7. Gears 4 sheets
- 7.1 Nomenclature of gears and conventional representation
 - 7.2 Drawing the actual profile of involute teeth of spur gear by different methods.

- Note:
- 1. 1st angle projection should be followed. 20% of the drawings may be made using 3rd angle projection.
 - 2. SP- 46-1998 should be followed. The drawings should include dimensions with tolerance wherever necessary and material as per BIS/ISO specifications.
 - 3. Uses, specifications, material and functions of above components should also be explained in the class..

RECOMMENDED BOOKS

- 1. Gill, P.S., "Machine Drawing", S.K. Kataria & Sons, Ludhiana.
- 2. Dhawn, RK, "A Text Book of Machine Drawing", S. Chand & Co. Ltd., New Delhi.
- 3. Bhatt, N.D, "Machine drawing", Charotar Book Depot, Anand.

4.6 WORKSHOP TECHNOLOGY-II

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3 6

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 workshop 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.
- Perform drilling, reaming, counter boring, counter sinking and tapping operations on drilling machine.
- Explain the nomenclature of a drill
- Perform filing, cutting, Fitting and die tapping operations
- Perform keyway cutting and angular/step surface shaping on shaper.
- Explain geometry of single point tools, various types of lathe tools and tool materials.
- Explain uses of lathe accessories and different types of lathes.
- Explain boring operation, features of boring machine and boring tool.
- Explain the uses and features of jigs, fixtures, locating devices and clamping devices.
- Select cutting fluid for different materials and operations.
- Describe the features of various types of broaching machines.

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (06 hrs)
 - 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, Description of insert bit type tool holders, insert grades & selection of insert bits.
 - 1.2 Cutting Tool Materials - Properties of cutting tool material, Study of various cutting tool materials viz. . High-speed steel, carbides, cobalt steel, stellite, ceramics, CBN and diamond.
2. Lathe (08 hrs)
 - 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 on lathe
 - 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. Drilling (06 hrs)
- 3.1 Principle of drilling.
 - 3.2 Classification of drilling machines and their description.
 - 3.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
 - 3.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
 - 3.5 Types of drills and their features, nomenclature of a drill
 - 3.6 Drill holding devices.
 - 3.7 Radial Drilling Machine: Construction, working principle and applications.
 - 3.8 Types of reamers.
4. Boring (04 hrs)
- 4.1 Principle of boring
 - 4.2 Classification of boring machines and their brief description.
 - 4.3 Specification of boring machines.
 - 4.4 Boring tools, boring bars and boring heads.
 - 4.5 Description of jig boring machine.
5. Shaping and Planing (08 hrs)
- 5.1 Working principle of shaper and planer
 - 5.2 Type of shapers
 - 5.3 Type of planers
 - 5.4 Quick return mechanism applied to shaper and planer machine.
 - 5.5 Work holding devices used on shaper and planer
 - 5.6 Types of tools used and their geometry.
 - 5.7 Specification of shaper and planer .
 - 5.8 Speeds and feeds in above processes.

6. Broaching (04 hrs)
- 6.1 Introduction
 - 6.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down. Continuous broaching and rotary broaching.
 - 6.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.
7. Jigs and Fixtures (05 hrs)
- 7.1 Importance and use of jigs and fixture
 - 7.2 Principle of location
 - 7.3 Locating devices
 - 7.4 Clamping devices
 - 7.5 Types of Jigs – Drilling jigs, bushes, template jig, plate jig, channel jig, leaf jig.
 - 7.6 Fixture for milling, turning, welding, grinding
 - 7.7 Advantages of jigs and fixtures
8. Cutting Fluids and Lubricants (04 hrs)
- 8.1 Function of cutting fluid
 - 8.2 Types of cutting fluids
 - 8.3 Degradation, replacement and disposal of cutting fluids. Testing of cutting fluids. Various hazards associated with the storage and use of cutting fluids.
 - 8.4 Difference between cutting fluid and lubricant
 - 8.5 Selection of cutting fluids for different materials and operations
 - 8.6 Common methods of lubrication of machine tools.

PRACTICAL EXERCISES

Turning Shop

- Job 1. Sharpening of single point turning tool on a Tool & Cutter grinder as per tool signature.
- Job 2. Exercise of simple turning and step turning.
- Job 3. Demonstration of grinding process on surface grinding machine
- Job 4. Preparation of a composite job involving turning, taper turning, external thread cutting, knurling and parting-off.

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. Exercise on making a simple fixture for milling machine.

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes.
2. Focus should be on preparing jobs using various machines in the workshop.
3. 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. Raghuwanshi, B.S., "Workshop Technology", Dhanpat Rai and Sons, Delhi.
2. Choudhry, SK, and Hajra, "Elements of Workshop Technology", Asia Publishing House.
3. Sharma, PC, "A Text Book of Production Engineering", S Chand and Company Ltd. Delhi
4. Rao, P N, "Manufacturing Technology Vol I, II and III", McGraw Hill Publication, Noida, UP.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	08	10
3	06	06
4	04	04
5	08	10
6	04	04
7	05	06
8	04	04
Total	45	50

ENTREPRENEURIAL AWARENESS CAMP

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

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

INDUSTRIAL TRAINING OF STUDENTS

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

This document includes guided and supervised industrial training of a minimum of 6 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. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of 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) Relationship with workers | 15% |
| d) Industrial training report | 55% |

5.1 BASICS OF MANAGEMENT

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RATIONALE

The diploma holders are generally expected to take up middle level managerial positions, their exposure to basic management principles is very essential. Topics like Structure of Organization, Leadership, Motivation, Ethics and Values, Marketing management, Financial management, Customer Relationship Management, TQM and Cyber Security etc. have been included in the subject to provide elementary knowledge about these management areas.

LEARNING OUTCOMES

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

- Explain the principles of management including its functions in an organization.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources.
- Maintain and be a part of healthy work culture in an organization.
- Use marketing skills for the benefit of organization .
- Explain basics of accounting and finance.
- Explain the functions of material management.
- Use modern concepts of management.
- Understand various types of cyber crimes and cyber attacks.

DETAILED CONTENTS

- | | | |
|----|---|----------|
| 1. | Principles of Management | (06 hrs) |
| | 1.1. Introduction, importance and general functions of management. | |
| | 1.2. Concept and Types of an organization - Sole trading, partnership, companies, corporation, PSU's and cooperative societies. | |
| | 1.3. Structure of an organization: Line organization, Staff organization, Functional organization, Line and staff organization. | |
| | 1.4. Hierarchical Management Structure - Top, middle and lower level management | |
| | 1.5. Departmentalization - Introduction and its advantages. | |

2. Leadership and Motivation (06 hrs)
 - 2.1 Leadership - Definition and Need of Leadership, Qualities of a good leader, Manager vs. leader, Theories of leadership - trait theory and Behaviour theory.
 - 2.2 Motivation - Definition and characteristics of motivation, Factors affecting motivation, Maslow's Need Hierarchy Theory of Motivation and X&Y need Hierarchy theory of motivation.

3. Work Culture (06 hrs)
 - 3.1. Introduction and importance of healthy work culture in organization
 - 3.2. Components of culture
 - 3.3. Importance of attitude, values and behaviour
Behavioural Science – Individual and group behavior.
 - 3.4. Professional ethics – Concept and need of professional ethics and human values.

4. Human Resource Management and its Functions (04 hrs)

Manpower Planning, recruitment and selection, Training and development of work force at the shop-floor, Performance appraisal, Wages, salary and incentive schemes

5. Marketing and sales (06 hrs)
 - 5.1 Marketing - Introduction, importance and its functions, Marketing mix for industries and service sector, Basic Marketing strategies
 - 5.2 Sales - Difference between marketing and selling, Advertisement- print media and electronic media, Market Survey and Sales promotion.

6. Basic of Accounting and Finance (06 hrs)
 - 6.1 Basic of Accounting: Meaning and definition of accounting, Double entry system of book keeping, Trading account, PLA account and balance sheet of a company
 - 6.2 Objectives of Financial Management - Profit Maximization v/s Wealth Maximization

7. Material and Stores Management (04hrs)
- Introduction, functions and objectives of material management, Purchasing - definition and procedure, Just in time (JIT)
8. TQM and TPM (02 hrs)
- Total Quality Management (TQM) and Total Preventive Maintenance (TPM) - Concepts and importance
9. Customer Relationship Management (01 hrs)
- Customer Relationship management - Concept and importance
10. Cyber Security (04 hrs)
- Introduction to Cyberspace and Cyber Law, Pros and Cons of social media, Different Components of cyber Laws; Cyber Law and Netizens, Categories of Cyber Crime: Personal, Business, Financial, Office Security, Cyber Crime – Complete transparency, hacking/cracking, denial of service, IP piracy, phishing, hetaerism etc. Cyber Attack, cyber attackers. Introduction to IPR, copyright & patent

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. M. Mahajan, "Industrial Management", Dhanpat Rai & Co.
2. S. C. Sharma and T. R. Banga, "Industrial Engineering and Management", Khanna Book Publishing Co. (P) Ltd., New Delhi

3. Narinder Pal Singh, "Basics of Management", Eagle Prakashan, Jalandhar
4. Goel, SL, "Modern Management Techniques", Deep and Deep Publications Pvt. Limited, New Delhi.
5. Nina Godbole and Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1.	06	06
2.	06	06
3.	06	06
4.	04	05
5.	06	06
6.	06	06
7.	04	05
8.	02	02
9.	01	02
10.	04	06
Total	45	50

5.2 CNC MACHINES

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1 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.
- 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 (02 Hrs)

Introduction to NC, CNC & DNC, their advantages, disadvantages and applications, Machine Control Unit, input devices, 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. Construction and Tooling (02 Hrs)

Design features, specification Chart of CNC machines, use of slideways, balls, rollers and coatings, motor and lead screw, 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 (06 Hrs)
- Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using canned cycles, subroutines and do loops, tool off sets, cutter radius compensation and wear compensation.
4. System Devices (02 Hrs)
- Actuators, Transducers and Sensors, Tachometer, LVDT, opto-interrupters, encoder and decoder, axis drives, open loop system, close loop system.
5. Problems in CNC Machines (02 Hrs)
- Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines.
6. Automation and NC system (01 Hrs)
- Role of computer in automation, emerging trends in automation, automatic assembly, Overview of FMS, Group technology, CAD/CAM and CIM.

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. Use of software for turning operations on CNC turning center.
9. 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. M, Adithan and BS Pabla, “CNC Machines – Programming and Applications”, New Age International (P) Ltd., Delhi.
2. Rao, Kundra and Tiwari, “Computer Aided Manufacturing”, Tata McGraw Hill, New Delhi.
3. Bharaj, “NC Machine”, Satya Publications, New Delhi.
4. Singh, Ramandeep, “CNC Machines and Automation”, Eagle Parkashan, Jalandhar.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	02	06
2	02	06
3	06	20
4	02	08
5	02	08
6	01	02
Total	15	50

5.3 THERMODYNAMICS-II

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3	2

RATIOANLE

A diploma holder in this course is supposed to know about testing of IC Engines, fuel supply, ignition system, cooling and lubrication of engines and gas turbines. Hence this subject

Learning Outcomes

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

- Explain the working of IC engine.
- Diagnose and rectify simple problems in fuel supply and ignition system.
- Explain the functioning of different components of fuel supply of diesel engine.
- Explain the working of lubrication and cooling system in IC engine.
- Assist in testing an IC engine.
- Explain the functioning of steam turbine, and gas turbine.

DETAILED CONTENTS

1. IC Engines (05 hrs)
 - 1.1 Introduction
 - 1.2 Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, diesel cycle and dual cycle
 - 1.3 Location and functions of various parts of IC engines and materials used for them
2. Fuel Supply and Ignition System in Petrol Engine (06 hrs)
 - 2.1 Concept of carburetion
 - 2.2 Air fuel ratio
 - 2.3 Simple carburetor and its application, carburetor of two wheeler.
 - 2.4 Description of battery coil and electro ignition system
 - 2.5 Description of petrol injection system
 - 2.6 Introduction to electronic control unit (ECU)
3. Fuel System of Diesel Engine (04 hrs)
 - 3.1 Components of fuel system
 - 3.2 Description and working of fuel feed pump
 - 3.3 Fuel injection pump, Introduction to Common rail direct injection (CRDI) and Multi point fuel injection system (MPFI)
 - 3.4 Injectors

4. Cooling and Lubrication (8 hrs)
 - 4.1 Function of cooling system in IC engine
 - 4.2 Air cooling and water cooling system, use of thermostat, radiator and forced circulation in water cooling (description with line diagram)
 - 4.3 Function of lubrication
 - 4.4 Types and properties of lubricant
 - 4.5 Lubrication system of engine

5. Testing of IC Engines (6 hrs)
 - 5.1 Engine power - indicated and brake power
 - 5.2 Efficiency - mechanical, thermal, relative and volumetric
 - 5.3 Methods of finding indicated and brake power
 - 5.4 Morse test for petrol engine
 - 5.5 Heat balance sheet, simple numerical problems
 - 5.6 Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers - Bharat methods of reducing pollution in IC engines, alternative fuels like CNG, LPG, Hydrogen

6. Steam Turbines and Steam Condensers (8 hrs)
 - 6.1 Function and use of steam turbine
 - 6.2 Steam nozzles - types and applications
 - 6.3 Steam turbines - impulse, reaction, simple and compound, construction and working principle
 - 6.4 Governing of steam turbines
 - 6.5 Function of a steam condenser, elements of condensing plant
 - 6.6 Classification - jet condenser, surface condenser
 - 6.7 Cooling Tower

7. Gas Turbines (6 hrs)
 - 7.1 Classification, open cycle gas turbine and closed cycle gas turbine, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbine
 - 7.2 Open cycle constant pressure gas turbines - general layout, PV and TS diagram and working of gas turbine
 - 7.3 Closed cycle gas turbines, PV and TS diagram and working

LIST OF PRACTICALS

1. 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.
2. Servicing of petrol injection system
3. Inspection of ignition system of a multi-cylinder engine stressing ignition timings, setting, fixing order and contact breaker; gap adjustment, spark plug cleaning.
4. Fault finding in ignition system of petrol engine and remedial action.
5. Fault finding in cooling and lubrication system of IC engine and remedial action.
6. Service of cooling & lubrication system of IC engine and note down the functioning/testing of various components.
7. Determination of BHP by dynamometer.
8. Morse test on multi-cylinder petrol engine.
9. Draw layout of modern automobile workshop and note down the special tools and equipment in each shop.

Note : Local visit to roadways or private automobile workshop or power plant may be arranged.

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. Cengel and Boles, "Thermodynamics An Engineering Approach", Tata McGraw Hill, Delhi
2. Ganeshan, V, "IC Engine", Tata McGraw Hill, Delhi
3. Ballaney, PL., "Thermal Engineering", Khanna Publishers, New Delhi.
4. Yadav, R., "Steam and Gas Turbines", Central Publishing House, Allahabad.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	05	05
2	06	06
3	04	05
4	08	10
5	08	08
6	08	09
7	06	06
Total	45	50

5.4 THEORY OF MACHINES

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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.
- Determine the horizontal force required to move a body on an inclined plane and calculate the efficiency of screw jack.
- 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.
- Explain working of different types of governors.
- 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 hrs)
 - 1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversions.
 - 1.2 Different types of mechanisms (with examples)

2. Friction (8 hrs)
 - 2.1 Definition and its necessity
 - 2.2 Horizontal force required to move a body on an inclined plane both upward and downward
 - 2.3 Frictional torque in screws , both for square and V threads
 - 2.4 Screw jack (Derivation and Numericals)
 - 2.5 Different types of bearings and their application

3. Power Transmission (9 hrs)
 - 3.1 Introduction to Belt and Rope drives
 - 3.2 Types of belt drives and types of pulleys
 - 3.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
 - 3.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
 - 3.5 Different types of chains and their terminology
 - 3.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear

4. Flywheel (06 hrs)
 - 4.1 Principle and applications of flywheel
 - 4.2 Turning - moment diagram of flywheel for different engines

 - 4.3 Fluctuation of speed and fluctuation of energy - Concept only
 - 4.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy

5. Governor (8 hrs)
 - 5.1 Principle of governor
 - 5.2 Simple description and working of Watt, Porter and Hartnel governor (simple numerical based on watt and porter governor)
 - 5.3 Hunting, isochronism, stability, sensitiveness of a governor

6. Balancing (04 hrs)
 - 6.1 Concept of balancing
 - 6.2 Introduction to balancing of rotating masses (without numericals)

7. Vibrations (4 hrs)
 - 7.1 Types-longitudinal, transverse and torsional vibrations (simple numericals)
 - 7.2 Dampening of vibrations
 - 7.3 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. Malhotra, D.R., “Theory of Machines”, Satya Prakashan, New Delhi.
2. Singh, V.P, “Theory of Machines”, Dhanpat Rai and Sons, New Delhi.
3. Lal, Jagdish, “Theory of Machines”, Metropolitan Publishers, New Delhi.
4. Ubhi, B.S, “Theory of Machine”, S.K. Kataria and Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	08	09
3	09	12
4	06	06
5	08	09
6	04	04
7	04	04
Total	45	50

5.5 COMPUTER AIDED DRAFTING AND MODELING

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- 6

RATIONALE

Computer Aided Drafting is required for sketching and analysing ideas to determine the best solution for a problem at early stages of design project. Computer aided drafting eliminates the need for drawing new blueprints for every version of an idea

LEARNING OUTCOMES

On completion of this course, 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 commands in CAD software.
- create solids and assemblies using various tools in CAD software and SolidWorks.

DETAILED CONTENTS

1. Introduction to AutoCAD commands (6 drawing sheets)
 - 1.1 Concept of AutoCAD, Tool bars in Auto CAD, coordinate system, snap, grid, and ortho mode (Absolute, Relative and Polar modes)
 - 1.2 Drawing commands – point, line, arc, circle, and ellipse
 - 1.3 Editing commands – scale, erase, copy, stretch, lengthen and explode.
 - 1.4 Dimensioning and placing text in drawing area
 - 1.5 Sectioning and hatching
 - 1.6 Create layers within a drawing
 - 1.7 Specifying Geometrical Dimensioning & tolerancing 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

3. Isometric Drawing using Auto CAD (one sheet)

Drawings of following :

 - Cone
 - Cylinder
 - Isometric view of objects

4. Introduction to Solidworks

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

4.1 Part modeling (2 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 and 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

4.2 Assembly (1 model)

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. Manipulating Components - Replacing Components, Rotating Components, Move Components.

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. Jeyapooran, T., “Engineering Drawing with AutoCAD 2000”, Vikas Publishing House, Delhi.
2. Nageswara Rao, P., “AutoCAD for Engineering Drawing Made Easy”, Tata McGraw Hill, New Delhi.
3. Shettigar, Umesh, and Abdul Khader, “AutoCAD 2000 for you”, Janatha Publishers, Udupi.
4. Singh, Ajit, “Auto CAD 2000”, TMH, New Delhi.
5. Tickoo, Sham, “Designing with CATIA”, Dream Tech. Publications, New Delhi.

5.6 WORKSHOP TECHNOLOGY - III

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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 and modern machining methods is required to be imparted. Hence the subject of workshop technology.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Perform boring, internal threading on lathe machine.
- Perform milling machine operations on vertical and horizontal milling machine.
- Operate tool and cutter grinder
- Operate cylindrical grinder, surface grinder, internal grinder.
- Use milling machine accessories and attachments.
- Explain gear hobbing, gear shaping, gear shaving and gear finishing processes.
- Explain the working and use of modern machining practices.
- Explain the working principle of metallic coating processes.
- Explain the working principle of metal finishing processes.

DETAILED CONTENTS

- | | | |
|------|---|----------|
| 1. | Milling | (12 hrs) |
| 1.1 | Specification and working principle of milling machine | |
| 1.2 | Classification, brief description and applications of milling machines | |
| 1.3 | Details of column and knee type milling machine | |
| 1.4 | Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment, chuck and rotary table. | |
| 1.5 | Milling methods - up milling and down milling | |
| 1.6 | Identification of different milling cutters and work mandrels | |
| 1.7 | Work holding devices and machining centre | |
| 1.8 | Milling operations – face milling, angular milling, form milling, straddle milling and gang milling. | |
| 1.9 | Indexing and indexing methods – Simple, compound, differential and angular indexing | |
| 1.10 | Cutting speed and feed, simple numerical problems. | |
| 1.11 | Thread milling | |

- 2 Grinding (10 hrs)
- 2.1 Purpose of grinding
 - 2.2 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
 - 2.3 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
 - 2.4 Truing, dressing, balancing and mounting of wheel.
 - 2.5 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
 - 2.6 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
 - 2.7 Selection of grinding wheel
 - 2.8 Thread grinding.
3. Gear Manufacturing and Finishing Processes (06 hrs)
- 3.1 Gear terminology
 - 3.2 Gear hobbing
 - 3.3 Gear shaping
 - 3.4 Gear finishing processes
4. Modern Machining Processes (06 hrs)
- 4.1 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
 - 4.2 Electro Chemical Processes - Electro chemical machining (ECM) – Fundamental principle, process, applications
 - 4.3 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid, applications
 - 4.4 Laser beam machining (LBM) – Introduction, machining process and applications
 - 4.5 Plasma arc machining (PAM) and welding – Introduction, principle process and applications
 - 4.6 Additive manufacturing/ 3 D Printing – Introduction, process and applications
5. Metallic Coating Processes (06 hrs)
- 5.1 Metal spraying – Wire process, powder process, applications
 - 5.2 Electro plating, anodizing and galvanizing
 - 5.3 Organic Coatings- oil base paint, rubber base coating
6. Metal Finishing Processes (05 hrs)
- 6.1 Purpose of finishing surfaces.
 - 6.2 Surface roughness-Definition and units
 - 6.3 Honing Process, its applications
 - 6.4 Description of hones.

- 6.5 Brief idea of honing machines.
- 6.6 Lapping process, its applications.
- 6.7 Description of lapping compounds and tools.
- 6.8 Brief idea of lapping machines.
- 6.9 Polishing
- 6.10 Buffing.
- 6.11 Superfinishing
- 6.12 Tumbling

PRACTICAL EXERCISES

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. Produce a rectangular block by facing on a slotting machine
2. Produce a rectangular slot on one face with a slotting cutter
3. Produce a rectangular block using a milling machine with a side and face cutter
4. Prepare a slot on one face using milling machine
5. Job on grinding machine using a surface grinder
6. Prepare a job on cylindrical grinding machine.
7. Exercise on milling machine with the help of a form cutter
8. Exercise on milling machine to produce a spur gear
9. Grinding a drill-bit on tool and cutter grinder
10. Exercise on dressing a grinding wheel

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 practical's.

RECOMMENDED BOOKS

1. Rao, "Manufacturing Technology", Tata McGraw Hill Publishers, New Delhi.
2. Pandey and Singh, "Production Engineering and Science", Standard Publishers Distributors, New Delhi.

3. Sharma, P.C., "A Text Book of Production Engineering", S. Chand and Company Ltd., New Delhi.
4. Dhiman, R.P., "Workshop Technology Vol-III", Ishan Publications Jalandhar.
5. Aulakh, G.S., "Workshop Technology III", Eagle Parkashan, Jalandhar.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	12	14
2	10	12
3	06	06
4	06	06
5	06	06
6	05	06
Total	45	50

PERSONALITY DEVELOPMENT CAMP

This is to be organized at a stretch for two to three days.. Extension lectures by experts or teachers from the polytechnic will be delivered on the following broad topics. There will be no examination for this camp.

1. Communication Skills
2. Correspondence and job finding/applying/thanks and follow-up
3. Resume Writing
4. Interview Techniques: In-Person interviews; telephonic interviews, panel interviews; group interviews and video conferencing etc.
5. Presentation Techniques
6. Group Discussion Techniques
7. Aspects of Personality Development
8. Motivation
9. Leadership
10. Stress Management
11. Time Management
12. Interpersonal Relationship
13. Health and Hygiene

6.1 PRODUCTION MANAGEMENT

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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.
- Locate suitable plant location and draw plant layout for different production system.
- Handle different type of material and tools safely and effectively.
- Apply work study techniques for improving production
- Maintain inventory optimally and classify different types of inventory
- Use industrial engineering concepts to improve productivity
- Use resources optimally and economically.
- Carryout estimating and costing of production cost
- Apply different techniques to improve quality of products and processes.

DETAILED CONTENTS

- | | | |
|-----|---|----------|
| 1. | Production Planning and Control (PPC) | (03 hrs) |
| 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. Plant Location, Layout and Material Handling (06 hrs)
- 2.1 Definition and Factors affecting the plant location, Rural versus Urban Plant sites.
 - 2.2 Definition and importance of Plant layout, Factors affecting plant layout.
 - 2.3 Types of Plant layout- Process, product, combination and fixed position layout..
 - 2.4 Methods of plant layout
 - 2.5. Plant layout procedure and work station design.
 - 2.6. Material Handling- Definition, Significance and objectives of material handling, Principles of economic material handling,. Types of material handling equipment - Characteristics and classification of material handling equipment, Hoisting and conveying equipment (different types), Safety requirements while using material handling equipment
3. Work Study (8 hrs)
- 3.1 Production System and Productivity (Introduction and definitions), Difference between Production and productivity, Measures to improve productivity
 - 3.2 Definition, advantages and procedure of work study
 - 3.3 Method study – Definition, Objectives and Procedures, Process chart symbols, outline process chart, Flow process charts, Two handed processes charts, Multiple activity chart(Man-Machine charts), Flow diagram, string diagram.
 - 3.4 Principles of motion economy, Therblig symbols, SIMO chart.
 - 3.5. Work Measurement :- Definition and objective, Work measurement technique, Time Study- Definition, objectives and procedure, Calculation of basic time, performance rating and its techniques, normal time, allowance and its types, standard time (simple numerical problems)
4. Inventory Control (6 hrs)
- 4.1 Definition and objectives of inventory control.
 - 4.2 Inventory types
 - 4.3 Procurement and carrying cost, EOQ, lead time, reorder point (simple numerical problems)
 - 4.4 Inventory Classification - ABC Analysis, VED Analysis, FMS Analysis
 - 4.5 Standardization and Codification - Objective and advantages of standardization, Levels and types of standards, Objective and advantages of codes. Coding systems-. National and International Codes

5. Inspection and Quality Control (06 hrs)
- 5.1. Inspection – Introduction, Need and Importance, Types of Inspection, Role of operator and inspector in inspection
 - 5.2. Quality Control - Introduction, Need and Importance, Factors affecting product quality
 - 5.3. Quality Assurance
 - 5.4. Statistical Quality Control (SQC)
Acceptance Sampling, Sampling Plan- Single and double sampling plan, Operating Characteristics Curve, Control Charts – Introduction, advantages, Types of control charts (X, R, p and c charts)
 - 5.5. Quality improvement using 5S and Kaizan.
6. Repair and Maintenance (04 hrs)
- 6.1 Objectives and importance of Maintenance
 - 6.2 Different types of maintenance- Corrective or Breakdown maintenance, Scheduled Maintenance, Preventive Maintenance, Predictive Maintenance
 - 6.3 Nature of maintenance problems
 - 6.4 Range of maintenance problems
7. Value Engineering (02 hrs)
- 7.1 Introduction, Concept
 - 7.2 Objectives of value engineering
 - 7.3 Value Analysis Procedures (simple)
 - 7.4 Benefits of value analysis
 - 7.5 Technique of value engineering
8. Cost Estimation and Control: (10 hrs)
- 8.1 Definition and functions of cost estimation
 - 8.2 Estimation procedure
 - 8.3 Elements of cost, ladder of costs (simple numericals)
 - 8.4 Overhead expenses and its distribution
 - 8.5 Depreciation - Concept and Definition, Methods of calculating depreciation- Straight line method, Diminishing Balance Method, Sinking fund method (Numerical problems).
 - 8.6 Cost control- definition and objectives, Capital cost control (planning and scheduling), operating cost control.
 - 8.7 Cost estimation for machining processes like turning, drilling, and milling.

INSTRUCTIONAL STRATEGY

1. Teacher should put emphasis on giving practical problems related to plant location and plant layout
2. Students should be taken to industrial units to give an exposure of production environment, plant layout and material handling
3. Live problems may be given to students to carry out case studies in teams under guidance of teacher

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	3	04
2	6	06
3	8	10
4	6	06
5	6	06
6	4	06
7	2	02
8	10	10
Total	45	50

6.2 MACHINE DESIGN

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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.
- 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 | (06 hrs) |
| | 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: stress, strain, 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) | |
| | 1.3 Engineering materials and their mechanical properties: | |
| | 1.3.1 Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity, strength | |
| | 1.3.2 Selection of materials, criterion of material selection | |

2. Design Failure (03 hrs)
- 2.1 Various design failures-maximum stress theory, maximum strain theory
 - 2.2 Classification of loads
 - 2.3 Design under tensile, compressive and torsional loads.
 - 2.4 Design criteria on the basis of strength and rigidity
3. Design of Shaft (8 hrs)
- 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 (05 hrs)
- 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 (15 hrs)
- Types of joints - Temporary and permanent joints, utility of various joints
- 5.1 Temporary Joint:
 - 5.1.1 Knuckle Joint – 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 (04 hrs)

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 (04 hrs)

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 provide all the relevant data for the machine design numericals in the question paper.

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. Khurmi, R.S., and JK Gupta, “Machine Design”, Eurasia Publishing House (Pvt.) Limited, New Delhi.
2. Bhandari, V.B., “Machine Design”, Tata McGraw Hill, New Delhi.
3. Sharma and Agrawal, “Machine Design”, Katson Publishing House, Ludhiana.
4. Mandali, D.P., “Design Data Handbook”, SK Kataria and Sons, Delhi.
5. Verma, A.P., “Machine Design”, SK Kataria and Sons, Delhi.
6. Gupta, AR, and BK Gupta, “Machine Design”, Satya Parkashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	03	04
3	08	08
4	05	06
5	15	16
6	04	05
7	04	05
Total	45	50

6.3 AUTOMOBILE ENGINEERING

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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:

- Identify and explain the function of different chassis components and drive types.
- Understand the working of transmission system.
- Understand the balancing of wheels and steering geometry.
- Carry out routine servicing of brake system and bleeding of hydraulic brakes.
- Understand testing and charging of lead-acid battery.
- Interpret norms of exhaust emissions.

DETAILED CONTENTS

- | | | |
|----|--|----------|
| 1. | Introduction | (03 hrs) |
| | 1.1 Automobile and its development | |
| | 1.2 Various types of automobiles manufactured, their manufacturer and location of their manufacturing units. | |
| | 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) | |
| | 1.8 Concept of single overhead cam, double overhead cam, Twin cam 16 valve technology in 4 cylinder engine. | |
| | 1.9 Euro V and Bharat Stage VI emission norms | |
| 2. | Transmission System | (10 hrs) |
| | 2.1 Function of transmission system, | |
| | 2.2 Clutch - Functions, Constructional details of single plate and multi plate | |

- friction clutches, Centrifugal and semi centrifugal clutch, Cone clutch.
- 2.3 Gear Box – Function and need, Working of constant mesh and synchromesh gear box, Introduction to Automated Manual Transmission, Automatic transmission and Continuously Variable Transmission(CVT).
- 2.4 Propeller shaft and rear axle - Functions, Universal joint, Differential, Different types of rear axles.
- 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 (04 hrs)
- Function and principle, Ackerman and Davis Steering Mechanism. Types of steering gears - worm and wheel, rack and pinion. Power steering- Hydraulic and Electrical.
4. Braking system (06 hrs)
- 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, Bleeding, Introduction to Anti-lock Brake System (ABS) and its working.
5. Suspension System (06 hrs)
- Function and types of suspension system. Springs used in suspension system - Coil and leaf spring, Air suspension, Shock Absorber (Telescopic type) – Function, construction and working.
6. Battery (9 hrs)
- 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 methods, Maintenance of batteries, Checking of batteries for voltage and specific gravity. Batteries for electric and hybrid vehicles.
7. Dynamo and Alternator (3 hrs)
- 7.1 Dynamo - Function
- 7.2 Alternator - Construction and working, Charging of battery by alternator.

- 8 E Vehicle (4 hrs)

Concept and features of E Vehicles, Types of EVs, Benefits of EVs, Future scope of EVs

LIST OF PRACTICALS

- 1 Fault and their remedies in Battery Ignition system
2. Dismantle (i) rear axle (ii) differential and find out the gear ratio of crown wheel and driven sun gear and planet pinion.
- 3 Fault finding practices on an automobile – four wheelers (petrol/ diesel vehicles).
4. Servicing/Tuning of a 2 wheeler/4 wheeler.
5. Servicing of hydraulic brakes:
 - a) adjustment of brakes
 - b) bleeding of brakes
 - c) fitting of leather pads
- 6 Tuning of an automobile engine.
- 7 Testing and charging of an automobile battery and measuring cell voltage and specific gravity of electrolyte.
- 8 Changing of wheels and inflation of tyres, alignment and balancing of wheels.
9. Driving Practice and safety while driving.

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

RECOMMENDED BOOKS

1. Narang, GBS, “Automobile Engineering”, Khanna Publishers, Delhi.
2. Singh, Dr. Kirpal, “Automobile Engineering”, Standard Publishers and Distributors, Delhi.
3. Aulakh, G. S., “Automobile Engineering”, Eagle Prakashan, Jalandhar.
4. Gupta, R.B., “Automobile Engineering”, Satya Parkashan, New Delhi.
5. Singal, R.K., “Automobile Engineering”, S.K. Kataria and Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 60)
1	3	4
2	10	12
3	4	4
4	6	6
5	6	6
6	9	10
7	3	4
8	4	4
Total	45	50

6.4 REFRIGERATION AND AIR CONDITIONING

L	P
3	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 (02 hrs)
Introduction to refrigeration, and air conditioning, meaning of refrigerating effect, units of refrigeration, COP, difference between COP and efficiency, methods of refrigeration, Natural system and artificial system.
2. Vapour Compression System (08 hrs)
Introduction, principle, function, parts and necessity of vapour compression system, T- ϕ 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 (03 hrs)
Functions, classification of refrigerants, properties of R - 717, R - 22, CO₂, R - 11, R - 12, R - 502, R-32. Properties of ideal refrigerant, selection of refrigerant

4. Air Refrigeration System (06 hrs)
Introduction, advantages and disadvantages of air-refrigeration system over vapour compression system, bell – Collemann cycle, calculation of mass flow rate, work done and COP
5. Vapour Absorption System (04 hrs)
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 hrs)
- 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 (06 hrs)
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. (06 hrs)
Psychrometric chart, various lines, psychrometric process, by pass factor, room sensible heat factor, effective room sensible heat factor, grand sensible heat factor, ADP, room DPT.
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:- (02 hrs)
Inverter technology, auto-defrosting, blast cooling, star rating.

LIST OF PRACTICALS

1. Identify various tools of refrigeration kit.
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

INSTRUCTIONAL STRATEGY

1. Teaches 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

1. Domkundwar, “Refrigeration and Air Conditioning”, Dhanpat Rai and Sons, Delhi.
2. Arora, CP, “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi.
3. Khurmi, R.S, and J.K. Gupta, “Refrigeration and Air Conditioning”, S Chand and Company Limited, New Delhi.
4. Khanna, Dr. Harjeev, “Refrigeration and Air Conditioning”, Dhanpat Rai and Sons, Delhi.
5. Rajput, Dr. R.K, “Refrigeration and Air Conditioning”, S.K. Kataria and Sons, Ludhiana.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	02	02
2	08	09
3	03	04
4	06	06
5	04	05
6	08	10
7	06	06
8	06	06
9	02	02
Total	45	50

6.5.1 INDUSTRIAL AUTOMATION AND ROBOTICS

L	P
3	-

RATIONALE

Robotics and automation are becoming common for various applications in manufacturing plants. Basic knowledge of different configurations, end effectors, sensors and actuators are essential for the diploma students. Diversified applications of robots in industries are enormous and hence students have to be imparted the knowledge of robot applications. Hence, this subject.

LEARNING OUTCOMES

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

- Demonstrate knowledge of industrial robots, characteristics, end effectors and actuators.
- Apply spatial transformation to obtain forward and inverse kinematics.
- Describe working principle of various sensors and program different operations.
- Appreciate applications of robots in industry.

DETAILED CONTENTS

1. Fundamentals of Robotics (08 hrs)

Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.

2 Robotic Drive System and Controller (12 hrs)

Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.

3. Sensors (09 hrs)

Requirements of a sensor; Principles and Applications of sensors. Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing. Introduction to Machine Vision.

4. Robot Kinematics and Robot Programming (10 hrs)

Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effector commands; and Simple programs

5. Automation (06 hrs)

Basic elements of automated system, advanced automation functions, levels of automation. Industrial Applications: Application of robots in machining; welding; assembly and material handling

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching.
2. Arrange industry visits to supplement classroom teaching.
3. Video film may be used to explain concepts of industrial automation and robotics.

RECOMMENDED BOOKS

1. Bolton, "Mechatronics".
2. Koren, Yoram, Robotics for Engineers", McGraw Hill Publisher.
3. Radhakrishnana, P., and S. Subramaniyam, "CAD/CAM/CIM", Wiley Eastern Publilshers, New Delhi.
4. Groovers, M.P. et al., "Industrial Robotics", McGraw Hill Publisher.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	8	08
2	12	14
3	9	10
4	10	12
5	6	06
Total	45	50

6.5.2 MATERIAL HANDLING EQUIPMENT

L P
3 -

RATIONALE

After studying this subject, diploma holders will be able to cut cost, reduce damages, increase safety from disabilities, improve productivity of manufacturing plant/warehouses. Material handling can improve customer service by making products easy to find, move and ship out.

LEARNING OUTCOMES

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

- Explain the constructional features of various materials handling equipment.
- Select material handling equipment for specific applications.
- Comprehend the controls & safety measures incorporated on material handling equipment.
- Describe the role of material handling devices in automation of industrial process.
- Understand the importance of safety instrumentation for equipment.
- Improve productivity of plants/warehouses.

DETAILED CONTENTS

1. Introduction to Material Handling System (5 hrs)

Main types of Material handling equipment & their applications; Types of load to be handled; Types of Movements; Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

2. Hoisting Machinery & Equipment (10 hrs)

Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists, Worm geared and Spur geared hoists, Electric & Pneumatic hoists, Jumper; Construction, Working & Maintenance (basic idea) of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Cable cranes, Floating cranes & Cranes traveling on guide rails; Construction, Working & Maintenance of Elevating equipment such as Stackers, Industrial lifts, Freight elevators, Passenger lifts, and Mast type elevators

3. Conveying Machinery (12 hrs)

Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators; Construction, Working & Maintenance (basic idea) of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors,

Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers; Construction, Function, Working of Cross handling equipment such as Winches, Capstans, Turntables, Transfer tables, Monorail conveyors.

4. Components of Material Handling Systems (12 hrs)

Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices; Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals; Construction & Working of Arresting gear & Brakes; Construction & use of electromagnetic shoe brakes, Thruster operated shoe brakes, Control brakes.

5. Mechanism used in Material Handling Equipment (6 hrs)

Steady state motion; Starting & stop- ping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism, Slewing Mechanism, Rope & chain operated Cross- Traverse Mechanism

RECOMMENDED BOOKS

1. T. H., Allegri, "Material Handling (Principles & Practice)", CBS Publisher, New Delhi.
2. J. M., Apple, "Plant Layout & Materials Handling", John Wiley Publishers.
3. Rundenko, N., "Material Handling Equipment", Peace Publisher, Moscow.
4. Alexandrov, M. P., "Material Handling Equipment", MIR Publisher, Moscow.
5. Oberman, Y. I., "Material Handling Equipment", MIR Publisher, Moscow.

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching.
2. Arrange industry visits to supplement classroom teaching.
3. Video film may be used to explain concepts.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	10	10
3	10	12
4	8	10
5	5	06
6	6	06
Total	45	50

6.5.3 INSTALLATION AND MAINTENANCE OF EQUIPMENT

L P
3 -

RATIONALE

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

LEARNING OUTCOMES

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

- Comprehend the procedure for erection and commissioning of machines.
- Understand the concept of testing, repair and maintenance.
- Comprehend the procedure of repair and maintenance.
- Know the various lubrication systems.

DETAILED CONTENTS

1. Erection and Commissioning of Machines (Installation) (10hrs)
 - 1.1 Location, layout and positioning of machines
 - 1.2 Foundation – types of foundation, foundation plan, erection and leveling, grouting, vibration damping, vibration isolation – methods of isolation, anti vibration mounts.

2. Maintenance (20 hrs)
 - 2.1 Definition, objectives, challenges in maintenance, concept of maintainability, principles of maintenance,
 - 2.2 Different types of maintenance viz. preventive, breakdown, predictive. Advantages and limitations.
 - 2.3 Basic concept of condition monitoring
 - 2.4 Preparation of yearly plan for preventive maintenance
 - 2.5 Organization of maintenance
 - 2.6 Introduction to computerized maintenance record
 - 2.7 ISO standards for maintenance documentation

3. Lubrication Systems (6 hrs)
- 3.1 Lubrication methods and periodical lubrication chart for various machines (daily, weekly, monthly)
 - 3.2 Lubricant needed for specific components such as gears, bearings, and chains
 - 3.3 Purpose and procedure of changing oil periodically (like gear box oil)
 - 3.4 Lubricants conditioning and disposal
 - 3.5 Handling and storage of lubricants
4. Repairing (9 hrs)
- 4.1 Basics of failure, Failure modes,
 - 4.2 Common parts which are prone to failure, reasons of failure
 - 4.3 Repair schedule
 - 4.4 Parts that commonly need repair such as belts, couplings, nuts, and bolts

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.

RECOMMENDED BOOKS

1. Garg, HP, "Industrial Maintenance", S. Chand and Company, Delhi.
2. Jain, RK, "Plant Maintenance Engineering", Khanna Publishers, Delhi.
3. Bhattacharya, SN, "Installation, Servicing and Maintenance", S Chand and Company, Delhi.
4. Mishra, RC, and K Pathak, "Maintenance Engineering and Management", Prentice Hall of India Pvt. Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	10	12
2	20	22
3	9	10
4	6	06
Total	45	50

6.5.4 POWER PLANT ENGINEERING

L P
3 -

RATIONALE

Electric power is the main resource for any type of energy. Economic growth of the nation essentially results into growth in power sector. Various conventional power plant such as Hydro, Steam, Gas, Diesel, Nuclear power plants are employed for power generation. Most of the power plants use mechanical engineering equipment and components. Hence, this course attempts to provide the basic knowledge of the components, operation and maintenance of power plants to the students and would also acquaint them with the latest technological advances taking place in the sector so that they grab the job opportunity in private as well as public sector in this field.

LEARNING OUTCOMES

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

- Analyze economics of power plants and list factors affecting the power plants and interpret the performance of power plants based on load variations.
- Identify elements and their functions of hydro power plants.
- Identify elements and their functions and operations of thermal power plants.
- Identify elements and their functions and operations of gas, diesel and nuclear power plants.
- Know the Social and economical issues of power plants.

DETAILED CONTENTS

1. Introduction to Power plant (6 hrs)

Introduction to power plant, Classification of power plants, Energy and its types, Law of conservation of energy, Terminology used in power plants, Factors affecting power plant design (Location and choice of power plant), Performance and operating characteristics of power plants, Methods of meeting fluctuating loads in power plants, Energy scenario in India.

2. Hydro Power Plant (10 hrs)

Introduction to Hydro electric power plant; Rainfall, Runoff and its measurement, Selection of sites for hydro electric power plant, General layout of Hydro electric power plant and its working, Penstock, Turbines and its types, Selection of turbine, Concept of cavitation and methods to prevent it, Draft tube and its types, Major hydroelectric power plants in India, Advantages and disadvantages of hydro electric power plant.

3. Thermal Power Plant (10 hrs)

Introduction to thermal power plants, Working of thermal power plants, Calorific value of coal, pulverization of coal, pulverized fuel handling system - unit and central system. ash handling system – gravity system. Boilers and its types, boiler mountings and accessories, Steam turbines and its types, Major thermal power plants in India, Advantages and disadvantages of thermal power plants.

4. Diesel and Gas turbine Plant (8 hrs)

The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; Gas turbine power Plant-Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram).

5. Nuclear Power Plant (5 hrs)

Introduction, Atomic Structure, Nuclear fission and fusion, Radio activity, Nuclear Reactors, Safety measures for nuclear power plant, Nuclear power stations in India, Advantages and Disadvantages of Nuclear power plant.

6 Environmental Pollution Due to Power Plant (6 hrs)

Green house effect; Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Radiation from nuclear power plant effluents, Pollution control technologies including waste disposal options for coal and nuclear power plants. Power plant safety, Plant safety concept, Safety practices to be observed in boiler operation; Safety in oil handling system; Safety in Chemical handling system.

RECOMMENDED BOOKS

1. Arora and Domkundwar, "Power Plant Engineering", Dhanpat Rai & Co (P) Ltd.
2. Nag, P. K., "Power plant Engineering", McGraw Hill.
3. Nagpal, G. R., "Power plant Engineering", Khanna Publishers.
4. Sharma, Dr. P. C., "Power plant Engineering", S. K. Kataria.
5. Rajput, R K, "A Text Book of Power Plant Engineering", Laxmi Publications.

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching.
2. Arrange industry visits to supplement classroom teaching.
3. Video film may be used to explain concepts.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (Out of 50)
1	06	06
2	10	12
3	10	12
4	8	09
5	5	05
6	6	06
Total	45	50

6.6 PROJECT WORK

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- 12

RATIONALE

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 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.
- 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 abilities like interpersonal skills, communication skills, positive attitude and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strength 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 them as 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. There should not be more than 6 students in a group. The project work identified in collaboration with industry should be preferred.

This project work should not be considered as merely conventional industrial/field training in which students are sent to work places with either minimal or no supervision. The project work 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 industry/field organizations for providing such an experience to students. It is necessary that each organization is visited well in advance to identify the project. The chosen project needs to match with the curricular interest of students and should be of professional value to industrial/ field organizations.

Some of the suggested projects 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

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 an external and an internal (teacher) examiner is given in the table below:

Sr. No.	Performance Criteria	Max. Marks	Rating Scale						
			Outstanding	Excellent	Very Good	Good	Above Average	Average	Pass
1.	Planning	10	10	9	8	7	6	5	4
2.	Execution	30	30	27	24	21	18	15	12
3.	Quality of Project	20	20	18	16	14	12	10	8
4.	Report Writing	20	20	18	16	14	12	10	8
5.	Presentation/ Viva voce	20	20	18	16	14	12	10	8
Total marks		100	100	90	80	70	60	50	40

Important Note

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.
3. The external examiner may be a person from industry/organization, who has been associated with the project-oriented professional training of the students or a senior faculty from technical institute ,
4. It is proposed that the institute may organize an annual exhibition of the project work.

9. RESOURCE REQUIREMENTS

9.1 Physical Resources

9.1.1 Equipment Requirement:

Sr. No.	Description	Qty	Total Price (Rs)
MATERIAL SCIENCE LABORATORY			
1.	Salt bath oil fired furnace	1	30,000
2.	Salt bath electric resistance furnace	1	40,000
3.	Electric furnace muffle type	1	60,000
4.	Forced circulation tempering furnace	1	30,000
5.	Quenching tank	2	5,000
6.	Work benches	2	4,000
7.	Pyrometers	1	1,000
8.	Pot for bailing out the salt	1	1,500
9.	Metallurgical microscope	1	35,000
10.	Abrasive cut off machine	1	50,000
APPLIED MECHANICS LABORATORY			
1.	Polygon of forces apparatus	1	1,000
2.	Apparatus for reaction at supports	1	1,000
3.	Jib crane	1	1,000
4.	Screw jack	1	300
5.	Inclined plane and friction apparatus	1	500
6.	Worm and worm wheel	1	1,500
STRENGTH OF MATERIALS LABORATORY			
1.	Brinell and Rockwell hardness tester	1	30,000
2.	Impact testing machine	1	20,000
3.	Microprocessor based universal testing machine	1	4,00,000
4.	Torsion testing machine (fully computerized)	1	2,00,000

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
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 AND PNEUMATICS LABORATORY			
1.	Piezometer tube	2	1,000
2.	U tube differential manometer	2	2,000
3.	Inclined manometer	1	1,000
4.	Bourdan pressure gauge	1	1,000
5.	Hydraulic jack	1	4,000
6.	Hydraulic press	1	20,000
7.	Bernoulli's apparatus	1	15,000
8.	Venturimeter apparatus with differential manometer	1	10,000
9.	Pipe friction apparatus	1	15,000
10.	Reciprocating pump	1	20,000
11.	Centrifugal pump	1	25,000
12.	Model of pelton wheel	1	5,000
13.	Model of Francis turbine	1	5,000
THERMODYNAMICS LABORATORY			
1.	Throttling Calorimeter	1	25,000
2.	Bomb Calorimeter	1	40,000
3.	Junker's Gas Calorimeter	1	30,000

4.	Gravimetric Analysis	1	15,000
5.	Orsat Apparatus	1	20,000
6.	Mechanical Types Co ₂ Recorder	1	25,000
7.	Single Stage Reciprocating	1	50,000
8.	Rotary Compressor	1	25,000
9.	Flash Point Apparatus	1	10,000
10.	Pyrometer	2	2,000
11.	Lancashire boiler model	1	5,000
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.	Spring loaded safety valve	1	6,000
16.	Single cylinder 2 stroke petrol engine	1	35,000
17.	Single cylinder 4 stroke petrol engine	1	40,000
18.	Multicylinder petrol engine test ring	1	70,000
METROLOGY AND INSTRUMENTATION 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
COMPUTER LABORATORY			
1.	AutoCAD	1	50,000
2.	SolidWorks	1	3,00,000
3.	Pro-Engineering	1	3,00,000
4.	Computer – Pentium	11	4,00,000
5.	Mechanical Desk Top	1	50,000
6.	Catia	1	2,00,000
7.	Digitiser	1	50,000
8.	Plotter	1	75,000
9.	Scanner	1	3,500
10	Printer (Laser, DMP)	3	80,000
REFRIGERATION AND AIR CONDITIONING LABORATORY			
1.	Refrigeration trainer	1	6,000
2.	Air conditioner trainer	1	10,000
3.	Water cooler	1	6,000
4.	Experimental Ice plant	1	10,000
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	1	8,000
8.	Vacuum pump	1	3,000
AUTOMOBILE ENGINEERING LABORATORY			
1	Compressor	2	60,000
2	Pumps	1	40,000
3	Drier	1	20,000
4	Pulley block	1	5,000
5	Mobile Crane	1	30,000
6	Fork Lift	1	20,000
7	Hydraulic Jack	1	7,000
8	Winch	1	5,000

NOTE:

The prices are indicative and purchase officers should verify the prices from various manufacturers.

In addition to above, laboratories in respect of physics, chemistry will be required for effective implementation of the course.

Provision for overhead projector, TV with DVD playback facility, slide cum strip projector, DVD player, photocopier, PC-XT facilities, drafting machines etc has also to be made available.

9.1.2 Space Requirement:

Norms and standards laid down by All India Council for Technical Education (AICTE) may 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.

9.1.3 Furniture Requirement

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

9.2 Human Resources:

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.

10. LIST OF CONTRIBUTORS/EXPERTS

- a) Online Curriculum Workshops for Designing the Contents of First Year Subjects for Diploma Programmes for Punjab State on 22nd April, 2022, 26th April, 2022, 28th April, 2022, 12th May, 2022 13th May, 2022, 16th May, 2022, 17th May, 2022, 24th May, 2022 and 6th June, 2022 at NITTTR, Chandigarh

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29.	Ms. Shelly Singla, Lect, Govt Polytechnic College Khuni Majra
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35.	Mr. Gurjit Singh, Foreman Instructor, Govt Polytechnic College Bathinda
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42.	Mr. Gagandeep Singh, Lecturer, Govt Polytechnic College Bathinda
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46.	Mr. Ajay Kumar, Lecturer, Chemistry, Pt JR Govt Polytechnic Hoshiarpur
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58.	Ms. Meenu Dutta, Lecturer, Pt JR Govt Polytechnic, Hoshiarpur
59.	Ms. Sharanjit Kaur, Lecturer, Mehr Chand Polytechnic
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61.	Ms. Tarandeep Kaur, Lecturer, CSE, Thapar Polytechnic, Patiala
62.	Ms. Divya Jyoti, Lecturer, Pt. J R Govt. Polytechnic, Hoshiarpur
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64.	Dr. Anshu Sharma, Sr Lecturer, Govt Polytechnic College, Khunimajra
65.	Mr. Kulwinder Singh Pannu, HOD, Electronics & Communication Engineering, SGHS GPC, Ranwan
66.	Dr. A B Gupta, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh

- b) Online Curriculum Workshops for Designing the Contents of Open Electives for Diploma Programmes for Punjab State on 27th March, 2023, and 8th May, 2023, at NITTTR, Chandigarh

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12.	Mr. Suresh Gandhi, PITT, Amritsar
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14.	Ms. Ramanpreet Kaur, Lecturer Spinning, Textile Technology, Amritsar
15.	Ms. Ravneet Kaur, HOD, Architecture Assistantship, Govt Polytechnic College For Girls, Patiala
16.	Dr. A B Gupta, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh

- c) Online Workshop to Develop the Curriculum of Diploma Programme in 'Mechanical Engineering' for the State of Punjab on 1st June, 2022, 25th November, 2022, 2nd December, 2022 at NITTTR, Chandigarh

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1.	Mr. Jasvinder Singh, HOD, Govt Polytechnic College, Bathinda
2.	Mr. Aman Chadha, Senior Lecturer, Govt Polytechnic College, Baretta
3.	Mr. Baljit Singh Virk, Senior Lecturer, Govt Polytechnic College, Bathinda
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8.	Mr. Sudhir Kumar, HOD, Govt Polytechnic College, Ferozpur
9.	Mr. D K Soni, Lecturer, CCET Diploma Wing Chd
10.	Mr. Balwan Singh, Officer Incharge- Mechanical, ABIT
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13.	Mr. Pardeep Kumar, Lecturer, CCET Diploma Wing Chd
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