Curriculum for

Diploma Programme in

MECHANICAL ENGINEERING

For the State of Uttar Pradesh

Prepared by:
Curriculum Development Centre
National Institute of
Technical Teachers Training and Research
Sector 26, Chandigarh - 160 019

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PREFACE

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

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

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

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

Dr. SS Pattnaik
Director
National Institute of
Technical Teachers Training & Research
Chandigarh

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Coordinator

1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

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

8) Industrial Training:

Four weeks of industrial training is included after IV semester during summer vacation. Total marks allotted to industrial training will be 50.

9) Ecology and Environment :

As per Govt. of India directives, a subject on Environmental Studies has been incorporated in the curriculum.

10) Energy Conservation:

A subject on Energy Conservation has been incorporated in the curriculum.

11) Entrepreneurship Development:

A full subject on Industrial Management and Entrepreneurship Development has been incorporated in the curriculum.

12) Student Centred Activities:

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

13) Project work

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

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN MECAHNICAL ENGINEERING

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

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

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

3. LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

After undergoing this programme, students will be able to:

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

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

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

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

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

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

38.	Apply inventory control techniques to reduce	– Industrial Engineering and Safety

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

5. ABSTRACT OF CURRICULUM AREAS

a) General Studies

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

b) Applied Sciences

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

c) Basic Courses in Engineering/Technology

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

d) Applied Courses in Engineering/Technology

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

e) Industrial Training

27. Project Work

f) Elective

28. Repair and Maintenance
29. Tool Engineering

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

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

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

FIRST SEMESTER

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

* Common with other diploma programmes

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

SECOND SEMESTER

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

* Common with other diploma programmes

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

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

THIRD SEMESTER

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

* Common with other diploma programmes

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

FOURTH SEMESTER

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

* Common with other diploma programme

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

FIFTH SEMESTER

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

* Common with other diploma programme

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

SIXTH SEMESTER

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

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

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

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

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

i. 10 Marks for general behavior and discipline
(by HODs in consultation with all the teachers of the department)

ii. 5 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)

a)	75 - 80%	2 Marks
b)	80 - 85%	4 Marks
c)	Above 85%	5 Marks

iii. 15 Marks maximum for Sports/NCC/Cultural/Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a)	15	-	State/National Level participation
b)	10	-	Participation in two of above activities
c)	5	-	Inter-Polytechnic level participation

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

5.1 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

SECTION – A

ENTREPRENEURSHIP

1. Introduction (04 Periods)

    1.1 Concept /Meaning and its need
    1.2 Qualities and functions of entrepreneur and barriers in entrepreneurship

1.3 Sole proprietorship and partnership forms and other forms of business organisations
1.4 Schemes of assistance by entrepreneurial support agencies at National, State, District –level, organisation: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. Market Survey and Opportunity Identification/Ideation (04 Periods)

2.1 Scanning of the business environment
2.2 Salient features of National and Haryana State industrial policies and resultant business opportunities
2.3 Types and conduct of market survey
2.4 Assessment of demand and supply in potential areas of growth
2.5 Identifying business opportunity
2.6 Considerations in product selection
2.7 Converting an idea into a business opportunity

3. Project report Preparation (06 Periods)

3.1 Preliminary project report
3.2 Detailed project report including technical, economic and market feasibility
3.3 Common errors in project report preparations
3.4 Exercises on preparation of project report
3.5 Sample project report

SECTION –B

MANAGEMENT

4. Introduction to Management (06 Periods)

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

4.7 Line and staff organisation
4.8 Functional Organisation

5. Leadership and Motivation (08 Periods)

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

6. Management Scope in Different Areas (14 Periods)

6.1 Human Resource Management: Introduction and objective, Introduction to Man power planning, recruitment and selection, Introduction to performance appraisal methods
6.2 Material and Store Management: Introduction functions, and objectives, ABC Analysis and EOQ

6.3 Marketing and sales: Introduction, importance, and its functions, Physical distribution, Introduction to promotion mix, Sales promotion

6.4 Financial Management: Introductions, importance and its functions, knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture (08 Periods)

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

8. Basic of Accounting and Finance (10 Periods)

8.1 Basic of Accounting: Meaning and definition of accounting, Double entry system of book keeping, Trading account, PLA account and balance sheet of a company

8.2 Objectives of Financial Management: Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics (10 Periods)

9.1 Total Quality Management (TQM): Statistical process control, Total employees Involvement, Just in time (JIT)

9.2 Intellectual Property Right (IPR) : Introduction, definition and its importance, Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

5.2 THEORY OF MACHINES

L	T	P
5	2	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS
THEORY

1. Simple Mechanisms (06 Periods)

   1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversions.
   1.2 Different types of mechanisms (with examples)

2. Kinematic Analysis and synthesis (12 Periods)

   2.1 Displacement, velocity and acceleration of plane mechanism
   2.2 Graphical and analytical techniques.

3. Dynamics of Machine (12 Periods)

   3.1 Static and dynamic force analysis graphical and analytical approaches
   3.2 Gyrosopic action in machines.

4. Power Transmission (12 Periods)

   4.1 Introduction to Belt and Rope drives

4.2 Types of belt drives and types of pulleys
4.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
4.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
4.5 Different types of chains and their terminology
4.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear

5. Flywheel (06 Periods)
5.1 Principle and applications of flywheel
5.2 Turning - moment diagram of flywheel for different engines
5.3 Fluctuation of speed and fluctuation of energy - Concept only
5.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy

6. Cam and follower (08 Periods)

Introduction, types of Cam and follower, construction of Cam profile for constant velocity motion, constant acceleration motion and simple harmonic motion

7. Balancing (06 Periods)

7.1 Concept of balancing
7.2 Introduction to balancing of rotating masses (simple numericals)

8. Vibrations (08 Periods)

8.1 Types-longitudinal, transverse and torsional vibrations (simple numericals)
8.2 Dampening of vibrations
8.3 Causes of vibrations in machines, their harmful effects and remedies

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

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

Website for Reference:

http://swayam.gov.in .

SUGGESTED DISTRIBUTION OF MARKS

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

5.3 MACHINE DESIGN

L	T	P
5	**2**	**-**

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (08 Periods)

1.1 Design – Definition, Type of design, necessity of design
- 1.1.1 Comparison of designed and undesigned work
- 1.1.2 Design procedure
- 1.1.3 Characteristics of a good designer

1.2 Design terminology: , factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.
- 1.2.1 General design consideration
- 1.2.2 Codes and Standards (BIS standards)
- 1.2.3 Selection of materials, criteria of material selection

1.3 Ergonomics and Aesthetic Consideration in design
- 1.3.1 Ergonomics of design-man-machine relationship. Design of equipment for control, environment and safety.
- 1.3.2 Aesthetic consideration regarding shape, size, color and surface finish.

2. Design Failure (08 Periods)

2.1 Theories of failure.
2.2 Classification of loads

2.3 Design under tensile, compressive and torsional loads.

3. Design of Shaft (12 Periods)

3.1 Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available

3.2 Shaft subjected to torsion only, determination of shaft diameter (hollow and solid shaft) on the basis of :

- Strength criterion
- Rigidity criterion

3.3 Determination of shaft diameter (hollow and solid shaft) subjected to bending

3.4 Determination of shaft diameter (hollow and solid shaft) subjected to combined torsion and bending .

4. Design of Key (08 Periods)

4.1 Types of key, materials of key, functions of key

4.2 Failure of key (by Shearing and Crushing).

4.3 Design of key (Determination of key dimension)

4.4 Effect of keyway on shaft strength. (Figures and problems).

5. Design of Joints (02 Periods)

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

5.1 Temporary Joint:

5.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems).

5.1.2 Cotter Joint – Different parts of the spigot and socket joints, Design of spigot and socket joint.

5.2 Permanent Joint:

5.2.1 Welded Joint - Welding symbols. Type of welded joint, strength of parallel and transverse fillet welds.

5.2.2 Strength of combined parallel and transverse weld.

5.2.3 Riveted Joints. : Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering.

5.2.4 Different modes of rivet joint failure.

5.2.5Design of riveted joint – Lap and butt, single and multi riveted joint.

6. Design of Flange Coupling (10 Periods)

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

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

Note : a) Use of design data book during the examination is allowed.

b) The paper setter should normally provide all the relevant data for the machine Design in the question paper.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

– Design and drawing

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

5.4 PRODUCTION TECHNOLOGY

L	T	P
6	-	8

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (06 Periods)

1.1. Cutting Tools - Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect, Heat produced during cutting and its effect, Cutting speed, feed and depth of cut and their effect

1.2 Cutting Tool Materials - Properties of cutting tool material, Study of various cutting tool materials viz. High-speed steel, tungsten carbide, cobalt steel cemented carbides, stellite, ceramics and diamond.

2. Lathe (12 Periods)

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

3. Milling (10 Periods)

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

3.8 Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.
3.9 Cutting speed and feed, simple numerical problems.

4. Drilling (06 Periods)

4.1 Principle of drilling.
4.2 Classification of drilling machines and their description.
4.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
4.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
4.5 Types of drills and their features, nomenclature of a drill
4.6 Drill holding devices.
4.7 Types of reamers.

5. Boring (06 Periods)

5.1 Principle of boring
5.2 Classification of boring machines and their brief description.
5.3 Specification of boring machines.
5.4 Boring tools, boring bars and boring heads.
5.5 Description of jig boring machine.

6. Shaping and Planing (08 Periods)

6.1 Working principle of shaper and planer
6.2 Type of shapers
6.3 Type of planers
6.4 Quick return mechanism applied to shaper and planer machine.
6.5 Work holding devices used on shaper and planer
6.6 Types of tools used and their geometry.
6.7 Specification of shaper and planer .
6.8 Speeds and feeds in above processes.

7. Broaching (04 Periods)

7.1 Introduction
7.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.
7.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.

8. Jigs and Fixtures (10 Periods)

8.1 Importance and use of jigs and fixture
8.2 Principle of location
8.3 Locating devices
8.4 Clamping devices
8.5 Types of Jigs – Drilling jigs, bushes, template jig, plate jig, channel jig, leaf jig.
8.6 Fixture for milling, turning, welding, grinding
8.7 Advantages of jigs and fixtures

9. Cutting Fluids and Lubricants (06 Periods)

9.1 Function of cutting fluid
9.2 Types of cutting fluids
9.3 Difference between cutting fluid and lubricant
9.4 Selection of cutting fluids for different materials and operations
9.5 Common methods of lubrication of machine tools.

10. Grinding (08 Periods)

10.1 Purpose of grinding
10.2 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
10.3 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
10.4 Truing, dressing, balancing and mounting of wheel.
10.5 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
10.6 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
10.7 Selection of grinding wheel

11. Modern Machining Processes (08 Periods)

11.1 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
11.2 Electro Chemical Processes - Electro chemical machining (ECM) – Fundamental principle, process, applications
11.3 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid, applications
11.4 Laser beam machining (LBM) – Introduction, machining process and applications
11.5 Plasma arc machining (PAM) and welding – Introduction, principle process and applications

PRACTICAL EXERCISES

TURNING SHOP

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

ADVANCE FITTING SHOP

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

MACHINE SHOP

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

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

ADVANCE TURNING SHOP

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

MACHINE SHOP

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

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

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

5.5 PRODUCTION MANAGEMENT

L	T	P
4	-	2

RATIONALE

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

Learning Outcomes

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

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

DETAILED CONTENTS.

1. Production Planning and Control (PPC) (12 Periods)

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

2. Inspection and Quality Control (14 Periods)

2.1. Inspection – Introduction, Need and Importance
- 2.1.1. Types of Inspection
- 2.1.2. Role of operator and inspector in inspection

2.2 Quality Control
- 2.2.1 Introduction, Need and Importance
- 2.2.2 Factors affecting product quality

2.3 Quality Assurance

2.4 Statistical Quality Control (SQC)
- 2.4.1 Acceptance Sampling, Sampling Plan- Single and double sampling plan
- 2.4.2 Operating Characteristics Curve
- 2.4.3 Control Charts – Introduction, advantages, Types of control charts(X, R, p and c charts)
- 2.4.4 Concept of ISO 9000, ISO 14000 and TQM.
- 2.4.5 QC tools
- 2.4.6 6σ Approach

3. Cost Estimation (14 Periods)

3.1 Definition and functions of cost estimation
3.2 Estimation procedure
3.3 Elements of cost, ladder of costs (simple numericals)
3.4 Overhead expenses and its distribution
3.5 Depreciation- Concept and Definition, Methods of calculating depreciation- Straight line method, Diminishing Balance Method, Sinking fund method (Numerical problems).
3.6 Cost control- definition and objectives, Capital cost control (planning and scheduling), operating cost control.
3.7 Cost estimation for machining processes like turning, drilling, and milling.Cost estimation of forming processes like forging, pattern making, and casting.

4. Repair and Maintenance (08 Periods)

4.1 Objectives and importance of Maintenance
4.2 Different types of maintenance- Corrective or Breakdown maintenance, Scheduled Maintenance, Preventive Maintenance, Predictive Maintenance
4.3 Nature of maintenance problems
4.4 Range of maintenance problems

5. Labour Legislation and Pollution Control Acts (08 Periods)

5.1 Factory Act 1948.
5.2 Workmen's compensation Act 1923.

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted	Marks Allotted

	(Hrs)	(%)
1	12	22
2	14	25
3	14	25
4	08	14
5	08	14
Total	**56**	**100**

5.6 AUTOMOBILE ENGINEERING

L	T	P
4	-	4

RATIONALE

These days, automobile has become a necessity instead of luxury. The diploma holders inthis course are required to supervise production and repair and maintenance of vehicles. For this purpose, knowledge and skills are required to be imparted to them regarding automobile industry as a whole. This subject aims at developing required knowledge and skills in this area.

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (06 Periods)

   1.1 Automobile and its development
   1.2 Various types of automobiles manufactured in India, their manufacturer and location of their manufacturing unit.
   1.3 Classification of automobiles
   1.4 Layout of chassis
   1.5 Types of drives-front wheel, rear wheel, four wheel.
   1.6 Introduction to electric and hybrid vehicles.
   1.7 Governing of fuel- carburettor, electronic control module (ECM i.e, 8 bit,16 bit and 32 bit computers)
   1.8 Concept of double overhead cam, single overhead cam, Twin cam 16 valvetechnology in 4 cylinder engine.

2. Transmission System (12 Periods)

   2.1 Clutch - Function, Constructional details of single plate and multi plate friction clutches, Centrifugal and semi centrifugal clutch, Cone clutch, Hydraulic clutch
   2.2 Gear Box - Function, Working of sliding mesh, constant mesh and synchromesh gear box, Torque converter and overdrive, Introduction to Automated Manual Transmission, Automatic transmission and Continuously Variable Transmission.

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

2.4 Wheels and Tyres - Types of wheels, Types and specifications of tyres used in Indian vehicles, Toe in, toe out, camber, caster, kingpin inclination, Wheel balancing and alignment, Factors affecting tyre life.

3. Steering System (06 Periods)

Function and principle, Ackerman and Davis steering gears, Types of steering gears - worm and wheel, rack and pinion, Power steering-Hydraulic and Electrical.

4. Braking system (08 Periods)

Constructional details and working of mechanical, hydraulic, air and vacuum brake, Relative merits and demerits. Details of master cylinder, wheel cylinder, Concept of brake drum, brake lining/pad and Brake adjustment, Introduction to Anti-lock Brake System and its working.

5. Suspension System (08 Periods)

Function and types of Coil spring, leaf spring, Air suspension, Shock absorber –Function, construction and working of Telescopic type.

6. Battery (10 Periods)

Constructional details of lead acid cell battery, Specific gravity of electrolyte -effect of temperature on specific gravity, Specification of battery-capacity, rating , number of plates, selection of battery for particular use, Battery charging,chemical reactions during charge and discharge, Maintenance of batteries, Checking of batteries for voltage and specific gravity. Batteries for electric and hybrid vehicles.

7. Exhaust Emissions (06 Periods)

Types and use of catalytic converters, selective catalytic reduction methods for emission control, emission norm standards i.e. Bharat norms.

LIST OF PRACTICALS

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

a) adjustment of brakes

b) bleeding of brakes

c) fitting of leather pads

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

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

Website for Reference

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

6.1 INDUSTRIAL ENGINEERING

L	T	P
6	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

Different Layout and structures of stores, Inventory control, calculation of EOQ, Bin cards and various forms required in stores for documentation. Purchase procedures.

8. Industrial Safety (10 Periods)

8.1 Accident- causes, types, results and control.
8.2 Mechanical and electrical hazards- types, causes and preventive steps/procedure.
8.3 Describe salient points of Factories Act 1948 for health and safety- wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels etc.
8.4 Safety colour codes.
8.5 Fire prevention and fire fighting, equipment and methods.

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

6.2 METROLOGY AND MEASURING INSTRUMENTS

L	T	P
5	-	4

RATIONALE

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

LEARNING OUTCOME

After undergoing the subject, students will be able to :

- use verniercalliper, 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 indictor, angle deckor, poppy dial for angular measurements.
- measure spur gear characteristics using gear tooth vernier, outside diameter over dovel pins.
- use tool makers microscope
- measure surface roughness parameters.
- use profile projector, auto collimeter, angle deckor.
- select and measure variables using electrical and electronics comparators and measuring instrument, sensors, transducers.
- select and use non destructive testing methods.
- explain the use of coordinate measuring machine.
- use the concept of limits, fits and tolerance in assembly of components

DETAILED CONTENTS

1. Introduction (08 Periods)

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

2. Linear and Angular Measurement (20 Periods)

2.1 Construction features and use of instruments for non precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block.

2.2 Construction features and use of instruments for precision measurements :verniercalipers, vernier height and depth gauges, micrometers.

2.3 Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges.

2.4 Cylinder bore gauges, feeler and wire gauges. Checking flatness, roundness and squareness

2.5 Comparators – Characteristics, uses, working principles of different types of comparators: mechanical, electrical, electronics and pneumatic .

2.6. Construction and use of instruments for angular measurements: bevel protector, sine bar, angle gauges, clinometer, angle dekker. Optical instruments for angular measurement, auto collimator.

3. Measurement of Surface Finish (12 Periods)

3.1 Terminology of surface roughness.

3.2 Concept of primary texture and secondary texture.

3.3 Factors affecting surface finish.

3.4 CLA, RMS and RA value.

3.5 Principle and operation of stylus probe instruments. Tomlinson surface meter and Taylor surface talysurf.

4. Limits, Fits and Tolerance (05 Period)

5. Measurements of Screw threads and Gauges (10 Periods)

5.1 Measurement of screw threads- Introduction, measurements of external and core diameters, checking of pitch and angle of threads with gauges.

5.2 Measurements of gears (spur) – Measurement of tooth thickness, pitch, Gear Ball tester, Lead and Profile Testers.

5.3 Profile projector, Coordinate Measuring Machine (CMM), Tool maker's microscope.

6. Instrumentation (15 Periods)

6.1 Various types of instruments used for mechanical quantities such as displacement, velocity, acceleration, speed and torque. Use of transducers and electronic counters, stroboscope, vibrating reeds and tachometers.

6.2 Strain gauge – use of strain gauge and load cells

6.3 Various types of temperature measuring instruments such as thermometers, Thermistor, Bimetallic strip, Pyrometers

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

Website for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

6.3 CNC MACHINES AND AUTOMATION

L	T	P
4	-	4

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (06 Periods)

   Introduction to NC, CNC & DNC, their advantages, disadvantages and applications, Machine Control Unit, input devices, serial communication and Ethernet techniques, selection of components to be machined on CNC machines, Problems with conventional NC, New developments in NC, Axis identification, PLC Control and its components.

2. Constructional details and Tooling (08 Periods)

   Design features, specification Chart of CNC machines, use of slideways, balls, rollers and coatings, motor and leadscrew, swarf removal, safety and guarding devices, various cutting tools for CNC machines, overview of tool holder, different pallet systems and automatic tool changer system, management of a tool room.

3. Part Programming (12 Periods)

   Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using canned

cycles, subroutines and do loops, tool off sets, cutter radius compensation and wear compensation.

4. System Devices (08 Periods)

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

5. Problems in CNC Machines (06 Periods)

Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines.

6. Automation and NC system (06 Periods)

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

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

7.1 Introduction to operations involved in turning machines- Facing OD and ID Rough cut, Finish cut, Taper turning, Drilling, Threading, Grooving and cut-off (parting).
7.2 Introduction to operations involved in Milling-contouring, pocketing, Drilling, Facing, Circular tools paths.
7.3 Different terms like clearance, Retract, Feed plane, Depth of cut, lead in, lead out, overlap.
7.4 Simple programmes in Milling and Turning involving different operations.

LIST OF PRACTICALS

1 Study the constructional details of CNC lathe.
2. Study the constructional details of CNC milling machine.

3. Study the constructional details and working of:
Automatic tool changer and tool setter
- Multiple pallets
- Swarf removal
- Safety devices

4. Develop a part programme for following lathe operations and make the job on CNC lathe and CNC turning center.
- Plain turning and facing operations

- Taper turning operations
- Operation along contour using circular interpolation.

5. Develop a part programme for the following milling operations and make the job on CNC milling
   - Plain milling
   - Slot milling
   - Contouring
   - Pocket milling
6. Preparation of work instruction for machine operator
7. Preparation of preventive maintenance schedule for CNC machine.
8. Demonstration through industrial visit for awareness of actual working of FMS in production.
9. Use of software for turning operations on CNC turning center.
10. Use of software for milling operations on machine centres.

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.
2. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
3. CNC Machine by Bharaj; Satya Publications, New Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE,NITTTR, Chandigarh.

Website for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

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

6.4.1REPAIR AND MAINTENANCE

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (06 Periods)

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

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

   Location, layout of machines in Plant Layout, Principles of Plant layout, types of plant layout and positioning of machines, grouping of machines.
   Foundation – types of foundation, various considerations for machine foundations, foundation plan, types of foundation bolts, erection and leveling, grouting
   Vibration, damping, vibration isolation – methods of isolation, anti vibration mounts.

3. Testing of Machines (10 Periods)

Testing equipment – dial gauge, mandrel, spirit level, straight edge, auto collimator.
Recalibration of measuring instruments like vernier calliper.
Testing methods – geometrical/alignment test, performance test, testing under load, run test, vibrations, noise

4. Maintenance (10 Periods)

Definition, advantages, limitations, functions and types of maintenance organisation. Types of maintenance viz. emergency, preventive, breakdown/corrective, predictive
Introduction to computerized maintenance record like facility register, maintenance request.
ISO standards for maintenance documentation
Introduction to machine history card – purpose and advantages
Preparation of scheduled yearly plan for preventive maintenance, difference of work content of servicing, repairs and overhauling. MTBF and MTTR. Maintainability
Spare parts- Need of frequently needed spare parts inventory, Make provision of spares for parts not available in market

5 Repairing (08 Periods)

Common parts which are prone to failure, reasons of failure
Repair schedule Parts that commonly need repair such as belts, couplings, nuts, and bolts repairing the engines, compressors and boilers.

6 Lubrication Systems (09 Periods)

Lubrication methods and periodical lubrication chart for various machines (daily, weekly, monthly)
Handling and storage of lubricants
Lubricants conditioning and disposal
Lubricant and their grades needed for specific components such as gears, bearings, and chains
Purpose and procedure of changing oil periodically (like gear box oil)

7 Material Handling Systems (09 Periods)

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

8 Maintenance Manuals and Reports (08 Periods)

Types of manuals need for maintenance contents of manuals, manual writing and reporting, action- taken report (ATR)
Fitter common tools: Appliances and devices, handling facilities and measuring instruments.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

6.4.2 TOOL ENGINEERING

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Cutting Tools (24 Periods)

   Mechanical property and uses of high-speed steel, stellite, cemented carbide, ceramics diamond, study of commercially available cutting tools. Tool geometry of single point cutting tools, multipoint cutting tools, reamer, drill, milling cutter, throw-away inserts, chip breaker, tool and cutter maintenance, regrinding and lapping of tools.

2. Location and Clamping (16 Periods)

   Principles of location, 3-2-1 principle, Location with previous machined hole, different locating devices, V-location, conical locations. Purpose of Clamping elements, types of clamps.

3. Jigs and Fixtures (30 Periods)

   Need for jigs and fixtures, fundamental principles of jigs and fixtures design.
   Types of bushes, advantages of bushings.
   Types of drilling jigs- template jig, channel jig, latch jig, quick acting jig, indexing jig, box jig.
   Types of fixtures-simple fixture, milling fixture, welding fixture, turning fixture, assembly fixture & inspection fixture.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:
http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

6.5 PROJECT WORK

L	T	P
-	-	12

RATIONALE

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

LEARNING OUTCOMES

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

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

General Guidelines

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

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

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

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

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

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

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

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

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

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

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

Important Notes

1. **This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**

2. **The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**

3. **The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**

4. **It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

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

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