Curriculum for

Diploma Programme in

MECHANICAL ENGINEERING

Campus:
Puran Murti Campus
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SIXTH SEMESTER

SIXTH SEMESTER (MECHANICAL ENGINEERING)

Sr. No.	SUBJECTS	STUDY SCHEME Hours/Week		Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
6.1	Automobile Engineering	3	2	4	25	25	50	100	3	50	-	150	200
6.2	*Inspection and Quality Control	3	2	4	25	25	50	100	3	50	3	150	200
6.3	*Estimation and Costing	4	-	4	25	-	25	100	3	-	-	100	125
6.4	*Entrepreneurship Development and Management	3	-	3	25	-	25	100	3	-	-	100	125
6.5	+Elective	4	-	4	25	-	25	100	3	-	-	100	125
6.6	Project Work	-	12	6	-	100	100	-	-	100	3	100	200
*Soft Skills - IV		-	2	-	-	25	25	-	-	-	-	-	25
Total		17	18	25	125	175	300	500	-	200	-	700	1000

+Elective: To choose any one from the following:

*Plant Maintenance & Material Handing

*Mechatronics

*CAD/CAM

* **Common with other Diploma programmes**

6.1 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.
- maintain transmission system.
- carry out balancing of wheels to maintain steering geometry.
- carry out routine servicing of brake system and bleeding of hydraulic brakes
- carry out testing and charging of Lead-acid battery.
- interpret Bharat norms of exhaust emissions.

DETAILED CONTENTS

1. Introduction (04 Hours)

1.1 Automobile and its development
1.2 Various types of automobiles manufactured, 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 single overhead cam, double overhead cam, Twin cam 16 valve technology in 4 cylinder engine.

2. Transmission System (12 Hours)

2.1 Clutch - Functions, Constructional details of single plate and multi plate friction clutches, Centrifugal and semi centrifugal clutch, Cone clutch, Hydraulic clutch

2.2 Gear Box - Functions, 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 - Functions, 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 (04 Hours)

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 Hours)

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 (06 Hours)

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

6. Battery (8 Hours)

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. Dynamo and Alternator (8 Hours)

7.1 Dynamo - Function and details, Regulators - voltage current and compensated type, Cutout - construction, working and their adjustment,7.2 Alternator - Construction and working, Charging of battery by alternator. Introduction to Integrated starter-alternator, wiring Diagram of an Automobile.

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-term and end-term written tests,model/prototype making
- Actual laboratory and practical work, model/prototype making, and viva-voce

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
5 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hours)	Marks Allotted (%)
1	04	10
2	12	26
3	04	10
4	06	12
5	06	12
6	08	16
7	08	14

Total	**48**	**100**

6.2 INSPECTION AND QUALITY CONTROL

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RATIONALE

Diploma holders in this course required to measure and inspect for ensuring quality of product. For this purpose, knowledge and skills about standards of measurement, limits, fits and tolerances, types of inspection and various measuring instruments, SQC & quality standards are necessary. Hence this subject.

LEARNING OUTCOMES

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

- Apply different inspection techniques to improve quality of products and processes.
- Select and use suitable measurement tools//gauges to measure product dimensions.
- Measure geometrical parameters such as Straightness, Flatness and Parallelism.
- Use different quality charts to control products quality.
- Interpret different quality control charts
- Explain the use of different business tools (TQM//ISO-Standards) and QC tools in manufacturing environment.
- Measure displacement, vibration, pressure and temperature.

DETAILED CONTENTS

1. Inspection (04 Hours)

- Introduction, units of measurement, standards for measurement and interchangeability.
- International, national and company standard, line and wavelength standards.
- Planning of inspection: what to inspect? When to inspect? Who should inspect? Where to inspect?
- Types of inspection: remedial, preventive and operative inspection, incoming, in-process and final inspection.
- Factors influencing the quality of manufacture.

2. Measurement and Gauging (18 Hours)

- Basic principles used in measurement and gauging, mechanical, optical, electrical and electronic.

- Study of various measuring instruments like: calipers, micrometers, dial indicators, surface plate, straight edge, try square, protectors, sine bar, clinometer, comparators – mechanical, electrical and pneumatic. Slip gauges, tool room microscope, profile projector. Limit gauges: plug, ring, snap, taper, thread, height, depth, form, feeler, wireand their applications for linear, angular, surface, thread and gear measurements, gauge tolerances.

- Geometrical parameters and errors:
Errors & their effect on quality, concept of errors, measurement of geometrical parameter such as straightness, flatness and parallelism.

- Study of procedure for alignment tests on lathes, drilling and milling machines.

- Testing and maintenance of measuring instruments.

3. Statistical Quality Control (14 Hours)

- Basic statistical concepts, empirical distribution and histograms, frequency, mean, mode, standard deviation, normal distribution, binomial and Poisson, Simple- examples.

- Introduction to control charts, namely, X and R, X and , P, , C charts and their applications.

- Sampling plans, selection of sample size, method of taking samples, frequency of samples.

- Inspection plan format and test reports

4. Modern Quality Concepts (06 Hours)

- Concept of total quality management (TQM)
- National and International Codes.
- ISO-9000, concept and its evolution
- QC tools
- Introduction to Kaizen, 5S

5. Instrumentation (06 Hours)

Measurement of mechanical quantities such as displacement, vibration, frequency, pressure temperature by electro mechanical transducers of resistance, capacitance & inductance type.

LIST OF PRACTICALS

1 Use of dial indicator for measuring taper.
2 Use of combination set, bevel protector and sine bar for measuring taper.
3 Measurement of thread characteristic using vernier and gauges.
4 Use of slip gauge in measurement of center distance between two pins.
5 Use of tool maker's microscope and comparator.
6 Plot frequency distribution for 50 turned components.
7 With the help of given data, plot X and R, P and C charts..

.MEANS OF ASSESSMENT

 Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
 Actual laboratory and practical work, model/prototype making, and viva-voce

RECOMMENDED BOOKS

1. Statistical Quality Control by M.Mahajan: Dhanpat Rai and Sons, Delhi
2. Inspection and Quality Control by J.S. Narang & A. Gupta, Dhanpat Rai & Sons,Delhi.
3. Engineering Metrology by RK Jain
4. Engineering Metrology by RK Rajput; SK Kataria and Sons
5. Production Planning Control and Management by KC Jain & Aggarwal; Khanna Publishers, New Delhi.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hours)	Marks Allotted (%)
1	04	10
2	18	36
3	14	28
4	06	14
5	06	12
Total	48	100

6.3. ESTIMATING AND COSTING

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RATIONALE

Diploma holders are also engaged in purchasing in Raw materials of production process.
For this purpose, they must know the basics of Estimating and Costing. This is must for getting him involved in tendering and putting specifications for estimate.

LEARNING OUTCOMES

On completion of this course, the students will be able to
- Know about the elements of costing.

- Understand the fundamentals of cost accounting.

- Understand the fundamentals of estimation.

- Estimate the material cost.

- Estimate machining time.

- Estimate foundry cost, forging cost and welding cost.

DETAILED CONTENTS

1. Introduction (06 Hours)

Definition of estimation, Importance, aims and functions of estimating; cost accounting, purposes of cost accounting, Comparison of estimating and costing, estimating procedure, cost estimators and their qualifications, types of estimates, constituents of job estimates, cost of production, selling price, capital investment, rate of return(ROR) on investment

2. Elements of Costing (08 Hours)

Definitions, objectives, elements of costs, components of costs, overhead expenses:: factory expenses, depreciation-causes; methods of calculation of epreciation, obsolescence, interest on capital, idleness costs, repairs and maintenance cost, selling and distribution overheads and methods of allocation of overhead charges, procedure for costing

3. Cost Accounting 08 Hours)

Objectives of cost accounting, difference between financial accounting and cost accounting, advantages of cost accounting, methods of costing; unit costing, batch costing, departmental costing, process costing, multiple and composite costing

4. Fundamentals of Estimating (08 Hours)

Objectives of cost estimating, functions of cost estimating, organization of estimating department, principal factors in estimating, miscellaneous allowances, estimating procedures, qualities of estimator.

5. Estimation of Material Cost 10 Hours)

Estimation of volumes, weights and cost of material for items like pulley, spindle, lathe centre, fly wheel, crank shaft and similar items. Simple numericals on the above, budgets and types of budgets.

6. Estimation of Machine Shop (14 Hours)

Set up time, operation time, handling time, machining time, tear down time, allowances; personal, fatigue, tool checking/sharpening/changing, unit operation time, cycle time and total time, full depth of cut, cutting speeds for variousoperations for different tool materials and product materials, estimation of time for various machining operations - turning, drilling, boring, tapping, shaping, planning, milling and grinding.

7. Estimation of Other Shops (10 Hours)

Estimation of cost of different products produced in welding- gas and electric welding, forging and foundry shops.

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.
4. Motivate students to bring calculators in class from very first day.

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. Mechanical Estimating and Costing by T.T.T.I, Madras: Tata McGraw Hill, New Delhi.
2. Mechanical Estimating and Costing by Sinha BP; Tata McGraw Hill, New Delhi.
3. Production Engineering, Estimating and Costing by M Adithan and BS Pabla; Konark Publishers, New Delhi.
4 Production and Costing by GBS Narang and V. Kumar, Khanna Publishers, New Delhi.
5 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted in Hours	Marks allotted (%)
1.	Introduction	06	10
2.	Elements of Costing	08	12
3.	Cost Accounting	08	12
4.	Fundamentals of Estimating	08	12
5.	Estimation of Material Cost	10	16
6.	Estimation of Machine Shop	14	20
7.	Estimation of other Shops	10	18
Total		64	100

6.4 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS
SECTION – A ENTREPRENEURSHIP

1. Introduction (10 Hours)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms and other forms of business organisations
- 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 (08 Hours)

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

3. Project report Preparation (06 Hours)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report
- Sample project report

SECTION –B MANAGEMENT

4. Introduction to Management (04 Hours)

- Definitions and importance of management
- Functions of management: Importance and process of planning, organising, staffing, directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations and their advantages
- Line organisation, staff organisation
- Line and staff organisation
- Functional Organisation

5. Leadership and Motivation (03 Hours)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership
- Case studies of great leaders

b) Motivation

- Definition and characteristics
- Importance of self motivation
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas (06 Hours)

a) Human Resource Management

- Introduction and objective
- Introduction to Man power planning, recruitment and selection

 Introduction to performance appraisal methods

b) Material and Store Management
 Introduction functions, and objectives
 ABC Analysis and EOQ

c) Marketing and sales
 Introduction, importance, and its functions
 Physical distribution
 Introduction to promotion mix
 Sales promotion

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

7. Work Culture **(04 Hours)**

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

8. Basic of Accounting and Finance **(04 Hours)**

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

b) Objectives of Financial Management
- Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics **(03 Hours)**

a) Total Quality Management (TQM)
 Statistical process control
 Total employees Involvement
 Just in time (JIT)

b) 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/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hours)	Marks Allotted (%)
1	10	20
2	08	16
3	06	14
4	04	10
5	03	06
6	06	14
7	04	08
8	04	08
9	03	06
Total	48	100

6.5.1 PLANT MAINTENANCE AND MATERIAL HANDLING

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RATIONALE

A diploma holder is involved in supervision and maintenance jobs. He must know the various processes carried out during maintenance and material handling and documentation of the same.

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

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
Fits and tolerances – common fits and tolerances used for various machine parts

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

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

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

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

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

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

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,

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/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted in Hours	Marks allotted (%)
1.	Introduction	08	12
2.	Erection and Commissioning of Machines (Installation)	10	14
3.	Testing of Machines	10	14
4.	Maintenance	16	25
5.	Repairing	10	18
6.	Lubrication Systems	06	09
7.	Material Handling	04	08
	Total	64	100

6.5.2 MECHATRONICS

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RATIONALE

Diploma holders in Mechanical Engineering are required to operate and maintain automatic machines and computerized mechanical systems. Therefore it is essential that they have skills of mechatronics i.e. various elements of electro-mechanical systems. This subject aims t development of working, operation and application of sensors, data flow, pneumatic and hydraulic servo motor, micro process and PLCs etc. which are widely used now a days in all industries.

LEARNING OUTCOMES

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

- Explain the concept of mechatronics.
- Explain the working of various sensors and transducers.
- Use data presentation system.
- Maintain pneumatic and hydraulic systems.
- Operate and Maintain electrical actuation systems.
- Explain the concepts of digital logic.
- Explain the working of microprocessors.
- Explain the working of input/output systems.
- Carry out interfacing of various devices.
- Programme a PLC.

DETAILED CONTENTS

1. Introduction **(04 Hours)**

1.1 Introduction to Mechatronics
1.2 Mechatronic system
1.3 Measurement systems
1.4 Control system-open Loop, Close loop and sequential
1.5 Microprocessor based controllers
1.6 The Mechatronics approach

2. Sensors and Transducers **(08 Hours)**

2.1 Sensors and transducers
2.2 Performance terminology
2.3 Displacement, position and motion sensors
2.4 Electromechanical sensors and transducers
2.5 Force sensors
2.6 Liquid flow sensors
2.7 Liquid level sensors
2.8 Temperature sensors
2.9 Light sensors
2.10 Selection of sensors

3. Data Presentation Systems **(05 Hours)**

3.1 Displays
3.2 Data presentation elements
3.3 Magnetic recording
3.4 Data acquisition systems
3.5 Measurement systems
3.6 Testing and calibration

4. Pneumatic and Hydraulic Systems **(08 Hours)**

4.1 Actuation systems
4.2 Pneumatic and hydraulic systems
4.3 Directional control valves
4.4 Pressure control valves
4.5 Cylinders
4.6 Process control valves
4.7 Rotary actuators

5. Electrical Actuation System **(08 Hours)**

5.1 Electrical systems
5.2 Mechanical switches
5.3 Solid-state switches
5.4 Solenoids
5.5 D.C. motors
5.6 A.C. motors
5.7 Stepper motors

6. Digital Logic (05 Hours**)**

6.1 Digital logic
6.2 Number systems
6.3 Logic gates
6.4 Boolean algebra
6.5 Karnaugh maps
6.6 Applications of logic gates

6.7 Sequential logic
6.8 Simple Problems

7. Microprocessors **(10 Hours)**

7.1 Control
7.2 Microcomputer structure
7.3 Microcontrollers
7.4 Applications
7.5 Simple Programming problems

8. Input/output Systems **(06 Hours)**

8.1 Interfacing
8.2 Input/output ports
8.3 Interface requirements
8.4 Peripheral interface adapters
8.5 Serial communications interface
8.6 Examples of interfacing

9. Programmable Logic Controllers **(10 Hours)**

9.1 Programmable logic controllers- Applications
9.2 Basic structure
9.3 Input/output processing
9.4 Programming-ladder diagrams
9.5 Mnemonics
9.6 Timers, internet relays and counter
9.7 Shift registers
9.8 Master and jump controls
9.9 Data handling
9.10 Analogue input/output
9.11 Selection of a PLC
9.12 Simple programmes

LIST OF PRACTICALS

1. Make and Simulate Hydraulic and Pneumatic circuits(at least two each).
2. Make and simulate some simple PLC programs (at least three).
3. Designing a mechatronic system exploring possible design solutions.
4. Case studies of mechatronic system.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching learning.
2. Use some suitable software for practical work.
3. Students should be taken to various industrial units for clear conception of various topics.
4. 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. Mechatronics by HMT, Tata McGraw Hill, New Delhi.
2. Mechatronics: Electronic Control System in Mechanical Engineering by W. Bolton;Pearson Education, Singapore.
3. Fundamentals of Electrical Engineering and Electronics by BL Thareja; S. Chand and Company,New Delhi.
4. Basic Electronics by Gupta, NN Bhargava, Ku1shreshtha, TTTI, Chandigarh.
5. Programmable Logic Controllers by W. Bolton; Newnes Publishers, U.K.
6. Industrial Control and Instrumentation by W. Bolton; Orient Longman Limited, Hydrabad.
7 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

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

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Periods)	Marks Allotted(%)
1.	Introduction	04	06
2.	Sensors and Transducers	08	15
3.	Data Presentation Systems	05	08
4.	Pneumatic and Hydraulic Systems	08	12
5.	Electrical Actuation Systems	08	14
6.	Digital Logic	05	06
7.	Microprocessors	10	15
8.	Input/Output Systems	06	08
9.	Programmable Logic Controllers	10	16
	Total	64	100

6.5.3 CAD/ CAM

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RATIONALE

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

LEARNING OUTCOMES

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

- Know about CAD/CAM.
- Use Auto CAD for surface/solid modelling.
- Know the method of viewing objects in 3D space.
- Know about CNC operations for turning and milling.
- Know about different types of tools and tooling requirements.
- Understand about tool path generation and verification.
- Know about flexible manufacturing system.
- Know about robotics.

DETAILED CONTENTS

1. Introduction (06 Hours)

1.1 Introduction to CAD/CAM
1.2 Advantages of CAD
1.3 Product Cycle and CAD/CAM
1.4 Automation and CAD/CAM
1.5 Reasons for implementation of CAD/CAM
1.6 Steps involved in CAM operation

2. Surface / Solid Modelling Using AUTOCAD (08 Hours)

2.1 Introduction to parametric and non-parametric surfaces
2.2 Creation of simple surfaces using revolved surface, ruled surface and 3D surfaces commands
2.1 Designing Software used in creation of solid models
2.2 Concept of solid models
2.3 Solid Primitives- Box, cylinder, Cone, Sphere, Wedge and torus
2.4 Construction of solid using Region, Extrude and Revolved feature
2.5 Creation of Composite solid using Boolean function e.g. Union, Subtraction and Intersection.
2.6 Sectioning of Solids and modification of solid Edges and faces using solid editing commands. Shell, Separate commands.
2.7 Performing 3D operations like 3D array, mirror and rotate
2.8 Creation of fillets and chamfers
2.9 Dimensioning of solids

3. Viewing Objects in 3D Space (06 Hours)

3.1 Viewing the objects in different views.
3.2 Concept of SW, SE, NE and Isometric Views.
3.3 View Ports
3.4 Layout, changing from Model to Paper space Layout
3.5 Arranging the Drawing showing different views to get the hard copy
3.6 Plotting the drawing

4. CNC Operations Involved in Turning and Milling (18 Hours)

4.1 Introduction to operations involved in Turning machines - Facing, OD and
ID Rough cut, Finish Cut, Taper turning, Drilling, Threading, Grooving and Cut-off (parting)
4.2 Introduction to operations involved in Milling - Contouring, Pocketing, Drilling, Facing, Circular tool paths.
4.3 Different terms like Clearance, Retract, Feed plane, Depth of cut, Lead in,
Lead out, Overlap
4.4 Simple programs in Milling and Turning involving different operations.

5. Different Types of Cutting Tools (08 Hours)

Type of tools, different standards, tool holders, tool storage devices in CNC

6. Tool Path Generation and Verification 08 Hours)

6.1 Setting up the jobs, defining the operation, chaining the geometry
6.2 Specifying the tools, machining parameters and type of machining
6.3 Back plotting and verification of operation
6.4 Post processing - Converting the generated tool path in NC codedepending on the system
6.5 Setting up the parameter relating to communication like transfer of programs to CNC machine
6.6 Transfer of drawing from any CAD software like AutoCAD to CAM and Vice Versa.

7. Flexible Manufacturing System (04 Hours)

7.1 Introduction, definition of FMS.
7.2 Principles of flexibility, changes in manufacturing system – external changes and internal changes job flexibility, machine flexibility.
7.3 Features of FMS – production equipment, support system, material handling system, computer control system.
7.4 Advantages & limitations of FMS.

8. Robotics (06 Hours)

8.1 **Introduction to robot**
8.2 Robot configuration
8.3 Robot motions
8.4 Robot programming languages
8.5 Work cell, control and interlock, robot sensors
8.6 Robot applications

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

 Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. CAD/CAM by Mikell Groover and Zimmers; Prentice Hall of India Pvt. Ltd., Delhi.
2. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
3. Introduction to Robotics by John J. Craig; Pearson Education Asia,Singapore.
4. Industrial Robot by Groover; Prentice Hall of India Pvt. Ltd., Delhi.
5. Robotics by Yorem Korem; McGraw Hill International. Book Co., New Delhi.
6. CAD/CAM – Theory and Practice by Zeid; Tata McGraw Hill Publishers, New Delhi.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

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

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Hours)	Marks Allotted (%)
1.	Introduction	06	10
2.	Surface/Solid Modelling Using AutoCAD	08	12
3.	Viewing Objects in 3D Space	06	10
4.	CNC Operations involved in Turning/Milling	18	30
5.	Different Types of Cutting Tools	08	12
6.	Tool Path Generation and Verification	08	12
7.	Flexible Manufacturing System	04	06
8.	Robotics	06	08
Total		64	100

6.6 PROJECT WORK

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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 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 first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems 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 some one 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

SOFT SKILLS – IV

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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

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

 Apply techniques of effective time management

 Develop habits to overcome stress

 Face problems with confidence

 Exhibit attributes required to appear for an interview

 Learn about current and future career opportunities

 Exhibit entrepreneurial skills

 Use QC/QT tools

DETAILED CONTENTS

 Communication Skills - Presentation

 Time management

 Stress Management

 Problem solving

 Career opportunities-Current and future

 Entrepreneurial Skills

 Quality and Quality tools used in industry

In addition, the students must participate in the following activities to be organized in the institute

 Sports

 NCC/NSS

 Cultural Event

Note: Extension Lectures by experts may be organized. There will be no examination For this subject.