Curriculum for

Diploma Programme in

MECHANICAL ENGINEERING (BATCH 2018)

For the State of Haryana

Prepared by:

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

Haryana State Board of Technical Education
Bays 7-12, Sector 4
Panchkula-134 112

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FIRST YEAR (Mechanical Engineering)

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK			CREDIT	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*	English	2	-	2	6	40	25	65	60	3	50	3	110	175
1.2*	Applied Mathematics	3	1	-	7	40	-	40	60	3	-	-	60	100
1.3*	Applied Physics	2	1	2	7	40	25	65	60	3	50	3	110	175
1.4*	Applied Chemistry	2	-	1	5	40	25	65	60	3	50	3	110	175
1.5*	Applied Mechanics	2	-	2	6	40	25	65	60	3	50	3	110	175
1.6*	Environmental Studies	2	-	1	5	40	25	65	60	3	50	3	110	175
1.7*	Engg. Graphics	-	-	3	3	40	25	65	60	3	25 (viva)	3	85	150
1.8*	Information Technology	-	-	2	2	-	50	50	-	-	50	3	50	100
1.9*	Internet of Things & Artificial Intelligence	-	-	2	2	-	50	50	-	-	100	3	100	150
1.10*	General Workshop Practice	-	-	3	3	-	50	50	-	-	50	3	50	100
#	Student Centered Activities(SCA)	-	-	2	2	-	25	25	-	-	-	-	-	25
Total		13	02	20	48	280	325	605	420	-	475	-	895	1500

*Common with other diploma programmes

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs, seminars, declamation contests, educational field visits, N.C.C., N.S.S., Cultural Activities and Disaster management etc.

THIRD 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	
3.1	*Strength of Materials	3	2	4	25	25	50	100	3	50	3	150	200
3.2	*Thermodynamics-I	3	2	4	25	25	50	100	3	50	3	150	200
3.3	*Basics of Electrical and Electronics Engineering	3	2	4	25	25	50	100	3	50	3	150	200
3.4	*Mechanical Engineering Drawing	-	6	3	-	50+	50	100	3	25 (Viva)	2	125	175
3.5	*Workshop Technology-I	3	-	3	25	-	25	100	3	-	-	100	125
3.6	*Workshop Practice –I	-	9	4	-	100	100	-	-	100	3	100	200
	*Soft Skills- I	-	2	-	-	25	25	-	-	-	-	-	25
Total		**12**	**23**	**22**	**100**	**250**	**350**	**500**	**-**	**275**	**-**	**775**	**1125**

* Common with other Diploma programmes

+ Includes 25 marks for viva-voce

FOURTH 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	
4.1	*Computer Aided Drafting	-	4	2	-	50	50	-	-	50	3	50	100
4.2	*Materials and Metallurgy	4	2	5	25	25	50	100	3	50	3	150	200
4.3	*Hydraulics and Pneumatics	3	2	4	25	25	50	100	3	50	3	150	200
4.4	*Thermodynamics-II	3	2	4	25	25	50	100	3	50	3	150	200
4.5	*Industrial Engineering	3	-	3	-	25	25	100	3	-	-	100	125
4.6	*Workshop Technology –II	4	-	4	-	25	25	100	3	-	-	100	125
4.7	*Workshop Practice-II	-	6	3	-	100	100	-	-	100	3	100	200
	*Soft Skills -II	-	2	-	-	25	25	-	-	-	-	-	25
Total		17	18	25	75	300	375	500	-	300	-	800	1175

* Common with other Diploma programmes

Industrial Training

After examination of 4th Semester, the students shall go for training in a relevant industry/field organization for a minimum period of 8 weeks and will prepare a diary. It shall be evaluated during 5th semester by his/her teachers for 100 marks. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated for another 100 marks. This evaluation will be done by HOD and lecturer in- charge – training in the presence of one representative from Industry/Sector Skill Council/Training and Placement Officer/Subject Expert from other institution.

FIFTH 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	
Industrial Training		-	-	5	-	100	100	-	-	100	-	100	200
5.1	*Theory of Machines	3	2	4	25	25	50	100	3	50	3	150	200
5.2	*Refrigeration and Air-conditioning	3	2	4	25	25	50	100	3	50	3	150	200
5.3	*Machine Design	4	-	4	25	-	25	100	3	-	3	100	125
5.4	*CNC Machines and Automation	3	4	5	25	25	50	100	3	50	3	150	200
5.5	*Workshop Technology-III	3	-	3	25	-	25	100	3	-	-	100	125
5.6	*Workshop Practice –III	-	9	4	-	100	100	-	-	100	3	100	200
*Soft Skills-III		-	2	-	-	25	25	-	-	-	-	-	25
Total		16	19	29	125	300	425	500	-	350	-	850	1275

* Common with other Diploma programmes

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:

6.5.1 *Plant Maintenance & Material Handing

6.5.2 *Mechatronics

6.5.3 *CAD/CAM

* **Common with other Diploma programmes**

Subjects common in Mechanical Engineering and Allied Group

Sem	Name of the Subject	Mechanical Engg.	Mechanical Engg. (Production)	Production Engg.	Mechanical Engg. (CAD/CAM)	Mechanical Engg. (Tool & Die)	Automobile Engg.	Aircraft and Maintenance Engg.
3rd	Strength of Materials	✓	✓	✓	✓	✓	✓	✓
	Thermodynamics	✓ *	✓	✓	✓	×	✓	✓
	BEEE	✓	✓	✓	✓	✓	✓	×
	Mechanical Engg. Drawing	✓	✓	✓	✓	✓	×	×
	Workshop Technology-I	✓	✓	✓	✓	✓	✓	×
	Workshop Practice-I	✓	✓	✓	✓	✓	×	×
4th	Computer Aided Drafting	✓	✓	✓	✓	✓	✓	✓
	Materials and Metallurgy	✓	✓	✓	✓	✓	✓	×
	Hydraulics and Pneumatics	✓	✓	✓	✓	✓	×	×
	Industrial Engg.	✓	✓	✓	✓	×	×	×
	Workshop Technology-II	✓	✓	✓	✓	✓	✓	×
	Workshop Practice-II	✓	✓	✓	✓	✓	×	×

Sem	Name of the Subject	Mechanical Engg.	Mechanical Engg. (Production)	Production Engg.	Mechanical Engg. (CAD/CAM)	Mechanical Engg. (Tool & Die)	Automobile Engg.	Aircraft and Maintenance Engg.
5th	Theory of Machines	✓	✓	✓	✓	×	×	×
	Refrigeration and Air Conditioning	✓	✓	×	×	×	×	×
	Machine Design	✓	✓	✓	×	×	×	×
	CNC Machines and Automation	✓	✓	✓	×	×	×	×
	Workshop Technology-III	✓	✓	✓	✓	✓	×	×
	Workshop Practice-III	✓	✓	✓	✓	✓	×	×
6th	Inspection and Quality Control	✓	✓	✓	✓	✓	×	×
	Estimation and Costing	✓	✓	✓	×	✓	×	×
	Plant Maintenance & Material Handling	✓	✓	✓	✓	✓	×	×
	Mechatronics	✓	✓	✓	✓	×	×	×
	CAD/CAM	✓	✓	×	×	✓	×	×

* Nomenclature as Thermodynamics-I in Mechanical Engg.

FIRST YEAR

(Annual System)

1.1 ENGLISH

L	T	P
2	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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- Understand the importance of good communication
- Describe process of communication.
- Explain, Compare and re-write the types of communication
- Identify and match the parts of speech
- Rewrite sentences correctly
- Modify sentences and relate them with real life situations.
- Reproduce and match words and sentences in a paragraph.
- Re-write the sentences according to given situation.
- Relate and use various words using proper vocabulary and grammar.
- Write the various types of paragraphs, notices and composition on picture with appropriate format.

DETAILED CONTENTS

1. **Basics of Communication** **(06 Hrs)**
   - 1.1. Definition and process of communication
   - 1.2. Types of communication – Verbal (Listening, Speaking, Reading and Writing) and Non-verbal

2. **Functional Grammar** **(22 Hrs)**
   - 2.1. Noun and Pronoun
   - 2.2. Punctuation
   - 2.3. Preposition
   - 2.4. Conjunction
   - 2.5. Tenses (verb (Main verb and Auxiliary verb)

3. Reading Skills (12 Hrs)

3.1. Unseen passage for comprehension. Based upon the passage, flowing aspects may be covered

- Questions from the passage
- One-word substitution
- Prefixes and Suffixes
- Antonyms and Synonyms etc.

4. Writing skills (30 Hrs)

4.1. Correspondence – Business and official
4.2. Notice, including Press Releases
4.3. Memos
4.4. Circular
4.5. Basics of Report Writing
4.6. Resume Writing
4.7. Writing E-mail
4.8. Paragraph writing
4.9. Picture composition

LIST OF PRACTICALS

1. Listening Exercises
2. Self and Peer Introduction
3. Debate
4. Situational Conversations: Offering - Responding to offers; Requesting – Responding to requests; Congratulating; Expressing sympathy and condolence; Apologizing and Forgiving; Complaining; Warning; Asking and giving information; Getting and giving permission; Asking for and giving opinions; Talking about likes and dislikes
5. Just a minute sessions – Extempore
6. Group Discussion
7. Newspaper reading
8. Mock Interviews: Telephonic and Personal

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1.1, 2.1, 4.1	1st Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 2.2, 4.2, 4.3	2nd Internal		
C	60%	Unit 1.2, 2.3 to 2.5 , 3, 4.4 to 4.9	FINAL	60%	

1.2 APPLIED MATHEMATICS

L	T	P
3	1	-

RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, partial fractions, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus. Statistics is important for understanding of tolerances, quality assurance and quality control and it is also essential for data analysis.

LEARNING OUTCOMES

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

- Apply complex number in engineering problems.
- Apply permutation and combination to count without actual counting.
- Apply permutation and combination to understand binomial theorem.
- Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.
- Resolve rational functions to partial fractions for the use in Integral Calculus.
- Use matrices to provide solution to engineering problems.
- Solve different problems using trigonometry.
- Understand the geometric shapes used in engineering problems by Co-ordinate Geometry.
- Explore the idea of location, graph, and linear relationships between two variables.
- Compute slope, the equation of tangent and normal to a curve at a point using differentiation.
- Find maximum and minimum values of a function by application of differential calculus..
- Calculate simple integration by using concepts of integration.
- Find the velocity from acceleration and displacement from velocity using integration.
- Evaluate area under curves by using definite integrals
- Calculate the area under a curve and axes.
- Calculate the approximate area under a curve by applying numerical integration using Trapezoidal and Simpson’s rules.

- Solve engineering and industrial problems using differential equations.
- Apply differential Equations and numerical methods for higher learning of mathematics and engineering applications.

DETAILED CONTENTS

1. Algebra (30 Hrs)

- Law of Indices, Formula of Factorisation and expansion i.e. $(a+b)^2$, (a^3+b^3) etc.
- Partial fraction:- Definition of Polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, only.
- Complex numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex number.
- Logarithms and its basic properties
- Determinants and Matrices – Evaluation of determinants (up to 3 order) by laplace method. Solution of equations (up to 3 unknowns) by Cramer's Rule. Definition of Matrices and types, addition subtraction and multiplication of Matrices (up to 2 order).
- Permutation, combination formula, Values of ${}^nP_r$ and ${}^nC_r$.
- Binomial theorem for positive integral index , General term, simple problems

2. Trigonometry (14 Hrs)

- Concept of angle: measurement of angle in degrees, grades, radians and their conversions.
- T-Ratios of standard angle (0^0,30^0,45^0etc) and fundamental Identities, Allied angles (without proof) Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa)
- Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

3. Co-ordinate Geometry (12 Hrs)

- Point: Distance Formula, Mid Point Formula, Centroid of triangle and area of triangle.
- Straight line: Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, normal form, general form), angle between two straight lines.

- Circle: General equation of a circle and identification of centre and radius of circle. To find the equation of a circle, given:
  * Centre and radius
  * Coordinates of end points of a diameter

4. Differential Calculus (40 Hrs)

- Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

- Differentiation of standard function (Only formulas), Differentiation of Algebraic function, Trigonometric functions, Exponential function, Logarithmic function

- Differentiation of sum, product and quotient of functions.
- Successive differentiation (up to 2nd order)
- Application of differential calculus in:
  (a) Rate measures
  (b) Maxima and minima

5. Integral Calculus (28 Hrs)

- Integration as inverse operation of differentiation with simple examples.
- Simple standard integrals, Integrations by parts and related Simple problems
- Evaluation of definite integrals with given limits.

  Evaluation of $\int_0^{\pi/2} \sin^n x\, dx$, $\int_0^{\pi/2} \cos^n x\, dx$, $\int_0^{\pi/2} \sin^m x \cos^n x\, dx$

  using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.
- Applications of integration: for evaluation of area under a curve and axes (Simple problems where the limits are given).
- Numerical integration by Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule using pre-existing mathematical models

6. Differential Equations (04 Hrs)

Definition, order, degree and linearity, of an ordinary differential equation. Solution of I^{st} order and I^{st} degree differential equation by variable separable method (Simple problems)

7. Statistics (12 Hrs)

- Measures of Central Tendency: Mean, Median, Mode
- Measures of Dispersion: Mean deviation from mean, Standard deviation

- Correlation coefficient and Coefficient of rank correlation (Simple problems)

INSTRUCTIONAL STATREGY

Activity based teaching and learning process using Mathematics lab consisting of physical models and computer based tools/software emphasising Practice => Theory => Practice.
Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics Vol. I & II by S Kohli, IPH, Jalandhar
3. Applied Mathematics, Vol. I & II by SS Sabharwal & Dr Sunita Jain, Eagle Parkashan, Jalandhar
4. Engineering Mathematics, Vol I, II & III by V Sundaram et al, Vikas Publishing House (P) Ltd., New Delhi
5. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
6. Applied Mathematics I, by Archana Sharma, Lords Publications, Jalandhar.
7. Engineering Mathematics by Srimanta Pal and Subodh C. Bhunia; Oxford University Press, New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1	1st Internal	40%	40%(Combined in internal & final assessment)with minimum 25% marks in final assessment)
B	20%	Unit 2,3	2nd Internal		
C	60%	Unit 4,5,6,7	FINAL	60%	

1.3 APPLIED PHYSICS

L	T	P
2	1	2

RATIONALE

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

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

LEARNING OUTCOMES

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

- Identify physical quantities, parameters and select their units for use in engineering solutions.
- Find units and dimensions of different physical quantities.
- Represent physical quantities as scalar and vectors.
- Use basic laws of motions,
- Analyse and design banking of roads and apply conservation of momentum principle to explain recoil of gun etc.
- Define work, energy and power and their units. Solve problems about work and power
    - State the principle of conservation of energy.
    - Identify forms of energy, conversion from one form to another.
    - Compare and contrast the physical properties associated with linear motion and rotational motion and give examples of conservation of angular momentum.
    - Describe the surface tension phenomenon and its units, applications, effects of temperature on surface tension.
    - Describe the viscosity of liquids.
    - Define stress and strain, modulus of elasticity.
    - State Hooke's law.
    - Measure temperature in various processes on different scales.
    - Distinguish between conduction, convection and radiation.

- Use equipments like Vernier calliper, screw gauge, Spherometer.

- Differentiate between Transverse and Longitudinal, Periodic and Simple Harmonic Motion.
- Explain the terms: frequency, amplitude, wavelength, wave velocity, frequency and relation between them.
- Explain various engineering and industrial applications of ultrasonics.
- Apply acoustics principles to various types of buildings to get best sound effect.
- Explain the laws of reflection and refraction of light.
- Explain total internal reflection as applied to optical fibers.
- Define capacitance and its unit and solve simple problems using C=Q/V
- Explain the role of free electrons in insulators, conductors and semiconductors.
- Application of semiconductors as diode, rectifiers, concept of transistors
- Explain electric current as flow of charge, the concept of resistance, heating effect of current.
- State and apply Ohm's law.
- Calculate the equivalent resistance of a variety of resistor combinations.
- Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Apply the use of optical fibre in medical field and optical fibre communication.

DETAILED CONTENTS

1. Units and Dimensions (11Hrs)

1.1 Definition of Physics, Physical quantities (Fundamental and derived),
1.2 Units: fundamental and derived units,
1.3 Systems of units: CGS, FPS, MKS, SI
1.4 Definition of Dimensions;
1.5 Dimensional formulae and SI units of physical quantities (distance, displacement, area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)
1.6 Principle of homogeneity of dimensions
1.7 Dimensional equations, Applications of dimensional equations; checking of correctness of equation, Conversion of system of unit (force, work)

2. Force and Motion (14 Hrs)

2.1 Scalar and vector quantities –(Definition and examples),
2.2 Addition of Vectors, Triangle & Parallelogram Law (Statement only),

2.3 Scalar and Vector Product (statement and formula only)
2.4 Definition of Distance, displacement, speed, velocity, acceleration
2.5 Force and its units, concept of Resolution of force
2.6 Newton's Law of motion (Statement and examples),
2.7 Linear Momentum, conservation of momentum (Statement only), Impulse
2.8 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity.
2.9 Centripetal and centrifugal forces(definition and formula only)
2.10 Application of centripetal force in Banking of roads (derivation for angle of banking)

3. Work, Power and Energy (08 Hrs)

3.1 Work (Definition, Symbol, Formula and SI units)
3.2 Energy (Definition and its SI units), Examples of transformation of energy.
3.3 Kinetic Energy (Formula, examples and its derivation)
3.4 Potential Energy (Formula, examples and its derivation)
3.5 Law of conservation of mechanical energy for freely falling bodies (With . Derivation)
3.6 Power (definition, formula and units)
3.7 Simple Numerical problems based on formula of Power

4. Rotational Motion (05 Hrs)

4.1 Rotational motion with examples
4.2 Definition of torque and angular momentum and their examples
4.3 Conservation of angular momentum (quantitative) and its examples
4.4 Moment of inertia and its physical significance, radius of gyration (definition, derivation and formula).

5. Properties of Matter (10 Hrs)

5.1 Definition of Elasticity, Deforming force, Restoring force, example of Elastic and plastic body,
5.2 Definition of Stress and strain with their types,
5.3 Hooke's law, Modulus of Elasticity (Young's, Bulk modulus and shear)
5.4 Pressure (definition, formula, unit), Pascals Law
5.5 Surface tension: definition, its units, applications of surface tension,

effect of temperature on Surface tension

5.6 Viscosity: definition, units, effect of temperature on viscosity

5.7 Fluid motion, stream line and turbulent flow.

6. Heat and temperature (05 Hrs)

6.1 Definition of heat and temperature (on the basis of kinetic theory),

6.2 Difference between heat and temperature

6.3 Principles of measurement of temperature.

6.4 Modes of transfer of heat (Conduction, convection and radiation with examples).

6.5 Properties of heat radiation

6.6 Different scales of temperature and their relationship

7. Wave motion and its applications (09 Hrs)

7.1 Wave motion, transverse and longitudinal wave motion with examples, Terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length .

7.2 Simple Harmonic Motion (SHM): definition, examples

7.3 Cantilever (definition, formula of time period (without derivation).

7.4 Free, forced and resonant vibrations with examples

7.5 Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time.

7.6 Ultrasonics: Introduction and their engineering applications (cold welding, drilling, SONAR)

8. Optics (05 Hrs)

8.1. Reflection and refraction with laws, refractive index, lens formula (no derivation), power of lens (related numerical problems).

8.2. Total internal reflection and its applications, Critical angle and conditions for total internal reflection

8.3. Microscope, Telescope (definition)

8.4. Uses of microscope and telescope.

9. Electrostatics (09 Hrs)

9.1. Electric charge, unit of charge, conservation of charge.

9.2. Coulombs law of electrostatics,

9.3. Electric field, Electric lines of force (definition and properties), Electric field intensity due to a point charge.

9.4. Definition of Electric flux, Gauss law (Statement and derivation)

9.5. Capacitor and Capacitance (with formula and units), Series and parallel combination of capacitors (simple numerical problems)

10. Current Electricity (08 Hrs)

10.1 Electric Current and its Unit, Direct and alternating current,

10.2 Resistance, Specific Resistance and Conductance (definition and units)

10.3 Series and Parallel combination of Resistances.

10.4 Ohm's law (statement and formula),

10.5 Heating effect of current, Electric power and its units

10.6 Kirchhoff's laws (statement and formula)

11 Electromagnetism (05 Hrs)

11.1. Introduction to magnetism, Types of magnetic materials. Dia, para and ferromagnetic materials with examples.

11.2. Magnetic field, magnetic intensity, magnetic lines of force, magnetic flux and their units

11.3. Electromagnetic induction (definition)

12. Semiconductor physics (08 Hrs)

12.1. Definition of Energy level, Energy bands,

12.2. Types of materials (insulator, semi conductor, conductor) with examples,

12.3. Intrinsic and extrinsic semiconductors, p-n junction diode and its V-I characteristics

12.4. Diode as rectifier – half wave and full wave rectifier (centre tap only)

12.5. Semiconductor transistor; pnp and npn (Introduction only), symbol.

13. Modern Physics (08 Hrs)

13.1. Lasers: full form, principle, spontaneous emission, stimulated emission, population inversion, engineering and medical applications of lasers.

13.2. Fibre optics: Introduction to optical fibers (definition, parts), applications of optical fibers in different fields.

13.3. Introduction to nanotechnology (definition of nanomaterials with examples) and its applications.

LIST OF PRACTICALS (To perform minimum fourteen experiments)

1. To find diameter of solid cylinder using a vernier calliper
2. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
3. To find the diameter of wire using screw gauge

4. To find thickness of paper using screw gauge.
5. To determine the thickness of glass strip using a spherometer
6. To determine radius of curvature of a given spherical surface by a spherometer.
7. To verify parallelogram law of forces
8. To determine the atmospheric pressure at a place using Fortin's Barometer
9. To determine force constant of spring using Hooke's law
10. Measuring room temperature with the help of thermometer and its conversion in different scale.
11. To find the time period of a simple pendulum
12. To determine and verify the time period of Cantilever
13. To verify ohm's laws by plotting a graph between voltage and current.
14. To verify laws of resistances in series combination.
15. To verify laws of resistance in parallel combination.
16. To find resistance of galvanometer by half deflection method
17. To verify laws of reflection of light using mirror.
18. To verify laws of refraction using glass slab.
19. To find the focal length of a concave lens, using a convex lens
20. To study colour coding scheme of resistance.

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II by Dr. HH Lal; TTTI Publications, Tata McGraw Hill, Delhi

3. Concepts in Physics by HC Verma, Vol. I & Vol.II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
5. e-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
6. Practical Physics, by C. L. Arora, S Chand Publication

Websites for Reference:

http://swayam.gov.in

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B	20%	Unit 3,4,5	2nd Internal		
C	60%	Unit 6,7,8,9, 10,11, 12, 13	FINAL	60%	

1.4 APPLIED CHEMISTRY

L	T	P
2	-	1

RATIONALE

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

LEARNING OUTCOMES

After undergoing this subject, the students will able to:

- Classify matter based on state of aggregation.
- Calculate percentage composition of chemical compounds.
- Substantiate the laws and principles on which structure of atom is established.
- Prepared solution of required concentration.
- Understand pH and prepare buffer solution and understand their significance in industrial processes such as electrolysis, electrochemical machining of materials etc.
- Explain various characteristics of water.

- Explain cause and facture factors which adversely affecting natural water quality and remedial measure available for water purification to achieve water quality standards required for domestic, agriculture and industrial applications .
- Explain chemistry and technology of industrial metal extraction processes.
- Explain chemistry of fuel and relative advantages.
- Select most efficient fuel for engine and engineering applications.
- Explain mechanism of lubrication and their advantages.
- Explain the chemistry of various polymers and plastics.
- Verify suitability and select polymer/ plastic material for engineering applications.

DETAILED CONTENTS

1. Some Basic Concepts in Chemistry (8 Hrs)

1.1 General introduction: Importance and scope of chemistry.

1.2 Classification of matter:

a) Physical classification: Solid, Liquid and Gases (only definition with examples).

b) Chemical Classification: elements, compounds and mixture (Definition and examples Types of mixture excluded).

1.3 Definition of atom, molecule, symbol and significance of symbol.

1.4 Molecular Formula, Writing the formula of compounds containing CI^-, OH^-, HCO_3^-, SO_4^{2-},CO_3^{2-} and NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, Zn^{2+}, Fe^{3+}, Al^{3+} ions

1.5 Calculation of molecular mass (Atomic mass of constituents should be provided), Calculation of mass percentage composition of elements in compound (Atomic masses of elements should be provided)

2. Structure of Atom (8 Hrs)

2.1 Fundamental particles of atom: electron, proton and neutron, charge and mass of electron, proton and neutron.

2.2 Bohr's model of atom (postulates only) i,e concept of orbit or shell.

2.3 Atomic number (Z), mass number (A), calculation of protons, electrons and neutrons in $^{A}_{z}X$.

2.4 Isotopes, isobars and isotones (definition with examples).

2.5 Concept of orbital (wave nature of electron), difference between orbit and orbital.

2.6 Principles of filling electrons in various orbital: a) Aufbau principle b) Hund's Rule of maximum multiplicity c) Pauli's exclusion principle.

2.7 Electronic configuration of atoms (upto Z=30)

3. Chemical Bonding (5 Hrs)

3.1 Valence electrons, Lewis symbol.

3.2 Octet rule (Limitation excluded).

3.3 Chemical bond (definition) and its type.

3.4 Electrovalent or Ionic Bond with example of NaCI,

3.5 Covalent Bonding in H_2, O_2

4. Solution (8 Hrs)

4.1 Definition of solution, Binary solution, aqueous solution.

4.2 Definition of solute, solvent.

4.3 Definition of acid and base and salt.

4.4 Definition of acidity and basicity.

4.5 Concentration of solution

4.6 Modes of expressing concentration of solution

a) Strength

b) Molarity (M)

c) Normality (N) and

d) simple numerical problems based on (a) and (b)

4.7 Definition of pH and industrial application of pH. (Numericals excluded)

5. Electrochemistry. (8 Hrs)

5.1 Electronic concept of oxidation, reduction

5.2 Definition of terms electrolyte, non electrolyte with example

5.3 Types of electrolytes: strong and weak with examples

5.4 Definition of electrolysis.

5.5 Faradays laws of electrolysis

5.6 Industrial applications of electrolysis: Electroplating, electrolytic refining, electrometallurgy.

6. General Principles of extraction of metals (8 Hrs)

6.1 Metals and Non-metals (definition)

6.2 Definition of Mineral, Chief ores of iron, aluminum and copper.

6.3 Definition of metallurgy, types of metallurgy

6.4 General Steps of metallurgy

a) Crushing

b) Pulverization of ore

c) Concentration or purification of ore:

i) Gravity separation method ii) froth flotation method.

d) Oxidation of ore:

i) Roasting ii) Calcination

e) Reduction:

i) Smelting (Pyrometallurgy) and ii) Electrolytic reduction

f) Refining of Metal:

i) Electrolytic refining

6.5 Definition of alloy, types of alloys and purpose of alloying.

7. Fuel (8Hrs)

7.1 Definition of fuel, classification of fuel a) on the basis of physical state b) on the basis of source.

7.2 Definition of calorific value

7.3 Characteristics of good fuel, advantages of gaseous fuel over solid fuels.

7.4 Coal- Proximate analysis of coal and its importance.

7.5 Fuel quality rating- octane number and cetane number (definition only)

7.6 Gaseous fuel: Composition, calorific value and application of CNG, LPG and biogas.

8. Water (8 Hrs)

8.1 Type of water: Soft and hard water.

8.2 Types of hardness of water

8.3 Units of hardness of water: ppm, mg/L (with simple numericals).

8.4 Disadvantages of using hard water in boiler. a) Scale and sludge formation b) Boiler Corrosion c) Caustic embrittlement

8.5 Qualities of drinking (potable) water

9. Lubricants (4 Hrs)

9.1 lubricant and lubrication.

9.2 Functions of lubricants.

9.3 Classification of lubricants: solid, semisolid and liquid lubricants with examples.

9.4 Type of lubrications – hydrodynamic and boundary lubrication with illustrative diagrams.

9.5 Properties of lubricants

a) Physical properties- viscosity, viscosity index, cloud point, pour point, flash point, fire point, oiliness

b) Chemical properties- TAN or TAV (Total acid number), emulsification, aniline point and iodine value.

10. Polymer and Plastic (5 Hrs)

10.1 Definition of polymer, Monomer, Degree of Polymerization

10.2 Monomer and uses of PE, PVC, PS, Teflon, Nylon-66, Bakelite

10.3 Brief introduction to addition and condensation polymers with suitable examples (PE, PVC, PS, Teflon, Nylon-66, Bakelite).

10.4 Definition of plastics, thermoplastic and thermosetting polymer with example, difference between thermoplastic and thermosetting polymers.

10.5 Uses of polymer and plastic in daily life and in industries.

LIST OF PRACTICALS

1. Volumetric analysis and apparatus used their in.
2. To prepare standard solution of oxalic acid (N/20).
3. To determine the strength of given sodium hydroxide solution by titrating against standard oxalic acid (N/10) solution using phenolphthalein as indicator.
4. Gravimetric analysis and apparatus used their in.
5. To determine the percentage of moisture in given sample of coal.
6. To determine the percentage of ash in given sample of coal.
7. To determine the percentage of volatile and non volatile substance in given mixture.
8. To determine the viscosity of lubricant by using Redwood viscometer.
9. To determine total acid number (TAN) or Total acid value of given lubricant (liquid).
10. Detection of iron metal in the given solution of rust.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Engineering Chemistry by Dr.Himanshu Pandey, Goel Publishing House, Meerut, India.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

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B	20%	Unit 3, 4	2nd Internal		
C	60%	Unit 5, 6, 7, 8, 9, 10	FINAL	60%	

1.5 APPLIED MECHANICS

(Common for Civil Engineering, Automobile Engineering, Mechanical Engineering, Production Engineering, Plastic Technology, Mechanical Engineering (Tool &Die), Mechanical Engineering (Production), Mechanical Engineering (CAD/CAM), Aircraft Maintenance Engineering, Packaging Technology, Mechatronics Engineering)

L	T	P
2	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (06 Hrs)

    1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields.

1.2 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another e.g. density, force, pressure, work, power, velocity, acceleration(Simple Numerical Problems), Fundamental Units and Derived Units.

    1.3 Concept of rigid body, scalar and vector quantities

2. Laws of forces (12 Hrs)

2.1 Definition of force, Bow's Notations, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force.

2.2 Different force systems, principle of transmissibility of forces, law of super-position

2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces

2.4 Free body diagram

2.5 Equilibrant force and its determination

2.6 Lami's theorem

[Simple problems on above topics]

3. Moment (12 Hrs)

3.1 Concept of moment

3.2 Moment of a force and units of moment

3.3 Varignon's theorem (definition only)

3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)

3.5 Parallel forces (like and unlike parallel force), calculating their resultant

3.6 Concept of couple, its properties and effects

3.7 General conditions of equilibrium of bodies under coplanar forces

3.8 Position of resultant force by moment

[Simple problems on the above topics]

4. Friction (14 Hrs)

4.1 Definition and concept of friction, types of friction, force of friction, Limiting Friction.

4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose.

4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane.

4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:

a) Acting along the inclined plane

b) At some angle with the inclined plane

4.5 Ladder friction

4.6 Advantages and Disadvantages of friction

4.7 Methods of increasing/decreasing the force of friction.

[Simple problems on the above topics]

5. Centre of Gravity (10 Hrs)

5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies, difference between centroid and C.G.

5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion

5.3 Determination of center of gravity of solid bodies - cylinder, cube, cuboid and sphere; composite bodies and bodies with portion removed

[Simple problems on the above topics]

6. Simple Machines (16 Hrs)

6.1. Definition of Simple and compound machine (Examples)

6.2. Definition of load, effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines

6.3. Definition of ideal machine, reversible and self locking machine

6.4. Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency

6.5. System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency

6.6. Working principle and application of wheel and axle, Weston's Differential Pulley Block , simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application

[Simple problems on the above topics]

LIST OF PRACTICALS

1. Verification of the polygon law of forces using Gravesand's apparatus.
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the mechanical advantage, velocity ratio and efficiency in case of an inclined plane.
5. To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
6. To find the mechanical advantage, velocity ratio and efficiency of worm and worm wheel.

7. To find mechanical advantage, velocity ratio and efficiency of single purchase crab.
8. To find out center of gravity of regular lamina.
9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

INSTRUCTIONAL STRATEGY

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

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1,2	1st Internal	40%	40%(Combined in internal & final assessment)with minimum 25% marks in final assessment)
B	20%	Unit 3	2nd Internal		
C	60%	Unit 4 to 6	FINAL	60%	

1.6 ENVIRONMENTAL STUDIES

L	T	P
2	-	1

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (4 Hrs)
    - Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.

2. Air Pollution (12 Hrs)
    - Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.

3. Water Pollution (16 Hrs)

- Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O_2, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

4. Soil Pollution (14 Hrs)
   - Sources of soil pollution
   - Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
   - Effect of Solid waste
   - Disposal of Solid Waste- Solid Waste Management

5. Noise pollution (8 Hrs)
   - Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

6. Environmental Legislation (10 Hrs)
   - Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).

7. Impact of Energy Usage on Environment (6 Hrs)
   - Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

LIST OF PRACTICALS

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil

11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.

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1.7 ENGINEERING GRAPHICS

L	T	P
-	-	3

RATIONALE

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

Note:

i) First angle projection is to be followed

ii) Minimum of 30 sheets to be prepared

iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students

iv) For better understanding, students should be encouraged to use engineering graph book, and computer based software like Auto CAD for free hand and orthographic projection practice.

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction to Engineering Drawing (4 sheets)

   1.1 Definition of Engineering Drawing, Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards, engineering graph book, different grades of pencils to be used.
   1.2 Different types of lines in engineering drawing as per BIS specifications
   1.3 Practice of vertical, horizontal and inclined lines
   1.4 Principles of dimensioning: Types, elements, placing, different methods of dimensioning
   1.5 Practice of geometrical figures such as –triangles, rectangles, circles, ellipses and parabola, hexagonal, pentagon with the help of drawing instruments.
   1.6 Definition and classification of lettering, single stroke vertical and inclined lettering at 75^0 (alphabet and numerals)
   1.7 Freehand letter writing and sketches of various kind of objects in graph Sketch book/graph paper.

2 Scales (2 sheets)

   2.1 Scales-their needs and importance(theoretical instructions), types of scales, definition of Representative Fraction(R.F.) and length of scale.
   2.2 Construction of Plain and diagonal scale.

3 Orthographic Projection (5 sheets)

   3.1 Theory of orthographic projections (Elaborate theoretical instructions)
   3.2 Projections of points in different quadrants
   3.3 Projection of line (1^{st} angle and 3^{rd} angle)
      3.3.1 Line parallel to both planes
      3.3.2 Line perpendicular to any one of the principal plane
      3.3.3 Line inclined to any one of the principal plane and parallel to other
   3.4 Projection of Solid-Cube, Cuboid, Cone, Prism, pyramid
   3.5 Three views of orthographic projections of different objects (At least one sheet in 3^{rd} angle)

4 Sectioning and Identification of surfaces (2 sheets)

   4. 1 Identifications of surfaces, Importance and salient features of sectioning of objects.
   4. 2 Description of full section, half section.

5 Isometric Views (2 sheets)

5.1 Fundamental of isometric projections and isometric scale

5.2 Isometric views of different objects

6 Graphics using CAD (5 sheets)

6.1 Meaning, requirement of computer graphics, CAD, screen structure and toolbars in AutoCAD, coordinate system, Drawing Limits, Units.

6.2 Practice of LINE command, coordinates-Absolute, incremental, polar. POLYLINE, CIRCLE(3P,2P, TTR), ARC, ELLIPSE

6.3 Using above geometrical commands for making figure e.g. triangle, rectangle, hexagon, pentagon, parabola.

6.4 Editing commands-Scale, erase, copy, stretch, lengthen and explode.

6.5 Use of SNAP, GRID and ORTHO mode for selection of points quickly. Use of these modes while picking points in LINE, CIRCLE, PLINE, ARC, ELLIPSE etc commands.

6.6 Drawing projections of lines and solids.

6.7 Drawing orthographic projections of different objects (at least 2 sheets)

6.8 AutoCAD for the isometric views sheets. Making single computer sheet showing all the three views and an isometric (in single split screen view) of any object showing understanding of use of AutoCAD in making isometric views – at least 1 sheet

7 Common Symbols and conventions used in Engineering (1 sheet)

7.1 Civil Engineering sanitary fitting symbols

7.2 Electrical fitting symbols for domestic interior installations

7.3 Safety symbols used in engineering works

8 Development of surfaces (cylinder, cuboid, cone) (1 sheet)

8.1 Parallel line, radial line method

(The teacher may explain both methods but will use one method in sheet in classroom and other method on sketchbook)

9 Detailed and assembly drawing (3 sheets)

9.1 Principle and utility of detailed and assembly drawings

9.2 Wooden joints i.e. corner mortise and tenon joint, Tee Halving joint, Mitre faced corner joint, Tee bridle joint , crossed wooden joint, cogged joint, dovetail joint, through Mortise and tenon joint, furniture drawing – freehand and with the help of drawing instruments

9.3 Making Wooden Joint sheets in AutoCAD, rendering & showing assembly animation at least 1 sheet

10 Screw threads and threaded fasteners (5 sheets)

10.1 Type of threads-external and internal threads, right and left hand threads (actual conventional representation), Single and multiple start thread.
10.2 Different forms of screw threads –V threads (B.S.W. threads, B.A thread, American National and Metric thread), Square threads (Square, Acme, buttress and Knuckle thread)
10.3 Different views of hexagonal and square nuts. Square and hexagonal headed bolt.
10. 4 Foundations bolts-Rag bolt, Lewis bolt, Curved bolt and eye bolt.
10. 5 Freehand sketches of various types of screws and studs.

11 Keys and Cotters (3 sheets)

11. 1 Various types of keys and cotters - their practical application, drawings of various keys and cotters showing keys and cotters in position.
11. 2 Various types of Joints
-Spigot and Socket Joints
-Gib and cotter joint
-Knuckle joint

12 Couplings (2 sheets)

12.1 Introduction to coupling, their use and types
12.2 Muff coupling
12.3 Flange coupling (protected)
12.4 Flexible Coupling

MEANS OF ASSESSMENT

- Drawing sheets
- Assignments and quiz/class tests

RECOMMENDED BOOKS

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

6. CAD/CAM by J.S.Narang, Dhanpat Rai & Sons Publishers, New Delhi.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.
8. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran, Vikas Publishing House, Delhi
9. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill;, New Delhi.

Websites for Reference:

http://swayam.gov.in

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1 ,2	1st Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 3,4,5	2nd Internal		
C	60%	Unit 6, 7, 8, 9, 10, 11, 12	FINAL	60%	

1.8 INFORMATION TECHNOLOGY

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RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concept of information technology and its scope; operating a computer; use of various tools using MS Office/Open Office/Libre Office using internet etc.,. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

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

LEARNING OUTCOMES

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

- Identify Computer hardware components, network components and peripherals.
- Explain the role of an operating System.
- Install system and application software.
- Explain the function of the system components including processor, motherboard and input-output devices.
- Use Word Processing software to prepare document.
- Use spreadsheet software to create workbooks and automate calculation.
- Use presentation software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install antivirus.
- Safeguard against online frauds, threats and crimes.

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Basic Concepts of IT and Its Application

   Information Technology concept and scope, applications of IT. in office, Air and Railway Ticket reservation, Banks financial transactions, E-Commerce and E- Governance applications etc., Ethics of IT, concept of online frauds, threats of IT crimes.

2. Computer Hardware:

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

3. Software Concepts:

   System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Window / linux, Features of OPEN OFFICE/MS_OFFICE(MS word, Excel, PowerPoint) .

4. Internet Concepts:

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

LIST OF PRACTICAL EXERCISES

1. Given a PC, name its various components and peripherals. List their functions .
2. Installing various components of computer system and installing system software and application software
3 Installation of I/O devices, printers and installation of operating system viz. Windows/BOSS/ LINUX
4. Features of Windows as an operating system
   - Start
   - Shut down and restore
   - Creating and operating on the icons
   - Opening, closing and sizing the windows and working with windows interfacing elements (option buttons, checkbox, scroll etc.)

- Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file and folders
- Changing settings like, date, time, colour (back ground and fore ground etc.)
- Using short cuts
- Using on line help

5. Word Processing (MS Office/Open Office)

a) File Management:
   - Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file

b) Page set up:
   - Setting margins, tab setting, ruler, indenting

c) Editing a document:
   - Entering text, cut, copy, paste using tool- bars

d) Formatting a document:
   - Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
   - Aligning of text in a document, justification of document, inserting bullets and numbering
   - Formatting paragraph, inserting page breaks and column breaks, line spacing
   - Use of headers, footers: Inserting footnote, end note, use of comments, autotext
   - Inserting date, time, special symbols, importing graphic images, drawing tools

e) Tables and Borders:
   - Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
   - Print preview, zoom, page set up, printing options
   - Using find, replace options

f) Using Tools like:
   - Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelops and lables
   - Using shapes and drawing toolbar,
   - Working with more than one window .

6. Spread Sheet Processing (MS Office/Open Office)

a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets

b) Menu commands:

Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working

c) Work books:

Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations

Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting

d) Creating a chart:

Working with chart types, changing data in chart, formatting a chart, use chart to analyze data

Using a list to organize data, sorting and filtering data in list

e) Retrieve data with query:

Create a pivot table, customizing a pivot table. Statistical analysis of data

f) Exchange data with other application:

Embedding objects, linking to other applications, import, export document.

7. PowerPoint Presentation (MS Office/Open Office)

a) Introduction to PowerPoint
   - How to start PowerPoint
   - Working environment: concept of toolbars, slide layout & templates.
   - Opening a new/existing presentation
   - Different views for viewing slides in a presentation: normal, slide sorter.

b) Addition, deletion and saving of slides

c) Insertion of multimedia elements
   - Adding text boxes
   - Adding/importing pictures
   - Adding movies and sound
   - Adding tables and charts etc.
   - Adding organizational chart
   - Editing objects
   - Working with Clip Art

d) Formatting slides
   - Using slide master
   - Text formatting
   - Changing slide layout
   - Changing slide colour scheme
   - Changing background
   - Applying design template

e) How to view the slide show?
   - Viewing the presentation using slide navigator
   - Slide transition
   - Animation effects, timing, order etc.

f) Use of Pack and Go Options.

8. Internet and its Applications

a) Establishing an internet connection.
b) Browsing and down loading of information from internet.
c) Sending and receiving e-mail
   - Creating a message
   - Creating an address book
   - Attaching a file with e-mail message
   - Receiving a message
   - Deleting a message

d) Assigning IP Addresses to computers and use of domain names.

9. Functioning of Antivirus

a) Installation and updation of an antivirus.
b) How to scan and remove the virus.

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
3. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
4. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
6. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

1.9 INTERNET OF THINGS AND ARTIFICIAL INTELLIGENCE

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LEARNING OUTCOMES

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

- Understand the concepts of Internet of Things
- Build small IoT applications
- Understand and analysing sensor generated data using analytic techniques in Excel

DETAILED CONTENTS

1. Introduction to Internet of Things (IoT) (8 hrs)
   - Applications, architecture, protocols
   - Characteristics of IoT
   - Physical Design/Logical Design of IoT
   - Functional blocks of IoT, Communication Models.

2. Basics of C language using Arduino IDE (14 hrs)
   - Understating basics of Arduino IDE
   - Variables, datatype, loops, control statement, function

3 Practical using Arduino-interfacing sensors (28 hrs)

   i. Interfacing Light Emitting Diode(LED)- Blinking LED
   ii. Interfacing Button and LED – LED blinking when button is pressed
   iii. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
   iv. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)
   v. Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD
   vi. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD , switch on LED when data sensed is higher than specified value.
   vii. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
   viii. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).

4 Introduction to Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL). (20 hrs)

- Role of AI in IoT and its applications
- Managing and Analysing data generated by IoT devices – Big Data
- Machine learning (ML) Techniques e.g. classification, linear regression, etc.
- Numerical based on above techniques.
- Understanding excel for analysing data

INSTRUCTIONAL STRATEGY:

Since this subject is practical oriented, the teacher should demonstrate functioning of various sensors and demonstrate building of IoT applications. Solution to various regression and classification problems should also be built.

LIST OF REFERENCE BOOKS:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands On Approach, University Press
2. Yashavant Kanetkar, Shrirang Korde, "21 Internet Of Things (IOT) Experiments"
3. Neerparaj Rai , "Arduino Projects For Engineers"
4. Chandra S.S.V, "Artificial Intelligence and Machine Learning"

LIST OF COMPONENTS

1. One kit for 3-4 students : Arduino Uno, sensors(Bluetooth module(HC05), MQ135, DHT11, breadboard , LCD, 2-relay module etc)
2. Consumables : LED, button, connecting wires, LDR, LM35, battery, etc

1.10 GENERAL WORKSHOP PRACTICE

(Common for Agriculture Engineering, Automobile Engineering, Aircraft Maintenance Engineering, Civil Engineering, Mechanical Engineering, Mechanical Engineering (Tool & Die), Mechanical Engineering (Production), Mechanical Engineering (CAD/CAM), Production Engineering, Packaging Technology, Plastic Technology)

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SCHEDULING

The students will visit the different workshops in two major rounds in a year. In 1st round, they will learn basic skills of each workshop and in 2nd round, they will refine their skills further**.**

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

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

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Inspect visually to identify various types of defects in different type of materials.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment(PPE).
- Maintain good housekeeping practices.

DETAILED CONTENTS (PRACTICAL EXERCISES)

1st ROUND

Workshop Safety Induction Session:
First turn of each shop shall be dedicated to safety practices and the contribution of safety to quality. The safety aspects should be categorised into 3 categories

- PSS (Process Safety System)

- SSS (Safety Shutdown System)
- ESD (Emergency Shutdown) or Emergency Depressurisation System.

The following practices should be included:

- Use of PPE (Personal Protection Equipment)
- Use of Safety Equipment like fire extinguishers etc.
- Paramedic teaching suite, First aid
- Reports to be prepared for the damages
- At the end of this session the student must sign "Student Safety Declaration form".

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

The following shops are included in the syllabus:

1. Welding Shop – I
2. Fitting Shop – I
3. Sheet Metal Shop – I
4. Electric Shop - I
5. Carpentry Shop – I
6. Smithy Shop – I
7. Painting Shop

1. WELDING SHOP – I

1.1 Introduction and importance of welding process as compared to other material joining processes. Specifications and type of ARC welding machines, parts identification, classification, selection and coding of electrodes, welding parameters, welding joints and welding positions. Common weldable Materials, safety precautions, use of PPEs, welding screens, Hazards and remedies during welding, Elementary symbolic representations, demo of types of welding defects.

1.2 Jobs to be prepared

Job I Practice of striking arc (Minimum 4 continuous beads on 100 mm long M.S. flat).

Job II Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level and differentiating their characteristics).

Types of joints and their edge preparations:

Job III Preparation of lap joint using arc welding process.

Job IV Preparation of butt joint using arc welding process. (100 mm long).

Job V Preparation of T Joint using arc welding (100mm x 6 mm M.S. Flat).

2. FITTING SHOP – I

2.1 Introduction and Practical Importance of fitting jobs
2.2 Basic deburring processes.
2.3 Introduction to fitting shop tools, marking and measuring devices/equipment.
2.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)
2.5 Identification of various steel sections (flat, angle, channel, bar etc.).
2.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing). Demonstration of wrong fitting practices causing damage to filed surfaces(outsized, out angled etc.) and tool/blade breakages.
2.7 Jobs to be prepared:

Job I Marking of job, use of marking tools and various types of files, use of tri square, surface plate, filing and use of measuring instruments. (zero error and least count of Vernier calliper, Micrometer and Vernier height gauge).

Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of ±0.5 mm.

Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping.

3. SHEET METAL SHOP – I

3.1. Introduction and practical importance of sheet metal jobs, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.
3.2 Introduction and demonstration of hand tools used in sheet metal shop.
3.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Turning Machine, Wiring Machine, Setting Down Machine, Forming Machine, Stake etc.
3.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.
3.5 Study of various types of nuts, bolts, rivets, screws etc.

Job I Shearing practice on a sheet using hand shears.

Job II Prepare a seam joint of G.I. Sheet

Job III Practice on making Single(/double) riveted lap joint/Butt Joint.

Job IV Development of sheet for preparation of cubical container(300x150x25 mm)

4. ELECTRIC SHOP - I

4.1 Study, demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, MCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.
4.2 Study of electrical safety measures and protective devices.

Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. Difference between series and parallel wiring.

Job II Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping. Demo of conduit wiring through junctions

Job III To prepare a three level Godown wiring circuit with PVC conduit wiring system.

4.3 Introduction to the construction of lead acid battery, its working and its specification parameters(maH, specific gravity), precautions while handling battery, Introduction to battery charger and its functioning. Types of charging

Job IV Installation of battery and connecting two or three batteries in series and parallel and its effect. Charging a battery and testing with hydrometer and cell tester

4.4 Introduction to solar energised lighting or water heater system and their defects.

Job V Installation of Solar cells, costing according to capacity

5. CARPENTRY SHOP - I

5.1 Introduction and industrial applications of carpentry jobs.

5.1.1 Name and use of raw materials used in carpentry shop : wood & alternative materials(board, plywood)

5.1.2 Names, uses, care, precautions and maintenance of hand tools such as different types of Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, Marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools , measuring tools etc.

5.1.3 Specification of tools used in carpentry shop.

5.1.4 Identification of different types of Timbers, their properties, uses & defects. Study of the joints in roofs, doors, windows and furniture available in Polytechnic

5.1.5 Seasoning of wood and its need.

5.1.6 Estimation of wood.

5.2 Practice

5.2.1 Practices for Basic Carpentry Work

5.2.2 Sawing practice using different types of saws

5.2.3 Assembling jack plane — Planning practice including sharpening and blade adjustment of jack plane cutter

5.2.4 Chiselling practice using different types of chisels including sharpening of chisel

5.2.5 Making of different types of wooden pin and fixing methods. Marking measuring and inspection of jobs.

5.2.6 Housekeeping practices and instructions.

5.3 Job Practice

Job 1	Marking, sawing, planning to size , chiselling and their practice
Job II	Half Lap Joint (cross, L or T – any one)
Job III	Mortise and Tenon joint (T-Joint)
Job IV	Dove tail Joint (Half lap dovetail joint or Bridle Joint)

6. SMITHY SHOP - I

6.1 Introduction and industrial applications of smithy jobs.

6.1.1 Purpose of Smithy shop

6.1.2 Different types of Hearths used in Smithy shop, Types of fuel used and maximum temperature obtained

6.1.3 Purpose, specifications, uses, care and maintenance of various tools and equipments used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools, punches etc.

6.1.4 Types of raw materials used in Smithy shop

6.1.5 Uses of Fire Bricks & Clays in Forging workshop.

6.2 Practice

6.2.1 Practice of firing of hearth/Furnace, Cleaning of Clinkers and Temperature Control of Fire.

6.2.2 Practice on different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting

a) Demonstration — Making cube, hexagonal cube, hexagonal bar from round bar

6.2.3 Practice of Simple Heat treatment processes like Tempering, Normalizing, and Hardening etc

Job Practice: Job Preparation

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

7 PAINTING SHOP

Introduction to painting shop and its necessity. Different types of paints. Introduction of powder coating plant and spray painting with their uses.

Job I Preparation of surface before painting such as cleaning, sanding, applying putty, filling procedure and application of primer coat and painting steel item.

Job II Painting practice by brush on MS sheet

Job III Practice of dip painting

Job IV Practice of lettering: name plates / sign board

Job V Polishing and painting on wooden and metallic surfaces(furniture or utility of Polytechnic)

Job VI Practical demonstration of powder coating

Job VII Practical demonstration of spray painting on a utility object

2nd ROUND

DETAILED CONTENTS (PRACTICAL EXERCISES)

The following shops are included in the syllabus.

1 Welding Shop – II
2 Fitting Shop – II
3 Sheet Metal Shop – II
4 Electric Shop -II
5 Carpentry Shop – II
6 Smithy Shop – II (Not for Civil Engg. Branch)
7 Plumbing Shop (only for Civil Engg. Branch)

1. WELDING SHOP - II

1.1 Introduction to gas welding, gas welding equipment, introduction to soldering and brazing, introduction to resistance welding, safety precautions.

1.2 Jobs to be prepared

Job I Identification and adjustment of various types of gas flames. Practice them on pipe joint in round and linear fashion

Job II Preparation of lap joint on 75 mm × 35 mm × 3mm M.S. plate using gas welding.

Job III Preparation of butt joint on 75mm×35mm×3mm M.S.flat using gas welding process.

Job IV Preparation of a small cot frame (M.S. steel bed frame) from M.S. conduit pipe using gas welding process.

Job V Preparation of a square pyramid from M.S. rod by welding (Arc or Gas welding).

Job VI Practice of Spot/Seam welding or repair of an iron furniture of institute or demo of Gas cutting process

2. FITTING SHOP - II

2.1 Care and maintenance of various measuring tools.

2.2 Handling of measuring instruments, finding least count and checking of zero error. Use of dial gauges and feeler gauges.

2.3 Description and demonstration of various types of drills, taps and dies.

2.4 Selection of drills and taps.

2.5 Precautions while drilling soft metals (Aluminium, Copper, Brass etc.).

Job I Drilling practice on soft metals-Aluminium

Job II Preparation of a job by filing on non ferrous metals upto an accuracy of ±0.1 mm.

2.6 file and make angle, surfaces (Bevel gauge accuracy 1 degree) make simple open and sliding fits Inside square fit, make combined open and sliding fit, straight sides

Job III Step fit(.02mm accuracy) or angular V fit(30 minute) or radius fitting(40x40x3mm MS sheet)

2.7 Sliding fitting, Diamond fitting, Lapping flat surfaces using lapping plate. Application of lapping, material for lapping tools, lapping abrasives, charging of lapping tool. Surface finish importance, equipment for testing-terms relation to surface finish

Job IV T fit or H fit with highest lapped accuracy to be checked by feeler gauge or any as deemed to be.

3. SHEET METAL SHOP - II

3.1 Introduction to various metal forming processes e.g. Spinning, Punching, Blanking, cup drawing

3.2 Introduction to soldering and brazing.

3.3 Introduction to metal spinning process.

Job I Preparation of job involving shearing, circular shearing, rolling, folding, beading and soldering process e.g. Funnel/oil can/bucket or any other job involving above operations.

Job II Exercise on job involving brazing process

Job III Spinning a bowl/cup/saucer

Job IV Visit to a sheet metal industry e.g. coach builders etc.

4. ELECTRIC SHOP - II

4.1 Introduction to single phase and three phase supply and wiring system. Importance of three phase supply (RYB)& its sequence and wiring system.

Job I Connecting Generator and 3 phase wiring through Change over Switch.

4.2 Estimating and costing of power consumption

Job II Connecting single phase energy meter with supply and load. Reading and working out power consumption and cost of energy.

4.3 Study of internal wiring diagram of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc.Demonstration of

dismantling, servicing and reassembling of table/ceiling fan, air-cooler, auto electric iron, heater etc.

Job III Dismantling, servicing and reassembling of any of the above electrical appliances, finding faults with series testing lamp and multimeter.

4.4 Testing and reversing direction of rotation of single phase and three phase motors.

Job IV Acceptance Testing of single phase/three phase motors by using voltmeter, ammeter and tachometer.

Job V Reversing direction of rotation of single phase and three phase motors.

4.5 Identification and familiarisation with the following tools:

Tweezers, Screw Drivers (Different sizes), Insulated pliers, Cutters, Sniper, Philips Screw driver (star screw driver), L-Keys, Soldering Iron and their demonstration and uses.

Job VI Practice on joining using soldering flux and removing components/wires by desoldering

5. CARPENTRY SHOP – II

5.1 Introduction to joints, their relative advantages and uses.

Job I Preparation of glued joint. *

Job II Preparation of mitre joint *

Job III Preparation of a lengthening joint *

* These jobs should be more prepared for utility articles like coat-hanger, shoe-rack, book-shelf etc.

5.2 Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.

5.3 Demonstration of job on Band Saw and Circular Saw, Chain and Chisel, Universal wood working machine, Saw re-sharpening machine, Saw Brazing unit.

5.4 Importance and need of polishing wooden items, Introduction to polishing materials.

5.5 Practice on Wood Working Lathe

a) Safety precaution on wood working machines
b) Study of wood working lathe
c) Sharpening of lathe tools
d) Setting of jobs and tools
e) Different type of wood turning practice

Job IV a) Making Handles of chisels/files/screw drivers etc.
b) Making legs of cabinets: Straight, Tapered and Ornamental

Job V Repair of wooden furniture of the Institute

6. SMITHY SHOP – II (Not for Civil Engg Branch)

6.1 Introduction to various heat treatment processes e.g annealing, hardening, tempering, normalizing etc.

6.2 Description of various types of power hammers and their usage (Demonstration only).

Job I To forge a ring to acquaint the students with forge welding.

Job II To forge a chisel and acquaint the students with simple idea of hardening and tempering.

Job III To forge squares on both ends of a circular rod.*

Job IV To prepare a job involving drawing down process*

* Prepare utility articles like screw drivers, hinges, hexagonal nut, gib head key, chain links

7. PLUMBING SHOP (only for Civil Engg. Branch)

7.1 Introduction to various types of threads (internal and external)-single start, multi-start, left hand and right hand threads.

7.2 Description and demonstration of various types of drills, taps and dies. Selection of dies for threading, selection of drills, taps and reamers for tapping operations.

7.3 Introduction to use of plumbing tools like pipe wrench , plumber vice and materials like Putty, thread, duct(Teflon) tape, epoxy resin, araldite, m-seal.

Job I Making internal and external threads on a job by tapping and dieing operations (manually)

7.4 Precautions while drilling soft metals, e.g. copper, brass, aluminium etc.

Job II Fitting of all components of wash basin and ball valve in a tank

Job III Practice on opening a jammed pipe(MS or PVC) joint with least damage and repair of a leaking joint, reconditioning of a tap.

Job IV Preparation of job involving thread on GI pipe/ PVC pipe and fixing of at least 5 types of fittings (viz. elbow, tee, union, socket, reducer, nipple, stopcock, taps etc)

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi

5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

THIRD SEMESTER

3.1 STRENGTH OF MATERIALS

L	T	P
3	-	2

RATIONALE

Diploma holders in this course are required to analyze reasons for failure of different components and select the required material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Stresses and Strains (08 Hours)

   1.1. Basic concept of load, stress and strain

   1.2. Tensile, compressive and shear stresses

   1.3. Linear strain, Lateral strain, Shear strain, Volumetric strain.

   1.4 Concept of Elasticity, Elastic limit and limit of proportionality

   1.5 Hook’s Law and Elastic Constants

1.6. Stress-strain curve for ductile and brittle materials

1.7 Nominal stress

1.8 Yield point, plastic stage

1.9 Ultimate stress and breaking stress

1.10 Percentage elongation

1.11 Proof stress and working stress

1.12. Factor of safety

1.13 Poisson's Ratio

1.14 Thermal stress and strain

1.15 Longitudinal and circumferential stresses in seamless thin walled cylindrical shells.

1.6 Introduction to Principal stresses

2. Resilience (03 Hours)

2.1 Strain Energy, Resilience, proof resilience and modulus of resilience

2.2 Strain energy due to direct stresses and Shear Stress

2.3 Stresses due to gradual, sudden and falling load.

3. Moment of Inertia (08 Hours)

3.1. Concept of moment of inertia and second moment of area

3.2 Radius of gyration

3.3 Theorem of perpendicular axis and parallel axis (with derivation)

3.4 Second moment of area of common geometrical sections : Rectangle, Triangle, Circle (without derivation); Second moment of area for L,T and I section

3.5 Section modulus

4. Bending Moment and Shearing Force (08 Hours)

4.1 Concept of various types of beams and form of loading

4.2 Concept of end supports-Roller, hinged and fixed

4.3 Concept of bending moment and shearing force

4.4 B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.

5. Bending stresses (06 Hours)

5.1 Concept of Bending stresses

5.2. Theory of simple bending, Derivation of Bending Equation

5.3. Use of the equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$

5.4. Concept of moment of resistance

5.5. Bending stress diagram

5.6 Section modulus for rectangular, circular and symmetrical I section.

5.7. Calculation of maximum bending stress in beams of rectangular, circular, and T section.

6 Columns (05 Hours)

6.1. Concept of column, modes of failure

6.2. Types of columns, modes of failure of columns

6.3. Buckling load, crushing load

6.4. Slenderness ratio

6.5. Effective length

6.6 End restraints

6.7 Factors effecting strength of a column

6.8 Strength of column by Euler Formula without derivation

6.9. Rankine Gourdan formula (without derivation)

7. Torsion (06 Hours)

7.1. Concept of torsion, difference between torque and torsion.

7.2. Derivation of Torsion Equation, use of torsion equation for circular shaft, (solid and hollow)

7.3. Comparison between solid and hollow shaft with regard to their strength and weight.

7.4. Power transmitted by shaft

7.5 Concept of mean and maximum torque

8. Springs (04 Hours)

8.1. Closed coil helical springs subjected to axial load and calculation of:

- Stress deformation
- Stiffness and angle of twist and strain energy
- Strain energy and proof resilience.

8.2. Determination of number of plates of laminated spring (semi elliptical type only)

LIST OF PRACTICALS

1. Tensile test on bars of Mild steel and Aluminium.
2. Bending tests on a steel bar or a wooden beam.
3. Impact test on metals
   a) Izod test
   b) Charpy test
4. Torsion test of solid specimen of circular section of different metals for determining modulus of rigidity.
5. To plot a graph between load and extension and to determine the stiffness of a helical spring.
6. Hardness test on different metals.

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

INSTRUCTIONAL STRATEGY

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

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

Topic No.	Time Allotted (Hours)	Marks Allotted (%)
1	08	20
2	03	06
3	08	16
4	08	16
5	06	10
6	05	10
7	06	12
8	04	10
Total	**48**	**100**

3.2 THERMODYNAMICS - I

L	T	P
3	-	2

RATIOANLE

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

LEARNING OUTCOMES

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

- Apply thermodynamic laws.
- Solve basic problems of gas equation using perfect gas laws.
- Determine enthalpy, specific heat capacity and P-V-T surface of an ideal and real gas.
- Determine various properties of Steam
- Explain the working, construction and applications of steam boilers and steam generators
- Explain the working, construction and application of air compressor.

DETAILED CONTENTS

1. Fundamental Concepts (04 Hours)

   Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy and internal energy.

2. Laws of Perfect Gases (04 Hours)

   Definition of gases, explanation of perfect gas laws – Boyle's law, Charle's law, Avagadro's law, Regnault's law, Universal gas constant, Characteristic gas constants and its derivation.

   Specific heat at constant pressure, specific heat at constant volume of a gas, derivation of an expression for specific heats with characteristics, simple numerical problems on gas equation.

3. Thermodynamic Processes (06 Hours)

Types of thermodynamic processes – isochoric, isobaric, isothermal, adiabatic, isentropic, polytropic and throttling processes, equations representing the processes

Derivation of work done, change in internal energy, change in entropy, rate of heat transfer for the above processes

4. Laws of Thermodynamics (10 Hours)

Laws of conservation of energy, first law of thermodynamics (Joule's experiment) and its limitations, Application of first law of thermodynamics to Non-flow systems – Constant volume, Constant pressure, Adiabatic and polytropic processes, steady flow energy equation, Application of steady flow energy equation for turbines, pump, boilers, compressors, nozzles, and evaporators.

Heat source and sink, statements of second laws of thermodynamics: Kelvin Planck's statement, Classius statement, equivalency of statements, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility and concept of entropy.

5. Ideal and Real Gases (04 Hours)

Concept of ideal gas, enthalpy and specific heat capacities of an ideal gas, P – V – T surface of an ideal gas, triple point, real gases, Vander-Wall's equation

6. Properties of Steam (04 Hours)

Formation of steam and related terms, thermodynamic properties of steam, steam tables, sensible heat, latent heat, internal energy of steam, entropy of water, entropy of steam, T-S diagrams, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes, determination of quality of steam (dryness fraction),

7. Steam Generators (06 Hours)

Uses of steam, classification of boilers, function of various boiler mounting and accessories, comparison of fire tube and water tube boilers. Construction and working of Lancashire boiler, Nestler boiler, Babcock & Wilcox Boiler. Introduction to modern boilers.

8. Air Standard Cycles (05 Hours)

Meaning of air standard cycle – its use, condition of reversibility of a cycle

Description of Carnot cycle, Otto cycle, Diesel cycle, simple problems on efficiency for different cycles.

Comparison of Otto, Diesel cycles for same compression ratio, same peak pressure developed and same heat input.

Reasons for highest efficiency of Carnot cycle and all other cycles working between same temperature limits

9. Air Compressors (05 Hours)

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

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

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

Rotary compressors – types, working and construction of centrifugal compressor, axial flow compressor, vane type compressor

LIST OF PRACTICALS

1. Determination of temperature by
   - 1.1 Thermocouple
   - 1.2 Pyrometer
   - 1.3 Infrared thermometer
2. Demonstration of mountings and accessories on a boiler.
3. Study the working of Lancashire boiler and Nestler boiler.
4. Study of working of high pressure boiler.
5. Study of boilers (Through industrial visit)
6. Determination of Dryness fraction of steam using calorimeter.
7. Demonstrate the working of air compressor.

INSTRUCTIONAL STRATEGY

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

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. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi.
2. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi.
3. Engineering Thermodynamics by CP Arora; Tata McGraw Hill, Delhi.
4. A Treatise on Heat Engineering by VP Vasandani and DS Kumar; Metropolitan Book Company.
5. 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	04	08
3	06	12
4	10	20
5	04	10
6	04	08
7	06	12
8	05	10
9	05	10
Total	**48**	**100**

3.3 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P
3	-	2

RATIONALE

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

LEARNING OUTCOMES

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

- Measure basic electrical quantities.
- Measure and improve power factor in a given circuit.
- Explain the construction, working principle, performance and applications of transformers.
- Identify different wires of distribution system.
- Select and operate single phase and three phase motors.
- Follow electrical safety measures.
- Describe the characteristics and applications of diodes, transistors and thyristor.

DETAILED CONTENTS

1. Application and Advantage of Electricity (03 Hours)

   Difference between ac and dc, various applications of electricity, advantages of electrical energy over other types of energy

2. Basic Electrical Quantities (04 Hours)

   Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities, connection of these instruments in an electric circuit

3. AC Fundamentals (08 Hours)

   Electromagnetic induction-Faraday's Laws, Lenz's Law; Fleming's rules, Principles of a.c. Circuits; Alternating emf, Definition of cycle, frequency, amplitude and time period. Instantaneous, average, r.m.s and maximum value of sinusoidal wave; form factor and

Peak Factor. Concept of phase and phase difference. Concept of resistance, inductance and capacitance in simple a.c. circuit. Power factor and improvement of power factor by use of capacitors. Concept of three phase system; star and delta connections; voltage and current relationship (no derivation)

4. Transformers (06 Hours)

Working principle and construction of single phase transformer, transformer ratio, emf equation, losses and efficiency, cooling of transformers, isolation transformer, CVT, auto transformer (brief idea), applications.

5. Distribution System (06 Hours)

Difference between high and low voltage distribution system, identification of three-phase wires, neutral wire and earth wire in a low voltage distribution system. Identification of voltages between phases and between one phase and neutral. Difference between three-phase and single-phase supply

6. Electric Motor (08 Hours)

Description and applications of single-phase and three-phase motors. Connection and starting of three-phase induction motors by star-delta starter. Changing direction of rotation of a given 3 phase induction motor. Motors used for driving pumps, compressors, centrifuge, dyers etc. Totally enclosed submersible and flame proof motors

7. Domestic Installation (04 Hours)

Distinction between light-fan circuit and single phase power circuit, sub-circuits, various accessories and parts of domestic electrical installation. Identification of wiring systems. Common safety measures and earthing

8. Electrical Safety (04 Hours)

Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs

9. Basic Electronics (05 Hours)

Basic idea of semiconductors – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, their characteristics and uses. Characteristics and applications of a thyristor, characteristics and applications of stepper motors and servo motors in process control.

LIST OF PRACTICALS

1. Connection of a three-phase motor and starter with fuses and reversing of direction of rotation
2. Connection of a single-phase induction motor with supply and reversing of its direction of rotation
3. Troubleshooting in domestic wiring system, including distribution board
4. Connection and reading of an electric energy meter
5. Use of ammeter, voltmeter, wattmeter, and multi-meter
6. Measurement of power and power factor in a given single phase ac circuit
7. Study of different types of fuses, MCBs and ELCBs
8. Study of zener diode as a constant voltage source and to draw its V-I characteristics
9. Study of earthing practices
10. To draw V-I characteristics of a (i) NPN transistor (ii) thyristor (SCR)
11. Study of construction and working of a (i) stepper motor and (ii) servo motor

INSTRUCTIONAL STRATEGY

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

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, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhogal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
8. Basic electronics and Linear circuits by NN Bhargava and Kulshreshta, Tata Mc Graw Hill New Delhi.
9. Electronic principles by SK Sahdev, Dhanpat Rai and Sons, New Delhi.

10. Electronic Devices and circuits by Rama Raddy Narora Publishing House Pvt. Ltd. New Delhi.
11. Principles of electrical and electronics Engineering by VK Mehta; S Chand and Co. New Delhi
12. 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	03	06
2	04	08
3	08	16
4	06	12
5	06	12
6	08	16
7	04	10
8	04	10
9	05	10
Total	**48**	**100**

3.4 MECHANICAL ENGINEERING DRAWING

L	T	P
-	-	6

RATIONALE

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

LEARNING OUTCOMES

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

- Interpret different limits and fits of components
- Draw different kind of machine components like bearings, brackets, pulleys, pipe joints and lathe tool holder.
- Read and interpret drawings of mechanical components
- Interpret and draw the drawings of mechanical machine parts like jig, vices and screw jack
- Interpret and prepare the drawings of boiler and J.C. engine parts.
- Interpret gear terminology and draw spur gear teeth profile.

DETAILED CONTENTS

1. Limit, fits and tolerance (01 sheets)

   Need of limit, fits and tolerance, Maximum limit of size, minimum limit of size, tolerance, allowance, deviation, upper deviation, lower deviation, fundamental deviation, clearance, maximum clearance, minimum clearance. Fits – clearance fit, interference fit and transition fit. Hole basis system, shaft basis system, tolerance grades, calculating values of clearance, interference, hole tolerance, shaft tolerance with given basic size for common assemblies like H_7/g6, H_7/m6, H_8/p6. Basic terminology and symbols of geometrical dimensioning and tolerances.

2. Drawing of the following with complete dimensions, tolerances, bill of material and surface finish representation.
   - 2.1 Universal coupling and Oldham coupling (Assembly) (01 Sheets)
   - 2.2 Bearings (04 sheets)
     - 2.2.1 Bushed Bearing (Assembly Drawing)
     - 2.2.2 Ball Bearing and Roller Bearing (Assembled Drawing)
     - 2.2.3 Plummer Block (Detail and Assembly Drawing)
     - 2.2.4 Foot step Bearing (Assembled Drawing)
   - 2.3 Pulleys (02 sheets)

2.3.1 Pulleys, Function of pulley, Types and materials of Pulley.
2.3.2 Free hand Sketch of Various types of pulleys.
2.3.3 Fast and loose pulley (Assembly Drawing)

2.4 Pipe Joints (03 sheets)

2.4.1 Types of pipe Joints, Symbol and line layout of pipe lines
2.4.2 Expansion pipe joint (Assembly drawing)
2.4.3 Flanged pipe and right angled bend joint (Assembly Drawing)

2.5 Lathe Tool Holder (Assembly Drawing) (01 sheets)
2.6 Reading and interpretation of mechanical components and assembly drawings
2.7 Sketching practice of bearings and bracket. (01 sheet)

3. Drilling Jig (Assembly Drawing) (01 sheets)

4. Machine vices (Assembly Drawing) (02sheets)

5. I.C. Engine Parts (03 sheets)

Piston
Connecting rod (Assembly Drawing)
Crankshaft and flywheel (Assembly Drawing)

6. Boiler Parts (02 sheets)

Steam Stop Valve (Assembly Drawing)
Blow off cock. (Assembly Drawing)

7. Mechanical Screw Jack (Assembled Drawing) (01 sheet)

8. Gears (02 sheets)
Gear, Types of gears, Nomenclature of gears and conventional representation
Draw the actual profile of involute teeth of spur gear by different methods.

Note:- (1) First angle projection should be followed, 20% of drawings may be prepared in third angle projection.
(2) SP-46-1988 should be followed
(3) The drawing should include discussion with tolerances, whenever necessary and material list as per BIS / ISO specifications.
(4) At least 18 sheets may be prepared covering all the topics.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

- Sketching
- Drawing

LIST OF RECOMMENDED BOOKS

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

3.5 WORKSHOP TECHNOLOGY-1

L	T	P
3	-	-

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Welding (16 Hours)

1.1 Welding Process

Principle of welding, Classification of welding processes, Advantages and limitations of welding, Industrial applications of welding, Welding positions and techniques, symbols. Safety precautions in welding.

1.2 Gas Welding

Principle of operation, Types of gas welding flames and their applications, Gas welding equipment - Gas welding torch, Oxygen cylinder, acetylene cylinder, cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes and personal safety equipment for welding.

1.3 Arc Welding

Principle of operation, Arc welding machines and equipment. A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes: Classification, B.I.S. specification and selection, Flux for arc welding. Requirements of pre heating, post heating of electrodes and work piece. Welding defects and their testing methods.

1.4 Other Welding Processes

Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding, Atomic hydrogen welding, Shielded metal arc welding, submerged arc welding, Welding distortion, welding defects, methods of controlling welding defects and inspection of welded joints.

1.5 Modern Welding Methods

Methods, Principle of operation, advantages, disadvantages and applications of, Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding, Robotic welding

2. Foundry Techniques (16 Hours)

2.1. Pattern Making

Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S., Introduction to cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores

2.2.. Moulding and Casting

2.2.1. Moulding Sand

Properties of moulding sand, their impact and control of properties viz. permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability,

collapsibility, Various types of moulding sand, Testing of moulding sand. Safety precautions in foundry.

2.2.2. Mould Making

Types of moulds, Step involved in making a mould, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floor molding, pit molding and machine molding, Molding machines squeeze machine, jolt squeeze machine and sand slinger.

2.2.3 Casting Processes

Charging a furnace, melting and pouring both ferrous and non ferrous metals, cleaning of castings, Principle, working and applications of Die casting: hot chamber and cold chamber, Centrifugal casting

2.2.4. Gating and Risering System

Elements of gating system, Pouring basin, sprue, runner, gates, Types of risers, location of risers, Directional solidification

2.2.5 Melting Furnaces

Construction and working of Pit furnace, Cupola furnace, Crucible furnace – tilting type, Electric furnace

2.2.6 Casting Defects

Different types of casting defects, Testing of defects: radiography, magnetic particle inspection and ultrasonic inspection.

3 Metal Forming Processes (10 Hours)

3.1 Press Working - Types of presses, type of dies, selection of press die, die material. Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping

3.2 Forging - Open die forging, closed die forging, Press forging, upset forging, swaging, up setters, roll forging, Cold and hot forging

3.3 Rolling - Elementary theory of rolling, Types of rolling mills, Thread rolling, roll passes, Rolling defects and remedies

3.4 Extrusion and Drawing - Type of extrusion- Hot and Cold, Direct and indirect. Pipe drawing, tube drawing, wire drawing

4. Plastic Processing (06 Hours)

4.1 Industrial use of plastics, and applications- Advantages and limitations of use of plastics.
4.2 Injection moulding-principle, working of injection moulding machine.
4.3 Compression moulding-principle, and working of compression moudling machine.

INSTRUCTIONAL STRATEGY

1. Teachers should lay special emphasis in making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.
2. Use of audio-visual aids/video films should be made to show specialized operations.

MEANS OF ASSESSMENT

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

LIST OF RECOMMENDED BOOKS

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

Topic No.	**Time Allotted (**Hours**)**	**Marks Allotted (%)**
1	16	35
2	16	35
3	10	20
4	06	10
Total	**48**	**100**

3.6 WORKSHOP PRACTICE -1

L	T	P
-	-	9

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, skills in operating various machines need to be developed. Hence the subject of workshop practice.

LIST OF PRACTICALS

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

Welding Shop

Job 1. Preparing gas welding joint in vertical/Horizontal position joining M.S. Plates
Job 2. Exercise on gas cutting of mild steel plate with oxy-acetylene gas torch.
Job 3. Exercise on gas welding of cast iron and brass part or component.
Job 4. Exercise on preparation of T Joint by arc welding (200 mm x 6 mm Flats)
Job 5. Exercise on spot welding/seam welding (any utility item)
Job 6. Exercise on MIG and TIG welding
Job 7 Exercise on arc welding pipe joint MS.

Pattern making

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

Foundry Shop

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

Forging Shop/Fitting Shop/Sheet Metal Shop

Job 1. Preparation of single ended spanner by hand/machine forging.
Job 2. Demonstration of spinning process on lathe and spinning a bowl on a lathe machine.
Job 3. Demonstration of grinding process on lathe machine and grinding a job on a lathe machine
Job 4. Preparation of utility item such as Dustbin or Paper tray out of G.I. sheet.
Job 5. Preparation of drilling Jig.

INSTRUCTIONAL STRATEGY

1. Focus should be laid in preparing jobs using various machines/equipment in the workshop.

2 Foreman Instructor should conduct classes of each Workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva-voce

SOFT SKILLS – I

L	T	P
-	-	2

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:

- Identify components of effective verbal communication
- Prepare a report
- Learn the techniques of enhancing memory
- Set goals for overall personality development
- Understand the concept of quality and its implementation in an organisation.

DETAILED CONTENTS

- Soft Skills - Concept and Importance
- Communication Skills- Improving verbal communication
- Report Writing
- Method to enhance memory and concentration
- Component of overall personality- Dressing sense/etiquettes/body language etc.

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

- Sports
- NCC/NSS
- Camp – Blood donation
- Cultural Event

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

FOURTH SEMESTER

4.1 COMPUTER AIDED DRAFTING

L	T	P
-	-	4

RATIONALE

A diploma holder is expected to prepare and interpret CAD Drawings. Hence this subject.

LEARNING OUTCOMES

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

- know the advantages of using CAD in comparison with conventional method.
- draw and interpret CAD drawings using drawing, editing and viewing in CAD software.
- create easy and complex solids and assemblies using various tools in CAD software.
- Assemble various mechanisms using CAD software.

DETAILED CONTENTS

1. Introduction to Computer Aided Drafting (2D) commands of any one software (Auto CAD, ProE, Solid works, Unigraphics etc.) (6 drawing sheets)

    1.1 Concept of AutoCAD, Tool bars in CAD software, coordinate system, snap, grid, and ortho mode (Absolute, Relative and Polar), setting of units and layout.
    1.2 Drawing commands – point, line, arc, circle, ellipse,
    1.3 Editing commands – scale, erase, copy, stretch, lengthen and explode.
    1.4 Dimensioning and placing text in drawing area
    1.5 Sectioning and hatching
    1.6 Inquiry for different parameters of drawing entity
    1.7 Create layers within a drawing
    1.8 Specifying Geometrical Dimensioning & tolerancing (GD&T) parameters in drawing

2. Detail and assembly drawing of the following using Drafting Software (2D) (4 sheets)

    2.1 Plummer Block
    2.2 Wall Bracket
    2.3 Stepped pulley, V-belt pulley
    2.4 Flanged coupling
    2.5 Machine tool Holder (Three views)
    2.6 Screw jack, joints, crank shaft and piston.

3. Isometric Drawing by CAD using any part modeling Software (3D) (one sheet)

Drawings of following on computer:

- Cone
- Cylinder
- Cube
- Spring
- Isometric view of objects

4. Introduction to any part modeling software(ProE, Solid works, AutoCAD, Uni Graphic , Catia etc.)

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

4.1 Part modeling (4 models)

Part Modeling Tools:-

4.1.1 Creating reference planes

4.1.2 Creating Extrude features Creating Revolve Creating Swept features

4.1.3 Creating Loft features

4.1.4 Creating Reference - points, axis, coordinates

4.1.5 Creating curves

4.1.6 Creating Fillet features

4.1.7 Inserting Hole types

4.1.8 Creating Chamfer

4.1.9 Creating Shell

4.1.10 Creating Rib

4.1.11 Environment& Utilities - Working with views and manipulating views.

4.1.12 Create parts e.g. Piston, Pin, Bolts and Nuts, Fixture, Jig parts, Washer, Rings, Gaskets, Machine parts etc.

4.2 Assembly and Simulation (2 sheets)

Assembly Modeling Tools:-

Introduction to Assembly Modeling & Approaches – Top down and Bottom up approach, Applying Standard Mates- Coincident, Parallel, Perpendicular, Tangent, Concentric, Lock, Distance, Angle. Assemble of any two Mechanism e.g. Crank slider mechanism, Piston and Cylinder assembly, Quick Return Mechanism (QRM), Machine vices, Crank Shaft, Bearing assembly, any other mechanism.

INSTRUCTIONAL STRATEGY

1. Teachers should show model or realia of the component/part whose drawing is to be made.
2. Emphasis should be given on cleanliness, dimensioning, & layout of sheet.

3. Teachers should ensure use of IS codes related to drawing.

MEANS OF ASSESSMENT

- Drawings
- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Software installation, operation, and viva-voce
- **LIST OF RECOMMENDED BOOKS**

1. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran; Vikas Publishing House, Delhi.
2. AutoCAD for Engineering Drawing Made Easy by P. NageswaraRao; Tata McGraw Hill, New Delhi.
3. AutoCAD 2000 for you by UmeshShettigar and Abdul Khader; Janatha Publishers, Udupi.
4. Auto CAD 2000 by Ajit Singh, TMH, New Delhi.
5. Instruction Manual of the software used (AutoCAD, ProE, Solidwors, Unigraphic etc.)

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

Websites for Reference:

http://swayam.gov.in

4.2 MATERIALS AND METALLURGY

L T P
4 - 2

RATIONALE

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

LEARNING OUTCOMES

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

- Distinguish between metals and non metals and ferrous and non ferrous materials.
- Analyze microstructure and changes in microstructure due to heat treatment.
- Carryout various heat treatment processes such as annealing, normalizing. tempering and hardening.
- Draw and interpret iron-carbon diagram.
- Classify various types of plastics and rubber.
- Explain properties and applications of composites, ceramics and smart materials.
- Select suitable material to be used for various engineering applications.

DETAILED CONTENTS

1. Introduction (08 Hours)

Material, Engineering materials, History/Timeline of Material Origin, Scope of Material Science, Overview of different engineering materials and applications, Importance, Classification of materials, Difference between metals and non-metals, Physical and Mechanical properties of various materials, Present and future needs of materials, Various issues of Material Usage-Economical, Environment and Social, Overview of Biomaterials and semi-conducting materials.

2. Crystallography (08 Hours)

Fundamentals: Crystalline solid and amorphous solid, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals, Number of atoms per unit Cell, Atomic Packing Factor, coordination number (without derivation), Defects/Imperfections, types and effects in Solid materials.

Deformation: Overview of deformation behaviour and its mechanisms, Elastic and Plastic deformation, behaviour of material under load and stress-strain curve.

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

3. Metallurgy: (03 Hours)

Introduction, Cooling curves of pure metals, dendritic solidification of metals, effect of grain size on mechanical properties, Binary alloys, , Thermal equilibrium diagrams, Lever rule, Solid Solution alloys

4. Metals And Alloys (18 Hours)

Ferrous Metals: Different iron ores, Flow diagram for production of iron and steel, allotropic forms of iron- Alpha, Delta, Gamma. Basic process of manufacturing of pig iron and steel-making.

Cast Iron: Properties, types of Cast Iron, manufacture and their use.

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

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

5. Heat Treatment (09 Hours)

Definition and objectives of heat treatment, Iron carbon equilibrium diagram, different microstructures of iron and steel .. Formation and decomposition of Austenite, Martensitic Transformation. Various heat treatment processes- hardening, tempering, , annealing, normalizing, surface hardening , carburizing, nitriding, cyaniding. Hardenability of Steels, Types of heat treatment furnaces (only basic idea), measurement of temperature of furnaces.

6. Plastics (06 Hours)

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

7. Advanced Materials (12 Hours)

Heat Insulating materials- Asbestos, glasswool, thermocole.
Ceramics-Classification, properties, applications
Refractory materials –Dolomite, porcelain.
Glass – Soda lime, borosil.

Joining materials/Adhesives – Classification, properties and applications
Abrasive materials
Composites-Classification, properties, applications
Materials for bearing metals
Materials for Nuclear Energy
Smart materials- properties and applications.

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Text book of Material Science by R.K. Rajput; Katson Pubs, Ludhiana

2. Text book of Material Science by V.K. Manchanda and GBS Narang; Khanna Publishers, New Delhi
3. Introduction to Material Science by A.R. Gupta, Satya Prakashan, New Delhi.
4. Material Science by Hazra, Chaudhary
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.	08	12
2.	08	12
3.	03	05
4.	18	30
5.	09	15
6.	06	10
7.	12	16
Total	**64**	**100**

4.3 HYDRAULICS AND PNEUMATICS

L T P

3 - 2

RATIONALE

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

LEARNING OUTCOMES

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

- Explain fluid properties, their units and conversion.
- Use and Maintain different types of pressure gauges.
- Calculate velocity and discharge of various liquids.
- Apply Bernoulli's theorem for calculating pipe diameter and height of pipe from ground.
- Calculate pipe friction and losses in pipelines.
- Specify hydraulic machines for different applications.
- Select maintain and resolve troubles in pumps.
- Apply Pascal's law in practical applications.
- Maintain hydraulic and pneumatic system.

DETAILED CONTENTS

1. Introduction (03 Hours)

   Introduction to Hydraulics and Pneumatics. Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility, surface tension, kinematic viscosity and dynamic viscosity and their units. Simple numeric problems related to properties of fluids.

2. Pressure and its Measurement (07 Hours)

   2.1 Concept of pressure, Intensity of pressure, static pressure and pressure head.

Types of Pressure (Atmospheric Pressure, Gauge Pressure, Absolute Pressure).

2.2. Pressure measuring devices: Manometers and Mechanical Gauges

Manometers: Piezometer, Simple U- tube Manometer, Micromanometer, Differential U-tube Manometer, Inverted U-tube, Manometers Construction, working and application , including simple numerical problems.

Mechanical Gauges: Bourdon Tube pressure gauge, Diaphragm Pressure Gauge, Dead weight pressure gauge. Construction, working and application.

2.3 Statement of Pascal's law and its applications.

3. Flow of Fluids (12 Hours)

3.1 Types of fluid flow – Steady and Unsteady, Uniform and Non-uniform, Laminar and Turbulent; Rate of flow (Discharge) and its units; Continuity Equation of Flow; Hydraulic Energy of a flowing fluid ; Total head ; Bernoulli's Theorem statement (without proof) and its applications. Discharge measurement with the help of Venturimeter, Orifice meter, Pitot-tube, limitations of Bernoulli's theorem , simple numerical problems on above topics.

3.2 Pipe and pipe flow, wetted perimeter, hydraulic mean depth, hydraulic gradient; loss of head due to friction; Chezy's equation and Darcy's equation of head loss (without proof), Reynold's number and its effect on pipe friction; Water hammer.

Simple numerical problems on pipe friction.

3.3 Nozzle - definition, velocity of liquid flowing through the nozzle, power developed.

4. Hydraulic Machines (6 Hours)

Description, operation and application of – hydraulic press, hydraulic jack, hydraulic accumulator, hydraulic brake ,hydraulic ram, hydraulic door closer.

5. Pumps and Water Turbines (10 Hours)

5.1 Concept of hydraulic pump. Classification of pumps.

5.2 Construction, operation and application of Single acting reciprocating pump, vane, screw and gear pumps.

5.3 Construction, operation and application of centrifugal pump. Trouble shooting and problems in centrifugal pumps and remedial measures, pitting, cavitation, priming.

5.4 Concept of a turbine, classification of turbines, types of turbines - impulse and reaction type (concept only), difference between them. Construction and working of pelton wheel, Francis turbine and Kaplan turbines.

6. Oil power Hydraulic and Pneumatic systems (10 Hours)

6.1 Introduction to oil power hydraulics and pneumatic system. Relative Merits and Demerits as oil power hydraulic and pneumatic system.

6.2 Industrial applications of oil power hydraulic and pneumatic system.

6.3 Basic components of hydraulic system, definition and functions of each component in a hydraulic circuit. Hydraulic oils- Classification and their properties. Seals and packing- classification of seals, sealing materials.

6.4 Maintenance of hydraulic system: common faults in hydraulic system, simple visual checks of oil, causes of contamination, preventive measures.

6.5 Basic Components of Pneumatic Systems , definition and functions of each component in a Pneumatic circuit. Necessity of Filter, Regulator and Regulator(FLR).

6.6 Common problems in pneumatic systems. Maintenance schedule of pneumatic systems.

LIST OF PRACTICALS

1. Measurement of pressure head by employing.

i) Piezometer tube
ii) Simple U-tube manometer
iii) Bourdon.s tube pressure gauge

2. Verification of Bernoulli's theorem.

3. Measurement of flow by using venturimeter.

4. To find out the value of coefficient of discharge for a venturimeter.

5. To find coefficient of friction for a pipe (Darcy's equation).

6. To study a single stage centrifugal pump and reciprocating pump for constructional details with the help of cut section models.

7. Study the working of Pelton wheel, Francis and Kaplan turbine with the help of working model.

8. Study of hydraulic circuit of any available machine or working model

9. Study of pneumatic circuit of any available machine or working model

INSTRUCTIONAL STRATEGY

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

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. Fluid Mechanics by KL Kumar; S Chand and Co Ltd., Ram Nagar, New Delhi.
2. Hydraulics and Fluid Mechanics Machine by RS Khurmi ; S.Chand & Co. Ltd., New Delhi.
3. Fluid Mechanics through Problems by RJ Garde; Wiley Eastern Ltd., New Delhi.
4. Fluid Mechanics by Dr AK Jain, Khanna Publishers, New Delhi.
5. Hydraulic and Pneumatic Control by K Shammuga Sundaram, S. Chand & Co. Ltd., New Delhi

6. Hydraulics and Hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd., Delhi.

7. Hydraulic and Pneumatic Power and Control Design, Performance and Application by Yeaple, McGraw Hill, New York..

8. Pneumatic Controls by Festo Didactic; Bangalore.

9. Pneumatics Control: An Introduction to the Principles by Werner Deppert and Kurt Stoll;Vogel – Verlag.

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

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (**Hours**)**	**Marks Allotted (%)**
1	03	06
2	07	16
3	12	24
4	06	14
5	10	20
6	10	20
Total	**48**	**100**

4.4 THERMODYNAMICS-II

L	T	P
3	-	2

RATIOANLE

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

Learning Outcomes

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

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

DETAILED CONTENTS

1. IC Engines (07 Hours)

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

2. Fuel Supply and Ignition System in Petrol Engine (06 Hours)

    2.1 Concept of carburetion
    2.2 Air fuel ratio
    2.3 Simple carburetor and its limitations and application.
    2.4 Description of battery coil and electro ignition system, fault finding/ and remedial action in ignition system
    2.5 Description of petrol injection system

3. Fuel System of Diesel Engine (04 Hours)

    3.1 Components of fuel system
    3.2 Description and working of fuel feed pump
    3.3 Fuel injection pump, Common rail direct injection (CRDI)
    3.4 Injectors

4. Cooling and Lubrication (07 Hours)

4.1 Function of cooling system in IC engine
4.2 Air cooling and water cooling system, use of thermostat and radiator.
4.3 Function of lubrication
4.4 Types and properties of lubricant
4.5 Lubrication system of engine
4.6 Fault finding in cooling and lubrication and remedial action

5. Testing of IC Engines (07 Hours)

5.1 Engine power - indicated and brake power
5.2 Efficiency - mechanical, thermal. relative and volumetric
5.3 Methods of finding indicated and brake power
5.4 Morse test for petro1 engine
5.5 Heat balance sheet, simple numerical problems
5.6 Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers - EURO - 1, EURO - 2, Bharat methods of reducing pollution in IC engines, alternative fuels like CNG, LPG, Hydrogen

6. Steam Turbines and Steam Condensers (08 Hours)

6.1 Function and use of steam turbine
6.2 Steam nozzles - types and applications
6.3 Steam turbines - impulse, reaction, simple and compound, construction and working principle
6.4 Governing of steam turbines
6.5 Function of a steam condenser, elements of condensing plant
6.6 Classification - jet condenser, surface condenser
6.7 Cooling pond and cooling towers

7. Gas Turbines and Jet Propulsion (09 Hours)

7.1 Classification, open cycle gas turbine and closed cycle gas turbine, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbine
7.2 Open cycle constant pressure gas turbines - general layout, PV and TS diagram and working of gas turbine
7.3 Closed cycle gas turbines, PV and TS diagram and working
7.4 Principle of operation of ram-jet engine and turbo jet engine - application of jet engines
7.5 Rocket engine - its principle of working and applications

7.6 Fuels used in jet propulsion

LIST OF PRACTICALS

1. Dismantle an IC engine and note down the condition of various parts, removal and fitting of piston, rings, measuring of bore size, crank shaft ovality and assemble it.
2. Dismantle a carburetor
3. Servicing of petrol injection system
4. Valve servicing, grinding, lapping and fitting mechanism and tappet adjustment.
5. Inspection of ignition system of a multi-cylinder engine stressing ignition timings, setting, fixing order and contact breaker; gap adjustment, spark plug cleaning.
6. Service of cooling & lubrication system of IC engine and note down the functioning/testing of various components.
7. Determination of BHP by dynamometer.
8. Morse test on multi-cylinder petrol engine.
9. Draw layout of modern automobile workshop and note down the special tools and equipments in each shop.
10. Local visit to roadways or private automobile workshop.

INSTRUCTIONAL STRATEGY

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

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. Elements of Heat Engines by Pandey and Shah; Charotar Publishing House, Anand.
2. Thermal Engineering by PL. Ballaney; Khanna Publishers, New Delhi.
3. Engineering Thermodynamics by Francis F Huang; McMillan Publishing Company, Delhi.
4. Engineering Thermodynamics by CP. Arora; Tata McGraw Hill Publishers, New Delhi.
5. Thermal Engineering by RK Purohit; Standard Publishers Distributors, 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	07	15
2	06	12
3	04	10
4	07	15
5	07	15
6	08	15
7	09	18
Total	**48**	**100**

4.5 INDUSTRIAL ENGINEERING

L	T	P
3	-	-

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. In addition, knowledge of production planning and control and estimating and costing is 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
- Solve planning, scheduling and sequencing problems for shop floor
- Interpret different kinds of production systems
- Prepare break-even analysis and Gantt chart.
- Locate suitable plant location and draw plant layout for different production system.
- Maintain inventory optimally and classify different types of inventory

DETAILED CONTENTS

1. Productivity (04 Hours)

   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 Hours)

   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 (04 Hours)

Definition, Objectives and procedure for Method study analysis; Information collection and recording techniques through various diagrams.

4. Motion Analysis (06 Hours)

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 (08 Hours)

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 (04 Hours)

Introduction to wages, Wage payment for direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour.

7. Production Planning and Control (8 Hours)

Production and its types- job order, batch type and continuous type of productions. Objectives and components (functions) of P.P.C, Advantages of production planning and Production Control, stages of P.P.C, process planning, routing, scheduling, dispatching and follow up, routing purpose, route sheets, scheduling – purpose, machine loading chart, dispatching – purpose, and procedure, follow up – purpose and procedure. Structure and function of Production, Planning Department, Gantt chart. CPM/PERT technique, drawing of simple networks and critical time calculation. Production Control in job order, batch type and continuous type of productions. Difference between these controls.

8. Stores Management: (04 Hours)

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

LIST OF CLASSROOM EXERCISES:

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

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, 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/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

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

4.6 WORKSHOP TECHNOLOGY-II

L	T	P
4	-	-

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (08 Hours)

   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. Drilling (08 Hours)

2.1 Principle of drilling.
2.2 Classification of drilling machines and their description.
2.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
2.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
2.5 Types of drills and their features, nomenclature of a drill
2.6 Drill holding devices.
2.7 Types of reamers.

3. Lathe (12 Hours)

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.

4. Boring (06 Hours)

4.1 Principle of boring
4.2 Classification of boring machines and their brief description.
4.3 Specification of boring machines.
4.4 Boring tools, boring bars and boring heads.
4.5 Description of jig boring machine.

5. Shaping and Planing (10 Hours)

5.1 Working principle of shaper and planer
5.2 Type of shapers
5.3 Type of planers
5.4 Quick return mechanism applied to shaper and planer machine.
5.5 Work holding devices used on shaper and planer
5.6 Types of tools used and their geometry.
5.7 Specification of shaper and planer .
5.8 Speeds and feeds in above processes.

6. Broaching (06 Hours)

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

7. Jigs and Fixtures (08 Hours)

7.1 Importance and use of jigs and fixture
7.2 Principle of location
7.3 Locating devices
7.4 Clamping devices
7.5 Types of Jigs – Drilling jigs, bushes, template jig, plate jig, channel jig, leaf jig.
7.6 Fixture for milling, turning, welding, grinding
7.7 Advantages of jigs and fixtures

8. Cutting Fluids and Lubricants (06 Hours)

8.1 Function of cutting fluid
8.2 Types of cutting fluids
8.3 Difference between cutting fluid and lubricant
8.4 Selection of cutting fluids for different materials and operations
8.5 Common methods of lubrication of machine tools.

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes.
2. Focus should be on preparing jobs using various machines in the workshop.
3. Foreman Instructor should conduct classes of each workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons; Delhi
7. Elements of Workshop Technology by SK Choudhry and Hajra; Asia Publishing House
8. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi

4 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	08	12
2	08	14
3	12	22
4	06	08
5	10	16
6	06	08
7	08	12
8	06	08
Tot1al	**64**	**100**

4.7 WORKSHOP PRACTICE-II

L	T	P
-	-	6

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, skills related to various machining processes, modern machining methods, and use of tools, jigs and fixtures are required to be developed. Hence the subject of workshop practice.

PRACTICAL EXERCISES

Turning Shop

Job 1. Grinding of single point turning tool with demonstration of all angles.
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 and assemblage of same.

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.

INSTRUCTIONAL STRATEGY

1) Focus should be on preparing jobs using various machines in the workshop.
2) Foreman Instructor should conduct classes of each workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

MEANS OF ASSESSMENT

- Workshop jobs

- **Report writing, presentation and viva-voce**

RECOMMENDED BOOKS

1. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons; Delhi
2. Elements of Workshop Technology by SK Choudhry and Hajra; Asia Publishing House
3. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi
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Websites for Reference:

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SOFT SKILLS – II

L	T	P
-	-	2

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:

- Develop Communication Skills
- Work in a team
- Learn to resolve conflict by appropriate method
- Identify leadership traits and learn self motivation
- Follow ethics

DETAILED CONTENTS

- Concept of team building, behavior in a team
- Developing Interpersonal Relations- empathy, sympathy
- Communication skills - improving non-verbal communication
- Conflict Management
- Motivation
- Leadership
- Professional Ethics and Values
- Health, Hygiene, Cleanliness and Safety

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

- Sports
- NCC/NSS
- Camp – Environment awareness
- Cultural Event

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

INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 6 weeks upto 8 weeks duration to be organized during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 100 and external assessment of 100 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behavior, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry. The components of evaluation will include the following.

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%

FIFTH SEMESTER

5.1 THEORY OF MACHINES

L	T	P
3	-	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.
- Explain working of different types of governors.
- Identify different types of cams and followers and construct displacement diagram
- Calculate balancing of rotating mass and its position.
- Identify different type of vibrations, their causes, harmful effect and remedies.

DETAILED CONTENTS

1. Simple Mechanisms (06 Hours)

1.1 Kinematics of Machines: - Definition of Kinematics, Dynamics, Statics, Kinetics, Kinematic link, Kinematic Pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, inversion, machine and structure.

1.2 Inversions of Kinematic Chain: Inversion of four bar chain, coupled wheels of Locomotive & Pantograph. Inversion of Single Slider Crank chain- Rotary I.C. Engines mechanism, Crank and Slotted lever quick return mechanism. Inversion of Double Slider Crank Chain- Scotch Yoke Mechanism & Oldham's Coupling.

2. Power Transmission (12 Hours)

2.1 Introduction to Belt and Rope drives
2.2 Types of belt drives .
2.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
2.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
2.5 Different types of chains and their terminology
2.6 Gear Drive - Simple, compound, reverted and epicyclic gear trains(simple numericals)
2.7 Relative advantages and disadvantages of various drives

3. Flywheel (06 Hours)
3.1 Principle and applications of flywheel
3.2 Turning - moment diagram of flywheel for different engines
3.3 Fluctuation of speed and fluctuation of energy - Concept only
3.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy Simple numericals on above topics

4. Governor (06 Hours)

4.1 Function of a governor, comparison of flywheel and governor.
4.2 Simple description and working of Watt, Porter and Hartnel governor (simple numerical based on watt and porter governor)
4.3 Terminology used in governors: Height, equilibrium speed, Hunting, isochronisms, stability, sensitiveness of a governor.

5. Cams (06 Hours)

5.1 Definition and function of cam. Description of different types of cams and followers with simple line diagram.

5.2 Terminology of cam profile.

5.3 Displacement diagram for uniform velocity, S.H.M. and uniform acceleration and deceleration.

6. Balancing (06 Hours)

6.1 Need of balancing, concept of static and dynamic balancing.

6.2 Introduction to balancing of rotating masses in the same plane and different Planes (simple numericals)

7. Vibrations (06 Hours)

7.1 Causes of vibrations in machines, their harmful effects and remedies.

7.2 Types-longitudinal, transverse and torsional vibrations.

7.3 Damping of vibrations

LIST OF PRACTICALS

1. To study inversion of Four Bar Mechanism, Single Slider Crank Chain Mechanism and Double Slider Crank Chain Mechanism with the help of working models.
2. To study various kinds of belts drives and gear trains with the help of working models.
3. To find the moment of inertia of a flywheel.
4. To Study the different types of centrifugal governors & to plot graph between R.P.M & Displacement.
5. To construct cam profile for uniform velocity, SHM and uniform acceleration and retardation on drawing sheet.
6. To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces.

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.

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. Theory of Machines by D.R. Malhotra; Satya Prakashan, New Delhi.
2. Theory of Machines by V.P Singh; DhanpatRai and sons, New Delhi.
3. Theory of Machines by JagdishLal; 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/HSBTE/NITTTR.

Websites for Reference:

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hours)**	**Marks Allotted (%)**
1	06	12
2	12	24
3	06	14
4	06	12
5	06	14
6	06	12
7	06	12
Total	**48**	**100**

5.2. REFRIGERATION AND AIR CONDITIONING

L	T	P
3	-	2

RATIONALE

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

LEARNING OUTCOMES

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

- Explain the working and construction features of refrigeration and air conditioning systems
- Draw and interpret various refrigeration cycles.
- Make basic calculation of psychometric properties and processes.
- Calculate heating and cooling load requirements of a room.
- Explain latest developments in the field of refrigeration and air conditioning.
- Calculate the properties of air by using psychometric chart.
- Detect faults in an air-conditioner/refrigerator.
- Carry out charging of air conditioner.

DETAILED CONTENTS

REFRIGERATION

1. Fundamentals of Refrigeration (04 Hours)

   Introduction to refrigeration, and air conditioning, meaning of refrigerating effect, units of refrigeration, COP, difference between COP and efficiency, methods of refrigeration, Natural system and artificial system.

2. Vapour Compression System (12 Hours)

   Introduction, principle, function, parts and necessity of vapour compression system, T- ϕ and p– H charts, dry, wet and superheated compression. Effect of sub cooling, super heating,. actual vapour compression system. Introduction to air refrigeration system, advantage and disadvantage of air refrigeration over vapour compression system.

3. Refrigerants (04 Hours)

Functions, classification of refrigerants, properties of R - 717, R – 22, R–134 (a), CO_2, R – 12, R – 502, Properties of ideal refrigerant, selection of refrigerant

4. Vapour Absorption System (04 Hours)

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

5. Refrigeration Equipment (08 Hours)

5.1 Compressors- Function, various types of compressors

5.2 Condensers - Function, various types of condensers

5.3 Evaporators- Function, types of evaporators

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

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

AIR CONDITIONING

6. Psychrometry (06 Hours)

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

7. Applied Psychrometry and Heat Load Estimation. (08 Hours)

Psychrometric chart, various lines, psychrometric process, by pass factor, room sensible heat factor, effective room sensible heat factor, grand sensible heat factor, ADP, room DPT.

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

8. Latest development in refrigeration and air conditioning:- (02 Hours)

Inverter technology, auto-defrosting, blast cooling, star rating.

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

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

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	08
2	12	24
3	04	10
4	04	10
5	08	16
6	06	12
7	08	16
8	02	04
Total	**48**	**100**

5.3 MACHINE DESIGN

L	T	P
4	-	-

RATIONALE

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

LEARNING OUTCOMES

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

- Explain the terms related to design.
- Use codes and standards for designing a component.
- Select material for designing a component.
- Interpret the various causes of design failures.
- Design shaft on the basis of strength and rigidity.
- Design various machine elements (key, joint, flange coupling and screwed joints)

DETAILED CONTENTS

1. Introduction (08 **Hours**)

1.1 Design – Definition, Type of design, necessity of design

1.1.1 Comparison of designed and undesigned work
1.1.2 Design procedure
1.1.3 Characteristics of a good designer

1.2 Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.

1.2.1 General design consideration
1.2.2. Codes and Standards (BIS standards)

1.3 Engineering materials and their mechanical properties :

1.3.2 Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity and strength etc.

1.3.3 Selection of materials, criteria of material selection

2. Design Failure (04 Hours)

2.1 Various design failures-maximum stress theory, maximum strain theory
2.2 Classification of loads
2.3 Design under tensile, compressive and torsional loads.

3. Design of Shaft (10 **Hours**)

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 (06 **Hours**)

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 (20 **Hours**)

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

5.1 Temporary Joint:

5.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems).
5.1.2 Cotter Joint – Different parts of the spigot and socket joints, Design of spigot and socket joint.

5.2 Permanent Joint:

5.2.1 Welded Joint - Welding symbols. Type of welded joint, strength of parallel and transverse fillet welds.
5.2.2 Strength of combined parallel and transverse weld.
5.2.3 Riveted Joints. : Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering.
5.2.4 Different modes of rivet joint failure.
5.2.5 Design of riveted joint – Lap and butt, single and multi riveted joint.

6. Design of Flange Coupling (08 Hours)

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 (08 Hours)

5.1 Introduction, Advantages and Disadvantages of screw joints, location of screw joints.
5.2 Important terms used in screw threads, designation of screw threads
5.3 Initial stresses due to screw up forces, stresses due to combined forces
5.4 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/HSBTE/NITTTR.

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2	04	06
3	10	16
4	06	10
5	20	32
6	08	12
7	08	12
Total	**64**	**100**

5.4 CNC MACHINES AND AUTOMATION

L	T	P
3	-	4

RATIONALE

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

LEARNING OUTCOMES

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

- Explain the construction and tooling of CNC machine.
- Prepare simple part programme.
- Operate a CNC lathe.
- Operate a CNC milling machine.
- Diagnose common problems in CNC machines.
- Explain the trends in the field of automation.
- Use Advanced programming structures.

DETAILED CONTENTS

1. Introduction (08 Hours)

   Introduction to NC, Basic Components of NC, binary coding, MCU, , input devices, advantages /disadvantages of NC machines over conventional machines, CNC & DNC, their types, their advantages, disadvantages and applications, selection of parts to be machined on CNC machines, Problems with conventional NC, Rules for Axis identification, New developments in NC, PLC Control and its purpose.

2. Construction and Tooling (08 Hours)

   Design features, special mechanical design features, specification Chart of CNC machines, types of slideways, balls, rollers, motor- servo/stepper , axis drive and leadscrew, recirculating ball screw and nut assembly, swarf removal, safety and guarding devices,
   Various cutting tools for CNC machines, overview of tool holder, different pallet systems and automatic tool changer system, tool change cycle, management of a tool room.

3. System Devices (06 Hours)

Control System , Feedback control classification(open loop, closed loop), Actuators, Transducers and Sensors, characteristics of sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder and decoder, axis drives, other classifications of CNC machines-Feedback, motion , positioning.

4. Part Programming (12 Hours)

Part programming and basic procedure of part programming, NC words, Blocks, part programming formats, simple programming for rational components (Point to point, Straight line, curved surface), tool off sets, cutter radius compensation and wear compensation.
Advanced structures: Advantages of using advanced structures, part programming using canned cycles, subroutines and do loops, mirror image

5. Problems in CNC Machines (06 Hours)
Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-line fault finding diagnosis tools in CNC machines, methods of using discussion forums, environmental problems.

6. Automation and NC system (08 Hours)

Automation, suitability of production system to automation , types, emerging trends in automation, automatic assembly, manufacture of printed circuit boards, manufacture of integrated Circuits, Overview of FMS, AGV, ASRS, Group technology, CAD/CAM and CIM, Automated Identification system , concept of AI, Robotics, nomenclature of joints, motion.

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.(for finish pass only) – (At least two)

Calculating coordinate points for a cylindrical job by considering sign convention for lathe

- 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 (for finish pass only)- At least two

- Plain milling
- Slot milling
- Contouring
- Pocket milling

Calculate coordinate points for a zig zag job by considering sign convention for milling

6. Develop a part program by using canned cycle on CNC lathe for turning , facing
7. Preparation of work instruction for machine operator
8. Preparation of preventive maintenance schedule for CNC machine.
9. Demonstration through industrial visit for awareness of actual working of FMS in production.
10. Use of software for turning operations on CNC turning center.
11. 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.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.
2. CNC Machine and Automation by JS Narang, Dhanpat Rai &Co, New Delhi.
3. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
4. CNC Machine by Bharaj; Satya Puble-books ications, 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

Topic No.	Time Allotted (Hours)	Marks Allotted (%)
1	08	20
2	08	16
3	06	16
4	12	24
5	06	12
6	08	12
Total	**48**	**100**

5.5 WORKSHOP TECHNOLOGY - III

L	T	P
3	-	-

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

1. Milling (12 Hours)

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

2. Gear Manufacturing and Finishing Processes (06 Hours)

    2.1 Gear hobbing

2.2 Gear shaping
2.3 Gear finishing processes

3 Grinding (10 Hours)

3.1 Purpose of grinding
3.2 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
3.3 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
3.4 Truing, dressing, balancing and mounting of wheel.
3.5 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
3.6 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
3.7 Selection of grinding wheel
3.8 Thread grinding.

4. Modern Machining Processes (08 Hours)

4.1 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
4.2 Electro Chemical Processes - Electro Chemical Machining (ECM) – Fundamental principle, process, applications
4.3 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid, applications
4.4 Laser Beam Machining (LBM) – Introduction, machining process and applications
4.5 Plasma Arc Machining (PAM) and welding – Introduction, principle process and applications

5. Metallic Coating Processes (04 Hours)

5.1 Metal spraying – Wire process, powder coating process, applications
5.2 Electro plating, anodizing and galvanizing
5.3 Organic Coatings- oil base paint, rubber base coating

6. Metal Finishing Processes (08 Hours)

6.1 Purpose of finishing surfaces.
6.2 Surface roughness-Definition and units
6.3 Honing Process, its applications
6.4 Description of hones.
6.5 Brief idea of honing machines.
6.6 Lapping process, its applications.
6.7 Description of lapping compounds and tools.

6.8 Brief idea of lapping machines.
6.9 Polishing
6.10 Buffing.
6.11 Burnishing

INSTRUCTIONAL STRATEGY

3. Teachers should lay special emphasis in making the students conversant with concepts and principles of manufacturing processes.
4. Focus should be on preparing jobs using various machines in the workshop.
5. Foreman Instructor should conduct classes of each workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons, Delhi
2. Elements of Workshop Technology by S.K. Choudhry and Hajra, Asia Publishing House.
3 A Textbook of Production Engineering by PC Sharma; S.Chand and Company Ltd. Delhi.
4 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	12	25
2	06	12
3	10	20
4	08	18
5	04	10
6	08	15
Total	**48**	**100**

5.6 WORKSHOP PRACTICE - III

L	T	P
-	-	9

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, skills in operating various machines are required to be developed. Hence the subject of workshop practice.

PRACTICAL EXERCISES

Advanced 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 with greater finishing/accuracy on lathe machine
5. Resharpening of single point cutting tool with given geometry

Machine Shop

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

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva-voce

INSTRUCTIONAL STRATEGY

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

SOFT SKILLS – III

L	T	P
-	-	2

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:

- Develop communication skills.
- Learn how to speak without fear and get rid of hesitation
- Use effective presentation techniques
- Understand entrepreneurial traits
- Exhibit attitudinal changes

DETAILED CONTENTS

- Communication Skills – Handling fear and phobia
- Resume Writing
- Applying for job through email/job portal
- Interview preparation : Mock Interview, Group Discussions and Extempore
- Presentation Techniques
- Developing attitude towards safety. Disaster management.

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

- Sports
- NCC/NSS
- Camp – Entrepreneurial awareness
- Cultural Event

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

SIXTH SEMESTER

6.1 AUTOMOBILE ENGINEERING

L	T	P
3	-	2

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

L	T	P
3	-	2

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, wire and 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 σ, P, $\eta\rho$, 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

L	T	P
4	-	-

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 depreciation, 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 various operations 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

L	T	P
3	-	-

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 behaviour
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

L	T	P
4	-	-

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

L	T	P
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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

L	T	P
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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 code depending 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

L	T	P
-	-	12

RATIONALE

Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem 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.