

**TECHNICAL EDUCATION DEPARTMENT (DIPLOMA SECTOR)
UTTAR PRADESH**

CURRICULUM FOR FIRST AND SECOND SEMESTER

COMMON FOR ALL ENGINEERING DIPLOMA COURSES^

=====
Semester System
=====



EFFECTIVE FROM YEAR -----

Prepared By

INSTITUTE OF RESEARCH DEVELOPMENT & TRAINING, U.P., KANPUR

^Curriculum of First and Second Semester for the following Engineering Branches

Sr. No.	Name of Diploma Programme	Duration
1	Diploma in Mechanical Engineering	3 Years
2	Diploma in Mechanical Engineering (Repair & Maintenance)	3 Years
3	Diploma in Mechanical Engineering(Computer Aided Design)	3 Years
4	Diploma in Mechanical Engineering (Refrigeration & Air conditioning)	3 Years
5	Diploma in Mechanical Engineering (Automobile)	3 Years
6	Diploma in Mechanical Engineering(Production)	3 Years
7	Diploma in Electronics Engineering	3 Years
8	Diploma in Electronics Engineering (Advanced Microprocessor & Interface)	3 Years
9	Diploma in Electronics Engineering (Modern Consumer Electronics Appliances)	3 Years
10	Diploma in Electronics Engineering (Micro Electronics)	3 Years
11	Diploma in Electrical Engineering	3 Years
12	Diploma in Electrical Engineering (Industrial Control)	3 Years
13	Diploma in Electrical & Electronics Engineering	3 Years
14	Diploma in Electronics & Communication Engineering	3 Years
15	Diploma in Chemical Engineering	3 Years
16	Diploma in Chemical Technology (Rubber & Plastic)	3 Years
17	Diploma in Chemical Technology (Fertilizer)	3 Years
18	Diploma in Chemical Engineering (Petro Chemical)	3 Years
19	Diploma in Paint Technology	3 Years
20	Diploma in Civil Engineering	3 Years
21	Diploma in Computer Science & Engineering	3 Years
22	Diploma in Information Technology	3 Years
23	Diploma in Instrumentation & Control Engineering	3 Years
24	Diploma in Civil Engineering (Environmental Pollution & control)	3 Years

25	Diploma in Agricultural Engineering	3 Years
26	Diploma in Plastic Mould Technology	3 Years
27	Diploma in Glass & Ceramics	3 Years
28	Diploma in Dairy Engineering	3 Years
29	Diploma in Leather Technology (Tanning)	3 Years
30	Diploma in Leather Technology Footwear (Computer Aided Shoe Design)	3 Years
31	Diploma in Textile Technology	3 Years
32	Diploma in Textile Chemistry	3 Years
33	Diploma in Textile Engineering	3 Years
34	Diploma in Printing Technology	3 Years
35	Diploma in Food Technology	3 Years
36	Diploma in Paper & Pulp Technology	3 Years
37	Diploma in Carpet Technology	3 Years
38	Diploma in Mining Engineering	3 Years
39	Renewable Energy	3 Years
40	Communication and Computer Networking	3 Years
41	Civil and Environment Engineering	3 Years

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FIRST SEMESTER

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PREFACE

An important issue generally debated amongst the planners and educators world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and opens economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by the State Board of Technical Education, UP to revise the existing curricula of 42 diploma programmes as per the needs of the industry and making them NEP-2020/AICTE compliant, are laudable.

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

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

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

Director
Institute of Research Development & Training

ACKNOWLEDGEMENTS

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1. Sh. M. Devraj, IAS, Principal Secretary Govt. of UP, Technical Education Department, Secretariat Lucknow.
2. Sh. Annavi Dinesh Kumar, IAS, Special Secretary /Director, Technical Education, UP for taking keen interest in the review of this curriculum.
3. Sh. F.R. Khan, Director, I.R.D.T., Kanpur for entrusting this project of Curriculum revision.
4. All the participants from industry/field organizations, engineering colleges, polytechnics, and other technical institutions for their professional inputs during curriculum workshops.
5. Faculty /Subject Experts from U.P. Government polytechnics.

CDC Officer
IRDT Kanpur

1. SALIENT FEATURES OF DIPLOMA PROGRAMME FOR ENGINEERING & TECHNOLOGY BRANCHES

- 1) Duration of the Programme : Three years (Six Semesters)
- 2) Entry Qualification : Matriculation or equivalent as Prescribed by State Board of Technical Education, UP
- 3) Intake : 60 (or as prescribed by the Board)
- 4) Pattern of the Programme : Semester Pattern

5) **Student Centred Activities:**

A provision of 2 hrs per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise of co-curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS, library and other cultural activities, disaster management and safety etc.

6) **Project work**

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

7) **Industrial Training**

Industrial Training (Summer Internship –I) of 4 Weeks duration to be organized after II-semester exam. Evaluation will be completed in III-Semester.

STUDY AND EVALUATION SCHEME FOR ALL ENGINEERING AND TECHNOLOGY BRANCHES (Listed in Annexure -1)

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
1.1	Mathematics-I	2	1	-	3	40	-	40	60	3	-	-	60	100	
1.2	Applied Physics-I	3	-	2	4	40	60	100	60	3	40	3	100	200	
1.3	Applied Chemistry OR Introduction to IT Systems	3	-	2	4	40	60	100	60	3	40	3	100	200	
	2	-	4												
1.4	Communication Skills in English OR Fundamentals of Electrical & Electronics Engineering	3	-	2	4	40	60	100	60	3	40	3	100	200	
1.5	Engineering Graphics OR Engineering Workshop Practice	-	-	4	2	-	40	40	60	3	-	-	60	100	
	-					60	60	-	-	40	3	40			
1.6	Sports & Yoga	-	-	2	1	-	50	50	-	-	-	-	-	50	
# Student Centered Activities (SCA)		-	-	10	-	-	50	50	-	-	-	-	-	50	
TOTAL					18									900	

Note :-The Institutional authority may select alternative subjects, as indicated at Sr. No. 1.3, 1.4 and 1.5 based on the need of the respective branches offered at their institute.

The alternative subjects once selected in first semester will not be selected in second semester.

Students centered activities will comprise of co-curricular activities like extension lecture, games, hobby, clubs, e.g., photography etc., seminars, declamation contents, education field visit, library, NCC,NSS, Cultural Activities and self-study etc. The Lecture allotted to SCA can also be utilized for the course completion of other subjects.

1-Each Period will be 60 minutes duration.

2-Each Session will be 16 weeks.

3- Effective teaching will be at least 14 weeks.

STUDY AND EVALUATION SCHEME FOR ALL ENGINEERING AND TECHNOLOGY BRANCHES (Listed in Annexure -1)

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
		Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
2.1	Mathematics-II	3	1	-	4	40	-	40	60	3	-	-	60	100
2.2	Applied Physics-II	3	-	2	4	40	60	100	60	3	40	3	100	200
2.3	Applied Chemistry OR	3	-	2	4	40	60	100	60	3	40	3	100	200
	Introduction to IT Systems	2	-	4										
2.4	Fundamentals of Electrical & Electronics Engineering OR Communication Skills in English	3	-	2	4	40	60	100	60	3	40	3	100	200
2.5	Engineering Mechanics	2	1	2	4	40	60	100	60	3	40	3	100	200
2.6	Engineering Graphics OR			4	2	-	40	40	60	3	-	-	60	100
	Engineering Workshop Practice					-	60	60	-	-	40	3	40	
2.7	(Q) Environmental Sciences	3	-	-	-	-	-	-	60	3	-	-	60	-
# Student Centered Activities (SCA)		-	-	4	-	-	50	50	-	-	-	-	-	50
Total					22									1050

Note :-The Institutional authority may select alternative subjects, as indicated at Sr. No. 2.3, 2.4 and 2.6 based on the need of the respective branches offered at their institute.

The alternative subjects once selected in first semester will not be selected in second semester.

Students centered activities will comprise of co-curricular activities like extension lecture, games, hobby, clubs, e.g., photography etc., seminars, declamation contents, education field visit, library, NCC,NSS, Cultural Activities and self-study etc. The Lecture allotted to SCA can also be utilized for the course completion of other subjects.

(Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.

1-Each Period will be 60 minutes duration.

2-Each Session will be 16 weeks.

3- Effective teaching will be at least 14 weeks.

1.1 MATHEMATICS - I

L T P
2 1 -

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

- Understand and apply angle measurements, T-Ratios, and graph functions.
- Grasp the concepts of limits, differentiation and apply differentiation rules.
- Resolve proper and improper fractions into partial fractions with various factors.
- Solve problems using binomial theorem.
- Understand complex numbers in different forms , perform arithmetic operations and applications of De Moivre's theorem.

COURSE CONTENT

UNIT - I: Trigonometry

(08 Periods)

Concept of angles, measurement of angles in degrees, and radians and their conversions, T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub- multiple angles (2A) only. Graphs of $|x|$, $\sin x$, $\cos x$, and e^x .

UNIT-II : Differential Calculus

(10 Periods)

Definition of function, concept of limits. Four standard limits $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$, $\lim_{x \rightarrow 0} \frac{\sin x}{x}$, $\lim_{x \rightarrow 0} \frac{a^x - 1}{x}$, $\lim_{x \rightarrow 0} (1 + x)^{\frac{1}{x}}$.

Differentiation of x^n , $\sin x$, $\cos x$, $\tan x$, e^x , $\log_e x$ by definition. Differentiation of sum, product and quotient of functions. Differentiation of function of a function. Differentiation of trigonometric, functions, logarithmic differentiation, exponential functions.

UNIT - III: Partial fractions:

(08 Periods)

Definition of polynomial fraction, proper & improper fractions and definition of partial fractions. To resolve proper fraction and improper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors.

UNIT- IV : Binomial theorem

(06 Periods)

Value of ${}^n P_r$, ${}^n C_r$.

Binomial theorem (without proof) for positive integral index (expansion and general form); applications of Binomial theorem (General term, middle term, independent terms only).

UNIT-V : Complex Numbers:**(10 Periods)**

Definition, real and imaginary parts of a complex number, polar and Cartesian representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number. Addition, subtraction, multiplication and division of complex numbers. De Moivre's theorem and its simple applications.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayanan, Engineering Mathematics, 6/e., Vikas Publishing House.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	08	20
2.	10	25
3.	08	20
4	06	10
5	10	25
Total	42	100

1.2 APPLIED PHYSICS – I

L T P
3 - 2

COURSE OBJECTIVES

Applied physics includes the study of a diversified topics related to the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this course content.

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

COURSE OUTCOMES

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

- Identify the use of S.I. system of measurement and how it is used in engineering
- Represent physical quantities as scalars and vectors, applying the physical laws and concepts of linear and circular motion in everyday life.
- Analyse banking of roads/railway tracks and apply conservation of momentum principle to Explain recoil of gun etc.
- Derive work, power and energy relationship and solve problems about work and power.
- Define work, energy and power and their units.
- Describe conservation of energy and its applications
- Understand the concept of rotational motion of a rigid body and its applications
- Apply the physical laws and concepts of gravity, its variation with height and depth
- Understand the concept of elasticity, surface tension, pressure and the laws governing movement of fluids.
- Express physical work in term of heat and temperature; Measure temperature in various processes on different scales (Celsius, Kelvin, Fahrenheit etc.)
- Distinguish between conduction, convection and radiation and uses in daily life.

COURSE CONTENTS

1. Units and Dimensions

(6 Periods)

- 1.1 Need of Measurement in engineering and science, unit of physical quantities - fundamental and derived units, systems of units (FPS, CGS and SI units)
- 1.2 Dimensions and dimensional formulae of physical quantities.
- 1.3 Principle of homogeneity of dimensions
- 1.4 Dimensional equations and their applications, conversion of numerical values of physical quantities from one system of units into another, checking the correctness of physical equations and deriving relations among various physical quantities
- 1.5 Limitations of dimensional analysis.

2. Force and Motion

(6 periods)

- 2.1 Scalar and vector quantities – examples, representation of vector
- 2.2 Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product.
- 2.3 Resolution of Vectors.
- 2.4 Force, Momentum, Statement of Conservation of linear momentum, its applications such as recoil of gun.
- 2.5 Gravitational force, Acceleration due to gravity (g) and its variation with depth and height from earth surface.

3. Work, Power and Energy

(6 periods)

- 3.1 Work: and its units, examples of zero work, positive work and negative work.
- 3.2 Friction: modern concept, static, limiting and dynamic friction, Coefficient of friction.
- 3.3 Energy and its units, Kinetic energy, potential energy and Mechanical energy with examples.
- 3.4 Work Energy Theorem (statement only), Conservation of mechanical energy for freely falling bodies.
- 3.5 Power and its units, calculation of power in numerical problems.

4. Circular motion

(6 periods)

- 4.1 Circular motion, Definition of Uniform and Non-uniform Circular motion
- 4.2 Definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
- 4.3 Relation between linear and angular velocity, linear acceleration and angular acceleration
- 4.4 Centripetal acceleration (Definition and formula only)
- 4.5 Centripetal force with examples such as banking of roads and bending of cyclist. Definition of Centrifugal force.

5. Rotational Motion of a rigid body

(6 periods)

- 5.1 Definition of rigid body, Rotational Motion of rigid body, Definition of torque with examples
- 5.2 Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only)
- 5.3 Moment of inertia of rod, disc, ring and sphere (hollow and solid) (Formulae only).
- 5.4 Rotational kinetic energy
- 5.5 Angular momentum, Conservation of angular momentum and its examples

6. Properties of Matter

(6 periods)

- 6.1 Elasticity: definition of stress and strain, Hooke's law (Definition and formula only).
- 6.2 Pressure: definition, its units.
- 6.3 Surface tension: concept, its units, cohesive and adhesive forces, angle of contact, Capillary action ascent formula (without derivation), applications of surface tension, effect of temperature on surface tension
- 6.4 Viscous force, Velocity gradient and its unit, coefficient of viscosity, Stoke's law and effect of temperature on viscosity.
- 6.5 Stream line flow of fluid motion, Equation of continuity, Bernoulli's Theorem (without derivation) and their applications to Torricelli's formula [$v=(2gh)^{1/2}$].

7. Heat and Thermometry

(6 periods)

- 7.1 Concept of Heat and Temperature.
- 7.2 Different scales of temperature and their relationship
- 7.3 Modes of transfer of heat (Conduction, convection and radiation with examples)
- 7.4 Expansion of solids: coefficient of linear, surface and cubical expansions and relation amongst them
- 7.5 Concept of Mercury Thermometer

LIST OF PRACTICALS (To perform any Six Practicals)

1. To measure length, radius of a given cylindrical body using a vernier calipers and find its volume.
2. To determine diameter of a wire using a screw gauge and find its volume.
3. To determine the Radius of curvature of (i) convex mirror, (ii) concave mirror by spherometer.
4. To determine value of acceleration due to gravity (g) using simple pendulum.
5. To verify parallelogram law of forces.
6. To find the coefficient of friction between wood and glass using a horizontal board.
7. To determine the viscosity of glycerine by Stoke's method.
8. To verify law of conservation of mechanical energy (PE to KE).
9. To measure room temperature and temperature of hot bath using mercury thermometer and convert it into different scales.
10. To determine force constant of spring using Hooks law.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENTS

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	14
2	06	14
3	06	15
4	06	15
5	06	14
6	06	14
7	06	14
Total	42	100

1.3 APPLIED CHEMISTRY

L	T	P
3	-	2

COURSE OBJECTIVES

There are numerous number materials are used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. On successful completion of this course content will enable technicians to understand, ascertain and analyses and properties of natural raw materials require for producing economical and eco-friendly finished products.

COURSE OUTCOMES

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

- Solve various engineering problems applying the basic knowledge of atomic structure and chemical bonding.
- Use relevant water treatment method to solve domestic and industrial problems.
- Solve the engineering problems using knowledge of engineering materials and properties.
- Use relevant fuel and lubricants for domestic and industrial applications
- Solve the engineering problems using concept of electrochemistry and corrosion.

COURSE CONTENT

Unit 1: Atomic Structure, Chemical Bonding and Solutions

(08 periods)

Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), Heisenberg uncertainty principle, Quantum number. Shapes of s, p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration.

Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bond (NaCl), covalent bond (H_2 , F_2 , HF), coordination bond (NH_4)⁺. Hybridization in $BeCl_2$, BF_3 , CH_4 , NH_3 , H_2O . Anomalous properties of NH_3 , H_2O due to hydrogen bonding, metallic bonding.

Solution – idea of solute, solvent and solution, methods to express the concentration of solution molarity (M = mole per liter), Molality, Normality, ppm, mass percentage, volume percentage and mole fraction.

Unit 2: Water

(08 periods)

Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.

Cause of poor lathering of soap in hard water, problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion etc), and total dissolved solids (TDS).

- i). Water softening techniques – soda lime process, zeolite process and ion exchange process.
- ii). Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization.

Unit 3: Engineering Materials

(08 periods)

Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, brief account of general principles of metallurgy.

Extraction of - Aluminum from bauxite ore.

Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

General chemical composition, composition based applications (elementary idea only, details omitted): Port land cement and hardening, Composite materials (Wood, Glass fiber reinforced composites).

Polymers – monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon – 6, nylon-6,6 and Bakelite), rubber and vulcanization of rubber.

Unit 4: Chemistry of Fuels and Lubricants

(09 periods)

Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula.

Fuel rating (octane and cetane numbers).

Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.

Lubrication – function and characteristic properties of good lubricant, classification with examples. Physical properties (viscosity and viscosity index, oiliness, flash and fire point, cloud and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.

Unit 5: Electro Chemistry

(09 periods)

Electronic concept of oxidation, reduction and redox reactions.

Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of Electrolysis and simple numerical problems. Industrial Application of Electrolysis –

- Electrometallurgy
- Electroplating
- Electrolytic refining.

Application of redox reactions in electrochemical cells –

- Primary cells – dry cell,
- Secondary cell - commercially used lead storage battery, fuel and Solar cells.

Introduction to Corrosion of metals –

Definition, types of corrosion (chemical and electrochemical), factors affecting rate of corrosion.

- Internal corrosion preventive measures –Purification, alloying and heat treatment
- External corrosion preventive measures: a) metal (anodic, cathodic) coatings, b) organic Inhibitors.

INSTRUCTIONAL STRATEGY

Unit 1: Atomic Structure, Chemical Bonding and Solutions

Assignments: Writing electronic configuration of elements up to atomic number 30 ($Z= 30$). Numerical on molarity, ppm, mass percentage, volume percentage and mole fraction of given solution.

Seminar: 1. Quantum numbers,

2. Discuss the metallic properties such as malleability, ductility, hardness, high melting point, conductance of heat and electricity, magnetic properties of metals. Projects: Model of molecules BeCl_2 , BF_3 , CH_4 , NH_3 , H_2O .

Unit 2: Water

Assignments: Simple problems on hardness calculation.

Seminar: 1. Quality and quantity requirement of water in house and industry.

2. Quality of control measures of effluents (BOD & COD).

Projects: Collect water samples from different water sources and measure of hardness of water.

Unit 3: Engineering Materials

Assignments: Preparation of table showing different ores of iron, copper and aluminum metals along with their chemical compositions and classify in to oxide sulphide halide ores.

Seminar: Discuss the chemical reactions taking place in blast furnace in extraction of Fe, Cu and Al metals.

Projects: Make table showing place of availability of different ores in India and show places on India map.

Unit 4: Chemistry of Fuels and Lubricants

Assignments: Calculation of HCV and LCV of fuel using fuel composition in Dulong's formula.

Seminar: Chemical structure of fuel components influence on fuel rating.

Projects: Mapping of energy recourses in India. Collection of data of various lubricants available in the market.

Unit 5: Electro Chemistry

Assignments: Simple problems on Faradays laws of electrolysis. Seminar:

1. Corrosion rate and units.
2. Corrosion preventions.

Projects: Mapping of area in India prone to corrosion. Collection of data of various electrochemical cells batteries used in equipment and devices and available in market. Visit to sites such as Railway station to watch corrosion area in railways and research establishment in and around the institution.

LIST OF PRACTICALS:

Perform any Ten Laboratory Practicals.

Volumetric and Gravimetric analysis:

1. Preparation of standard solution of oxalic acid or potassium permanganate.
2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3. Standardization of KMnO_4 solution using standard oxalic acid and determine the percentage of iron present in given Hematite ore by KMnO_4 solution.
4. Iodometric estimation of copper in the copper pyrite ore.
5. Volumetric estimation of total acid number (TAN) of given oil.
6. Volumetric estimation of:
 - a) Total hardness of given water sample using standard EDTA solution.
 - b) Alkalinity of given water sample using 0.01M sulphuric acid.
7. Proximate analysis of coal:
 - a) Gravimetric estimation of moisture in given coal sample.
 - b) Gravimetric estimation of ash in given coal sample.

Instrumental analysis:

8. Determine the conductivity of given water sample.
9. Determination of the iron content in given cement sample using colorimeter.
10. Determination of calorific value of solid or liquid fuel using bomb calorimeter.
11. Determination of viscosity of lubricating oil using Redwood viscometer.
12. Determination of flash and fire point of lubricating oil using Abel's flash point apparatus.
13. To verify the first law of electrolysis of copper sulfate using copper electrode.
14. Construction and measurement of emf of electrochemical cell (Daniel cell).
15. To study the effect of dissimilar metal combination.

(a) Open source software and website address:

- 1 www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
- 2 www.visionlearning.com (Atomic structure and chemical bonding)
- 3 www.chem1.com (Atomic structure and chemical bonding)
- 4 <https://www.wastewaterlearning.com/elearning/> (Water Treatment)
- 5 www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
- 6 www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)
- 7 www.chemcollective.org (Metals, Alloys)
- 8 www.wqa.org (Water Treatment)

References/Suggested Learning Resources:**(b) Books :**

1. Text Book of Chemistry for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2. Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
3. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
4. Dara, S. S. & Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Del-hi, 2015.
5. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
6. Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
7. Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
8. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	20
2	08	20
3	08	20
4	09	20
5	09	20
Total	42	100

1.4 COMMUNICATION SKILLS IN ENGLISH

COURSE OBJECTIVES

L T P
3 - 2

Communication Skills play an important role in career development. This lab course aims at actively involving students in various activities to improve their communication skills with an emphasis on developing personality of the students.

COURSE OUTCOMES

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

1. Develop listening skills for enhancing communications.
2. Develop speaking skills with a focus on correct pronunciation and fluency.
3. Introduce the need for personality development - Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc., for that purpose group discussion extempore and other activities should be conducted during lab classes.

COURSE CONTENTS

Unit -1 Communication: Theory and Practice (08 Periods)

- 1.1 Basics of Communication, Definition Process of Communication
- 1.2 Types of communication (formal and informal, verbal and non-verbal), 7 C's of Communication
- 1.3 Barriers to communication and ways to overcome them
- 1.4 Tools or devices of Communication

Unit – 2 Soft Skills for Professional Excellence (04 Periods)

- 2.1 Introduction to Soft skills and hard skills
- 2.2 Importance of soft skills
- 2.3 Applying soft skills across cultures

Unit – 3 Reading Comprehension: English for Communication (08 Periods)

On Communication

- 3.1 Professional Development of Technicians
- 3.2 Leadership and Supervision
- 3.3 The Romance of Reading
- 3.4 Sir C V Raman

Unit: 4 Professional Writing (14 Periods)

CV Writing, Covering Letter, Resume, Notices, Precis -Writing, Official Letters (Memo, Circular, Office Orders, Agenda, Minutes of Meeting, Report Writing, E-mail Drafting)

Unit: 5 Vocabulary and Grammar

(08 Periods)

5.1 Sentence and its Types

5.2 Parts of Speech

5.3 Tenses

5.4 Active and Passive Voice

5.5 Punctuation

5.6 One Word Substitution, Idioms and Phrases

LIST OF PRACTICALS

Unit-1 Listening skills

1.1 Introduction to listening process and practice

1.2 Listening to recorded lectures/speeches/poems/interviews and Dialogues

Unit 2 Introduction to phonetics

2.1 Sounds: consonants, vowels (Monophthongs and Diphthongs)

2.2 Transcription of words (IPA) syllable division and word stress

Unit 3 Speaking skills

3.1 Self and Peer introduction

3.2 Extempore-Just a minute session

3.3 Greeting and starting conversation

3.4 Leave taking

3.5 Wishing well

3.6 Talking about likes and dislikes

3.7 Asking questions-polite responses

3.8 Apologizing/forgiving

3.9 Complaining/Warning

4.0 Asking and giving information

4.1 Getting and giving Permission

4.2 Asking for and giving Opinion

4.3 Delivering formal speeches

4.4 Mock Interviews

4.5 Presentation

4.6 Conversation practices in various situations such as -asking address, enquiries at places like retail shop, service center, bank, customer care etc.

Unit 4 Building Vocabulary

4.1 Word Formation

4.2 Phrasal Verbs, Foreign Phrases, Jargons

4.3 Word Games such as crosswords, scrabble, quiz spell it etc. (To enhance self-expression and vocabulary of participants.)

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-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; DhanpatRai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. Excellent General English-R.B.Varshnay, R.K. Bansal, Mittal Book Depot, Malhotra
5. The Functional aspects of Communication Skills – Dr. P. Prasad, S.K. Katria& Sons, New Delhi
6. Q. Skills for success – Level & Margaret Books, Oxford University Press.
7. E-books/e-tools/relevant software to be used as recommended by AICTE/UPBTE/NITTTR.
8. English for Communication (text Book Published by IRDT, Kanpur 1998).

Websites for Reference:

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

SUGGESTED DISTRIBUTION OF MARKS

Unit No.	Time Allotted (Periods)	Marks Allotted (%)
1	8	20
2	4	10
3	8	20
4	14	30
5	8	20
Total	42	100

1.5 Engineering Graphics

L T P
- - 4

COURSE OBJECTIVES

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.

COURSE OUTCOMES

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

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

COURSE CONTENT

Unit – I Basic elements of Drawing

Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards. Different types of lines as per BIS specifications Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.

Common symbols and conventions of materials used in engineering.

Free hand and instrumental lettering (Alphabet and numerals) – Capital Letter, single stroke, vertical and inclined, series of 5, 8, 12 mm in the ratio of 7:4.

Dimensioning-

Necessity, method and principles, Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches Scales.

Scales –Needs & importance (theory), R.F., type of scales, and length of scale, drawing of plain and diagonal scales.

Unit – II Orthographic projections

Introduction, Projection of Points in different quadrant, Projection of Straight Line- parallel to both planes, perpendicular and inclined to reference plane, Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only, Three views of orthographic projection of different objects. Identification of surfaces.

Unit – III Projection of Solid and Sections

Definition and types of Solids, To make projections, sources, Top view, Front view and Side view of various types of Solid, Importance and salient features.

Drawing of full section, half section, partial or broken out sections, Off-set sections, revolved sections and removed sections, Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections.

Unit – IV Isometric Projections

Introduction, Isometric scale and Natural scale, Isometric view and isometric projection, Illustrative problems related to objects containing lines, circles and arcs shape only.

Conversion of orthographic views into isometric view /projection.

Unit-V Introduction to Auto CAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets on AutoCAD of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.

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

INSTRUCTIONAL STRATEGY

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

Teachers should undergo training in AutoCAD/Engineering Graphic. Separate labs for practice on AutoCAD should be established.

MEANS OF ASSESSMENT

- Sketches
- Drawing
- Use of software

RECOMMENDED BOOKS

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

1.6 SPORTS AND YOGA

L T P

- - 2

COURSE OBJECTIVES

To make the students understand the importance of sound health and fitness principles as they relate to better health. To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness. To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury .To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

COURSE OUTCOMES:

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

- Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
- Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
- Learn breathing exercises and healthy fitness activities
- Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
- Perform yoga movements in various combination and forms.
- Assess current personal fitness levels.
- Identify opportunities for participation in yoga and sports activities.
- Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
- Improve personal fitness through participation in sports and yogic activities.
- Develop understanding of psychological problems associated with the age and lifestyle.
- Demonstrate an understanding of sound nutritional practices as related to health and physical performance.
- Assess yoga activities in terms of fitness value.
- Identify and apply injury prevention principles related to yoga and physical fitness activities.
- Understand and correctly apply biomechanical and physiological principles related to exercise and training

COURSE CONTENT

1 Introduction to Physical Education

- Meaning & definition of Physical Education
- Aims & Objectives of Physical Education

2 Yoga

- Meaning & Importance of Yoga
- Elements of Yoga- Gyan Yoga, Bhakti Yoga, Karm Yoga, Hathyoga, Astang Yoga .

- Introduction - Asans, Pranayama, Meditation & Bandh , Mudra and shat Karm .
- Meaning of Practice of various Yogic Sukhasan, Vyayams
- Practice of Asans and Benefits – Sidhasana, Padmasana, Vajrasana, Shasakasan, Singhasan, Gomukhasan, Virasan, Dhanurasan, Matsnyendrasan, Gorakhasan, Paschimottansan, Mayurasan, Garunasan, Pawanmuktasan, Kurmasan, Mandukasan, Shalabhasan, Makrasan, Bhujangasan, Naukasan, Shavasan, Sharvangasans, Halasan.
- Practice and Benefits of Pranayamas – Anulom- Vilom, Surya Bhedhi, Ujjayi, Sheetkari, Bhastrika, Bharamri, Murchha, kewali etc .
- Practice of Meditation – Meaning of Meditation, Types , Techniques, Benefits .

3 Olympic Movement

- Olympic Symbols, Ideals, Objectives & Values
- Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award,
- Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

4 Physical Fitness, Wellness & Lifestyle

- Meaning & Importance of Physical Fitness & Wellness
- Components of Physical fitness
- Concept of Positive Lifestyle

5 Yoga & Lifestyle

- Ideal life style
- Asans and pranayams a preventive measures
- Yoga and Immunity
- Concept of Yogic diet.
- **Life Style Diseases-** Yoga management of Diseases, Yoga management of Stress, Yoga management of Obesity, Yoga management of High Blood Pressure, Yoga management of Insomnia, Yoga management of Asthma, Yoga management of Joints Pains, Yoga management of Digestive Disorders .

6 Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga

- Define Anatomy, Physiology & Its Importance
- Effect of exercise on the functioning of Various Body Systems.
- Circulatory System,
- Respiratory System,

7 Postures

- Meaning and Concept of Postures.
- Causes of Bad Posture.
- Advantages & disadvantages of weight training.

8 Training and Planning in Sports

- Meaning of Training
- Warming up and limbering down

9 Psychology & Sports

- Definition & Importance of Psychology in Physical Edu. & Sports
- Define & Differentiate Between Growth & Development

10 Doping

- Meaning and Concept of Doping

11 Sports Medicine

- First Aid – Definition, Aims & Objectives.
- Sports injuries: Classification, Causes & Prevention.

12 Sports / Games

Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.

- History of the Game/Sport.
- Specifications of Play Fields and Related Sports Equipment.
- Important Tournaments and Venues.

References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

2.1 MATHEMATICS –II

L T P
3 1 -

COURSE OBJECTIVES

This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, integral calculus, coordinate geometry, basic elements of vector algebra and first order differential equations.

COURSE OUTCOMES

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

- Solve linear equations using determinants and matrix algebra.
- Perform integration techniques, solve area and volume problems.
- Solve first order differential equations and apply numerical methods.
- Form and interpret equations of lines, circles and conics.
- Perform vector operations and solve related engineering problems of relevant branch.

COURSE CONTENTS

UNIT - I: Determinants and Matrices

(10 periods)

Elementary properties of determinants upto 3rd order, consistency of equations, Cramer's rule. Algebra of matrices, inverse of a matrix, matrix inverse method to solve a system of linear equations in three variables.

UNIT - II: Integral Calculus

(12 periods)

Integration as inverse operation of differentiation. Simple integration by substitution, by parts and by partial fractions (for linear factors only). Introduction to definite integration. Use of formulae $\int_0^{\pi/2} \sin^n x dx$, $\int_0^{\pi/2} \cos^n x dx$, $\int_0^{\pi/2} \sin^m x \cos^n x dx$ for solving problems, where m and n are positive integers. Applications of integration for (i). Simple problems on evaluation of area bounded by a curve and axes. (ii). calculation of volume of a solid formed by revolution of an area about axes. (Simple problems).

UNIT-III: Differential Equations & Numerical Methods

(15 periods)

Definition of differential Equations, order and degree of a differential equation, formation of differential equations, solution of first order and first degree differential equations by variable separable method (simple problems). Trapezoidal rule, Simpson's 1/3 and Simpson's 3/8 rule and their applications in simple cases. MATLAB – Simple Introduction.

UNIT - IV: Two dimensional Co-Ordinate Geometry

(10 periods)

Equation of straight line in various standard forms (without proof), intersection of two straightlines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula.

General equation of a circle and its characteristics. To find the equation of a circle, given:

- i. Centre and radius,
- ii. Three points lying on it and

iii. Co-ordinates of end points of a diameter;

Definition of conics (Parabola, Ellipse, Hyperbola), their standard equations without proof. Problems on conics when their foci, directories or vertices are given.

UNIT - V: Vector Algebra

(9 periods)

Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector product of two vectors. Simple problems related to work, moment and angular velocity.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. S.S. Sabharwal, Sunita Jain, Eagle Parkashan, Applied Mathematics, Vol. I & II, Jalandhar.
4. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	10	20
2.	12	20
3.	15	25
4	10	20
5	9	15
Total	56	100

2.2 APPLIED PHYSICS – II

L T P
3 - 2

COURSE OBJECTIVES

Applied physics includes the study of a diversified topics related to the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete knowledge of physical laws, analysis and applications in various fields of engineering and technology are given prominence in this course content.

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

COURSE OUTCOMES

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

- Define wave motion its types (Transverse and Longitudinal), Periodic and Simple Harmonic Motion, solve simple problems.
- Define the terms: frequency, amplitude, wavelength, velocity of a wave.
- Explain various Engineering, Medical and Industrial applications of Ultrasonic.
- Define capacitance and its unit. They will be able to explain the function of capacitors in simple circuits, solve simple problems using $C=Q/V$
- Explain the role of free electrons in insulators, conductors and semiconductors, qualitatively the terms: potential, potential difference, electromotive force.
- Explain the concept of electric current, resistance and its measurement.
- List the effects of an electric current and their common applications, State and apply Ohm's law, calculate the equivalent resistance of a variety of resistor combinations.
- Explain Bio-Savart Law, Lorenz Force, Faraday's law.
- State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field
- Apply the knowledge of diodes in various electronic circuits. Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Explain total internal reflection and apply this concept for optical fiber and its uses in Medical field and Communication.

COURSE CONTENTS

1. Oscillations and Wave motion

(06 periods)

- 1.1 Harmonic Motion, Oscillation, Definition of Simple Harmonic Motion (SHM),
- 1.2 Displacement equation $y = a \sin \omega t$ (without derivation), velocity, acceleration, time period, frequency in S.H.M., Energy of a body executing S. H. M.
- 1.3 Wave motion, transverse and longitudinal wave motion with examples.
- 1.4 Wave equation, phase, phase difference, wave length, wave velocity.
- 1.5 Ultrasonic – Introduction, properties and applications in engineering and medical applications.

2. Optics

(06 periods)

- 2.1 Basic optical laws - Reflection and Refraction, Refractive Index.
- 2.2 Critical angle, Total internal reflection (TIR) and conditions for total internal reflection,
- 2.3 Application of total internal reflection (List Only).

- 2.4 Dual nature of light (concept only): Wave and particle nature of light
2.5 Examples of Wave and particle nature of light (List Only).

3. Electrostatics

(06 periods)

- 3.1 Concept of charge, Quantization of charge, Coulombs law, Electric field of point charges
3.2 Electric lines of force and their properties, Electric flux, Gauss law of electrostatics (without derivation)
3.3 Electric potential and potential difference.
3.4 Capacitance and its units, Parallel plate Capacitor: Working principle and its Capacitance, Effect of Dielectric on capacitance.
3.5 Series and parallel combination of capacitors (numerical).

4. Current Electricity

(06 periods)

- 4.1 Electric Current and its unit, Ohm's law, Resistance and its units,
4.2 Factors affecting Resistance of a wire, Specific Resistance, Conductance, Specific Conductance,
4.3 Series and Parallel combination of Resistances.
4.4 Kirchhoff's laws (KCL and KVL), Wheatstone bridge: Construction and its balanced condition,
4.5 Measurement of an unknown resistance using Meter Bridge.

5. Electromagnetism

(06 periods)

- 5.1 Biot-Savart law for current carrying wire and Concept of Magnetic field (**B**) and its units.
5.2 Lorentz force (Force on moving charge in magnetic field), Force on current carrying conductor (Formula only).
5.3 Magnetic lines of forces and their properties, magnetic flux and its units.
5.4 Concept of electromagnetic induction, Faraday's Laws and Lenz's law.
5.5 Conversion of galvanometer into ammeter and voltmeter.

6. Semiconductor physics

(06 periods)

- 6.1 Classification of solids on the basis of Energy bands (Definition only): Insulator, Semi-conductor and Conductor.
6.2 Intrinsic and extrinsic semiconductors, P-type and N-type semiconductors.
6.3 PN junction diode and its biasing (Forward and Reverse Biasing).
6.4 Some application of semiconductor diodes (list only)
6.5 Construction of PNP and NPN transistors and some electronic applications (list only)

7. Modern Physics

(06 Periods)

- 7.1 Ground, Excited and Metastable energy levels of atom,
7.2 Spontaneous and stimulated emission, population inversion, pumping, Laser and its characteristics
7.3 Ruby laser and He-Ne laser, Engineering and medical applications of lasers.
7.4 Introduction to optical fibers, light propagation, acceptance angle and numerical aperture (without derivation).
7.5 Applications of optical fibers in telecommunication, medical and sensors.

LIST OF PRACTICALS (To perform minimum six experiments)

1. To determine the velocity of sound with the help of resonance tube.
2. To verify the laws of reflection from a plane mirror / interface.
3. To verify the laws of refraction (Snell's law) using a glass slab.
4. To determine the focal length and magnifying power of a convex lens.
5. To verify laws of resistances in series and parallel combination.

6. To verify ohm's laws by drawing a graph between voltage and current.
7. To measure very low resistance and very high resistances using Slide Wire bridge
8. Conversion of Galvanometer into an Ammeter and Voltmeter of given range.
9. To draw characteristics of a PN junction diode and determine knee and break down voltages.
10. To verify the Kirchoff's Law using electric circuit.
11. To find numerical aperture of an optical fiber.
12. To draw magnetic field lines due to bar magnet using magnetic compass.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	15
2	06	14
3	06	15
4	06	14
5	06	14
6	06	14
7	06	14
Total	42	100

2.3 INTRODUCTION TO IT SYSTEMS

L T P
2 - 4

COURSE OBJECTIVES

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

Note:

Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises.

COURSE OUTCOMES

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

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

COURSE CONTENTS

1. Introduction to Computers and Peripherals. (05 Periods)

Introduction, Computer Generations, Components of Computer, Types of Computer, CPU, RAM, ROM, Hard disk, USB, Flash drive, Keyboard, Mouse, display devices, Printer, Scanner, Modem, Sound Cards, Speakers, CMOS battery, Sharing of Printers.

1. Operating System and Application Software (06 Periods)

System Software, Application Software, Virtualization Software, Utility Software, MS Office/Open Office/LibreOffice, Working with windows OS, Desktop components, Menu bars, creating shortcut of program. Installation of Application software's, Antivirus and Drivers.

2. Office Tools: MS Office/Open Office/ Libre Office (06 Periods)

Creation of document, spreadsheets and presentation, Google Suits (Google drive, google sheet, google doc, google presentation)

3. Internet (06 Periods)

Network topologies, Basics of Networking,– LAN,MAN, WAN, Connecting Devices(Bridge, Switch, Router, Gateway),Wi-Fi technologies, Concept of IP Address, DNS, Search Engines, e-mail, Web Browsing.

4. Basics of Information Security (05 Periods)

Introduction to security, Security threats: detection and prevention, Indian Cyber laws.

LIST OF PRACTICAL EXERCISES

1. Identify various components, peripherals of computer and list their functions.
2. Installation of operating system. (windows/linux/others)
3. Installation of various application software and peripheral drivers.
4. Creation and Management of files and folders (Rename, delete, search)
5. Installation of Antivirus and remove virus.
6. Scanning and printing documents.
7. Browsing, Downloading, Information using Internet.
8. E-Mail ID creation, composing, sending and receiving e-mail. Attaching a file with e- mail message.
9. Word Processing (MS Office/Open Office) File Management, Editing documents, Mail Merge, Security etc.

10. Spread Sheet Processing (MS Office/Open Office/Libre Office) Addition, deletion, formulation, Security etc.
11. PowerPoint Presentation (MS Office/Open Office/Libre Office) Preparing Slides, customization, animation, Security etc.
12. Google Suite.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Information Technology for Management by Henery Lucas, Tata McGraw Hills, New Delhi
3. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
4. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
5. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi.
6. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
8. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
9. On Your Marks - Net...Set...Go... Surviving in an e-world by Anushka Wirasinha, Prentice Hall of India Pvt. Ltd., New Delhi
10. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

Reference websites

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	18
2	6	21
3	6	22
4	6	21
5	5	18
Total	28	100

2.4 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L T P
3 - 2

COURSE OBJECTIVES

To learn basic concepts of various active and passive electronic components, signals, measuring instruments, digital electronics, electric and magnetic circuits, ac circuits, transformer, motors and their applications. To help the students deal with the electrical and electronics engineering principles and applications in industrial processes of different fields.

COURSE OUTCOMES

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

- Understand and identify key electronic components and their applications.
- Use and understand basic electrical measuring instruments.
- Grasp the fundamentals of logic gates, Boolean algebra, and digital circuits.
- Understand basic concepts of electric and magnetic circuits.
- Analyze A.C. circuits and understand phase relationships and power calculations.
- Understand the principles and applications of transformers and electrical machines.

COURSE CONTENTS

UNIT- I Overview of electronic components:

(09 Periods)

Active and Passive components, Resistor, Capacitor, Inductor and their types. Introduction to semi-conductor, Intrinsic and Extrinsic semi-conductors, P-N Junction diode - forward and reverse bias; introduction of Bipolar Junction Transistor; FET and MOSFET (brief idea only).

UNIT- II Basic measuring instruments:

(05 Periods)

Basic concept of Ideal and non-ideal voltage and current sources, ammeter, voltmeter, wattmeter and digital multimeter, CRO (Block diagram, working and its uses).

UNIT –III Overview of Digital Electronics:**(7 Periods)**

Analog and digital signal, advantages of digital system. number system and its conversion (Decimal, binary ,octal ,hexadecimal) , Boolean Algebra, Logic Gates-Truth Table and Symbol of AND, OR, NOT, NAND, NOR, ExOR, ExNOR Gates.

Unit -IV Electric and Magnetic Circuits:**(7 Periods)**

Definitions of basic terms, such as Current, Resistance, EMF, Potential Difference, Power and Energy, Ohm's Law and its limitation, Kirchhoff's laws; M.M.F, magnetic force, flux, permeability, reluctance, BH curve, hysteresis loop; Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically and Statically induced emf; concept of self and mutual inductance.

Unit -V A.C. Circuits:**(7 Periods)**

Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; A.C in pure resistors, pure inductors and pure capacitors; Power in A.C. Circuit, power triangle; Introduction of poly phase system and comparison with single phase system.

Unit -VI Transformers and Machines:**(7 Periods)**

Single phase transformer: General construction, working principle, types, EMF equation, transformation ratio; Brief idea of Auto transformer.

DC machines: Types, EMF equation of motor.

Single Phase Induction Motor: Principle of operation and introduction to methods of starting.

Three Phase Induction Motor: Principle of operation.

INSTRUCTIONAL STRATEGY

The instructional strategy combines lectures, demonstrations, and hands-on labs. Lectures will cover key concepts, while demonstrations will illustrate component functions and instrument operations. Hands-on labs will provide practical experience with electronic components and measuring instruments. Interactive quizzes and problem-solving sessions will reinforce and assess understanding, ensuring practical application of theoretical knowledge.

MEANS OF ASSESSMENT

- Assignment & Quiz
- Lab & Practical Work
- Viva-Voice

List of Practicals:- (8 practical to be performed)

1. Identify various passive and active electronic components in the given circuit.
2. Determine the value of given resistor using digital multi-meter to confirm with color code.
3. Exercise of soldering and de-soldering of components in circuits.
4. To measure frequency, time period and amplitude of a sinusoidal signal using CRO.
5. To measure voltage and current using digital multi-meter.
6. To verify the truth tables for all logic gates – NOT, OR, AND, NAND, NOR, XOR, XNOR
7. Verify the Kirchhoff's laws.
8. Measure voltage, current and power in 1-phase circuit with resistive load.
9. Verify the ohms law.
10. Use of voltmeter, ammeter, and watt-meter.
11. Connect resistors in series and parallel combination on bread board and measure its value using digital multi-meter.
12. Connect capacitors in series and parallel combination on bread board and measure its value using multi-meter.

REFERENCE BOOKS –

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House.
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN: 978-0-07-0088572-5.
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition, ISBN: 9781107464353.
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405.
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924375.
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN: 97881236529513.
7. Sedha, R.S., A Textbook of Applied Electronics, S. Chand, New Delhi, 2008, ISBN-13: 978-8121927833.
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Education, New Delhi, 2015, ISBN-13: 0070634244-978.
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13: 9788121924504.
10. Bell, David, Fundamentals of Electronic Devices and Circuits, Oxford University Press, New Delhi, 2015, ISBN: 9780195425239.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	09	20
2	05	10
3	07	15
4	07	18
5	07	18
6	07	19
Total	42	100

2.5 ENGINEERING MECHANICS

L T P
2 1 2

COURSE OBJECTIVES

The course provides a foundational understanding of mechanics, covering force systems, equilibrium, and beam analysis under different loads. It explores friction and its applications, centroids and moments of inertia for various shapes, and the principles and applications of simple lifting machines.

COURSE OUTCOMES

After completing this course, student will be able to:

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.
5. Select the relevant simple lifting machine(s) for given purposes.

COURSE CONTENTS

Unit – I Introduction to Engineering Mechanics and Force System : (08 Periods)

Basic Concept and definitions, Law of Mechanics (Newton's Laws), Classification: Statics and Dynamics.

Principle of transmissibility of forces, System of forces and its classification, Moment of Force and couple, Resolution of force- Orthogonal component of force, Varignon's theorem, Composition of forces- Analytical method for determination of resultant for concurrent, non- concurrent and parallel co- planar force systems- Law of triangle, parallelogram and polygon of forces.

Unit– II Equilibrium of Forces and Concept of Beam: (10 Periods)

Condition of equilibrium, free body diagram (FBD), equilibrium of coplanar concurrent and non-concurrent forces, Lami's Theorem- statement and explanation, application for various engineering problems.

Beam- Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (Vertical and inclined point load, uniformly distributed load, couple). Beam reaction for cantilever, simply supported beam with or without overhang subjected to combination of point load and uniformly distributed load.

Unit– III Friction :

(06 Periods)

Introduction , types and Laws of friction, Co-efficient of friction, angle of friction, angle of repose, cone of friction, equilibrium of bodies on horizontal surface (force parallel and inclined to the plane) and inclined plane (force parallel to the plane only).

Unit– IV Centroid and Moment of Inertia :

(10 Periods)

Concept, definition and determination of Centroid of plain figures (square, rectangle, triangle, circle, semi-circle, quarter circle) and Centre of gravity of symmetrical solid bodies (Cube, cuboid, cone, cylinder, sphere, hemisphere).

Concept of moment of inertia, Perpendicular axis theorem and Parallel axis theorem. Concept of second moment of area (Rectangle, Triangle and circle) and composite section (L,T &I).

Unit – V Simple Machines :

(08 Periods)

Definition and types, mechanical advantage, velocity ratio. Application and efficiency of simple machines, Law of Machines, Ideal machine, reversible and irreversible machine.

System of pulleys (first, second, third system of pulleys) determination of velocity ratio, mechanical advantage and efficiency. Working Principle and application of : wheel and axel, simple screw jack, Worm and worm wheel, single and double winch Crab.

List of Practical (A minimum of eight practicals must be performed)

1. Verification of parallelogram law of forces.
2. Verification of triangle and polygon law of forces.
3. To find the Resultant of coplanar concurrent forces using force table.
4. Study of forces in various members of jib crane.
5. Determine reaction forces for simply supported beam.
6. Determine the coefficient of friction on horizontal and inclined plane.
7. Study of Ladder friction (analyze condition for equilibrium)
8. Determine the centroid of a composite lamina (Graphical and Analytical methods).
9. Determine moment of inertia of flywheel or physical pendulum or torsional pendulum.
10. To find the mechanical advantage, velocity ratio and efficiency for Screw Jack.
11. To find the mechanical advantage, velocity ratio and efficiency for Wheel and axel.
12. Derive Law of machine using Worm and Worm wheel.

INSTRUCTIONAL STRATEGY

The instructional strategy includes lectures, visual aids, and interactive examples for key mechanics concepts and force systems, along with problem-solving sessions. Equilibrium concepts are taught with practical demonstrations and hands-on beam analysis. Friction is explored through case studies and practical demonstrations, followed by exercises. Centroid and moment of inertia are covered with visual aids and practical tasks. Simple lifting machines are introduced through lectures and demonstrations, with problem-solving on mechanical advantage and efficiency.

MEANS OF ASSESSMENT

- Assignment & Quiz
- Lab & Practical Work
- Viva-Voice

RECOMMENDED BOOKS :

1. D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
2. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.
6. Ram, H. D.; Chauhan, A. K., Foundations and Applications of Applied Mechanics, Cambridge University Press.
7. Meriam, J. L., Kraige, L.G., Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.
8. Bhavikatti S.S., Engineering Mechanics, New Age International Publishers

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	20
2	10	25
3	06	10
4	10	25
5	08	20
Total	42	100

2.6 ENGINEERING WORKSHOP PRACTICE

L T P
- - 4

COURSE OBJECTIVES

The course aims to provide hands-on experience and practical skills in various essential workshops, including carpentry, fitting, welding, sheet metal, plumbing, and painting and polishing. Students will gain proficiency in using different tools and machines, understanding and executing various processes and operations, and completing multiple jobs that involve intricate tasks. This practical knowledge will equip students with the necessary skills to handle real-world tasks efficiently, fostering a deeper understanding of the techniques and safety measures required in each shop.

COURSE OUTCOMES

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

1. Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking, and cutting tools & equipment's and machines
2. Explain job drawing and complete jobs as per specifications in allotted time
3. Inspect the job for the desired dimensions and shape
4. Operate, control different machines and equipment's adopting safety practices

DETAILS OF PRACTICAL CONTENTS

1. CARPENTRY SHOP

- 1.1. Demonstration of different wood working tools / machines.
- 1.2. Demonstration of different wood working processes, like planing, marking, chiselling, grooving, turning of wood etc.
- 1.3. Three jobs involving joint like mortise and tenon, dovetail, bridle, and half lap.

2. FITTING SHOP

- 2.1. Demonstration of different fitting tools and drilling machines and power tools
- 2.2. Demonstration of different operations like filing, drilling, tapping, sawing, cutting etc.
- 2.3. Three fitting job involving practice of cutting, chipping, filing, marking, hacksawing, drilling, tapping, etc.

3. WELDING SHOP

- 3.1. Demonstration of different welding tools/machines.
- 3.2. Demonstration on Arc Welding, Gas Welding, MIG welding, gas cutting and rebuilding of broken parts with welding.
- 3.3. Two simple job involving butt and lap joint and T. Joint using electric arc welding.

4. SHEET METAL SHOP

- 4.1. Demonstration of different sheet metal tools/machines.
- 4.2. Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting.
- 4.3. Three simple job involving sheet metal operations, soldering, and riveting.
- 4.4. Jobs
 - 4.4.1. Cutting Practices
 - 4.4.2. Single / Double Seam Joint
 - 4.4.3. Cylinders

5. PLUMBING SHOP

- 5.1. Demonstration of different plumbing tools, accessories, valves and different pipe fittings and joints (GI and PVC).
- 5.2. Demonstration of different plumbing operations like cutting, threading, pipe fitting (GI and PVC).
- 5.3 One simple job involving pipe cutting and external thread cutting on GI pipe.

6. PAINTING AND POLISHING SHOP

- 6.1. Introduction of paints, Varnishes, Reason for Surface preparation, Advantage of painting, other method of surface coating i.e. Electroplating etc.
- 6.2. Jobs
 - 6.2.1. To prepare a wooden surface for painting apply primer on side and to paint in the same side.
 - 6.2.2. To prepare metal surface for painting, apply primer and paint on same side.
 - 6.2.3. To Prepare a metal surface for spray painting. First spray primer and paint the same by spray gun and compressor system.

REFERENCES:

- 1. S.K. Hajara Chaudhary, Workshop Technology, Media Promoters and Publishers, New Delhi, 2015
- 2. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai and sons, New Delhi 2014
- 3. J.P. Bhati, Engineering Workshop, C.B.H. Publication, Jaipur.
- 4. K. Venkat Reddy, Workshop Practice Manual, BS Publications, Hyderabad 2014
- 5. Kents Mechanical Engineering Hand book, John Wiley and Sons, New York
- 6. Roop Lal and Bharadwaj P. K., Prarambhik KaryashalaTakneeki (Hindi), Vayu Education of India, New Delhi

2.7 ENVIRONMENTAL SCIENCE

L T P

3 - -

COURSE OBJECTIVES:

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. He should know the concept of hazards and disaster management.

COURSE OUTCOMES:

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

- Comprehend the importance of ecosystem and sustainable development.
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Explain environmental legislation acts.
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Analyze the impact of human activities on the environment
- Understand the basic concept of disaster and hazards.
- Analyze the impact of disaster on various social components.

COURSE CONTENT

1. Introduction (06 Periods)

Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non-renewable. Global Warming, Climate change and its impact, Green House Effect, Acid Rain, Concept of Green Building, Ground water management.

2. Air Pollution and Noise pollution (08 Periods)

Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air Pollution Control Methods. Introduction to Air Pollution and its Prevention and Control Act 1981 & Environmental Protection Act 1986 and Function of State pollution control board and National Green Tribunal (NGT).

Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

3. Water Pollution and Soil Pollution (11 Periods)

Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Turbidity, pH, total suspended solids, total dissolved solids, Concept of dissolved O₂, BOD, COD. Prevention of water pollution. Introduction to Water (Prevention and Control of Pollution) Act 1974. Concept of rain water harvesting system.

Sources of soil pollution, Types of Solid waste- House hold, Hospital, From Agriculture,

Biomedical, Animal waste and human waste, sediments and E-waste, Plastic Waste .
Effect of Solid waste, Disposal of Solid Waste- Solid Waste Management.

4. Disaster Causes and Hazards (6 Periods)

4.1 Introduction

4.2 Classification of Natural Disasters

4.3 Classification of Natural Disasters in India

- Earthquake
- Tsunami
- Flood
- Drought
- Land Slide
- Thunderstorm and Lightning

5 Disaster Management (11 Periods)

5.1 Framework

- Yokohama Strategy for a Safer World (1999)
- The Hyogo Framework for Action (HFA) (2005-2015)
- Sendai Framework for Action (SDGS) (2015-2030)

5.2 Disaster Management, Preparedness and Response in India

- National Disaster Management Authority (NDMA) Guidelines
- National Policy on Disaster Management (2009)
- National Disaster Management Act (2005)
- NDRF (National Disaster Response Force), SDRF (State Disaster Response Force), DDRF (District Disaster Response Force), and Aapda Mitra.
- Case studies of disaster management efforts: COVID-19 Pandemic, Earthquakes, Firefighting, Thunder Storm, and Lightning.

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 DeepPublications, 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 ErachBharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
9. Disaster Management Second Edition AICTE Recommended by S C Sharma, Khanna Publishers
10. Bharat Bhautik Paryavaran Class 11, By NCERT.
11. Apda Avem Apda Prabhandhan | आपदा और आपदा प्रबंधन | Mahesh Kumar Barnwal | Cosmos Publication.
12. S.C. Sharma & M.P. Poonia, Environmental Studies, Khanna publishing House, New Delhi

Websites for Reference:

- <http://swayam.gov.in>
- <https://www.amazon.in/Prabhandhan>
- <https://ncert.nic.in/textbook.php?khgy1=0-6>
- <https://rb.gy/yergl>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	6	15
2	8	20
3	11	25
4	6	15
5	11	25
Total	42	100

4- Recourse Requirement

A- LIST OF EQUIPMENT

APPLIED PHYSICS LABORATORY				
Sr. No.	Description	Qty	Approx. Price (Rs)	Total
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12		3,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12		3,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12		3,000
4.	Mirrors (convex, concave and plane)	5 Each		1,500
5.	Pendulum Setup	03		6,000
6.	Gravesand's Apparatus	02		4,000
7.	Double Inclined Plane Setup	02		4,000
8.	D type Galvanometers Sensitivity: 20 microamperes per scale division,	10		10,000
9.	Resistance boxes (dial type) assorted	03		3,000
10.	Rheostats	02		1,000
11.	Stoke's Apparatus with all accessories	2		10,000
12.	Resonance Tube Apparatus with accessories and Tuning fork set	2		14,000
13.	Ohmic resistance coil	10		5,00
14.	Slide wire bridge with all accessories	2		8,000
15.	PN Junction diode Apparatus kit	2		10,000
16.	Numerical aperture setup	1		25,000
17.	Ohms law setup kit	2		4,000
18.	Series and parallel resistance combination kit	2		4,000
19.	Hooks law setup with pan and weights	2		3,000
20.	Optical bench with all accessories (setup) (with three holder in each setup)	2		7,000
21.	Mercury Thermometer measuring room temperature (range 0°C to 100°C)	5		3,000
22.	Coefficient of friction apparatus setup with pan and weights	2		4400
23.	Kirchhoff's law setup	2		5,000
24.	Miscellaneous (glycerin, glass slab for Snell's law, convex lens, optical fiber, bar magnet, compass needle, carbon composition resistors as per requirement .	LS		25,000
25	Digital Multimeter (AC & DC current & Voltage can be measured, resistance & capacitance can be measured .	05		10,000

APPLIED CHEMISTRY LABORATORY

Sr. No.	Description	Qty	Approx. Per Unit Price (Rs)
1.	Digital Balance	1	85,000
2.	Burette 50ml	30	250
3.	Pipette 25ml	60	200
4.	Beakers 100ml	60	200
5.	Burette stand	30	1,000
6.	Glazed tile	30	30
7.	Conical flask 50ml (Titration flask)	60	200
8.	Standard measuring flask 250/100ml	30	300
9.	Able's Flash Point apparatus	2	8,000
10.	(1/10) ^o C thermometer	06	1,000
11.	Candles	20	5
12.	Crucible with lid	06	700
13.	Muffle furnace	1	25,000
14.	Desiccator	06	3,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	150 200
16.	Digital hot plate with magnetic stirrer	2	17,000
17.	Conductivity meter with electrode	1	5,000
18.	Photo colorimeter	1	10,000
19.	Bomb calorimeter	1	1,30,000

20.	Ammeter (0-500mA)	5	800
21.	Rheostat (200ohm, 1A)	1	1,000
22.	Cuvette	20	800
23.	Copper electrode	1	6,500
24.	Salt bridge tube	5	800
25.	Zinc rod	1	1,000
26.	Voltmeter (0-12V)	1	700
27.	DC variable voltage source(0-30V)	1	8,000
28.	Chemicals - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH ₃ - 2.5 ltr, NH ₄ Cl – 1 kg) - Zinc sulphate- 1kg - H ₂ SO ₄ - 2.5 ltr - Phenolphthalein indicator (as per requirement) - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene (as per requirement) - KCl & agar-agar - Distilled water (as per requirement) - Cement - Ferrous ammonium sulphate - 40%Ammonium thiocyanate - Fuels(solid & Liquid) - Oxalic acid - Copper sulphate - NaOH - KMnO ₄ , Na ₂ CO ₃ , KOH, 2-Propanol - Hematite ore, copper pyrite ore - Hypo(Na ₂ S ₂ O ₃) , 10% KI, CH ₃ COOH	LS	40,000
29.	Miscellaneous	LS	10,000

COMMUNICATION LAB

Sr. No.	Description	Qty	Approx. Total Price (Rs)
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	Miscellaneous	LS	1,500

ENGINEERING WORKSHOP PRACTICE

S.No.	Description	Qty.	Approx. Total price (Rs.)
CARPENTRY SHOP			
1.	Work benches fitted with 4 carpenter vices 9"	5	60,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	5,000
5.	Bench drilling machine with different drill bits	1	8,500
6.	Wood turning lathe machine	1	40,000
7.	Wood planner	1	20,000
8.	Tool accessories measuring and marking instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	Miscellaneous	LS	1,500

PAINTING AND POLISHING SHOP			
1	Spray gun 1 Ltr. cup capacity with hose pipe	1	3,000
2	Paint brushes & rollers	20	3,000
3	Paint/varnish	LS	2,000
4	Air compressor with 2 hp motor	1 set	21,000
5	Miscellaneous	LS	2,000
WELDING SHOP			
1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas cutting unit	1	3,000
3.	Work benches with vices	3	5,000
4.	Portable welding machine (220 amp)	1	9,000
5.	Oxy acetylene welding set with accessories	1	7,000
6.	Acetylene generating set	1	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	1	15,000
9.	Brazing equipment with accessories	1	10,000
10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	3,000
12.	Angle grinder	1	3,000
13.	Metal spraying gun	1	10,000
14.	Spot welding machine	1	25,000
15.	Tig welding set	1	1,00,000
16.	Mig welding set	1	1,00,000
17.	Welding partition screen	5	2,500
18.	Miscellaneous	LS	3,000

FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	60,000
2.	Marking tables with scribes	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, v blocks, height, gauges steel rules and scribes	25	50,000
5.	Tool kits — taps, dies, drills, number punch, letter punch	25	40,000
6.	Tool kits — chisels, hammers, files, hacksaw	25	25,000
7.	Bench drilling machine 3 phase	1	10,000
8.	Hand drill machine	1	5,000
9.	Pipe vice	2	10,000
10.	Chain wrenches	2	2,000
11.	Bench grinder	1	6,500
12.	Ring spanner set	5	600
13.	Pipe die set 2"	2 set	2,000
14.	Pipe bending device	1	5,000
15.	Various plumbing fittings	LS	2,000
16.	Miscellaneous	LS	1,500
SHEET METAL SHOP			
1.	Hammers	8	3,000
2.	Mallets (hard & soft)	5	2,000
3.	Sheet and wire gauges	2	8,000
4.	Hand shearing machine	1	20,000
5.	Bar folding machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron)	1 Each	1,000
8.	Hand shears/snippers	4	2,000
9.	Nuts, bolts, rivets, screw	LS	1,000
10.	Miscellaneous	LS	2,000

INTRODUCTION TO IT SYSTEMS LAB /COMPUTER LAB

S.N.	Name of Equipment	No. of Equipment	Approx. Total Price
1	Computer System with latest configuration	30	21,00,000
2	Printer (MFP)	1	25,000
3	Printer (Laser)	1	35,000
4	Antivirus Software	LS	10,000
5	Internet Facility on Computers	LS	2,00,000
6	LCD Projector	1	70,000
7	UPS	30	60,000
8	Software (latest MS Office, Others) A4,A3 Size	1	1,00,000
9	Scanner (A4,A3 Size)	1	10,000

Fundamentals of Electrical and Electronics Engineering Lab

S.N.	Instruments	Quantity	Approx. unit price (Rs.)
1	Voltmeter	6	3000
2	Ammeter	6	3000
3	Wattmeter	6	4000
4	Single Phase Transformer	1	10000
5	Single Phase Variac	1	4000
6	Resistive Load	1	4000
7	Digital Multi-meter	6	10000
8	Variable Choke coil	1	5000
9	Bread board	5	500
10	Soldering stations temperature controlled	1	10500
11	Soldering Set	2	3000
12	PN junction experimental kit	1	3500
13	Digital logic trainer	2	20000
14	Miscellaneous (PN junction diodes, resistors, capacitors, CRO probes, multipurpose PCB, connecting wires, different logic gate ICs, etc.)	LS	7000
15	Decade resistors, capacitors and inductor box	2 each	4500
16	D.C regulated power supply	2	8000
17	CRO	2	30000
18	Function Generator	2	12000

ENGINEERING GRAPHICS

Sr No.	Instruments	Qty	Approx. unit Price in Rs.
1.	Drawing Boards (700 x 500mm)	60	800
2.	Draughtsman Tables	60	3,000
3.	Draughtsman Stools	60	750
4.	Computer Aided Drawing (CAD) Software	30 User	5,00,000
5.	Wooden Model of different solids- cone, cylinder, prism, and polygon.	1set	2,000
6.	Wooden Model of different hollow cut sections- cylinder, cube, and Rectangle.	1set	1,500
7.	Miscellaneous	LS	10,000

Note- This subject will be evaluated as a theory examination.

B - Furniture Requirement

Norms and standards laid down by AICTE -APH (latest) be followed for working out furniture requirement for diploma courses

C- Human Resources:

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

5- EVALUATION STRATEGY

INTRODUCTION

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

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

Formative Evaluation

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

Summative Evaluation

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

systematic manner since any mistake or lacuna is likely to affect the future of students.

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

STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

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

A. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

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

Section-III

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

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

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

B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals/field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behaviour and it should be followed by viva-voce.

C. Project Work

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

D. Professional Industrial Training

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

6 -RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

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

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that a proper mix of different teaching methods in all these places of instruction only can bring the changes in stipulated student's behavior as in the curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every teacher to read them carefully, comprehend and start using them.

(A) Broad Suggestions:

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

(B) Course Level Suggestions

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

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

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

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

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

7 - List of Experts

Mathematics I & II

1. Shri Pankaj Bhatnagar, Lecturer Mathematics, Govt. Poly. Deeh Sadar Unnao
2. Shri Nilesh Kumar, Lecturer Mathematics, Govt. Poly. Unnao
3. Smt. Pushpa Gautam, Lecturer Mathematics, Govt. Poly. Jamunia Deeh Harak Barabanki
4. Shri Manish Kumar, Lecturer Mathematics, Govt. Poly. Ghatampur Kanpur
5. Smt. Kshama Mishra, Lecturer Mathematics, Govt. Poly. Kanpur
6. Shri Sanjiv Agrawal, Lecturer Mathematics, Govt. Poly. Orai Jalaun

Applied Physics

1. Shri Rakesh Kumar Verma, Lecturer Physics, Govt. Poly. Tirwa Kannauj
2. Smt. Shalini, Lecturer Physics, Govt. Poly. Bindki Fatehpur
3. Dr. Ajay Maurya, Lecturer Physics, Govt. Poly. Kanpur
4. Smt. Monika Tandon, Lecturer Physics, Govt. Poly. Ghatampur Kanpur
5. Smt. Neelam, Lecturer Physics, Govt. Poly. Deeh Sadar Unnao

Applied Chemistry

1. Dr. Jagrati, Lecture Chemistry, Govt. Poly. Bighapur Unnao
2. Dr Tahir Jafar, Lecture Chemistry, Govt. Poly. Sicundra Kanpur Dehat
3. Shri Santosh Kumar Singh, Lecture Chemistry, Govt. Poly. Fatehpur
4. Shri Ravi Rajak, Lecture Chemistry, MMIT, Kanpur Dehat
5. Smt. Manisha Gangwar, Lecture Chemistry, Govt. Poly. Deeh Sadar Unnao
6. Dr Anshu Singh, Lecture Chemistry, Govt. Girls Poly. Lucknow

Communication In Skills In English

1. Mohd. Kamrujjma, Lecture English, Govt. Poly. Deeh Harak Barabanki
2. Dr. Dhruv Shankar, Lecture English, MMIT Kanpur Dehat
3. Smt. Jyotishna Singh, Lecture English, Govt. Poly. Unnao
4. Dr. Rupali, Lecture English, Govt. Poly. Bindki Fatehpur
5. Shri Amit Agnihotri, Lecture English, Govt. Poly. Kanpur

Engineering Graphics

1. Shri Pradeep Kumar, HOD Mechanical, Govt. Poly. Lucknow.
2. Shri Atul Roy, Lecturer Mechanical, Govt. Poly. Kanpur
3. Shri Pankaj Singh, Lecturer Mechanical, MMIT Auraiya
4. Smt. Charu Bajpai, Lecturer Civil, Govt. Poly. Sikandra Kanpur dehat
5. Shri Ram Sajivan, Lecturer Mechanical, MMIT, Kannauj
6. Smt. Ruchi Singh, Lecturer Civil, Govt. Poly. Kanpur
7. Shri Sakib Ali, Lecturer Mechanical, Govt. Poly. Bighapur Unnao

Engineering Workshop Practice

1. Shri. Narendra Kumar, Workshop Superintendent, Govt. Poly. Kanpur
2. Shri Pravin Kumar, Workshop Superintendent, Govt. Girls Poly. Lucknow
3. Shri V. K. Shrivastav, Workshop Superintendent, Govt. Poly. Ayodhya
4. Shri S. K. Saxena, Workshop Superintendent, Govt. Poly. Jhansi
5. Shri A. K. Shrivastav Workshop Superintendent, Govt. Poly. Hardoi

Introduction to IT Systems

1. Shri Madan Mishra, HOD Computer Science & Engg., MMIT Santkabir Nagar.
2. Dr. Jokhu Lal, HOD Computer Science & Engg., Govt. Girls Poly. Lucknow.
3. Shri Janmejai Kumar, Lecturer CSE, Govt. Poly. Jansath Muzaffarnagar.
4. Smt. Roopali Singh, Lecturer CSE, Govt. Poly. Kanpur.
5. Dr. Vikas Yadav, Lecturer CSE, Govt. Poly. Bighapur Unnao.

Fundamental Of Electrical & Electronics Engineering

1. Shri Anand Kumar, Hod Electrical, Govt. Poly. Lucknow
2. Smt. Geeta Gautam, Lecturer Electronics, Govt. Poly. Fatehpur
3. Smt. Priyanka Tiwari, Lecturer Electrical Govt. Poly. Kanpur
4. Shri Santosh Kumar Yadav. Lecturer Electronics Govt. Poly. Kanpur
5. Smt. Garima Singh, Lecturer Electronics Govt. Poly. Kanpur
6. Dr. Preeti Sonkar, Lecturer Electrical, Govt. Poly. Kanpur

Engineering Mechanics

1. Shri Kuldeep Singh, HOD Mechanical, Jamunia Deeh Harak Barabanki
2. Shri Atul Roy, Lecturer Mechanical, Government Polytechnic Kanpur
3. Shri Pranjal Mishra, Lecturer Mechanical, Govt. Poly. Deeh Unnao
4. Smt. Anshita Awasthi, Lecturer Mechanical, Govt. Poly. Deeh Unnao
5. Mohd. Saqib Ali Lecturer Mechanical Govt. Poly. Bighapur Unnao
6. Shri Ram Sajivan, Lecturer Mechanical, MMIT Kannauj

Environmental Science

1. Shri Rakesh Kumar, HOD Chemical, Govt. Poly. Kanpur
2. Shri Ravi Sachan, HOD Civil, Govt. Poly. Lucknow
3. Smt. Charu Bajpai, Lecturer Civil, Govt. Poly. Sikandra Kanpur Dehat
4. Dr. Shashi Bala, Lecture Chemical, Govt. Poly. Kanpur
5. Smt. Ruchi Singh, Lecturer Civil, Govt. Poly. Kanpur
6. Smt. Pratiksha Chaurasiya, Lecturer Plastic and Mold Technology, Govt. Poly. Kanpur.

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

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows

- I. 15 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)
- II. 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)
 - a) 75 - 80% 06 Marks
 - b) 80 - 85% 08 Marks
 - c) Above 85% 10 Marks
- III. 25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)
 - a) 25 - State/National Level participation
 - b) 20 - Participation in two of above activities
 - c) 15 - Inter-Polytechnic level participation

9 . Evaluation Scheme Guidelines : As Per AICTE

a. For Theory Courses:

(The weightage of Internal assessment is 40% and for End Semester Exam is 60%) The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

b. For Practical Courses:

(The weightage of Internal assessment is 60% and for End Semester Exam is 40%) The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

c. For Summer Internship / Projects / Seminar etc.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Note: The internal assessment is based on the student's performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.

10- (Annexure –I)**^Curriculum of First and Second Semester for the following Engineering Branches -**

Sr. No.	Name of Diploma Programme	Duration
1	Diploma in Mechanical Engineering	3 Years
2	Diploma in Mechanical Engineering (Repair & Maintenance)	3 Years
3	Diploma in Mechanical Engineering(Computer Aided Design)	3 Years
4	Diploma in Mechanical Engineering (Refrigeration & Air conditioning)	3 Years
5	Diploma in Mechanical Engineering (Automobile)	3 Years
6	Diploma in Mechanical Engineering(Production)	3 Years
7	Diploma in Electronics Engineering	3 Years
8	Diploma in Electronics Engineering (Advanced Microprocessor & Interface)	3 Years
9	Diploma in Electronics Engineering (Modern Consumer Electronics Appliances)	3 Years
10	Diploma in Electronics Engineering (Micro Electronics)	3 Years
11	Diploma in Electrical Engineering	3 Years
12	Diploma in Electrical Engineering (Industrial Control)	3 Years
13	Diploma in Electrical & Electronics Engineering	3 Years
14	Diploma in Electronics & Communication Engineering	3 Years
15	Diploma in Chemical Engineering	3 Years
16	Diploma in Chemical Technology (Rubber & Plastic)	3 Years
17	Diploma in Chemical Technology (Fertilizer)	3 Years
18	Diploma in Chemical Engineering (Petro Chemical)	3 Years
19	Diploma in Paint Technology	3 Years
20	Diploma in Civil Engineering	3 Years
21	Diploma in Computer Science & Engineering	3 Years
22	Diploma in Information Technology	3 Years
23	Diploma in Instrumentation & Control Engineering	3 Years

24	Diploma in Civil Engineering (Environmental Pollution & control)	3 Years
25	Diploma in Agricultural Engineering	3 Years
26	Diploma in Plastic Mould Technology	3 Years
27	Diploma in Glass & Ceramics	3 Years
28	Diploma in Dairy Engineering	3 Years
29	Diploma in Leather Technology (Tanning)	3 Years
30	Diploma in Leather Technology Footwear (Computer Aided Shoe Design)	3 Years
31	Diploma in Textile Technology	3 Years
32	Diploma in Textile Chemistry	3 Years
33	Diploma in Textile Engineering	3 Years
34	Diploma in Printing Technology	3 Years
35	Diploma in Food Technology	3 Years
36	Diploma in Paper & Pulp Technology	3 Years
37	Diploma in Carpet Technology	3 Years
38	Diploma in Mining Engineering	3 Years
39	Renewable Energy	3 Years
40	Communication and Computer Networking	3 Years
41	Civil and Environment Engineering	3 Years

NEP-2020 Aligned Curriculum for

Three year (Six Semester) Diploma Programme in

- MECHANICAL ENGINEERING (Repair And Maintenance)



Prepared by:
IRDT, Kanpur

(Effective from session 2025-26)

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PREFACE

An important issue generally debated among the planners and educator's world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization have created an environment for free flow of information and technology through fast and efficient means. This has led to the shrinking of the world, bringing people from different culture and environments together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. To cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by Technical Education, UP to revise the existing curricula of diploma programme as per the needs of the industry and making them NEP-2020 compliant, are laudable.

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

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

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

Director
Institute of Research Development & Training.
Kanpur

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6. All the participants from industry/field organizations, engineering colleges, polytechnics, and other technical institutions for their professional inputs during curriculum workshops.

Coordinator
Institute of Research Development & Training,
Kanpur, U.P.

1. SALIENT FEATURES

- Name of the Programme: Diploma in Mechanical Engineering (Repair And Maintenance)
- Duration of the Programme: Three years (Six Semesters)
- Entry Qualification: Matriculation or as Prescribed by State BTE, UP
- Intake: As prescribed by the Board
- Pattern of the Programme: Semester Pattern
- Ratio between theory and Practical: 40 : 60 (Approx.)
- Practicum subjects are to be evaluated by theory or practical examinations as mentioned in the scheme.

2. Employment Opportunities

1. Entry-Level and Production Roles

Diploma Engineer Trainee/Junior Engineer (Manufacturing/Production)

Plant Operator roles in agro-processing industries

2. Supervisory and Quality/Design Roles

Mid-level roles such as Production Supervisor, Quality Engineer, Mechanical Design Engineer, CNC Programmer/Operator, and Draughtsman

3. Government & Public Sector Jobs

Diploma holders are eligible to apply for Junior Engineer positions in UP state departments, CPWD, Public Sector Units (e.g., Indian Railways, NTPC), and Defence PSUs (e.g., HAL, Ordnance Factories) .

Entry into railways via RRB JE, DMRC JE-ME, etc., is common and offers stable pay and benefits

4. Apprenticeships & Training

Apprenticeship programs through Polytechnic placements are common in manufacturing, electronics, and mechanical workshops. These often involve training in CNC operation, maintenance, design tools, etc., leading to permanent roles .

5. Career Advancement & Further Education

Many diploma grads later pursue Graduation to advance technical credibility

Skill/Certification courses: AutoCAD, SolidWorks, CNC, SAP, NDT

PROGRAM OUTCOMES (POs)

P01: Basics and Discipline specific Knowledge

Assimilate knowledge of basic mathematics, science, engineering fundamentals, and electronics and communication engineering.

P02: Problem's Analysis and solution

Identify, analyse and solve problems using standard methods and established techniques.

P03: Design and Development

Design solutions for technical problems.

Assist in designing components, systems, or processes to meet specific requirements.

P04: Engineering Tools, Experimentation, and Testing

Use modern engineering tools and appropriate techniques to conduct experiments as per BIS standard.

P05: Socio/ Economic /Environmental impact assessment/remedy.

Apply relevant technologies while considering societal needs, environmental impact keeping in view sustainable and ethical responsibilities.

P06: Project Management and Communication

Apply engineering management principles, work effectively as an individual or in a team, and communicate clearly on activities.

P07: Lifelong Learning

Recognize the importance of continuous learning and actively pursue self-improvement to keep pace with technological developments.

Study Scheme
Diploma in Mechanical Engineering (Repair And Maintenance) (Six Semester)
Semester: III

Sr. No.	SUBJECTS	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External	End Semester Exam Type
		Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT								
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot				
1.	Thermal Engineering -I	4	0	0	3	40	-	40	60	3	-	-	60	100	Theory		
2.	Fluid Mechanics & Hydraulic Machinery	4	0	0	3	40	-	40	60	3	-	-	60	100	Theory		
3.	Fluid Mechanics & Hydraulic Machinery Lab	0	0	4	2	-	60	60	-	-	40	3	40	100	Practical		
4.	Workshop Practice	0	0	4	2	-	60	60	-	-	40	3	40	100	Practical		
5.	Measurements & Metrology	2	0	3	3	-	40	40	60	3	-	-	60	100	Practicum		
6.	Computer Aided Machine Drawing Practice	1	0	6	4	-	60	60	-	-	40	3	40	100	Practicum		
7.	Advance Skill Development OR	-	-	-	2	-	-	-	-	-	-	-	-	-	*Qualifying		
	*Open Elective-I	2	-	-		50	-	50	-	-	-	-	-	-			
8.	Summer Internship-I (4 weeks) after IInd Sem	0	0	0	1	-	50	50	-	-	-	-	-	50	Practical		
#Student Centred Activities (SCA)		-	-	6	-	-	50	50	-	-	-	-	-	50	-		
Total		13	0	23	20	80	320	400	180	-	120	-	300	700			

#

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

* **Qualifying paper** must have to pass, but the marks will not be added in awarded division or total marks.

* **Practicum subjects** are to be evaluated by theory or practical examinations as mentioned in above scheme.

***Tata Tech. Based** Open Elective-I subject will be offered preferably at the centers established by Tata Tech.

The lecture allotted to SCA can also be utilized for the course completion of other subjects.

Note -

- 1) Each period will be 60 minutes duration.
- 2) Each session will be of 16 weeks.
- 3) Effective teaching will be at least 14 weeks.

Open Elective-I

SR. NO.	SUBJECT NAME
1.	Material Handling Systems (AICTE)
2.	Energy Conservation & Audit (AICTE)
3.	Industrial Robotics & Automation (AICTE)
4.	Any Course Of Minimum 02 Credit From (Advance Skill Development) <ul style="list-style-type: none"> • NPTEL • MOOCS THROUGH SWAYAM • AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES • C-DAC • CERTIFICATES CONDUCTED BY THE INSTITUTE OF NATIONAL IMPORTANCE (IIT, NIT, IIT ETC.) • ISRO E-LEARNING • COURSES OFFERED BY TATA TECHNOLOGY (Annexure-1) OR OTHER REPUTED ORGNISATION. <ul style="list-style-type: none"> ○ Advanced Welding & Painting using Simulator (Tata Tech)

	<ul style="list-style-type: none">○ Internet of Things (Tata Tech)○ Product Verification & Analysis (Tata Tech)
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Advance Skill Development:

To fulfill the requirements for Advanced Skill Development, a minimum of 20 hours of skill certification is necessary. This certification must be obtained from a recognized national or international agency or institute. The assessment and certification process will be conducted by the respective agency or institute. Students must present their certificate to earn 02 credits for this subject.

Study Scheme
Diploma in Mechanical Engineering (Repair And Maintenance) (Six Semester)
Semester: IV

Sr. No.	SUBJECTS	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External	Exam Type
		Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT								
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot				
1.	Strength of Materials	4	0	0	3	40	-	40	60	3	-	-	60	100	Theory		
2.	Industrial Engineering & Management	4	0	0	3	40	-	40	60	3	-	-	60	100	Theory		
3.	Strength of Materials Lab	0	0	6	3	-	60	60	-	-	40	3	40	100	Practical		
4.	Manufacturing Engineering	2	0	3	3	-	40	40	60	3	-	-	60	100	Practicum		
5.	Material Science & Engineering	1	0	4	3	-	60	60	-	-	40	3	40	100	Practicum		
6.	Thermal Engineering-II	1	0	4	3	-	60	60	-	-	40	3	40	100	Practicum		
7.	Advance Skill Development OR	-	-	-	2	-	-	-	-	-	-	-	-	-	*Qualifying		
	*Open Elective-II	2	-	-		50	-	50	-	-	-	-	-	-			
8.	*Essence of Indian Knowledge and Tradition (Q)	2	0	0	-	50	-	50	-	-	-	-	-	-	*Qualifying		
#Student Centred Activities (SCA)		-	-	3	-	-	50	50	-	-	-	-	-	50	-		
Total		16	0	20	20	80	270	350	180	-	120	-	300	650	-		

uated in 5th sem.

Industrial training of 4-6 weeks duration to be organized after 4th semester exam and will be evaluated in 5th sem.

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

* **Qualifying paper** must have to pass, but the marks will not be added in awarded division or total marks.

* **Practicum subjects** are to be evaluated by theory or practical examinations as mentioned in above scheme.

***Tata Tech. Based open elective-II** subject will be offered preferably at the centers established by Tata Tech.

The lecture allotted to SCA can also be utilized for the course completion of other subjects.

Note -

- 1) Each period will be 60 minutes duration.
- 2) Each session will be of 16 weeks.
- 3) Effective teaching will be at least 14 weeks.

Open Elective-II

SR. NO.	SUBJECT NAME
1.	Refrigeration & Air-conditioning
2.	Power Plant Engineering
3.	Disaster Management
4.	Any Course Of Minimum 02 Credit From (Advance Skill Development) <ul style="list-style-type: none"> • NPTEL • MOOCS THROUGH SWAYAM • AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES • C-DAC • CERTIFICATES CONDUCTED BY THE INSTITUTE OF NATIONAL IMPORTANCE (IIT, NIT, IIT ETC.) • ISRO E-LEARNING • COURSES OFFERED BY TATA TECHNOLOGY (Annexure-1) OR OTHER REPUTED ORGNISATION. <ul style="list-style-type: none"> ○ Inspection & Quality Control (Tata Tech) ○ Advanced Automobile (Tata Tech)

Advance Skill Development:

To fulfill the requirements for Advanced Skill Development, a minimum of 20 hours of skill certification is necessary. This certification must be obtained from a recognized national or international agency or institute. The assessment and certification process will be conducted by the respective agency or institute. Students must present their certificate to earn 02 credits for this subject.

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

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

- i. 10 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)
- ii. 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)
 - a) 75 - 80% 8 Marks
 - b) 80 - 85% 9 Marks
 - c) Above 85% 10 Marks
- iii. 30 Marks maximum for Sports/ NCC/ Cultural/ Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)
 - a) 30 - State/National Level participation
 - b) 25 - Participation in two of above activities
 - c) 15 - Inter-Polytechnic level participation

3.1	Thermal Engineering-I	L	T	P	C
Theory		4	0	0	3

RATIONALE

Thermal Engineering is a fundamental subject for diploma holders in Mechanical, Automobile, and related engineering fields. It provides essential knowledge about thermodynamics, heat transfer, and energy systems, which form the backbone of various industrial and engineering applications.

As industries increasingly focus on energy efficiency, environmental impact, and sustainable technologies, a strong understanding of thermal principles is crucial. This subject enables diploma students to analyze, operate, and maintain thermal systems such as boilers, turbines, steam generators, sources of energy.

LEARNING OUTCOMES

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

- Understand the Fundamentals of Thermodynamics.
- Apply Thermodynamic Principles to Practical Systems.
- Understand and Apply Heat Transfer Principles.
- Understand Steam Properties and Steam Boilers.
- Analyze Steam Turbines and Steam Nozzles.

DETAILED CONTENT

UNIT-I: Fundamental Concepts: Role of Thermodynamics in Engineering .Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, properties of system, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, Zeroth law of thermodynamics,

Unit-II: Thermodynamic Processes on Gases and Laws of thermodynamics : Explanation of perfect gas laws – Boyle’s law, Charle’s law, Gay-Lussac’s law, Universal gas constant, Characteristic gas constants, simple problems on gas equation, Laws of conservation of energy, first law of thermodynamics (Joule’s experiment), Application of first law of thermodynamics ,Steady flow energy equation, Application of steady flow energy equation, statement of second laws of thermodynamics: Kelvin Planck’s statement, Clausius statement, Perpetual motion Machine of first kind, second kind, Carnot cycle, Carnot engine, Introduction of third law of thermodynamics.

UNIT-III: Properties of Steam: Formation and Industrial uses of Steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region,wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction,saturated steam, superheated steam, degree of superheat; Determination of enthalpy,internal energy, latent heat, of wet, dry and superheated steam at a given pressure using steam tables and simple direct problems on the above using table.

UNIT-IV: Steam generators: Introduction and classification of boilers with example, Boiler mountings and accessories, Brief explanation with line sketches of Cochran, Babcock and Wilcox

Boilers Locomotive boiler; Brief explanation with line sketches of High Pressure Boiler, Draught systems (Natural, forced & induced).

Unit-V : Steam Turbines and Steam Nozzles: Classification of steam turbines with examples . Difference between Impulse & Reaction turbines. Working Principle of a simple De-lavel turbine & Parson's Reaction turbine with line diagrams-Velocity diagrams; Basic concept used for calculation of work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency.

Governing of steam turbines: Throttle, By-pass & Nozzle control governing

Flow of steam through nozzle; Discharge of steam through nozzles; Critical pressure ratio; Effect of friction in nozzles and Super saturated flow in nozzles.

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should explain various sources of energy to the students and facilitate discussions where students evaluate pros and cons of different energy sources. It's recommended that teachers take action to grab students' interest and increase their confidence in their ability to learn. The demonstration might spark interest in the subject and encourage a scientific perspective. Every topic should have planned student activities. To make sure that learning is outcome and employability based, a theory – demonstrate practice - activity approach may be used throughout the course. If available, demonstrate small-scale models of steam boilers in the lab or use virtual labs to simulate their operation.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests.
- Sessional test.
- Model making, Mini-Projects.
- Small projects.

REFERENCE BOOKS/ ONLINE RESOURCES

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. R. K. Rajput, Thermal Engineering ,Laxmi Publications Pvt Ltd , New Delhi.
5. R.S. Khurmi, J. K. Gupta, A Textbook of Thermal Engineering, S. Chand Publications.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE,Lucknow.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted
1	10	12
2	10	12
3	12	12
4	12	12
5	12	12
Total	56	60

3.2	Fluid Mechanics & Hydraulic Machinery	L	T	P	C
THEORY		4	0	0	3

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENT

UNIT-I: Properties of Fluid: Definition of fluid, Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility. Different types of fluids: Ideal fluid, Real fluid, Ideal plastic fluid, Plastic fluid, Newtonian and non Newtonian fluid. Simple numerical problems.

Fluid Pressure: Fluid pressure, Pressure head, Conversion of Pressure head, Pressure Intensity, Statement of Pascal law and its applications.

Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure. Simple numerical problem.

UNIT-II: Pressure Measurement: Barometer, Simple manometer, differential manometers and sensitive Manometers, Bourdan pressure gauge.

Concept of Total pressure on immersed bodies, Center of pressure, Simple problems on Manometers.

UNIT-III: Fluid Flow: Types of fluid flows, Path line, Streamline and streak lines, Continuity equation, Bernoulli's theorem, Principle of operation of Venturi meter and Orifice meter, Principle of operation of Pitot tube and rotameter. Concept and relation of Cd, Cv and Cc. Simple numerical problem.

Flow Through Pipes: Laminar and turbulent flows; Reynold's number and its effect on pipe friction; critical velocity, siphon, Water hammer. Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes. Hydraulic gradient, Simple numerical problem.

UNIT-IV: Hydraulic Turbines: Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis

and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Cavitation causes, effects and remedies.

Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

UNIT-V: Hydraulic System: Description, operation and application of hydraulic systems – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press.

Hydro Power plant: Introduction, type of hydro-power plant, tidal and wave energy.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Sessional test
- Actual Practical Performance
- Small projects
- Viva-voice

REFERENCE BOOKS/ ONLINE RESOURCES:

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/NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted
1	10	12
2	08	12
3	14	12
4	16	12
5	08	12
Total	56	60

3.3	Fluid Mechanics & Hydraulic Machinery Lab	L	T	P	C
PRACTICAL		0	0	4	2

LIST OF PRACTICALS

1. Measurement of pressure head by employing.
 - i) Piezometer tube
 - ii) Single and double column manometer.
2. To verify Archimedes' Principle.
3. To find out the value of coefficient of discharge for a venturi meter. Measurement of flow by using venturi meter.
4. To find out the value of coefficient of discharge for an orifice meter. Measurement of flow by using orifice meter.
5. To find out the value of coefficient of discharge for V- notch.
6. Verification of Bernoulli's theorem.
7. To find coefficient of friction for a pipe (Darcy's friction).
8. To study hydraulic circuit of an automobile brake.
9. To study hydraulic circuit of a hydraulic ram.
10. To study the working of a Pelton wheel Turbine.
11. To study the working of a Francis turbine.
12. To study a single stage centrifugal pump for constructional details and its operation to find out its normal head and discharge.

3.4	Workshop Practice	L	T	P	C
PRACTICAL		0	0	4	2

RATIONALE: The subject workshop practice forms a crucial foundation in the education of mechanical engineering diploma students. It introduces them to the fundamental manufacturing processes, tools, equipment's, and basic fitting, machining, and fabrication techniques used in industry. This hands on exposure bridges the gap between theoretical knowledge and practical application fostering skill development, accuracy, safety consciousness and confidence in working with machines and material.

COURSE OBJECTIVES - The course aims to provide hands-on experience and practical skills in various essential workshops including Smithy Shop, Advance Welding Shop, Advance Fitting Shop and this curriculum is primarily divided into three parts. This practical knowledge will equip students with the necessary skills to handle real-world tasks efficiently, fostering a deeper understanding of the techniques and safety measures required in each shop.

1 SMITHY SHOP

1. General Shop Talk

1.1 Purpose of Smithy shop

1.2 Different types of Hearths used in Smithy shop

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

1.4 Types of fuel used and maximum temperature obtained

1.5 Types of raw materials used in Smithy shop

1.6 Uses of Fire Bricks & Clays in Forging workshop.

2. Practice

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

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

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

3. Job Practice : Job Preparation

3.1 Job I - Making a cold/hot, hexagonal/octagonal flat chisel including tempering of edges.

3.2 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]

3.3 Job III - To prepare a cube from a M.S. round by forging method

2 ADVANCE WELDING SHOP

1. General Shop Talk

1.1 Basic introduction of all types of Welding Techniques and Equipment Familiarization
Overview of advanced welding equipment's.

- 1.2 Overview of Advanced Welding Processes Brief review of foundational welding processes (e.g., SMAW, GMAW, GTAW, TIG, Plasma Arc, Submerged Arc) with explanation of their applications in industries like aerospace, automotive, oil and gas or manufacturing.
- 1.3 Safety Protocols and Hazard Awareness Personal Protective Equipment (PPE)- Importance of welding helmets with appropriate shade levels, gloves, flame-resistant jackets, safety boots and respiratory protection.
- 1.4 Discuss about proper storage of gas cylinders and handling of welding consumables and awareness of fire and explosion risks from flammable materials or gases.
- 1.5 Weld Imperfections and Quality Standards Common weld imperfections (e.g., porosity, cracks, lack of fusion) and their causes.

2. Practice

- 2.1 Preparation of key components (e.g., power sources, torches, wire feeders, shielding gas regulators)
- 2.2 Maintenance tips to prevent equipment malfunctions (e.g., cleaning nozzles, checking cables).
- 2.3 Complete awareness of workstation setup, calibration and shutdown procedures.
- 2.4 Importance of selecting appropriate filler metals, shielding gases and welding parameters for specific materials.
- 2.5 Practicing flame generation is an essential step in gas welding and cutting, especially using oxy- acetylene equipment. Discuss the classification of all types of flames.

3. Job Practice : Job Preparation

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

3 ADVANCE FITTING SHOP

1. General Shop Talk

- 1.0 Introduction of application of all types of tools used in fitting shop.
- 1.1 Basic knowledge of limits, fits and tolerances which is necessary for precision fitting work.
- 1.2 Familiarization with Interchangeable parts fitting.
- 1.3 Introduction to jigs and fixtures that improve efficiency and accuracy.
- 1.4 Understanding of Advanced shop safety, proper handling of tools and materials.

2. Practice

2.1 Precision use of tools like scrapers, micrometers, Vernier calipers and gauges, Hack sawing, drilling, reaming, and tapping with precision.

2.2 Use of taps and dies for internal and external threading.

2.3 Accurate chisel and file work to meet tight tolerances.

3. Job Practice : Job Preparation

3.1 Job 1. Exercise on drilling, reaming, counter boring, counter sinking and tapping.

3.2 Job 2. Dovetail fitting in mild steel.

3.3 Job 3. Radius fitting in mild steel.

3.4 Job 4. Pipe threading with die.

Text and Reference books:

1. Elements of workshop Technology Volume I & II- Hajra Chowdry & Bhattacharaya- Iith Edition- Media Promoters & Publishers Pvt. Ltd.,

2. A Textbook of workshop Technology- R.S.Khurmi & J.K.Gupta- 2nd Edition, S.Chand & Co., Ram Nagar, New Delhi- 2018.

3. Manufacturing process- Begeman- 5th Edition-McGraw Hill, New Delhi 2011.

4. Workshop Technology- WAJ Chapman- Volume I, II, & III- Vima Books Pvt. Ltd., 4262/3, Ansari Road, Daryaganj, New Delhi 110 002.

5. Production Technology- HMT- Edn. 18- published by Tata McGraw Hill publishing Co. Ltd., 7 West Patel nagar, New Delhi 110 008.- 20181

3.5	Measurements & Metrology	L	T	P	C
PRACTICUM		2	0	3	3

RATIONALE

The progress in metrology and measurements is highly necessary and has led to improvements in product quality, enhanced scientific research capabilities, and increased efficiency in diverse industries including manufacturing, automobile, aerospace, and quality control. It encompasses various disciplines and techniques used to ensure the accuracy, precision, and reliability of measurements. Therefore, the study of metrology and measurements is essential for maintaining uniformity and excellence across various fields, including manufacturing and scientific research.

Learning Outcomes

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

- Classify the measuring instruments based on their applications.
- Select appropriate instrument for linear dimensions.
- Select appropriate instrument for angular dimensions.
- Explain various instruments used in measuring screw threads and gears.
- Discuss about the applications of CMM and LASER technology in metrology.

UNIT I: LINEAR MEASUREMENTS AND COMPARATORS

Basics of Metrology: Scope of Metrology, basic units, important terminology, Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; international standardization, the bureau of Indian standards, important elements of measurements, methods of measurements. Precision, accuracy, factors affecting the accuracy of the measuring system, general rules for accurate measurements, precautions for use of instruments so as to avoid in accuracy in measurements, reliability, Measurement uncertainty, Compare systematic error and random error, Selection of measuring instruments, Calibration of measuring instruments.

Linear Measurements: Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, bore gauge, Gauge blocks – Use and precautions, slip gauges.

Comparator : Comparators – Working and advantages, Types - Mechanical and Pneumatic Comparators.

Practical Exercises:

Ex. No	Name of the Experiment	Hours
1	VERNIER CALIPER i) Measure the dimensions of ground MS flat/Cylindrical bush using Vernier Caliper. ii) Compare the results with Digital Vernier Caliper.	5
2	OUTSIDE MICROMETER i) Measure the diameter of a wire using micrometer ii) Compare the results with a digital Outside micrometer.	5
3	INSIDE MICROMETER i) Measure the inside diameter of the bore of a bush cylindrical component using Inside micrometer ii) Compare the results with digital inside micrometer.	4
4	SLIP GAUGES Measure the thickness of ground MS plates using slip gauges.	4
5	VERNIER HEIGHT GAUGE Measure the height of gauge blocks or parallel bars using vernier height gauge.	4
6	MECHANICAL COMPARATOR Find out the measurement of a given component and Compare with a standard component using a mechanical comparator and slip gauge.	4

UNIT II: ANGULAR MEASUREMENTS, CMM, SURFACE & ADVANCED METROLOGY

Angular Measurements: Angular measuring instruments, Bevel protractor, Angle gauges, Precision level, Sine bar, Autocollimator. Opto-mechanical measurements using a measuring microscope and Profile projector. Measurement of Screw threads – Single element measurements, Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose, Analytical measurement, Runout, Pitch variation, Tooth profile, Tooth thickness, Lead.

Coordinating measuring Machine: Basic concept of CMM, Types of CMM, Constructional features Probes, Accessories, Software, Applications.

Advanced Metrology: Basic concepts of lasers, types of lasers, Laser and LED based distance measuring instruments.

Practical Exercises:

Ex. No.	Name of the Experiment	Hours
7	UNIVERSAL BEVEL PROTRACTOR Measure the angle of a V-block/Taper Shank of Drill/ Dovetail using universal bevel protractor.	4
8	SINE BAR Measure the angle of the machined surface using sine bar with slip gauges.	4
9	SCREW THREAD MICROMETER Measure the geometrical dimensions of V-Thread using screw thread micrometer.	4
10	PROFILE PROJECTOR Measurement of a profile using profile projector.	4

Suggested List of Student Activity

1. Each student writes and submits the assignment on the topic of Methods of measurements, Precautions to avoid inaccuracy in measurements, Selection and Calibration of measuring instruments.
2. Four students can be grouped as a batch to measure the various dimensions of taper shank drill bit and spur gear and submit the activity report. The activity report should have the diagram and various dimensions of the taper shank drill bit and spur gear.
3. Visit Industry to study the working of the CMM. Prepare a report.
4. Visit Industry to study the working of the Profile Projector. Prepare a report.
5. Study the various types of Comparator. Prepare a report.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Sessional test
- Actual Practical Performance
- Small projects

Viva-voice

Text and Reference books:

1. R. K. Jain, Engineering Metrology, 22 nd Edition, Khanna Publishers, 2022.
2. N. V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press India, 2013.
3. R. K. Rajput, Engineering Metrology and Instrumentation, S.K. Kataria & Sons, 2nd Edition, 2013.
4. Samir Mekid, Metrology and Instrumentation: Practical Applications for Engineering and Manufacturing, John Wiley & Sons, Inc., 2021.
5. Anand K. Bewoor & Vinay A. Kulkarni, Metrology & measurement, Tata McGraw-Hill, 2009.
6. Rega Rajendra, Principles of Engineering Metrology, Jaico Publishing House, 2008.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted
1	14	30
2	14	30
Total	28	60

3.6	Computer Aided Machine Drawing Practice	L	T	P	C
PRACTICUM		1	0	6	4

Syllabus contents

<p>SECTIONAL VIEWS Sectioning, sectional views, representation of sectional plane, hatching, inclination, spacing, hatching large areas, hatching adjacent parts, full section/half section – types of half sections, conventional representation of materials in section.</p> <p>GEOMETRIC DIMENSIONING AND TOLERANCES. Importance of GD&T, Tolerance specification and interpretation, Tolerance symbols, Features, Datum plane and Axis, Shaft basis and hole basis system. Material Condition Modifiers. Maximum Material Condition (MMC), Least Material Condition (LMC), Feature Control Frames</p>	24
Manual Drawing Practice	
<p>Detailed drawings of the following machine components will be given to students to draw the assembled views. Only the assembled Front view (Without section / Full Section / Half Section) and Top view or Side view (Without section / Full Section / Half Section) with dimensions and Bill of materials in the Drawing Sheet.</p> <p>Note: All the exercises drawing sheet should be submitted for the model and end semester examination as a record of work done.</p>	24
COMPUTER AIDED DRAFTING (CAD) PRACTICES	
<p>PART A - Drafting Practices: 2D Drafting Practices - Draw the front view of the assembled drawing of the components with dimensions.</p>	24
<p>PART B - Solid modeling Practices: Detailed drawings of the machine components will be given to students to create the solid modeling and assemble using any CAD software in the computer and take the printout. Machine Components for the Practical Exercises</p> <ol style="list-style-type: none"> 1. Sleeve and Cotter Joint. 2. Plummer Block. 3. Flange Coupling. 4. Bushed Bearing. 	26
Total	98

Text and Reference Books:

1. A beginner's guide to 3D modeling by Cameron Coward
2. Solidworks 2022 step by step guide by Amit Bhatt and Mark Wiley

Web-based/Online Resources:

- <https://www.autodesk.in/campaigns/autocad-tytorials>
- <https://www.mycadsite.com/tutorials.html>
- NPTEL Lecturers

3.7.1	Material Handling Systems (Open Elective I)	L	T	P	C
QUALIFYING		2	-	-	2

RATIONALE

In the field of engineering and technology, the term materials handling system is used with reference to industrial activity. In any industry, be it big or small, involving manufacturing or construction type work, materials must be handled as raw materials, intermediate goods or finished products from the point of receipt and storage of raw materials, through production processes and up to finished good storage and dispatch point. Lot of development has taken place in the field of materials handling system. So, it is necessary to teach them various types of material handling system and their different parts and selection process

Learning outcomes

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

- Understand constructional & operational features of various materials handling systems.
- Identify, compare & select proper material handling equipment for specified applications.
- Know the controls & safety measures incorporated on material handling equipment.
- Appreciate the role of material handling devices in mechanization & automation of industrial process.
- Understand & appreciate safety instrumentation for equipment.

DETAILED CONTENT

UNIT-I: Introduction to Material Handling System

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

UNIT-II: Hoisting Machinery & Equipment's

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

UNIT-III: Conveying Machinery

Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators; Construction, Working & Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.

Surface Transportation Equipment

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

UNIT-IV: Components of Material Handling Systems

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

UNIT-V: Mechanism used in Material Handling Equipment

Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism, Slewing Mechanism, Rope & chain operated Cross-Traversal Mechanism.

Selection of Material Handling Equipment

Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Methods of stocking at initial, final & intermediate points, Nature of production process involved, Specific load conditions & Economics of material handling system.

REFERENCE BOOKS/ ONLINE RESOURCES

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

3.7.2	Energy Conservation & Audit (Open Elective I)	L	T	P	C
QUALIFYING		2	-	-	2

RATIONALE:

This subject aims to develop awareness among students about the importance of conserving energy reducing waste and promoting Eco-friendly technologies. It introduces them to tools, techniques and methodologies used for conducting energy audits in industrial, commercial and domestic setups.

Learning Outcomes:

Students will be able-

- To Identify demand supply gaps in present scenario.
- To understand conversations approaches to an industry.
- To draw the energy flow diagram of an industry.
- To identify energy wastage and suggest alternative methods.
- To understand the concepts energy audit.

Course Content:

UNIT-I: Introduction: General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits; Energy Efficiency Principle – Maximum energy efficiency, Maximum cost effectiveness; Mandatory provisions of EC act; Features of EC act-Standards and labeling, designated consumers, Energy Conservation Building Codes (ECBC);

Unit-II: Energy Conservation Approaches In Industries: Methods and techniques of energy conservation in ventilation and air conditioners- compressors pumps, fans and blowers - Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat / Control; Energy conservation in electric furnaces, ovens and boilers.

Unit-III: Energy Conservation Option: New equipment, technology, staffing, training; Calculation and costing of energy conservation project; Depreciation cost, sinking fund method. Cost evaluation by Return On Investment(ROI) and pay back method etc.

Unit-IV: Performance improvement of existing power plant: cogeneration, small hydro, DG Set;

Demand side management; Load response programme; Types of tariff and restructuring of electric tariff Technical measures to optimize T and D losses.

Unit-V: Energy Audit: Energy audit and its benefits; Energy flow diagram; Preliminary, Detailed energy audit; Methodology of -preliminary energy audit and Detailed energy audit – Phase I, Pre audit, Phase II- Audit and Phase III- Post audit; Energy audit report; Electrical Measuring Instruments - Power Analyzer.

Reference Books:

1. Electric Energy Generation, Utilisation and Conservation Sivaganaraju, S Pearson, New Delhi, 2012
2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi
3. O.P. Jakhar, Energy Conservations in Buildings, Khanna Publishing House, New Delhi
4. Financial Management, Prasanna Chandra Tata Mcgraw Hill, New Delhi.
5. Energy management Handbook, Prasanna Chandra, Tata Mcgraw Hill, New Delhi.
6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ed. 2018)

3.7.3	Advanced Welding & Painting using Simulator (Tata Tech.) (Open ELECTIVE I)	L	T	P	C
QUALIFYING		-	-	4	2

Rationale: The course on Advanced Welding & Painting using Simulator is designed to impart both theoretical understanding and practical skills in industrial welding and painting processes using modern simulation technologies. With increased industrial demand for precision, safety, and quality assurance, this course aims to bridge the skill gap by integrating XR-based simulation platforms to train students in a risk-free, industry-aligned environment. The curriculum also includes essential safety practices, equipment handling, defect inspection, and quality control for welding and painting, preparing students for real-time industrial challenges.

Learning Outcomes:

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

1. Demonstrate industrial safety practices including proper handling of fire extinguishers, tools, and PPE in welding and painting operations.
2. Identify and classify different welding processes, equipment, filler materials, and welding joints, along with their industrial applications.
3. Interpret welding symbols and drawings and apply standard inspection techniques to identify welding defects.
4. Operate and troubleshoot welding equipment and XR simulators, adhering to SOPs and safety protocols.
5. Explain the importance and application of industrial painting, including surface preparation, paint types, and coating technologies.
6. Use painting equipment like spray guns, booths, and compressors, and apply modern techniques like powder coating with safety and accuracy.
7. Ensure quality control and compliance in both welding and painting tasks by adhering to industry standards and documentation practices.
8. Integrate theory with XR simulator-based practicals to enhance precision, productivity, and confidence in welding and painting jobs.

Sr No	Course contents
1	Introduction to Industrial Safety Practices <ul style="list-style-type: none"> • Fire Extinguishers & its Types, • Safely handling Tools & Equipment, • Use of proper Tools & Equipment & its maintenance, • OSH & practices to be observed as a precaution

2	<p>Introduction to Welding</p> <ul style="list-style-type: none"> • Introduction and importance of welding in Industry. • Types of welding and its selection criteria. • Types of filler material and its selection criteria • Application of welding, • Advantages and disadvantages of welding joints. • Welding techniques and its application • Safety precautions, • Selection of welding equipment, • Types of welding joints its application & symbolic representation on drawing. (Welding drawing reading and symbols used for welding) • Defects in welding and its inspection technique. • Concept of welding skill and its impact on product quality. • Selection of welding technique
3	<p>Introduction to different components of welding equipment & XR station</p> <ul style="list-style-type: none"> • Power Source (Single Phase, Three Phase, Transformer, Inverter etc.) • Welding electrode, electrode holder and its types • Welding torch and its types and selection criteria • High-pressure cylinder and regulator used for welding work, • Types of cylinder & regulators, • Types of welding joints & its application, • Working functions and safety precautions. • Introduction to XR station simulator basic settings and user interface • Application and benefit of XR Station simulator. • Standard operating procedure for XR station and safety guidelines. • Basic troubleshooting and maintenance • Industrial case studies for selection of welding equipment's and XR Station.
,4	<p>Introduction to Industrial Painting</p> <ul style="list-style-type: none"> • Introduction to industrial Paintings and its importance. • paint and its manufacturing knowledge, • Paint preparation or mixing as per required shade of color. • Different types of paints, coatings, and its selection criteria. • Technology of painting, adhesives, • Safety precautions and use of equipment. • Paint storing guidelines and its standard procedure. • Quality assurance in painting and concept of life span for paint. • Advancement in painting technology • Compliance and Regulations in industrial painting.

5	<p>Different components of Painting booth, painting materials & Technology</p> <ul style="list-style-type: none"> • Equipment knowledge of paint booth • Powder coating spray gun • Oven and spray gun, compressor, etc., • Industry application of spray painting, • Advantages and disadvantages of different types of spray-painting technique, • Types of spray-painting components, Functional working & settings of painting guns, • Safety tips for handling spray painting guns, • Metal Surface painting – corrosion, effects, • Types of emery papers & protection.
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COURSE PRACTICALS

Conduct practicals as per lesson plan.

1. Prepare a list for safety equipments used in workplace.
2. Prepare a list of different types of welding, selection of welding criteria and its applications.
3. Prepare a check list as per industrial welding drawing.
4. Prepare a chart for welding symbols.
5. Prepare a list of welding defects.
6. Draw a sketch of welding set up and list the important parts and its function.
7. Perform settings for welding machine by using XR station.
8. Use welding torches for different stroke adjustment, speed, travel angle & work angle for different types of welding.
9. Guided welding practice on simple horizontal and vertical Plate/Pipe Joints.
10. Advance unguided welding practice on simple horizontal and vertical surfaces.
11. Guided welding practice on complex Job Positions.
12. Advance unguided welding practice on complex Job Positions.
13. Perform practice for various welding joint on Simulator.
14. Identify and apply welding on complex surfaces & positions.
15. Spray painting using spray gun by using paint booth.
16. Powder Coating and its application usage using available instruments.

17. Assembly & Connection of spray-painting device Perform settings for spray painting by using XR station & gun holding techniques.
18. Guided spraying practice on complex surface like as edges, corner, square, round & curved area to understanding Coverage level, Dry areas, Defect areas, Drips Areas, Travel Lines etc.
19. Case studies
20. Mini project

3.7.4	Industrial Robotics & Automation (Open Elective-I)	L	T	P	C
QUALIFYING		2	-	-	2

RATIONALE

Industrial Robotics & Automation is essential for mechanical engineering diploma students as it prepares them for the automation-driven industries of today. It equips them with practical skills to operate and maintain robotic systems, improving their employability in sectors like manufacturing and automotive. By understanding automation, students can contribute to optimizing production processes, enhancing efficiency and precision. Additionally, the subject provides a foundation for future studies in advanced fields like robotics and mechatronics, ensuring they stay competitive in a rapidly evolving technological landscape.

Learning Outcomes:

After successful completion of this course, students will be able to-

- Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.
- Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
- Explain about various types of sensors and concepts on robot vision system.
- Explain the concepts of robot programming languages and various methods of robot programming.
- Explain the various applications of robots.

DETAILED CONTENT

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

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

Unit-III: Sensors: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing. Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Vidicon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.

Unit-IV: Robot kinematics and Robot Programming: Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effector commands; and Simple programs

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

REFERENCE BOOKS/ ONLINE RESOURCES

1. Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGraw Hill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, McGraw Hill Book Co, 1987.
4. Robotics for Engineers – Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.
6. Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

3.7.5	Internet of Things (Tata Tech) (Open Elective-I)	L	T	P	C
QUALIFYING		2	-	-	2

Rationale:

This course is designed to develop skills on Internet of things (IOT) using latest software & Hardware. The course helps students to build IOT applications and devices using controller, sensors, actuators, and other electronic components. It also helps candidates to develop competency on latest technologies using IOT in various sectors such as home automation, smart city, agriculture, automotive, manufacturing etc. This course also provides opportunities for starting their own start up by developing novel IoT applications.

Sr No	Course contents
1	<p>Introduction to Industrial Safety Practices</p> <ul style="list-style-type: none"> • Fire Extinguishers & its Types • Safely handling Tools & Equipment • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution
2	<p>Fundamentals of Internet of Things</p> <ul style="list-style-type: none"> • Introduction of Internet of Things • Basics of electricals & electronics components used in IoT • History of IoT • Applications, Benefits and Limitations of IoT • Important components of IoT – Micro Controller, Sensors, actuators, communication protocol, cloud etc • IoT Architecture – Physical layer, Network layer, Data processing layer, Application layer.
3	<p>IoT Micro-controllers and Single board computer</p> <ul style="list-style-type: none"> • Introduction to micro-controller • Different types of micro-controllers, Arduino, Raspberry pi • Introduction to input, output and PWM, interface of camera to raspberry pi, interface of various sensors to raspberry pi, IOT protocol (HTTP, MQTT, HTTPS) for RPI, Study connection of raspberry pi to cloud • Important features of micro-controller • Specification of micro-controller • Selection of micro-controller based on IoT application. • Basic programming of micro-controller • Advanced programming of micro controller

	<ul style="list-style-type: none"> • Debugging of program, Testing of program
4	<p>IoT Sensors</p> <ul style="list-style-type: none"> • Introduction of Sensors • Various types of Sensors and their applications • Specifications of sensors • Working principle of important sensors • Comparison of sensors and relative advantages and limitations • Selection of sensor based on IOT application. • Interfacing of sensors with micro-controller to develop IOT application. • Testing of sensors for IOT application
5	<p>Use of Actuators for IoT applications</p> <ul style="list-style-type: none"> • Introduction to actuators • Various types of actuators • Working principle of actuator • Applications of actuators • Comparison of various actuators and relative advantages and limitations • Selection of actuator based on IOT application
6	<p>IoT Network Connectivity</p> <ul style="list-style-type: none"> • Introduction to IoT network technologies • Various options for IoT connectivity • Comparison of various options for IoT connectivity • Selection of IoT connectivity based on application parameter like Range, Data size, Rate of data transfer, Type of data, Number of devices to be connected etc.
7	<p>Cloud and Application of IoT</p> <ul style="list-style-type: none"> • Various options available to store IOT Data • Comparison of storage options • Storage on premises and Cloud • IOT Database • Selection of database • Interfacing Database with IOT application • Requirements for IoT applications • Selection of sensors and actuators as per IoT application • IoT dashboard building • Authentication • IoT application building as per real world application related to Smart City, Healthcare, Automotive, Manufacturing. • IoT based mobile application development • Use of API in IoT application Building • Basics of Machine Learning and AI • Use of Machine Learning and Artificial Intelligence in IoT • Industrial Use cases

COURSE PRACTICALS

Please conduct the practicals as per lesson plan.

1. Writing and understanding basic code syntax and setting configuration of IDE.
2. Adding external libraries and boards in IDE.
3. Implementing basic Programs like LED Blink, LED fading etc.
4. Interfacing of digital sensor to microcontroller.
5. Interfacing of analog sensor to microcontroller.
6. Uploading and monitoring digital and analog sensor data to cloud.
7. Interfacing of actuator to microcontroller
8. Interfacing of wireless module to microcontroller.
9. Controlling actuators remotely using IoT.
10. Implementing Monitoring and alert data system using IoT.
11. Interfacing led to raspberry pi and performing blinking and fading operations on led with raspberry pi.
12. Interfacing Camera to raspberry pi and performing picture and video operations.
13. Implementation sensors to raspberry pi.
14. Sending data from raspberry pi to cloud and receiving data from cloud
15. Write code for IOT application.
16. Develop IOT application based on specific need.
17. Develop IoT application for Agriculture application.
18. Develop IoT application for Home Automation
19. Develop IoT application for Smart City
20. Develop IoT application for manufacturing
21. Develop IoT application for Automotive
22. Develop IoT application for Industrial automation
23. Develop IoT application for Warehouse management
24. Testing of IOT application
25. Case studies

3.7.6	Product Verification & Analysis (TataTech) (Open Elective-I)	L	T	P	C
QUALIFYING		2	-	-	2

RATIONALE : This course provides basic concept of design, modeling, FEA concepts and real time simulation methods. Further it gives hands on working experience on important areas in Product Verification & Analysis using analytical software. It includes Basics of Product design & development, 3D modelling, FEA basics, Meshing, Meshing Quality criteria, Material Properties, defining boundary conditions, Post Processing, Interpretation of results, countermeasure planning, optimization of results. It also includes various case studies such as Structural, modal Analysis, Buckling & other types of analysis.

TABLE OF CONTENTS

Sr No	Course contents
1	Introduction to Industrial Safety Practices <ul style="list-style-type: none"> • Fire Extinguishers & its Types • Safely handling Tools & Equipment • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution
2	Overview of Product Design and Development <ul style="list-style-type: none"> • Various Phases of Product Design and Development • Concept Design, Detail Design • Product Verification and Validation • User interface, basic settings & customization for creation of geometry. • 2D sketching, 3D Modelling • Concept creation, Modelling, Assembly • Design Modifications • Engineering Drawing • Bill of Material • Basic Understanding of Regulatory Requirements and testing.
3	FEA & Meshing <ul style="list-style-type: none"> • Basics of FEA and Meshing • Basics of strength of materials • Introduction to FEA, FEA Steps • Types of Analysis • FEA software user interface • Importing Geometry

	<ul style="list-style-type: none"> • Geometry cleanup & editing • Mid Surface Extraction • Basics of Discretization (Meshing) • Understanding of basic of Meshing such as nodes, elements etc. • Selection of type of the mesh / element based on the structure • Mesh Parameters • Checking of Mesh Quality • Refining of Mesh
4	<p>Material, Meshing and Boundary conditions</p> <ul style="list-style-type: none"> • Applying Material Properties • Basics of Types of Loads • Applying Load • Define Boundary Condition • Rigidity Check of FEA Model • Solving • Post Processing • Interpretation of Results • Countermeasure planning • Optimization of Results.
5	<p>Structural and nodal analysis</p> <ul style="list-style-type: none"> • Concept of structural and modal analysis • Interactive design exploration for static structural • Structural condition -support constraints • Force & pressure condition • Remote load condition, • Nodal analysis-frequency calculation, • Real time topology optimization • Post-processing - Contour Plot Viewing • Post-processing - Report Generator • Simulation report reading • Industrial case study
6	<p>Buckling Analysis and other types of Analysis</p> <ul style="list-style-type: none"> • Basic Buckling Analysis • Basic Thermal Analysis • Thermal Analysis • Thermo-Mechanical Analysis • Simple Nonlinear Analysis, Other advanced Types of Analysis • Interpretation of Results • Countermeasure & Recommendations • Industrial case studies

4 COURSE PRACTICALS

Please conduct practicals as per lesson plan

1. List the industrial safety procedures.
2. Create a sketch, 3d model and assembly
3. Create a drawing and Bill of Materials
4. Import the computer aided design model
5. Modify the imported computer aided design model.
6. Cleaning of 3D Model
7. Extract Mid surface of given model
8. Create 1D element using computer aided design software
9. Create 2D element using computer aided design software
10. Create 3D Element for a given problem | Generate the 3d meshing for given problem
11. Generate the meshing by tetrahedral, hexahedral, polyhedral, pyramid, or wedge cells (or a combination of these) in 3D.
12. Apply material properties as per given specifications
13. Apply the boundary condition like pressure, force, remote force, fixed support, etc.
14. Interpret Finite Element Analysis Results
15. Structural analysis of simply supported beam.
16. Structural analysis of truss structure
17. Topology optimization of design using structural analysis.
18. Modal analysis for natural frequencies.
19. Modal analysis for vibration analysis.
20. Generate and export simulation report for structural and modal analysis.
21. Steady state thermal analysis of simple metal plate
22. Steady state thermal analysis of heat sink.
23. Free-vibration analysis and Buckling analysis using FEA software
24. Thermal Analysis using FEA software.
25. Advanced Finite Element Analysis.
26. Optimize the design
27. Preparation of FEA report

Advance Skill Development

To fulfill the requirements for Advanced Skill Development, a minimum of 20 hours of skill certification is necessary. This certification must be obtained from a recognized national or international agency or institute. The assessment and certification process will be conducted by the respective agency or institute. Students must present their certificate to earn 02 credits for this subject.

3.8	Summer Internship-I (4 weeks) after IInd Sem	L	T	P	C
		0	0	0	1

RATIONALE

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

DETAILED CONTENT

This document includes guided and supervised industrial/summer training of 4 weeks duration to be organised during the semester break starting after first year i.e. after 2nd semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

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

An Internal assessment of 50 marks has been provided in the study and evaluation scheme of 3th Semester. Evaluation of summer training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 2nd semester for further details.

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

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

4.1	Strength of Materials	L	T	P	C
THEORY		4	0	0	3

RATIONALE

This subject provides a crucial foundation for designing safe and efficient mechanical components. It equips students with the ability to analyse material behaviour under various loads, ensuring proper material selection and failure prevention. SoM also enhances problem-solving skills, helping students calculate stress, deformation, and stability in structures. Additionally, it prepares students for advanced courses and real-world applications in industries ensuring career readiness in technical roles.

Learning Outcomes:

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

- Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.
- Calculate thermal stresses, in bodies of uniform section and composite sections.
- Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads.
- Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads.
- Calculate the safe load, safe span and dimensions of cross section.
- Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

DETAILED CONTENT

UNIT-I: Stresses and Strains:

Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics.

Unit-II: Strain Energy:

Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/ shock load; Related numerical problems.

Principal stresses

Concept of principal stresses, Principal Planes and maximum shear stresses for the bodies subjected to direct and shear stresses, determination by mohr's circle method.

Thin Cylindrical Shells:

Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell.

Unit-III: Shear Force & Bending Moment in beams:

Introduction of Beams, Types of Beams, Types of Loads – Point load, UDL and UVL; Definition, explanation and relation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Combination of point and UDL for the above; Related numerical problems.

Unit-IV: Theory of Simple Bending and Deflection of Beams:

Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

Unit-V: Torsion in Shafts and Springs:

Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation $T/J = fs/R = G\theta/L$; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

INSTRUCTIONAL STRATEGY

- Use lectures to introduce fundamental concepts (stress, strain, elasticity, material properties). Visual aids such as diagrams, charts, and animations can help students understand key principles.
- Provide real-life engineering problems where students need to calculate stresses, bending moments, and deflections in beams, rods, or structures. This encourages analytical thinking and application of theoretical knowledge

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Sessional test
- Actual Practical Performance
- Small projects
- Viva-voice

REFERENCE BOOKS/ ONLINE RESOURCES

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017

2. Strength of Materials – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted
1	10	12
2	12	12
3	12	12
4	12	12
5	10	12
Total	56	60

4.2	INDUSTRIAL ENGINEERING & MANAGEMENT	L	T	P	C
THEORY		4	0	0	3

RATIONALE

The rationale for teaching Industrial Engineering and Management to diploma students lies in its comprehensive approach to optimizing complex systems and processes. These subject combines engineering principles with management practices to improve efficiency, productivity, and quality in manufacturing and service industries. By studying this subject, students gain skills in areas such as operations research, production planning, quality control, and supply chain management. This knowledge equips them to design, analyze, and manage industrial systems effectively.

Learning Outcomes:

After successful completion of this course, students will be able-

- To understand the different types of layouts and plant maintenance with safety.
- Explain the production facilitating techniques of work and method studies.
- To understand production planning and controls for desired product quality.
- Define the principles of personal management and organizational behavior.
- List and explain the various financial and material managements.

DETAILED CONTENT

UNIT-I:

Plant Engineering:

Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

Plant Safety:

Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

UNIT-II:

Work Study:

Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions.

Method Study:

Definition; Objectives; Selection of a job for method study; Basic procedure for conduct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram.

Work Measurement:

Definition; Basic procedure in making a time study; Employees rating factor; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).

UNIT-III:

Production Planning and Control:

Introduction; Major functions of Production Planning and Control; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning;

Quality Control:

Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve(O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.

UNIT-IV:

Principles of Management:

Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems.

Personnel Management:

Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's sufficiency plan; Numerical Problems.

UNIT-V:

Financial Management:

Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems.

Material Management:

Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems; Supply Chain.

INSTRUCTIONAL STRATEGY

To teach Industrial Engineering and Management to diploma students effectively, integrate a variety of instructional strategies. Utilize active learning through group projects, hands-on activities, and case studies to engage students practically. Blend traditional teaching with online resources, including multimedia content and discussion forums, to enhance understanding.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Sessional test
- Viva-voice

REFERENCE BOOKS/ ONLINE RESOURCES

1. Industrial Engineering & Management, S.C. Sharma, Khanan Book Publishing Co (P) Ltd., New Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Wehrich, Harold Koontz, 10th Edition, McGraw Hill International Edition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted
1	10	12
2	12	12
3	12	12
4	12	12
5	10	12
Total	56	60

4.3	Strength of Materials Lab	L	T	P	C
PRACTICAL		0	0	6	3

LIST OF PRACTICALS

1. Study and understand the use and components of universal Testing Machine (UTM).
2. Perform tension test on mild steel specimen using UTM.
3. Conduct compression test on sample test piece using compression testing machine.
4. Conduct Izod impact test on any metal e.g. mild steel/ brass/ aluminum/ copper/ cast iron.
5. Conduct charpy impact test on any metal e.g. mild steel/ brass/ aluminum/ copper/ cast iron.
6. Determination of Rockwell's Hardness number for various materials like mild steel, high carbon steel, brass, copper, aluminum.
7. Determination of Brinell's Hardness number for various materials like mild steel, high carbon steel, brass, copper, aluminum.
8. To find the value of 'E' for a steel beam by method of deflection for different loads.
9. Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method. (Open and closed coil spring)
10. Plot shear force diagram for cantilever, simply support beams subjected to point load only.
11. Plot bending moment diagram for cantilever, simply support beams subjected to point load only.

4.4	Manufacturing Engineering	L	T	P	C
PRACTICUM		2	0	3	3

RATIONALE :

Manufacturing engineering is a crucial subject for diploma students as it provides a comprehensive understanding of the processes, tools, and technologies used in the production of goods. It lays the groundwork for understanding how products are designed, developed, and manufactured, which is essential for any career in engineering and production.

Learning Outcomes:

After successful completion of this course, students will be able to-

- Explain the functions of Jigs and Fixtures.
- Describe the advancements in the area of manufacturing and production processes.
- Familiarized with working principles and operations performed on non-traditional machines, machining center, SPM, and maintenance of machine tools.

Course Content:

UNIT-I :

Cutting Fluids & Lubricants: Introduction -Types of cutting Fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids ,methods of application of cutting fluid; Classification of lubricants (solid, liquid, gaseous) Properties and applications of lubricants.

Lathe Operations: Types of lathes, CNC lathe, Specifications, Basic parts and their functions, Operations and tools – Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.

Shaping and Planing -Working principle of shaper and planer, Type of shapers, Type of planers, Quick return mechanism applied to shaper and planer machine, Work holding devices used on shaper and planer, Specification of shaper and planer, Speeds and feeds in above processes.

Milling: Introduction; Types of milling machines: plain, Universal, vertical; constructional details – specifications; Milling operations: simple, compound and differential indexing; Milling cutters – types; Nomenclature of teeth; Teeth materials; Tool signature of milling cutter; Tool & work holding devices.

UNIT -II :

Drilling and Broaching: Classification of drilling machines; Basic parts and their functions; Radial drilling machine; Types of operations, Specifications of drilling machine, Types of drills and reamers. Introduction to broaching; Types of broaching machines –Elements of broach tool, broach teeth details, Nomenclature, Tool materials.

Grinding and finishing processes: Principles of metal Grinding, Abrasives-Bonds and binding processes, Factors affecting the selection of grind wheels, Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear, Dressing and Truing, Grinding machines classification: Cylindrical, Surface, Tool & Cutter grinding machines, Construction details, Principle of centreless grinding, Advantages & limitations of centre less grinding;

Super finishing Processes: Basic principles of Honing, Lapping, Buffing, Polishing, Burnishing etc.

UNIT -III:

Rolling and Forging: Definition and complete classification of Rolling and Forging process.

Extrusion and Drawing: Type of Extrusion- Hot & Cold and Direct & Indirect, Pipe Drawing, Tube Drawing; Wire Drawing.

Brazing and soldering: Types, Principles and Applications.

Jig and Fixture : Definition , Application and Basic Difference between a Jig and a Fixture

Press working: Types of Presses and Specifications, Press working operations - Cutting, bending, drawing, punching, blanking, notching, lancing.

UNIT -IV:

Pattern Making : Definition and Application of Patterns in casting, Classification of Patterns types (Single piece, Split pattern, match plate etc.) Materials used for patterns (wood, metal, plastic, etc.)

Pattern Allowances (shrinkage, machining, draft, and distortion) and Purpose and importance of Different types of Measuring and Marking using tools, Cutting, shaping and assembling wooden or metallic patterns, Pattern layout and planning, Surface finishing and polishing of patterns.

Casting and Moulding: Properties and various types of moulding sand, Types of moulds, All important steps of mould making, moulding boxes, hand tools used for mould making, Moulding processes,

Casting processes – Charging of furnace, melting, pouring, Cleaning of castings, Principle, Working and application of Die casting, Investment casting, Centrifugal casting, Gating and Riser System, Casting defects and Testing of casting defects.

Practical Course Content

Pattern Making Shop :

- 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.

Moulding/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. A visit to cast iron foundry should be arranged to have firsthand knowledge of cast iron melting pouring and casting.

Machine Shop : (Two Practicals are given in each group, any one is to be performed)

Job 1- Prepare a V-Block up to 0.5 mm accuracy on shaper machine.

Or

Exercise on key way cutting and spline cutting on shaper machine.

Job 2- Produce a rectangular block by facing on a slotting machine.

Or

Produce a rectangular slot on one face with a slotting cutter.

Job 3- Produce a rectangular block using a milling machine with a side and face cutter.

Or

Prepare a slot on one face using milling machine.

Job 4- Exercises on internal turning on lathe machine.

Or

Exercises on external turning on lathe machine.

Job 5- Exercises on internal threading on lathe machine.

Or

Resharpening of single point cutting tool with given geometry.

Job 6- Job on grinding machine using a surface grinder.

Or

Exercise of boring with the help of boring bar.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Sessional test
 - Viva-voice

Text and Reference books:

1. Elements of workshop Technology Volume I & II- Hajra Chowdry & Bhattacharaya- IIth Edition- Media Promoters & Publishers Pvt. Ltd.,
2. A Textbook of workshop Technology- R.S.Khurmi & J.K.Gupta- 2nd Edition, S.Chand & Co., Ram Nagar, New Delhi- 2018.
3. Manufacturing process- Begeman- 5th Edition-McGraw Hill, New Delhi 2011.
4. Workshop Technology- WAJ Chapman- Volume I, II, & III- Vima Books Pvt. Ltd., 4262/3, Ansari Road, Daryaganj, New Delhi 110 002.

5. Production Technology- HMT- Edn. 18- published by Tata McGraw Hill publishing Co. Ltd., 7 West Patel nagar, New Delhi 110 008.- 20181

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted
1	7	15
2	7	15
3	7	15
4	7	15
Total	28	60

4.5	Material Science & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

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 on this course are required to make use of different materials for various applications. For this purpose, it is necessary to teach them the basics of metal structure, properties, usage and testing of various ferrous and non-ferrous materials and various heat treatment processes. This subject aims to develop 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:

1. Distinguish between metals and non-metals and ferrous and non-ferrous materials.
2. Explain the arrangement of atoms in various crystals.
3. Carryout various heat treatment processes.
4. Analyze microstructure and changes in microstructure due to heat treatment.
5. Explain properties and applications of composites, ceramics and smart materials, plastics and rubber.
6. Perform destructive and non-destructive testing of materials.

COURSE CONTENT

UNIT-1: Introduction & Structure of Metals

Overview of different engineering materials and applications, Classification of materials, Thermal, Chemical, Electrical, Mechanical properties of various materials Crystallography Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals,. Deformation and Defects.

Metals And Alloys

Ferrous Materials: Raw materials in production of iron and steel, Basic process of iron-making and steel-making, Classification of iron and steel. Cast Iron: Different types of Cast Iron, manufacture and their use. Classification of cast iron and Steels: Steels and alloy steel, Classification of plain carbon steels, Properties and usage of different types of Plain Carbon Steels, Non Ferrous Materials: Properties and uses of Aluminum, Copper and Zinc and their alloys.

LIST OF PRACTICALS

EX NO.	NAME OF EXPERIMENT	HOURS
1	Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.	6
2	Prepare a specimen and examine the microstructure of the Ferrous and Non-ferrous metals using the Metallurgical Microscope.	6
3	Study and sketches of Blast furnace, Cupola Furnace	6
4	To detect defects and Deformation in any metals	4
5	Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.	5
6	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)	5

UNIT-2: Heat Treatment and Testing of Metals

Purpose of heat treatment, Transformation – Simplified Transformation Cooling Curves. Various heat treatment processes- hardening, tempering, annealing, normalizing, Casehardening and surface hardening, Harden ability of steels, Selection of case carburizing and induction hardening steels.

Destructive testing: Stress testing, Hardness testing, Impact testing Non-destructive testing: Eddy-current, Magnetic-particle, Liquid penetration, radiographic, Ultrasonic and visual testing Materials for bearing metals, Materials for Nuclear Energy, Refractory materials.

LIST OF PRACTICALS

EX NO.	NAME OF EXPERIMENT	HOURS
1	Identification of metal by giving mini projects.	4
2	Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii)	4

	Magnetic particle test.	
3	Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and Aluminium.	6
4	Single or double Shear test on M.S. bar to finding the resistance of material to shear load	4
5	Finding the resistance of materials to impact loads by Izod test and Charpy test.	6

Reference Books:

1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria & Sons, New Delhi, 2004.
3. Material Science – R.S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005.

4.6	Thermal Engineering -II	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

The purpose of this subject is to give conceptual and principles involving thermal science, especially focusing on Internal combustion engine, Refrigerator, and compressors. Through experiments and simulations conducted in the lab, students can validate theoretical concepts, optimize system performance, testing of various oil properties for using as a fuel and lubricant in thermal systems and develop innovative solutions for real-world applications. This practical knowledge enhances their problem-solving skills and prepares them for the challenges they will face in their careers.

Learning Outcomes:

After successful completion of this course, students will be able-

- To understand the fundamental concepts involved in thermal systems.
- To analyse the various performance parameters of internal combustion (IC) engines.
- To analyse the performance of refrigeration cycle/ components.
- To analyse the performance of the compressor and its volumetric efficiency.
- To study the properties, complete combustion of fuels and its products.

Detailed Content

Unit I : AIR CYCLES, IC ENGINES AND FUEL

Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines;

IC Engines : Introduction, Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, diesel cycle and dual cycle,

Testing of IC Engines: Engine power - indicated and brake power, Efficiency - mechanical, thermal, relative and volumetric, Methods of finding indicated and brake power, Morse test for petrol engine, Heat balance sheet.

Classifications of fuels: Requirements of a good fuel – stoichiometric air required for complete combustion of fuels –products of combustion – analysis of exhaust gases - calorific value of fuels – higher and lower calorific values ,Specific fuel consumption.

Practical Exercises:

Ex. No.	Name of Experiment	Hours
1	Determine the flash and fire point of the lubricating oil by using Open cup apparatus and Closed cup apparatus and compare the value for the given sample	5
2	Draw the valve timing diagram of single cylinder four stroke	5

	petrol and diesel engines	
3	Draw the port timing diagram of a single cylinder two stroke Petrol Engine	5
4	Load test (Performance test) on Four Stroke Diesel Engine or Four Stroke Petrol Engine	5
5	Morse test on multi-cylinder petrol engine	5
6	Heat balance test on Four Stroke Diesel or Petrol Engine	5
7	Find the Percentage of CO, CO ₂ , O ₂ , and amount of HC, NO _x using Exhaust gas analyser.	5

Unit II AIR COMPRESSOR ,REFRIGERATION AND POWER PLANTS

Air Compressor and its functions, Single stage & Multi stage reciprocating air Compressor. Introduction to Refrigeration, Refrigeration Effects . COP, TON of Refrigeration. Reversed Carnot cycle, Air-standard Brayton cycle, Functions and classification of Refrigerants, selection of Refrigerant. Component and Line diagram of thermal power plant , nuclear power plant and hydro-power plant .

Practical Exercises:

Ex. No.	Name of Experiment	Hours
8	Volumetric efficiency of Air Compressor.	5
9	Demonstration of various refrigeration tools and equipment.	5
10	Study of various parts of power plants.	5
11	Study and sketch of various mountings and accessories of boilers.	6

Textbook for reference

1. R. K. Rajput, Thermal Engineering, 11th Edition, Laxmi publications Pvt Ltd , New Delhi, 2020.
2. R.S. Khurmi, J. K. Gupta, A Textbook of Thermal Engineering, S. Chand Publishing, 2019.
3. R. K. Rajput , A Text Book of Automobile Engineering, Laxmi publications Pvt Ltd, New Delhi, 2012.
4. P. K. Nag, Basic And Applied Thermodynamics 2/E, McGraw-Hill Education (India) Pvt Limited, 2010.

Website links for reference

- NPTEL (Website): <https://archive.nptel.ac.in/courses/112/103/112103316/>
- NPTEL (Website): <https://archive.nptel.ac.in/courses/112/103/112103262/>

4.7.1	REFRIGERATION AND AIR CONDITIONING (Open Elective-II)	L	T	P	C
QUALIFYING		2	-	-	2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENT

Unit- 1 Fundamentals of Refrigeration

Introduction to refrigeration, Meaning of refrigerating effect, units of refrigeration, COP, Methods of refrigeration- Ice, Dry ice, Steam jet, Throttling, Liquid Nitrogen refrigeration. Reversed carnot cycle and its representation on P-V and T-S diagram.

Air Refrigeration System

Bell – Coleman cycle, Boot strap system, calculation of mass flow rate, work done and COP; Advantages and Disadvantages of air-refrigeration system.

Unit- 2 Vapour Compression System

Introduction, principle, function, parts and necessity of vapour compression system, T- S and p- h charts, dry, wet and superheated compression. Effect of sub cooling, super heating, Refrigerating effect and COP. advantages and disadvantages of vapour compression system over air-refrigeration system.

Vapour Absorption System

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.

Unit- 3 Refrigerants

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

Refrigeration Equipment

Compressors- Function, various types of compressors. Condensers - Function, various types of condensers. Evaporators- Function, types of evaporators. Expansion Valves - Function, various types such as capillary tube, thermostatic expansion valve, low side and high side float valves, application of various expansion valves Safety Devices-Thermostat, overload protector LP, HP cut out switch.

Unit-4 Psychrometry

ASHRAE Nomenclature, Specific Humidity, Relative Humidity, Degree of Saturation, DBT, WBT, DPT, Sensible Heat, latent Heat, Total enthalpy of air.; Air Water vapour mixture; Psychrometric processes- Sensible Heating and Cooling, Adiabatic Cooling, Humidification and Dehumidification, Cooling and Humidification, Cooling and Dehumidification, Heating and Humidification, Heating and Dehumidification, By Pass Factor; Psychrometric Chart.

Air Conditioning Systems

Classification of air conditioning systems; Thermal Comfort; Mathematical analysis of Air-Conditioning Systems; Cooling and Heating Load Estimation.

Unit- 5 Other Refrigeration Systems

Steam Jet Refrigeration System; Vortex tube refrigeration; Thermoelectric refrigeration system; Magnetic refrigeration.

Latest development in refrigeration and air conditioning

Inverter technology, auto-defrosting, blast cooling, star rating, Ionocaloric cooling, Thermo Acoustic Refrigeration.

REFERENCE BOOKS/ ONLINE RESOURCES

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

4.7.2	Power Plant Engineering (Open Elective-II)	L	T	P	C
QUALIFYING		2	0	0	2

RATIONALE

Power Plant Engineering equips mechanical engineering diploma students with critical skills and knowledge needed to operate and maintain energy production systems, preparing them for careers in the power and energy industries.

LEARNING OUTCOME

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

- Explain the principles of operation for different power plants and their economics.
- Describe the control methods of major pollutants emitted from fossil-fuel power plants.
- Distinguish the major types of hydro-power and wind-power turbines and estimate power generation potential.
- Calculate the performance of gas turbines with reheat and regeneration, and discuss the performance of combined cycle power plants.
- Assess the environmental impact of electric power product.

DETAILED CONTENT

UNIT I- Power plants – types and classification based on energy sources.

Coal based Thermal Power Plants: Basic Rankine cycle and its modifications; Layout of modern coal power plant; Super critical boilers, FBC boilers; Turbines, condensers, steam and heating rates; Subsystems of thermal power plants; Fuel and ash handling; Draught system; Feed water treatment; Binary cycles and cogeneration systems.

UNIT II- Gas Turbine and Combined Cycle Power Plants: Brayton cycle analysis and optimization; Components of gas turbine power plants; Combined cycle power plants; Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT III- Nuclear Power Plants: Basics of nuclear energy conversion; Layout and subsystems of nuclear power plants; Boiling Water Reactor (BWR); Pressurized Water Reactor (PWR); CANDU Reactor; Pressurized Heavy Water Reactor (PHWR); Fast Breeder Reactors (FBR); Gas cooled and liquid metal cooled reactors; Safety measures for nuclear power plants.

UNIT IV- Hydroelectric Power Plants: Classification; Typical layout and components. Renewable Power Systems: Principles of wind, tidal, solar photo-voltaic, solar thermal, geothermal, biogas and fuel cell power systems.

UNIT V- Energy Economics and Environment: Economic and environmental issues; Power tariffs; Load distribution parameters; Load curve; Capital and operating cost of different power plants; Pollution control technologies including waste disposal options for coal and nuclear plants.

REFERENCE BOOKS/ ONLINE RESOURCES

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.
4. https://onlinecourses.nptel.ac.in/noc22_me73/preview

4.7.3	Disaster Management (Open Elective-II)	L	T	P	C
QUALIFYING		2	0	0	2

RATIONALE: The subject of disaster management helps diploma mechanical engineering students become responsible professionals who can anticipate, respond to and help recover from emergency in industrial and societal contexts it supports the development of safer work places and communities by preparing students to be key players in sustainable engineering practices

Learning Outcomes:

After successful completion of this course, students will be able-

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organizations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

Course Content:

Unit – I: Understanding Disaster

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit- III: Disaster Management Cycle and Framework

Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness. During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

Unit- IV: Disaster Management in India

Disaster Profile of India – Mega Disasters of India and Lessons Learnt. Disaster Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies.

Unit- V: Applications of Science and Technology for Disaster Management

Geo-informatics in Disaster Management (RS, GIS, GPS and RS). Disaster Communication System (Early Warning and Its Dissemination). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India.

References

1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4. Alexander, David, Natural Disasters, Kluwer Academic London
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

4.7.4	Inspection & Quality Control (Tata Tech) (Open Elective-II)	L	T	P	C
QUALIFYING		2	-	-	2

Rationale

This course is designed for individuals in the quality and manufacturing sectors, aiming to enhance their skills in inspection and quality control through the use of various measurement instruments. It offers a comprehensive, entry-level introduction and practical exposure to the measurement tools frequently used in inspections, with a special emphasis on hand-held devices.

Upon successful completion of the course students will qualify as Quality Control Inspectors or Quality Assurance Technicians. They will have job opportunities in inspection and quality control roles across diverse industries, including automotive, defence, aerospace, locomotive, construction, consumer goods, and more.

TABLE OF CONTENTS:

Sr No	Course contents
1.	Introduction to Industrial Safety Practices <ul style="list-style-type: none"> • Safely handling Tools & Equipment • Fire Extinguishers & its Types • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution.
2.	Introduction to Inspection and Quality <ul style="list-style-type: none"> • Different Stages of Quality Control in the production process • Quality Assurance vs quality control • Importance of Quality control in minimizing defect and optimizing production Types of Inspection <ul style="list-style-type: none"> • Visual Inspection • Dimensional Inspection • Functional Inspection • Destructive Vs Non-Destructive Testing Quality Standards <ul style="list-style-type: none"> • International Quality Standards • Six Sigma • Lean Manufacturing • Total Quality Management
3.	Engineering Drawing and Its importance in Inspection <ul style="list-style-type: none"> • Drawing symbols • Types of Dimensions (Linear, Angular, Geometric dimensions)

	<p>(GD&T)</p> <ul style="list-style-type: none"> • Inspection based on Engineering Drawing • Inspect parts and assemblies based on Engineering Drawing • Use of Drawing for Quality in Manufacturing <p>Geometric Dimensioning and Tolerancing (GD&T) and its role in manufacturing and Inspection</p> <ul style="list-style-type: none"> • GD&T Symbols • Types of Tolerances • Interpreting GD&T on Engineering Drawing • Case studies
4.	<p>Importance of Metrology in Quality Control</p> <ul style="list-style-type: none"> • Importance of Quality Control in engineering sector • Basic principles of measurement • Units of Measurements • Measurement Terminology • Precision, Accuracy, Tolerances and error analysis. • Types and classifications of handheld measuring instruments <p>Vernier Calipers (Digital, Dial and Vernier Scale)</p> <ul style="list-style-type: none"> • Measuring the depth, diameter, depth and thickness. • Measurement of external and internal diameters. • Measuring thickness and small components with high precision • Dial, Digital, and Vernier Calipers: Structure, reading techniques, applications, and calibration • Differences between dial, digital, and vernier calipers • Common errors and troubleshooting in caliper measurements <p>Micrometers and Gauges</p> <ul style="list-style-type: none"> • Outside and Digital Micrometers: Structure, working principles, applications, and calibration • Inside and Tubular Inside Micrometers: Measurement techniques, accuracy, and calibration • Specialized Micrometers: Digital Disc, Gear Tooth, Blade, and Analog 3 Pin Micrometers - specific uses, advantages, and limitations • Bore Gauges: Types, measurement techniques, applications, and calibration • Depth Gauges: Structure, reading techniques, applications, and calibration
5.	<p>Height Gauges, Profile Projector, Protractors and Gauges</p> <ul style="list-style-type: none"> • Height Gauges: Structure, reading techniques, applications, and calibration

	<ul style="list-style-type: none"> • Types of Height Gauges, Use of Height Gauges • Profile Projector components, working of Profile Projectors • Importance of profile projector in inspecting surface profile, contours and shapes. • Protractors and Gauges: Universal Bevel Protractor, Thickness, Radius, and Thread Pitch Gauges - specific uses, advantages, and limitations • Digital and Dial Indicators: Structure, digital vs. analog readouts, applications, and calibration • Dial Test Indicator: Measuring small deviations, applications, and calibration • Common errors and troubleshooting in indicator measurements
6.	<p>Measurement Data Wireless Communication System and Statistical Process Control (SPC)</p> <ul style="list-style-type: none"> • Overview of Measurement Data Wireless Communication systems and their applications in measurement • Connection units, comparator stands, magnetic stands, and micrometer stands - structure, usage, and applications • Integration of Measurement Data Wireless Communication systems with other measuring instruments • Statistical Process Control (SPC) Software: Applications in statistical process control, IoT integration, and data analysis • Calibration of measuring Instruments • Real World Applications of Inspection and Quality Control • Maintenance of Measuring Instruments

LIST OF PRACTICALS

Please conduct practical as per lesson plan.

1. Make a list of available safety equipment and its application.
2. Read industrial manufacturing drawings and prepare an inspection process plan.
3. Draw a block diagram of a Micrometer and identify various components, explaining their functions.
4. Perform calibration of outside Micrometer (0-25mm and 25-50mm).
5. Measure various objects using outside Micrometer (0-25mm and 25-50mm) and record the measurements.
6. Perform calibration of Digital Micrometer (IP65, range: 0-25mm).
7. Measure internal dimensions using tubular inside Micrometer and record the measurements.
8. Basic troubleshooting and maintenance of Micrometer.
9. Write a report on the accuracy and precision of measurements taken with Micrometer.
10. Import measurement data into quality control software and analyze the results.

11. Make a quality report and inspect the workpiece according to the engineering drawing using Micrometer.
12. Measure the diameter of a cylindrical component. Record the measurements using an outside Micrometer (0-25mm).
13. Calibrate an outside Micrometer (25-50mm) and measure the thickness of a metal plate.
14. Use a Digital Micrometer (IP65, range: 0-25mm) to measure the thickness of a turbine blade. Record the measurements and integrate the data with SPC software.
15. Perform a series of measurements on precision gears using a digital gear tooth Micrometer. Analyze the data for consistency.
16. Measure the internal diameter of a bearing using a dial caliper (range: 0-300mm). Record the measurements and compare them with the specified tolerances.
17. Use a Digital caliper (range: 0-150mm) to measure the depth of a drilled hole in a metal component. Record the measurements and verify against the design specifications.
18. Measure the internal diameter of a cylinder bore using a bore gauge (range: 50-150mm). Record the measurements and assess the wear of the cylinder.
19. Calibrate a bore gauge and measure the internal diameter of a hydraulic cylinder.
20. Measure the height of a machined part using a Digital height gauge (range: 0-200mm). Record the measurements and verify against the engineering drawing.
21. Use a vernier height gauge (range: 0-12") to measure the height of a component. Record the measurements and compare with the design specifications.
22. Measure the depth of a slot in a metal part using a Digital depth gauge (range: 0-150mm). Record the measurements and ensure they meet the specified tolerances.
23. Calibrate a vernier depth gauge (range: 0-150mm) and measure the depth of a groove in a component.
24. Measure the angle of a machined part using a universal bevel protractor (blade length: 150mm). Record the measurements and verify against the design specifications.
25. Use a thickness gauge (range: 0.05-1mm) to measure the thickness of a sheet metal part. Record the measurements and compare with the specified tolerances.
26. Measure the thread pitch of a screw using a metric screw pitch gauge (range: 0.4-7mm). Record the measurements and ensure they match the specified thread standards.
27. Perform measurement using profile projector.
28. Perform measurement using Measurlink (SPC, IoT Software).

4.7.5	Advanced Automobile (Tata Tech) (Open Elective-II)	L	T	P	C
QUALIFYING		2	-	-	2

This course is designed to acquire adequate knowledge and practical experience of various systems and sub systems of automobile. It includes automotive body engineering, chassis, Powertrain, auto electrical & auto electronics, automobile Regulatory requirements, and advancements in Automobile such as electric vehicle, connected car and autonomous car etc.

It also includes automotive materials, manufacturing process etc. This course provides opportunities for students to build their career in automotive industry. It also provides opportunity to start up their own business.

Table Of Contents

Sr No	Course contents
1	Introduction to Industrial Safety Practices <ul style="list-style-type: none"> • Fire Extinguishers & its Types • Safely handling Tools & Equipment • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution
2	Introduction to Automobile <ul style="list-style-type: none"> • Introduction to Advanced automobile. • Evolution of Automobile & Automotive Industry • Key Automobile Companies and their Products • Product Segments (Criteria for Vehicle Types, Variants and Versions, Markets: India, EU, and US) • Vehicle Architecture, Classification & specifications of automobile (systems and subsystems: powertrain, chassis, electrical & electronics, body engineering, vehicle integration etc.) • Automotive materials (steels, Al alloys, magnesium alloys, plastics, composite, hybrid materials etc.) • Manufacturing processes: (forming, forging, plastic, assembly Processes, joining processes, welding etc.)

3	<p>Introduction to Chassis system</p> <ul style="list-style-type: none"> • Introduction to chassis & chassis system architecture • Difference between Ladder chassis and small commercial vehicles chassis • Different Long members (C type channels) and cross members (I channels) used in chassis • Chassis structure: Functions of chassis structure, types of chassis structures, ladder frame, backbone chassis, Space Frame, monocoque, etc • Introduction to chassis subsystems: wheels and tyres, suspension system, steering system, brake system, etc • Design considerations for chassis structures: types of loads acting on chassis • Materials and manufacturing processes used for chassis, Review of chassis frame FEA report • Regulations and standards for chassis system, future trends in chassis structures
4	<p>Introduction to Body Engineering</p> <ul style="list-style-type: none"> • Introduction to vehicle body engineering and its importance. • Overview of Body Structure, Exterior, Interior, Seating System, Safety System, Closures etc. • Body engineering terminology. • Identification and importance of components in car body assembly. (A-Pillar, B-Pillar, Fender, Hood, Door beam, frame rail, roof panel etc.) • Identification and importance of car underbody assemblies. (Engine support, suspension housing, mounting brackets, floor pan etc). • Concept of reinforcement in automotive body construction. • Sub assembly and construction of body shell (Bonnet panel assembly, boot lid assembly, shroud & Dash panel assembly, etc) • Design and safety Considerations: Morphology of Vehicle Body (Structural) Design, Material selection, vision importance, braking system, seat belt, air bag, child lock etc. • overview of paint and sealing.
5	<p>Introduction to Powertrain system</p> <ul style="list-style-type: none"> • Introduction to powertrain system and its components. • Engine and its development history (BSVI). • Internal combustion engines and external combustion engines • Working principle of gasoline and diesel engine • Electric motors in electric and hybrid vehicles. • Transmission system and its components

	<ul style="list-style-type: none"> • Types of Gears and a clutch or torque converter • Types of transmission system: Manual and automatic • Drivetrain and its components. (In conventional vehicle: Driveshaft, differentials, and axles & in electric vehicles: electric motors, power electronics, and a battery pack) • Alternative fuels, and fuel efficiency • Working principal of exhaust system and emission norms • Advancements in powertrain technology and its impact on industry.
6	<p>Automotive Electrical</p> <ul style="list-style-type: none"> • Auto Electrical Architecture & Power Supply: Architecture, Layout, Nomenclature of Auto Electrical Components, Power Supply (Starting Charging System): Battery and its types (Battery Monitoring System), Starter Motor, Alternator • Instrumentation: Instrument Cluster, Gauges, Meters and Tell-Tales, Horn, Power Socket, Clock, Flasher, Beeper, DC-DC Converter • Lighting System: Exterior: Head Lamp Assembly, Front Fog Lamp, Side Repeater, Tail Lamp Assembly, Rear Fog Lamp etc., Interior: Roof Lamp, Glove Box Lamp, Door Ajar Lamp, Mood Lighting • Switches: Combination Switch, Steering Lock cum Ignition Switch, Mechanical Switches, Fascia Switches, Pressure, Float etc. Switches • Electrical Distribution system: Power Distribution, Circuit Schematic Design: Wire, Fuse, Relay etc. selection process, Voltage, Drop Analysis, Grounding and Splicing Strategy, Wiring Harness Design: Harness Topology, Typical Layout, Harness Components • AC (HVAC, FATC), Wash & Wiper, Radiator and Condenser Fan, Heated Rear Window
7	<p>Automotive Electronics & other systems</p> <ul style="list-style-type: none"> • Introduction to automotive electronics and its application (safety, comfort, and convenience) • Engine Control Units (ECUs) • Infotainment Systems and its connectivity. (Touchscreen displays, audio systems, Bluetooth connectivity, GPS navigation, and smartphone integration). • Advanced Driver Assistance Systems (ADAS): (Sensors, cameras, adaptive cruise control, lane departure warning, blind-spot monitoring, and automatic emergency braking.) • Telematics Systems: (Vehicle tracking, remote diagnostics, emergency services, and connectivity with mobile devices). • Electric Power Steering (EPS): (Electronic sensors and motors) • Components and working principle of Anti-lock Braking Systems

	<p>(ABS)</p> <ul style="list-style-type: none"> • Importance of Electronic Stability Control (ESC) and Body Control Modules (BCMs) (Lighting, power windows, door locks, climate control, and security systems. • Electronics in electric vehicle (EV) systems, connected and autonomous vehicles.
	<p>Repair of Vehicle and Maintenance</p> <ul style="list-style-type: none"> • Repair and Servicing of Vehicles • Break down, Schedule Maintenance • Trouble Shooting • Common automobile issues, causes and how to solve them • Preventive Maintenance of Vehicle • Predictive Maintenance • Advancements and repair and maintenance
8	<p>Automotive regulatory requirements and latest trends</p> <ul style="list-style-type: none"> • Testing requirements: Necessity of testing, Types of testing. • Overview of Design Considerations for Crash Energy Management and Occupant Protection. Different Types of Air Bags, Overview of Vehicle Testing (Frontal Crash, Side Impact, Roof Crush, Pedestrian Safety.). • Overview of various loads acting on the Body. Durability and NVH Requirements. • Automotive Regulations and other requirements (AIS, FMVSS, CMVSS, ECE/EEC, JIS, ENCAP, US NCAP IIHS etc.). • Certification and Homologation: Worldwide agencies, component level approval, type approval, E marks etc. • Latest trends in Automobile – Introduction to Electric Vehicles, Advanced Drive Assistance System (ADAS), Autonomous Car, Connected Car, Internet of things, etc.

COURSE PRACTICALS

Please conduct practical as per lesson plan

1. Prepare a table for classification of vehicle (Draw sketches as applicable).
2. Draw a sketch of vehicle architecture.
3. Draw a sketch or photos of vehicle and label the important components with its function.
4. Identify and prepare a list of safety tools and equipment's in automotive workplace.
5. Prepare a table with sketches or photos of interiors and exterior components of vehicle and list the function of important part.

6. Identify and prepare a list of manufacturing process involved during vehicle manufacturing like welding, drilling, machining on vehicle cut section.
7. Prepare a list of chassis components with its function.
8. Prepare a table to compare chassis of two vehicles.
9. Identify and make a list of body structure components,
10. Prepare a table with sketches or photos of the automotive exterior, interior, seating system, safety system, closures etc. with their function.
11. Study of vehicle suspension system and working of its sub-systems.
12. Prepare a list of suspension components with its functional importance.
13. Prepare a table for automotive materials & manufacturing processes with examples.
14. Identify important components of powertrain.
15. Identify different components of engine and engine cooling system, types of sensors used in automotive.
16. Study the function of cooling system demo kit and list all its components.
17. Draw a schematic diagram of HVAC system and list the function of each component.
18. Demonstrate working of HVAC system.
19. Demonstrate the function of transmission, gearbox and list the important components with its function. Study the basic calculations used in transmission.
20. Demonstrate the function of rear axle and make a list of all its components with its functional importance.
21. Study exhaust system & identify components of exhaust system with its materials used and applications.
22. Identify important components of electrical & electronics parts in vehicles etc.
23. Study of automotive battery charging system.
24. Study of engine starting system with use of starter motor.
25. Identify all components of fuel systems, use a schematic circuit diagram & list the key sub-systems, components & their working principle.
26. Identify main components of wiring harness system & study of electrical components.
27. Study the brake system and prepare a report by drawing a simple sketch of brake system and label the important components and list the function of each part.
28. Demonstrate usage and working of HMI, ECUs & Sensors etc used in automotive subsystems.

29. Identify seat belt, air bag systems and other safety feature.
30. List important types of vehicles tests conducted for passenger car.
31. Prepare a list of all EV components with its function.
32. Trouble Shooting and repair of lighting system
33. Repair of given automotive system
34. Preventive Maintenance of vehicle
35. Predictive Maintenance of Vehicle.
36. Compare various standard for autonomous levels used in Autonomous Car.
37. Case Studies
38. Mini Project

4.8	Essence of Indian Knowledge and Tradition	L	T	P	C
QUALIFYING		2	0	0	-

RATIONALE

It is essential for students to understand the fundamental aspects of the Indian Knowledge System, its integration with modern science, principles of Yoga and holistic healthcare, and practical applications in contemporary contexts.

LEARNING OUTCOMES

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

- Overview, importance, and relevance of the Indian Knowledge System, including Vedas, Upavedas, Vedangas, and Upangas.
- Relevance of science and spirituality, and contributions of ancient Indian science and technology.
- Basic principles of Yoga, benefits of holistic healthcare, and integration with modern healthcare.
- Practical applications and case studies of the Indian Knowledge System's relevance today.

DETAILED CONTENT

Unit 1: Introduction to Indian Knowledge System

Overview of Indian Knowledge System

- Importance and relevance
 - Introduction to the Vedas
 - Upavedas
 - Vedangas
 - Upangas

Unit 2: Modern Science and Indian Knowledge System

- Relevance of Science and Spirituality,
- Science and Technology in Ancient India,

Unit 3: Yoga and Holistic Healthcare

- Basic principles of Yoga
- Benefits of holistic healthcare practices
- Integration with modern healthcare

Unit 4: Case Studies / Assignment

- Practical Applications / Case studies demonstrating the relevance of Indian Knowledge System in modern times

REFERENCE BOOKS/ ONLINE RESOURCES

1. Essence of Indian Traditions by Dr. Om Prakash Mishra, Khanna Publishers.
2. Indian Knowledge Systems by Kapil Kapoor and Avadhesh Kumar Singh
3. The Vedas: An Introduction to Hinduism's Sacred Texts by Roshen Dalal
4. Yoga and Ayurveda: Self-Healing and Self-Realization by David Frawley
5. Ancient Indian Science and Technology by Bal Ram Singh

	Summer Internship-II (4-6 weeks) after IVth Sem	L	T	P	C
		0	0	0	2

RATIONALE

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

DETAILED CONTENT

This document includes guided and supervised industrial/summer training of 4-6 weeks duration to be organised during the semester break starting after first year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

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

An Internal & External assessment of 60 & 40 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of summer training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

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

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

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

10. RESOURCE REQUIREMENT

10.1 PHYSICAL RESOURCES

(A) Space requirement

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

(B) Equipment requirement:

Following Laboratories are required for Diploma Programme in Mechanical Engineering/ Mechanical Engineering (Automobile)/Mechanical Engineering (CAD)/ Mechanical Engineering (Production)/ Mechanical Engineering (R.A.C) / Mechanical Engineering (Repair & Maintenance)

- Communication Laboratory/Language Lab
- Applied Physics Laboratory
- Applied Chemistry Laboratory
- Engineering Graphics Laboratory
- CAD Lab.
- Engineering Mechanics Laboratory
- IT Systems /Computer Laboratory
- Workshop-
 - Carpentry Shop
 - Painting and Polishing Shop
 - Smithy Shop
 - Fitting and Plumbing Shop
 - Sheet Metal Shop
 - Welding Shop
 - Foundry Shop
 - Machine Shop
- Fluid Mechanics & Hydraulic Machinery Laboratory
- Measurement and Metrology Laboratory
- Strength of Material Laboratory
- Material Science Laboratory
- Thermal Engineering Laboratory
- Automobile Engineering Lab (for Automobile specialization)
- Refrigeration and Air Conditioning Laboratory (for RAC specialization)
- Maintenance Lab (for Repair & Maintenance specialization)

EQUIPMENT REQUIRED

Sr. No.	Description	Qty	Total Price (Rs)
COMMUNICATION LABORATORY/Language Lab (As per the DTE Specification)			
1.	Computer Server	01	1,28,000
2.	Headphone With Mic	01	
3.	Webcam: HD	01	
4.	Server OS; Windows/Linux	01	
5.	Monitor	01	
6.	Computer system (i7 processor,16 GB 512 SSD latest configuration)	40	3000000
7.	UPS 5KVA Online (At Least 60 Min. backup)	02	350000
8.	Computer Chair and Table	40	400000
9.	AC	02	100000
10.	Laser Printer with ADF scanner	01	50000
11.	LAN Setup	LS	20,000
12.	Language lab Software License/ Open Source	01	1,00,000
13.	Misc. Items	LS	10,000

APPLIED PHYSICS LABORATORY			
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000
6.	Gravesand's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil weston-type ammeter with ebonite stand	10	3,500
12.	DC Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700
15.	DC Millivoltmeters	10	2,000
16.	Sensitivity Galvanometer	2	800
17.	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4,000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and	2	14,000

	Tuning fork set		
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00
30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	Miscellaneous	LS	3,000

APPLIED CHEMISTRY LABORATORY			
1.	Digital Balance	1	80,000
2.	Burette 50ml	30	3,000
3.	Pipette 25ml	60	4,000
4.	Beakers 100ml	60	4,000
5.	Burette stand	30	30,000
6.	Glazed tile	30	1,000
7.	Conical flask 50ml (Titration flask)	60	4,000
8.	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000
9.	Able's Flash Point apparatus	2	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	1	18,000
14.	Decicators	06	8,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	2,000
16.	Chemicals <ul style="list-style-type: none"> - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH₃ - 2.5 ltr, NH₄Cl - 1 kg) - Zinc sulphate- 500g - H₂SO₄- 2.5 ltr - Phenolphthalein indicator (as per requirement) - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene- 1 ltr 	LS	20,000
17.	Miscellaneous	LS	2,000

ENGINEERING GRAPHICS LABORATORY			
1.	Drawing Boards (700 x 500mm)	75	40000
2.	Draughtsman Tables	75	220000
3.	Draughtsman Stools	75	60000
4.	Model of different wooder joints	1	1,000
5.	Model of different screw threads	1	1,000
6.	Model of various locking devices	1	1,000
7.	Model of various joints	1	1,000
8.	Cut section Model of various couplings	1	5,000
9.	Miscellaneous	LS	5,000

CAD LAB.			
1.	Computer system (i7 processor,16 GB 512 SSD latest configuration)	40	3000000
2.	Online UPS 5kVA with at least 60 min. backup	02	350000
2.	Computer Aided Drawing (CAD) Software	40 User	7,00,000
3.	Computer Table with Chair	40	400000
4.	Internet facilities	LS	150000
5.	Printer (Laser) with ADF scanner	1	50000
6.	Miscellaneous	LS	10,000

ENGINEERING MECHANICS LABORATORY			
1.	Polygon law of forces apparatus	1	2,000
2.	Jib crane apparatus	1	4,000
3.	Apparatus for reaction at supports	1	5,000
4.	Inclined plane and friction apparatus	1	2,500
5.	Screw jack	1	1,000
6.	Worm and worm wheel	1	3,500
7.	Force table apparatus	1	4,000
8.	Miscellaneous	LS	1,000

IT SYSTEMS LABORATORY/COMPUTER LABORATORY

1.	Computer System with latest configuration	30	8,00,000
2.	Printer (MFP)	1	25,000
3.	Printer (Laser)	1	35,000
4.	Plotter	1	75,000
5.	Digitiser	1	50,000
6.	Antivirus Software	LS	10,000
7.	Internet Facility on Computers	LS	2,00,000
8.	AutoCAD/Solid Works/Unigraphics/Pro-C (any one software)	30 user	5,00,000
9.	LCD Projector	1	35,000
10.	UPS	60	1,20,000
11.	Software (latest windows, latest MS Office)	1	1,00,000
12.	Scanner	1	10,000
13.	Miscellaneous	LS	5,000

WORKSHOP**CARPENTRY SHOP**

1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	10,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000
8.	Tool accessories measuring and marking Instruments	30	30,000
9.	Band saw blade brazing unit	1	10,000
10.	Miscellaneous	LS	1,500

PAINTING AND POLISHING SHOP			
1.	Spray gun with hose pipe	1	1,000
2.	Paint brushes	20	2,000
3.	Paint/Varnish	LS	2,000
4.	Air Compressor with 2 hp motor	1 set	10,000
5.	Miscellaneous	LS	2,000

SMITHY SHOP			
1.	Black smithy forge (with open hearths, accessories to match the forge)	20	40,000
2.	Wrought iron anvils	20	20,000
3.	Swage blocks	4	8,000
4.	Blower with accessories, motor switch etc	1	6,000
5.	Work benches with vices	2	6,000
6.	Power hammer	1	20,000
7.	Tools and accessories - hammers, swages, tongs, pokers, pullers etc	20	10,000
8.	Miscellaneous	LS	1,500

FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribes	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribes	25	50,000
5.	Tool kits - taps, dies, drills	25	40,000
6.	Tool kits - chisels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	2	16,000

8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1800
10.	Ring spanner set	5	600
11.	Pipe die set 2"	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	Miscellaneous	LS	1,500

SHEET METAL			
1.	Hammers as per requirement	8	3,000
2.	Mallets (Hard & Soft)	5	2,000
3.	Sheet and wire Ganges	LS	8,00
4.	Shearing Machine	1	20,000
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminium)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	Miscellaneous	LS	1,000

WELDING SHOP			
1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas Cutting Unit	1	10,000
3.	Work benches with vices	3	30,000
4.	Welding generator set	1	10,000
5.	Oxy acetylene welding set with accessories	1	10,000
6.	Acetylene generating set	1	15,000
7.	Electric welder tool kit	10	10,000

8.	Projection welding machine	1	50,000
9.	Brazing equipment with accessories	1	20,000
10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	10,000
12.	Metal spraying gun	1	10,000
13.	Spot welder	1	40,000
14.	TIG welding set	1	1,00,000
15.	MIG welding set	1	1,00,000
16.	Welding Partition Screen	5	2,500
17.	Miscellaneous	LS	3,000

FOUNDRY SHOP			
1.	Moulding boxes	40	8,000
2.	Ladles	5	2,000
3.	Tool Kits	10 set	5,000
4.	Quenching tanks	2	5,000
5.	Portable grinder	1	3,000
6.	Pit furnace with blower	1	10,000
7.	Miscellaneous	LS	1,000

MACHINE SHOP			
1.	Centre Lathe (4 feet)	5	2000000
2.	Lathe with copy turning attachment and other attachments	1	1,70,000
3.	Universal milling machine	1	1,25,000
4.	Vertical milling machine	1	2,85,000
5.	Shaper machine	1	150000
6.	Planner Machine	1	6,00,000
7.	Radial drilling machine	1	1,00,000
8.	Upright drilling machine	1	50,000
9.	Gear Shaper	1	1,00,000
10.	Centreless grinder	1	1,50,000
11.	Universal cylindrical grinder	1	1,20,000
12.	Hydraulic surface grinder	1	1,00,000
13.	Tool and Cutter grinder	1	90,000
14.	Power hacksaw	1	150000
15.	Pedestal grinder	1	9,000
16.	Work bench	3	30,000
17.	Precision instruments	1	10,000
18.	Surface plates	2	15,000
19.	Hand tools and accessories	2	6,000
20.	CNC trainer lathe	1	3,00,000
21.	CNC trainer milling machine	1	4,00,000
22.	Computer based NC Programming Software	1	1,50,000
23.	CNC Simulation software	1	1,00,000
24.	CNC Milling machine accessories and holding devices	LS	1,00,000

FLUID MECHANICS AND HYDRAULICS MACHINERY LABORATORY			
1.	Piezometer tube	2	2500 each
2.	U tube differential manometer	2	5000
3.	Venturimeter apparatus with differential manometer	1	40000
4.	Orificemeter apparatus	1	45000
5.	V- notch apparatus	1	50000
6.	Bernoulli's apparatus	1	60000
7.	Pipe friction apparatus	1	65000
8.	Working Model of Pelton Wheel Turbine	1	170000
9.	Working Model of Francis Turbine	1	150000
10.	Working Model of Centrifugal pump	1	50000
11.	Hydraulic Brake apparatus	1	50000
12.	Hydraulic Ram apparatus	1	25000

MEASUREMENT AND METROLOGY LABORATORY			
1.	Digital vernier calliper	2	15000 each
2.	Vernier calliper	2	8000
3.	Digital micrometer	2	12000 each
4.	Micrometer	2	4000 each
5.	Height gauge	2	5000 each
6.	Depth gauge	2	1,000
7.	Combination set	1	1,000
8.	Bevel protractor	1	1,000
9.	Sine bar	1	1,000
10.	Precision balls and rollers	1	500
11.	Surface plate	2	15,000
12.	Slip gauges set	1	10,000
13.	Comparator – Mechanical , Pneumatic	2	40,000

14.	Gear tooth vernier	1	2,000
15.	Snap and ring gauges, Plug gauge, Thread gauge	2 each	1,500
16.	Feeler gauge, radius gauge	1	1,000
17.	Angle plate	1	1,000
18.	Tool makers microscope	1	40,000
19.	Optical Profile projector	1	75,000
20.	Tomlinson Surface roughness tester	1	60,000
21.	Dial Bore Gauge with Accessories	1	10,000

Thermal Engineering Lab			
1.	Throttling Calorimeter	2	10000
2.	Real Engine cut section of 4-stroke single cylinder Petrol and Diesel engine	1	30,000
3.	Gravimetric Analysis	1 each	20,000 each
4.	Model of Various Boiler Mounting and Accessories -Steam Stop Valve, Safety Valves, Blow off Cock, Water Level Indicator, Low Water High Pressure Safety Valve, Pressure Gauge, Economiser, Pre Heater (Air), Super Heater Model only.	1 each	10,000
5.	Single Stage Reciprocating Air Compressor	1	50,000
6.	Rotary Compressor, Air Compressor	1	25,000
7.	Flash Point Apparatus	1	10,000
8.	Pyrometer, Infrared, Thermocouple	2	5,000 each
9.	Lancashire boiler model, Nestler Boiler Model	1 each	10,000
10.	Model of impulse turbine	1	5,000
11.	Model of reaction turbine	1	5,000
12.	Model of surface condenser	1	5,000
13.	Bab Cox & Wilcox Boiler Model	1	10,000
14.	Heat Transfer apparatus for conduction , convection and Radiation	1 set	45,000
15.	Model of 2 stroke	01 set	6000

16.	Steam Separating & Throttling calorimeter fully instrumented to determine, quality of steam of 10-15 kg/cm ² . Pressure with steam condensing arrangement	01	30,000
17.	Single cylinder 2 stroke petrol engine test rig	1	45,000
18.	Single cylinder 4 stroke petrol engine test rig	1	50,000
19.	Multicylinder petrol engine test rig (Morse test rig)	1	2,00,000
20.	Open cup apparatus	1 No.	5,000
21.	Closed cup apparatus	1 No.	9,000
22.	Four stroke petrol engine cut section model for valve timing diagram.	1 No.	55,000
23.	Four stroke diesel engine cut section model for valve timing diagram.	1 No.	50,000
24.	Two stroke petrol cut section model for port timing diagram.	1 No.	35,000
25.	Four Stroke Petrol Engine or Diesel Engine Test rig.	1 No.	20,000
26.	Multi- Cylinder Petrol or Diesel Engine Test rig.	1 No.	20,000
27.	Air Compressor Test rig.	1 No.	60,000
28.	Exhaust Gas Analyzer.	1 No.	1,20,000
29.	Reciprocating and Rotary Air compressor for dismantling and assembling	1 No.	50,000

STRENGTH OF MATERIALS LAB			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Brinell and Rockwell hardness Tester	1	80,000 each
2.	Impact Testing machine (Izod and charpy)	1	50,000
3.	Microprocessor based Universal Testing Machine	1	4,00,000
4.	Spring Stiffness Tester	1	50,000
5.	Torsion test apparatus	1	50,000

6.	SFD & BMD apparatus (Simple supported and Cantilever Beam)	2	5,000
7.	Young's Modulus (Deflection of Beam apparatus)	1	5,000
8.	Digital Vernier Caliper 12 inch	2	5,000
9.	Misc. items	-	5,000

MATERIAL SCIENCE LABORATORY

Sr. No.	Description	Qty	Total Price (Rs)
1.	Forced circulation tempering furnace	1	50,000
2.	Quenching tank	2	10,000
3.	Models of- Simple Cubic , BCC, FCC and HCP	1 each	10,000
4.	Pedestal Grinder	1	8,000
5.	Specimen Kit (Ferrous and Non-ferrous Metals	1	10,000
6.	Metallurgical microscope	2	60,000 each
7.	Specimen Polishing Machine (Double Disk type)	1	50,000
8.	Set of Specimen of different alloys	1	5,000
9.	Misc. items	LS	5000

AUTOMOBILE ENGINEERING LAB (for Automobile Specialization)

S.NO.	EQUIPMENT NAME / ITEM NAME	SPECIFICATIONS	QTY	price
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1	Battery Charger 0-12 V, 0-6 Amp.	Output voltage in power supply mode: 12 Volt. Output voltage in charger mode: 13.2 – 14.4 Volt. Input 90-265VAC. Output current: 10Amp	1	3500
2	Batteries 6 V & 12 V	Lead-Acid Storage Batteries for Motor Vehicles with Light weight and High Cranking Performance conforming to IS:14257/1995,nominal voltage-12V,dimensions- as per IS specifications,maximum rated capacity-35AH.	1	5000
3	Hydrometer	With rubber bulb and tube, Range:1.100-1.300g/ml Division :5 Graduted at 20C	1	2000
4	Cell Tester	Measurement time 100 ms,Response time Approx. 1.6 sec.,Temperature: 0°C to 40°C (32°F to 104°F),Size AA alkaline battery (LR6) × 8	1	2000
5	Working Model of Battery Ignition System,And Magneto Ignition System Fitted on board	working Model for demonstration purpose for both ignition system	1	5000
6	Fuel Injection Pump	maximum flow rate-30 to248 Bar,pressure range-2 to 4.5 bar,material-stainless steel ,working temprature—30 to +120 degree.	1	20000
7	Calibration Machine with Fuel Injection Pump & Coupling	diesel injector tester,Voltage: 110V 220V, 220V or 110V,Power: Electronic,Applicable Models: Diesel Auto,Single package size: 40X20X20 cm,Single gross weight: 6.000 kg	1	35000

8	Electrical Testing Bench	length 300*150,Width 150 mm,Height500 mm.material wooden top	1	2500
9	Condemned petrol engine of light petrol vehicle	any engine of light petrol vehicle for demonstration	1	7000
10	Condemned Diesel engine of medium and heavy vehicles	any engine of medium and heavy vehicle for demonstration	1	7000
11	Tyre inflator with twin hose assembly and small hose assembly	HOSE LENGTH (m):0.85, TYRE VALVE CONNECTION Euro Clip-on, CALIBRATION 10-210 psi / 0.7-15 bar	1	3500
12	Spark plug cleaning machine and Testing machine	Weight-12 to 14kg, working pressure-5 to 12 kgf/ sq cm., supply voltage-220V, spark plug used-M10, M12, M14, M18, electronic vibrator voltage 220V	1	6500
13	Condemned chassis frame of any light motor vehicle	Model for demonstration purpose	1	8000
14	Sectioned working model of a single cylinder two stroke petrol engine	Model for demonstration purpose	1	1500
15	Sectioned working model of single cylinder two stroke diesel engine	Model for demonstration purpose	1	1500
16	Sectioned working model of a single cylinder four stroke diesel engine	Model for demonstration purpose	1	1500
17	Sectioned working model of a single cylinder four stroke petrol engine fitted with ignition system Hand Operated Motor Operated	Model for demonstration purpose	1+1	5000+6000
18	Work bench	length 3000*1200,Width 700 mm,Height850 mm.material wooden top	2	3000
19	Mechanical Jack	Model for demonstration purpose	2	3500

20	Tool Kit (Spanner, socket set, screw driver, plier, file, wrench, drill, tap set, hammer etc.)	LS	4 SETS	3000
21	Models of rear axle and differential	Model for demonstration purpose	1	15000

REFRIGERATION AND AIRCONDITIONING LAB (for RAC Specialization)			
1	Refrigeration Cycle Demonstration Unit-With Condenser & Evaporator Made of toughened glass & Instrumented to measure Temperature & Pressure, Refrigerant flow at All Suitable Locations. Arrangement for Using Different Expansion Devices.	2	@75000 =15000
2	Experimental Air Conditioner Window Type-1 Ton Capacity With Proper Instrumentation For Studying its performance.	2	@45000 =90000
3	PSYCHROMETERS		
	Sling Psychrometer. Aspirator Psychrometer. Hygrometer Dry & Wet bulb wall hygrometer. Dial type hygrometer Fortin's barometer Manometers	2	LS. Rs.24000
		2	LS. Rs.12000
4	Anemometer Hand Hold	2	4000
5	Misc.	Ls	20000

MAINTENANCE LAB (for Repair & Maintenance Specialization)			
1	Benchwise 10cm jaw	4 @1000	Rs.4000
2	Centre Punch	4 @100	Rs. 400
3	Pin Punch	4 @100	400
4	Callipers Inside (spring)	10 @200	2000
5	Callipers outside (spring)	10 @200	2000
6	V. Callipers 30 Cm.	2 @600	1200
7	Micrometer 0-25 Cm.	2@250	500
	25-50 Cm.	2@250	500
8	V.Depth gauge	2@700	1400
9	Feeler gauge 15 Blades	2@100	200
10	Radius gauge	2@150	300

11	Angle Gauge	2@150	300
12	Thread Gauge	2@150	300
13	Tap set	2 @3000	6000
14	Allen Key Set	2@700	1400
15	Adjustable Wrench	2 @2500	5000
16	Double Spanners		
	i. Size (6x7,8x9,...18x19,20x22 24x27,30x32mm)	4 @500	2000
	ii. Size (32x36, 36x41, 41x46, 46x50, 50x55mm)	2 @500	1000
17	Misc. Files, Scrapers, Dieset Hexaframe as per need	LS	5000
18	Pipe Vice 5cm	2 @500	1000
19	Chain Rinch	2 @500	1000
20	Ring Spanner Set	2 @250	500
21	Ball Peen Hammer	6 @100	600
22	Claw Hammer	2 @100	200
23	Battery Charger 0-12v,6 Amp.Call Tester Hydrometer Lead Acid Battery 12V,6V	2 @7000	14000
24	T-socket wrench Set	2 @1000	2000
25	Off socket wrench Set	2 @1000	2000
26	Old Jacks Hydraulic mechanical	2 Each @ LS 5000	10000
27	Automobile Gear Box Old	2 @5000	10000
28	Refrigerator Old	2	LS 8000
29	Airconditioner (Window Type)old	2 @7000	Ls. 14000
30	Water cooler (old)	2 @5000	Ls. 10000

31	Digital Multimeter Portable 4-5 digits, 0.5 LCD Auto zeroing and Auto polarity DC Voltage 10MV-1000V DC Current 0.1MA-10A Ac Voltage 10MV-750V AC Current 0.1MA-10A Batter Operated with connection Leads	2 @2000	4000
32	Clipon ammeter/Voltmeter Measuring rang 0-12A, 0-500V Opening 40mm for round conductors Set of spare fuses and connecting Leads.	2 @2000	4000
33	Pulley Pullers 2 2000 4000 (One two legged, One three Legged)	4 @2000	8000
34	Bearing Assorted	Ls.	4000
35	Couplings Assorted	Ls.	8000
36	Air compressor (old unit)	Ls.	
37	Portable tools - Pneumatic & Electrical (For Servicing & Repairing Work - Old).	2 @4000	8000
38	Old lathe Machine/Grinding Machine.	2 @2000 0	40000
39	Miscellaneous Needs and for the items omitted hear if any	Ls	35000
40	Apparatus for checking of slip of belt	1	Ls. 25000
41	Toolkit for dismantling of sub assembly for example pullers , pneumatic wrenches	1	LS.10,000

NOTE:-

If the items other than tools and instruments mentioned above are available in the institute, they should be used for the purpose alternatively they should be procured from other institutions from where they may be made available for the purpose . For the facilities which cannot be made available in the institution visits of repair and maintenance shops in the vicinity be arranged according to need. The approximate cost is mentioned for each equipment listed above.

Note:

1. Above items are for 2 batches of 30 students each.

Note:

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

NOTE:

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

(C) Furniture Requirement

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

10.2 Human Resources Development:

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

11. EVALUATION STRATEGY

11.1 INTRODUCTION

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

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

Formative Evaluation

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

Summative Evaluation

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

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

11.2 STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

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

A. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

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

Section-III

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

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

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

B. Practical Work

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

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

C. Project Work

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

D. Professional Industrial Training

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

12. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

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

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

(A) Broad Suggestions:

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

(B) Course Level Suggestions

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

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

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

1. Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available and courses to be taught.
2. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcomes and reinforce learning etc.
3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.
4. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.
5. Concept and content based field visits may be planned and executed for such content of course which is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.
6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.
7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive feed back to every student
8. The student centred activities may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.
9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.
11. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.
12. Students may be given relevant and well thought out project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment.
13. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, research institutes and other relevant field organizations in the state.

13. LIST OF PARTICIPANTS

The following experts participated in the workshops for Finalizing Curriculum Contents of 2nd year subjects of diploma course in Mechanical Engineering (Auto/Production/RAC/Repair & Maintenance/CAD) for UP State on organized by IRDT, Kanpur:

1. Tajammul Afzal, Joint Director, Technical Education Department, East Zone, Varanasi.
2. Pradeep Kumar, Head of Department Mechanical Engineering, Government Polytechnic Lucknow
3. Ashish Kumar, Head of Department Mechanical Engineering, Government Polytechnic Mawana Khurd Meerut
4. Stuti Srivastava, Head of Department Mechanical Engineering, Government Polytechnic Mirzapur.
5. Atul Rai Head of Department Mechanical Engineering, Government Polytechnic Bighapur.
6. Pankaj Singh, Head of Department Mechanical Engineering, Government Polytechnic Hamirpur.
7. Saqib Ali Lecturer, Head of Department Mechanical Engineering, Government Polytechnic Fatehpur.
8. Himanshu Bhaskar, Head of Department Mechanical Engineering, Government Polytechnic Pilibhit.
9. Anupama Yadav, Lecturer Mechanical Engineering, Government Polytechnic Kanpur.
10. Pranjul Mishra, Lecturer Mechanical Engineering, Government Polytechnic Deeh Unnao
11. Anshita Awasthi, Lecturer Mechanical Engineering, Government Polytechnic Deeh Unnao
12. Dr. Ram Sajeevan, Lecturer Mechanical Engineering, MMIT Kannauj
13. Anupriya Saxena, Lecturer Mechanical Engineering, Government Polytechnic Soron Kasganj
14. Ashish Kumar Mishra, Lecturer Mechanical Engineering, Government Polytechnic Hamirpur
15. Premantusha, Lecturer Mechanical Engineering, Government Polytechnic Lucknow
16. Kapildev Agarwal Lecturer Mechanical Engineering, Government Polytechnic Bachhrawa Raebareli
17. Prince Tyagi Lecturer Mechanical Engineering, Government Polytechnic Jansath Muzaffar Nagar
18. Puneet Pandey, Lecturer Mechanical Engineering, Government Polytechnic Azamgarh
19. Raja Ram, Lecturer Mechanical Engineering, Government Polytechnic Sitapur
20. Harshit Bajpai, Lecturer Mechanical Engineering, Manyavar Kanshi Ram Government Polytechnic Kannauj

21. Krishna Kumar, Workshop Superintendent, Government Polytechnic Manikpur Chitrakoot.
22. PAmit Ranjan, Lecturer Mechanical Engineering, Government Polytechnic Mohammadpur, Bahraich
23. Shazia Tabassum, Workshop Superintendent, Government Polytechnic Bargarh Chitrakoot
24. Puneet Pandey Workshop Superintendent, Government Polytechnic Gonda
25. Gaurav Kishor Kanaujiya, Assistant Professor/Course Co-Ordinator, IRDT U.P. Kanpur.

Annexure: 1

Proposed Courses by TATA Technology (Advance Skill Certification)

S. No.	Course Name
1	Fundamentals of Innovation and Design Thinking
2	Product Design and Development
3	Product Verification and Analysis
4	Advanced Automobile
5	Electric Vehicle
6	Internet of Things
7	Advanced Manufacturing
8	Advanced Welding & Painting using Simulator
9	Industrial Automation and MES
10	Industrial Robotics
11	Inspection and Quality Control
12	Advanced Plumbing
13	AI and ML

FIFTH SEMESTER

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

* Common with other diploma programme

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

SIXTH SEMESTER

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

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

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

INDUSTRIAL TRAINING

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

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

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

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

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

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

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

5.1 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

L	T	P
5	-	-

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

SECTION – A

ENTREPRENEURSHIP

1. Introduction (04 Periods)

1.1 Concept /Meaning and its need

1.2 Qualities and functions of entrepreneur and barriers in entrepreneurship

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

SECTION –B

MANAGEMENT

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

- 4.7 Line and staff organisation
- 4.8 Functional Organisation

5. Leadership and Motivation (08 Periods)

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

6. Management Scope in Different Areas (14 Periods)

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

7. Work Culture (08 Periods)

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

8. Basic of Accounting and Finance (10 Periods)

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

9. Miscellaneous Topics (10 Periods)

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

5.2 THEORY OF MACHINES

L T P
5 2 -

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS THEORY

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

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

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

Website for Reference:

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

SUGGESTED DISTRIBUTION OF MARKS

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

5.3 MACHINE DESIGN

L T P
5 2 -

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

2.3 Design under tensile, compressive and torsional loads.

3. Design of Shaft (12 Periods)

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

4. Design of Key (08 Periods)

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

5. Design of Joints (02 Periods)

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

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

6. Design of Flange Coupling (10 Periods)

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

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

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

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

– Design and drawing

RECOMMENDED BOOKS

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

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

5.4 PRODUCTION TECHNOLOGY

L T P
6 - 8

RATIONALE

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

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

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

DETAILED CONTENTS

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

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

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

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

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

PRACTICAL EXERCISES

TURNING SHOP

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

ADVANCE FITTING SHOP

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

MACHINE SHOP

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

FORGING SHOP/FITTING SHOP/SHEET METAL SHOP

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

ADVANCE TURNING SHOP

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

MACHINE SHOP

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

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

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

5.5 PRODUCTION MANAGEMENT

L T P
4 - 2

RATIONALE

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

Learning Outcomes

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

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

DETAILED CONTENTS.

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

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

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

5.6 AUTOMOBILE ENGINEERING

L T P
4 - 4

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

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

LIST OF PRACTICALS

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

a) adjustment of brakes

b) bleeding of brakes

c) fitting of leather pads

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

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

Website for Reference

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

6.1 INDUSTRIAL ENGINEERING

L T P
6 - 2

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

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

RECOMMENDED BOOKS

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

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

6.2 METROLOGY AND MEASURING INSTRUMENTS

L	T	P
5	-	4

RATIONALE

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

LEARNING OUTCOME

After undergoing the subject, students will be able to :

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

DETAILED CONTENTS

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

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

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

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

6.3 CNC MACHINES AND AUTOMATION

L T P
4 - 4

RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (06 Periods)

Introduction to NC, CNC & DNC, their advantages, disadvantages and applications, Machine Control Unit, input devices, serial communication and Ethernet techniques, selection of components to be machined on CNC machines, Problems with conventional NC, New developments in NC, Axis identification, PLC Control and its components.
2. Constructional details and Tooling (08 Periods)

Design features, specification Chart of CNC machines, use of slideways, balls, rollers and coatings, motor and leadscrew, swarf removal, safety and guarding devices, various cutting tools for CNC machines, overview of tool holder, different pallet systems and automatic tool changer system, management of a tool room.
3. Part Programming (12 Periods)

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

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

4. System Devices (08 Periods)

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

5. Problems in CNC Machines (06 Periods)

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

6. Automation and NC system (06 Periods)

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

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

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

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

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

7.4 Simple programmes in Milling and Turning involving different operations.

LIST OF PRACTICALS

- 1 Study the constructional details of CNC lathe.
2. Study the constructional details of CNC milling machine.
3. Study the constructional details and working of:
Automatic tool changer and tool setter
 - Multiple pallets
 - Swarf removal
 - Safety devices
4. Develop a part programme for following lathe operations and make the job on CNC lathe and CNC turning center.
 - Plain turning and facing operations

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

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

6.4.1 REPAIR AND MAINTENANCE

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RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

1. Introduction (06 Periods)

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

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

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

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

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

3. Testing of Machines (10 Periods)

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

Recalibration of measuring instruments like vernier calliper.

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

4. Maintenance (10 Periods)

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

ISO standards for maintenance documentation

Introduction to machine history card – purpose and advantages

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

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

5 Repairing (08 Periods)

Common parts which are prone to failure, reasons of failure

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

6 Lubrication Systems (09 Periods)

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

Handling and storage of lubricants

Lubricants conditioning and disposal

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

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

7 Material Handling Systems (09 Periods)

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

8 Maintenance Manuals and Reports (08 Periods)

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

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

6.4.2 TOOL ENGINEERING

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RATIONALE

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

LEARNING OUTCOMES

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

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

DETAILED CONTENTS

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

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

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

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

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

6.5 PROJECT WORK

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RATIONALE

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

LEARNING OUTCOMES

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

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

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

General Guidelines

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

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

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

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

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

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

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

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

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

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

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

Important Notes

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

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

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

10. RESOURCE REQUIREMENT

10.1 PHYSICAL RESOURCES

(A) Space requirement

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

(B) Equipment requirement:

Following Laboratories are required for Diploma Programme in Mechanical Engineering:

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

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

EQUIPMENT REQUIREMENT FOR MECHANICAL ENGG.

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

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

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

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

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

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

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

WELDING SHOP

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

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

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

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

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

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

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

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

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

REFRIGERATION AND AIR CONDITIONING LABORATORY

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

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

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

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

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

Note:

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

NOTE:

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

(C) Furniture Requirement

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

10.2 Human Resources Development:

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

11. EVALUATION STRATEGY**11.1 INTRODUCTION**

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

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

Formative Evaluation

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

Summative Evaluation

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

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

11.2 STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

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

A. Theory

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

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

Section-I

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

Section-II

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

Section-III

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

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

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

B. Practical Work

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

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

C. Project Work

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

D. Professional Industrial Training

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

12. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

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

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

(A) Broad Suggestions:

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

(B) Course Level Suggestions

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

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

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

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

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